Dictionary of cultivated plants and their regions of diversity

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Excluding most ornamentals, forest trees and lower plants

A.C. Zeven and J.M.J. de Wet

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Preface

The aim of this work is to give the reader quick reference to the regions of diversity of cultivated plants. For important crops, regions of diversity of related wild species are also presented. Wild species are often useful sources of genes to improve the value of crops.

Species cultivated primarily as ornamentals and timber crops, and useful lower plant species are not included.

Taxa are arranged alphabetically first by family, secondly by genus and thirdly by species within genera. The more common taxonomic synonyms, as well as the better known (English) names are listed. Taxonomy is based primarily on Willis's dictionary (1966) and the Baily Hortorium, Hortus Third (1976).

Somatic chromosome numbers and genome formulae are presented where known. Most of the chromosome numbers are derived from Bolkhovskikh et al. (1969). Where the chromosome number could not be traced, a space has been left open. Chromosome number and genome constitutions may indicate the relationships of a species.

The work included many more species than we could know. Corrections, criticisms and additions including data on chromosome number would be highly appreciated. They should be sent to the senior author, Institute of Plant Breeding (I.v.P.), Agricultural University, P.O.B. 386, 6700 AJ Wageningen, the Netherlands.

We hope that this work may help the plant breeder to ease shortages of food and other agricultural products. We hope that it will also encourage the establishment of natural wild plant reserves in anticipation of needs for wild genes.

Anton C. Zeven
Jan M.J. de Wet

History of the work

FIRST EDITION

In 1968 Prof. P.M. Zhukovskij published a paper 'New centres of origin and new gene centres of cultivated plants including specifically endemic micro-centres of species closely allied to cultivated species'. This paper was issued in Botanical Journal, Moskov 53:430-460 and was abstracted in Plant Breeding Abstracts (1968). I wrote to Prof. Zhukovskij asking whether he would prepare an English version. He wrote back that he was preparing a booklet in Russian on the 'World genofund of plants for breeding: world gene centres of cultivated plants and their wild progenitors', which was published in 1970. The text was translated by Dr E.E. Leppik, Research Botanist of the New Crops Research Branch of the US Department of Agriculture, Beltsville, Maryland, who invited me to edit the manuscript and to seek a publisher.

The publishers suggested that the work be extended to include more cultivated plants. Prof. Zhukovskij agreed to this proposal and the work has now been enlarged from 700 species to about 2300 species.

A.C. Zeven

SECOND EDITION

In October 1975 my co-author, Professor Dr P.M. Zhukovskij died at Leningrad after a long and fruitful life which he dedicated to cultivated plants: their botany, their taxonomy and their agriculture and use. He worked almost to the last day of his life to spread knowledge of cultivated plants. A few months before his death, he received copies of the first edition of this Dictionary and he expressed his happiness with the work.

In 1979, Pudoc informed me that the stock of the book was almost exhausted and that they considered reprinting the work. However as many scientists are working on cultivated crops, many new data were available for a new edition. Furthermore, colleagues and myself had discovered mistakes and omissions and so it was a good opportunity to prepare a revision. I am very grateful to those who have suggested additions and improvements.

To help in preparing a revised edition, I asked help from Professor J.M.J. de Wet, Crop Evolution Laboratory, Department of Agronomy, University of Illinois, Urbana-Champaign, Illinois, United States. He is an excellent taxonomist of cultivated plants and I was extremely happy that he took up the invitation despite a busy life as scientist. The present edition has greatly benefited from his encyclopaedic knowledge of cultivated plants.

A.C. Zeven

Origins of agriculture and domestication of plants

INTRODUCTION

Man was not always a farmer. Only during the last fifteen thousand years or so has he learned to some degree to control his food supply. Before the advent of agriculture, man was a hunter and food gatherer. Gradually, however, some of the animal species he used to hunt were protected, and selected species of food plants were brought into cultivation. Plant and animal husbandry were initiated, and these plants and animals eventually became so dependent on man that they could no longer compete successfully with their wild relatives for natural habitats. They became domesticated.

The antiquity of this shift in man's activities from food gathering to food producing is not known with certainty. Plant and animal husbandry were probably well established long before noticeable phenotypic changes occurred in species under domestication, and became preserved in archaeological records of man's history. Be that as it may, man had abandoned his nomadic food-gathering way of life some 10 000 years ago for one of sedentary food-production in several parts of both the Old and New Worlds.

In many regions, even with a high level of agriculture, man still gathers wild and semiwild plants or fruits, such as brambles, blueberries, raspberries, mushrooms, herbs for food, heath for brooms, wood for buildings, fuel or paper-making, and grass for domestic animals. However man does not depend on these plants; he only collects them for economic or recreative reasons. If he depended on them, he would grow them or find a substitute. Some people may grow plants while others collect the same species in the wild.

We may ask why man started to cultivate plants, why he started to do so only 'recently' and why only certain plant species or varieties were domesticated.

ORIGINS OF AGRICULTURE

Much has been written about man's shift from plant collecting to plant growing. Some authors have put forward 'deterministic' hypotheses, such as a higher mental or social level leading to the cultivation of plants, or climatic changes causing a progressive desiccation of the country and enforcing the application of artificial methods of food production (Spinden, 1971; MacNeish, 1964a). Sauer (1952), however, thought that agriculture could not have originated solely from chronic food shortage, as four conditions had to be fulfilled before plant or animal husbandry could be initiated:

- Previously acquired skills in other fields to start experiments.
- Sedentary way of living.
- Presence of wooded lands easier to clear than savannas or forests. Large river-valleys subject to periodical flooding are unsuitable, because man was not able to control floods.
- A marked diversity of plant populations must be present, so that a large reservoir of genes is available for selection.

Sauer concluded that the ancestors of the earliest agriculturists were relatively prosperous progressive fishermen living in a mild climate along fresh waters.

Little is known about the skills of the first farmers, and information on the correlation between earlier fixed dwelling and incipient food production is limited. The earliest sites with year-round occupation were discovered in the Nile Valley of Upper Egypt (15 000 to 10 500 B.C.) but they show no evidence of plant of animal domestication (Churcher & Smith, 1972). Early occupation sites found in southern Africa dating from 47 000 B.C. (Border Cave in Zululand), 43 000 B.C. (Howieson's Poort near Montagu, southwest Cape Province), 42 000 B.C. (Rose Cottage Cave near Ladybrand in eastern Orange Free State) belong to this category. But, it is not clear whether these sites were occupied all the year round. The botanical material associated with them has not yet been analysed (Dart & Beaumont, 1971; Beaumont & Boshier, 1972).

Sites where agriculture developed first must have been in areas where plant collectors/hunters/fishermen roamed. It is most likely that they lived in wooded lands for hunting game, or near water for fishing. Fishing communities led a sedentary life. Nomads roam, but return to sites known for their richness in animal and plant food. This may have led to annual occupation of sites for a few weeks until the food supply was depleted. On such sites, the soil may have become bare because of disturbance by man; paths, loam pits, graves, dilapidated mudhouses and abandoned compounds. Near water, there would be natural bare lands such as riverbanks, gravel, rocks, landslides and esturian plains. Plants pre-adapted to such environments would colonize them. Around dwellings, many plants would derive from plant parts collected by man and brought home. Plants adapted to disturbed habitats are weedy in habit and prefer 'open' rich soils. They grow quickly and have large food reserves that enables them to survive adverse conditions. These characteristics make them suitable for cultivation. They may grow wild in mountains or hills with a wide topographical diversity. In such areas with many microclimates, variants have most chance to survive. After they had migrated into the artificial habitat, man may have found some useful types among them. Some of the plants may have been genotrophes adapting quicker to man-made conditions than expected (Zeven, 1975).

Other sites where agriculture may have arisen would be middens on the compounds. Many parts of plants (fruits, seeds, tubers, roots) must have been accidently or purposefully thrown away. They must have developed into plants with a luxurious growth on these fertile places (Anderson, 1952; Burkill, 1952; Chang, 1970; Engelbrecht, 1916; Flannery, 1965; Harlan & de Wet, 1965; Hawkes, 1969).

The sequence by which crops arose may be summarized as follows:

- Wild plants collected by man.
- Wild plants migrated into temporary or permanent dwelling sites of man either by accident as gathered plant parts or spontaneously. This must have continued for an extremely long time.
- Plant preadapted to disturbed habitats colonized areas around dwellings. Man gathered wanted plant parts from some of these weedy plants.
- Natural selection was reduced and selection pressures introduced for adaptation to man-made habitats. Decrease in variation was counteracted by hybridization and mutation, followed by isolation, protection and conscious selection by man. Selected deviants from the wild phenotypes would survive. This state can be called proto-agriculture.
- The dependence of man on selected plants increased in such a way that when demand exceeded availability, man eradicated undesirable plants and started to improve useful plants. When man moved outside the natural range of a

species on which he depended, he was forced to plant. Thus man learned to retain seeds and other propagules when the plant was to grow outside its natural range, to purposefully prepare a habitat in order to reap a better harvest of the colonizer, now turned into crop. This stage represents incipient agriculture. Near-eradication has led to incipient cultivation of Tabernanthe iboga and Camassia leightlinii.

- Crops were further improved intentionally by cropping methods. This stage represents effective agriculture.

The change-over from food collector/hunter/fisher to full-time agriculturist must have been very gradual. Once the process started, it became practically automatic (Hawkes, 1969) or self-generating. This gradual change - including the change to animal husbandry - resulted in

- less energy to obtain more food,
- people becoming tied to the(ir) land
- spare time for other pursuits (MacNeish, 1964).

By inventing agriculture, mankind gained more from solar energy. Raising crops (and husbanding animals) are man's major means of exploiting that form of energy (Rappaport, 1971).

PLANT DOMESTICATION

Two kinds of organisms, weeds and domesticates, prosper in man-made habitats. Organisms adapted to habitats not notably disturbed by man are wild. Among wild organisms are kinds adapted to various degrees of natural disturbance. They occupy different positions in seral succession. Plants at the pioneer end of succession can also invade man's disturbed habitats. When the habitat is continously being disturbed by man, however, a different set of species becomes established.

Plants that are spontaneous and persistant in habitats that are continually being disturbed by man are weeds. There are degrees of weediness. Wild colonizers will invade man-disturbed habitats, but cannot survive continual disturbances by man or by natural means. If not continually disturbed, waves of species will become established until dynamic but essentially stable populations are achieved. When habitats are continually being disturbed, only weeds can survive spontaneously. One need only drive along highways to observe the strict adaptation of weeds to man-disturbed habitats. Roadside species rarely form part of the adjacent natural vegetation, even of cultivated fields.

Plants tended by man are cultivated but not necessarily domesticated. They may be wild, weed or domestic in adaptation. Man maintains cultivated plants in the man-made habitat because they are of sufficient value. Cultivation includes all kinds of agricultural practices, from merely protecting individual plants to actual planting or sowing, and tending of planted populations. Villages in West Africa are often built around one or more giant baobab trees (Adansonia digitata). These trees provide shade as well as fruits from which a refreshing drink is produced. Baobab is cultivated but wild, and survives continuous disturbance by man of its habitat because it is perennial and not because it is a weed. On the other hand, weeds can be cultivated. Animal fonio (Brachiaria deflexa) is a cultivated cereal in West Africa (Portères, 1976). It is widely distributed across the African savanna and often harvested as a wild cereal (de Wet, 1979). In Angola, however, a weed race of Brachiaria deflexa is often encouraged by local growers of sorghum (Sorghum bicolor) to invade their cultivated fields, and forms a considerable part of the annual cereal harvest (de Wet, 1975).

Domesticates are strictly adapted to habitats specially created for them by man. They have evolved under domestication to the point where they depend on man both for habitat and propagation. Domesticated seed-plants have lost the natural ability to disperse seed efficiently natural seed dispersal and domesticated root and tuber crops are often poor seed producers or are completely sterile sexually. Crops in an early stage of domestication often become weedy, and many weeds represent species in various stages of domestication. Indeed, weeds differ from domesticated primarily in degree of dependence on man for success in the continually disturbed man-made habitat.

Ecological boundaries, as well as boundaries of usefulness to man between wild, weed and domestic taxa are not always sharp. Higgs & Jarman (1969, 1972) correctly point out that the wild class of organisms merge into the domestic class by a continuous series of degrees of intimacy with man. The question thus arises whether domestication occurs from wild across bridging weedy races. This certainly has been one route. The majority of weeds, however, do not represent a stage in the evolution of crops.

Origins and evolution of weeds

Weeds evolved and are still evolving in man-made habitats in one or more of four principal ways (de Wet & Harlan, 1975). First, they evolve from colonizer species by selection for adaptation to habitats that are continually being disturbed. Second, weeds originate as derivatives of hybrids between wild and cultivated races of domestic species. Third, they evolve from domesticates that are abandoned by man or escape cultivation, by selection for a less intimate association with cultivation. Fourth, weedy races of crops originate as a result of introgression with related wild species of the domesticate.

A majority of weeds have evolved from wild colonizers that invaded the man-made habitat. Their wild ancestors are aggressive colonizers of all disturbed habitats, and many of them have been distributed by man well beyond their natural ranges. The common weeds of North America are Eurasian in origin (Reed & Hughes, 1970). In their new habitats these species are obligate weeds, while in their native habitats races are known that form part of the natural habitat. Dandelion (Taraxacum officinale), henbit (Lamium apoplexicaule), crabgrass (Digitaria sanguinalis) and many other urban weeds are natives of Europe, and have been introduced to the New World since the Fifteenth Century.

Weed races of domestic species originate by natural selection as a by-product of domestication, by selection from partially domesticated or abandoned domesticates, or from hybrid between wild progenitors and their domestic relatives. Weedy hybrid derivatives are known for most, if not all, crops (Harlan, 1965, 1969). There are, for instance, weed sunflowers (Helianthus annuus), weed carrots (Daucus carota), weed maize (Zea mays) and weed watermelons (Citrillus vulgaris). Indeed, even domestic species that are regularly propagated by vegetative means, such as cassava (Manihot esculenta), sweet potatoe (Ipomoea batatas) or potato (Solanum tuberosum) have weed races. Weed races that originate as a result of introgression (Anderson, 1949) between wild and domestic taxa are often strictly agricultural weeds. They rarely invade natural habitats of their wild relatives with any success. Adaptative traits acquired under domestication have little selective value in primary habitats, and gene exchange in the direction of wild taxa is not extensive. Gene flow in the direction of the crop, however, may not only produce successful weeds, but may actually benefit the crop (Harlan, 1969). In the Nobogame Valley of Chihuahua in Mexico, ears of maize showing traces of introgression from teosinte (Zea mays ssp. mexicana) are consciously selected by farmers as seed stock (Lumholz, 1902; Wilkes, 1970).

Weed races of domestic species often mimic the cultivated race they accompany in vegetative and inflorescence traits, except for retaining natural seed dispersal. Such weeds are particularly obvious in pearl millet (Pennisetum americanum) and are widely distributed with this crop across the West African savanna. Scholz (1979) suggests that these mimetic weeds are actually degenerate domesticates. Brunken et al. (1977) indicate, however, that although shibras closely resemble pearl millet in gross morphology, in more detailed inflorescence traits they are widely variable, and generally intermediate between pearl millet and its wild progenitor. Weed-crop mimicry may also become established between unrelated species. It was already known in Biblical times that darnel (Lolium temulentum) grains were difficult to separate from those of the wheat or barley it accompanies as a weed. Similarly, false flax (Camelina sativa ssp. linicola) is an obligate weed of flax fields in southern Russia, where it mimics races of cultivated flax in growth habit, time of flowering and seed size (Sinskaja & Beztuzhera, 1931). These weeds originated from ssp. sativa by selection in fields of cultivated flax.

Cultivated races of domestic species can revert back to weed habit. Many fence and hedgerow weeds of Europe are derived from species once grown in herb or vegetable gardens. The common Queen Anne's lace, the weedy spring annual of temperate Eurasia and North America is a weed race of the vegetable carrot. In cereals, where natural seed dispersal mechanisms have become lost under domestication, new dispersal mechanisms need to become established after the crop is abandoned as a cultigen. Seed dispersal in grasses commonly occurs as a result of an abscission layer that forms below the glumes or between the glumes and the florets. In the genus Sorghum disarticulation is commonly below the glumes. This is true of both wild and weed races of Sorghum bicolor in Africa. Mississippi chicken corn (ssp. drummondii) in the United States, however, disperses its grain by breaking of the rachis below the spikelet. This dispersal mechanism evolved in an escaped domesticate and is also encountered in parts of Ethiopia where wild relatives of S. bicolor are absent (de Wet, 1978). There are weed sorghums in the United States with the usual means of seed dispersal. These represent derivatives of introgression between diploid cultivated sorghum and tetraploid Johnson grass (Sorghum halepense), an introduced Mediterranean weed. This weed was introduced into the eastern United States some 100 years ago and has been extending its range by absorbing genes from cultivated sorghum. The initial hybrid is triploid and partially sterile. When backcrossed with the cultivated parent, some fully fertile tetraploid offspring are produced. Diploid offspring are also produced from such introgression. They resemble cultivated grain sorghum in habit and habitat preference, and have in recent years become obnoxious weeds in the cornbelt of the United States.

Weeds are not restricted to the plant kingdom. Numerous animal species are weedy. The housefly is a cosmopolitan 'weed', European rabbits are 'weedy' in Australia, and the Holy Brahmin cow is an obnoxious though revered weed in Hindu India. Indeed, by definition civilized man is the ultimate weed, being obligately confined to totally disturbed man-created habitats.

Evolutionary dynamics of plant domestication

Domesticates are adapted to permanently disturbed man-made habitats. Plant husbandry must have been initiated to protect and increase population and density of selected food-plants. Phenotypic changes that accompanied adaptation under domestication probably resulted from a combination of natural and conscious and unconscious selection. Sauer (1952) and Anderson (1960), among others, suggested that wild food-plants invaded the man-disturbed habitat, became weedy around waste places, and eventually adapted to cultivation. This is probably true of aggressive colonizers such as the several cultivated species of Chenopodium (Sauer, 1950) and probably some vegetatively propagated tuber-crops. Parts of edible tubers must have made their way to rubbish heaps where they sprouted to produce vigorous plants, and such dump heaps are notorious habitats for colonizers. Man certainly could not have failed to notice these plants nor failed to realize the convenience in having them readily available for harvesting. Plant husbandry is an obvious next step, and domestication of selected food-plants would be initiated.

Sowing or planting, however, is only part of plant domestication, and these practices were probably known to man long before the advent of agriculture. Domestication is initiated with planting or sowing, but the domestication process continues only as long as the crop is grown one generation after another in habitats specially created by man. Food collecting, sowing, planting or any other husbandry by food gatherers does not necessarily lead to domestication. Digging for edible underground parts, and stripping plants of edible leaves, stems or fruits are as extensively practiced by other animals than man. Plants that are uprooted during food-gathering are frequently allowed to set seed before harvesting (Burkill, 1952) and, even if not allowed to fully mature, seeds produced in previous generations will insure continuation of the gene pool of the species. Similarly, when populations are harvested for their mature fruits or seeds, sufficient seeds usually escape the harvester to insure establishment of a new generation. Individuals in a wild population do not all mature at the same time and inflorescences on the same individual usually mature at different times. Among the many thousands of plants regularly harvested in the wild as food, few have become domesticated. Even harvesting followed by sowing or planting will not necessarily lead to domestication. Wild cereals, as an example, are often sown by nomadic food gatherers to increase natural populations (Steward, 1941). This practice, however, will only maintain natural evolutionary development. These food gatherers rarely try to improve the habitat, except perhaps for burning the area to be sown, and very rarely repeat the experiment with the same population more than twice.

Adaptation to man-made habitats is complex. The ability to colonize disturbed habitats is characteristic of wild progenitors of all seed-crops as well as other food plants propagated by sowing. Sowing in prepared habitats selects for an increase in colonizing ability. It increases competition among individuals. Seedlings that germinate first when conditions become favourable, and those that grow most vigorously when crowded will provide most seeds from which the next sown generation will become established. With each successive man-sown generation, selection pressure for survival in the man-made habitat increases. Domesticated seed-crops therefore lack dormancy, and tolerate crowding by their own kind, but are poorly adapted to compete with natural colonizers.

Harvesting alone selects to enforce wild-type survival mechanisms. The deepest rooted individuals of tuber-bearing species or individuals with the most efficient means of seed dispersal escape the food gatherer, and transfer their genes for survival to the following generations. Wild seed-crops are harvested by beating, swinging of a basket, hand stripping, by uprooting whole plants, or by cutting inflorescences with a knife or sickle for later threshing. Wilke et al. (1972) point out that harvesting in any way other than for later threshing will not encourage loss of seed-dispersal ability, even if followed in successive generations by sowing. Cereals such as sauwi (Panicum sonorum) in northwestern Mexico, or raishan (Digitaria cruciata) in northeastern India (Singh & Arora, 1972) are commonly harvested by uprooting plants before the individuals are fully mature. They retain efficient seed-dispersal mechanisms although the species are fully domesticated in the sense that cultivated races can no longer compete successfully with their wild progenitors for natural habitats. Harvesting and later threshing, however, select for individuals with the most persistent florets or fruits at maturity. Major seed-crops therefore lack the ability of natural seed-dispersal, and domesticated races depend on man both for a suitable habitat and seed dispersal (sowing). They are never successfully spontaneous (weedy) in the man-made habitat for more than a few generations.

Food gatherers harvest an array of annual and perennial edible plants, seeds and fruits. Relatively few of these were domesticated. The sites of early agriculture must have limited the number of species available for cultivation. Numerous desirable food plants, however, do not lend themselves to domestication. Some have exact habitat requirements and are not already pre-adapted to man-made habitats. The progenitors of all seed-crops are aggressive colonizers, and the progenitors of vegetatively propagated crops readily adapt to transplanting by man. Many desirable food plants give a poor return for the effort and for time invested in sowing or planting, and were probably soon abandoned by man as cultigens. Still others were probably never brought into cultivation.

Plant domestication is sympatric evolution. The wild progenitors of crops are commonly sympatric with their domestic conspecific races. They usually differ strikingly in phenotype and adaptation, but remain sufficiently related genetically to cross and produce fertile hybrids. Hybridization is common and genes are exchanged, particularly in the direction of cultivated races. Divergence and introgression are opposing evolutionary processes. Evolutionary divergence depends on isolation. Burkill (1952) suggests that the initial isolation that led to domestication was provided by man when he transported his favourite food plants beyond their natural ranges. This would also have forced man to plant, replant seed harvested from populations planted in specially prepared habitats. However, selection pressures associated with domestication themselves act as isolating mechanisms. In domestication, isolation between wild and cultivated races becomes disruptive. Thoday (1972) demonstrates that under conditions of disruptive selection associated with differences in adaptation, population divergence continues, even with hybridization. When divergence has progressed to the stage where parent and daughter populations have distinctly different adaptive norms, interpopulation gene flow is effectively eliminated, since hybrids between them are poorly adapted to either parental habitat. Only with a change in selection pressures does divergent evolution come to an end. Racial isolation in domestic species is achieved by gametophytic and sporophytic barriers, and differences in flowering time. The principal isolating force between domestic races and their progenitors, however, is ecological adaptation. Wild races of domestic species do not successfully invade cultivated fields, and cultivated races are totally adapted to habitats specially created for them by man. Hybrids between wild and cultivated races, and derivatives of such introgression survive in 'intermediate' habitats as weeds and provide a bridge between them for occasional gene exchange.

Evolutionary dynamics of plant domestication

Crane (1950) and Masefield et al. (1969) present classes of selection schemes from wild plant to the present cultivated crop. The possible changes of a species caused by domestication were listed by Polunin (1960) and Purseglove (1968).

Domesticated plants
- spread to a more diverse environment and have a wider geographic range
- may have a different ecological preference
- may flower and fruit simultaneously
- may lack shattering or scattering of seeds and may have lost dispersal mechanism completely
- may have larger fruits and seeds, and so lower efficiency of dispersal
- may have been converted from a perennial to an annual
- may have lost seed dormancy
- may have lost photoperiodic controls
- may lack normal pollinating organs
- may have a different breeding system (Usually the change is from complete or partial cross-fertilization to partial or complete self-fertilization. This change may result from a change in flower morphology, or a change from self-incompatibility to self-compatibility.)
- may lack defensive adaptation such as hairs, spines and thorns
- may lack protective coverings and sturdiness
- may have better palatability and chemical composition, rendering them more likely to be eaten by animals
- may be more susceptible to diseases and pests
- may develop seedless parthenocarpic fruits
- may have undergone selection for double flowers, which may involve conversion of stamens into petals
- may have become sexually sterile and vegetatively reproduced.

Speed of domestication depends on the duration of a generation and intensity of selection pressures. For cereals, a generation usually takes one year, whereas for vegetatively propagated plants, fast changes are not usual. Braidwood & Howe (1962) estimated that all major changes in wheat and barley under domestication had taken place within 2 000 years. Helbaek (1966) suggested even 1 500 years.

Some crops were domesticated for several uses. Examples are:
- Sorghum bicolor: annual forage grass, syrup sorghum, grain sorghum, broom corn, popping sorghum used for confectionary, inflorescenses in floral arrangements,
- Cannabis sativus: fibre, drugs, oil seeds,
- Brassica napus: rape, swedes, hungary gap kales, oil-seed colzas,
- Brassica campestris: rapeseed, turnip, leafy vegetables,
- Brassica oleracea: vegetable, forage, ornamental, walking stick, construction material,
- Helianthus annuus: oil, cattle feed, ornamental, bird food, ceremonies,
- Elaeis guineensis: mesocarp oil, kernel oil, wine
- Vicia faba: dry seed, fresh seed, forage, green manure.

This list can easily be extended. Some plants may have been domesticated for one use that eventually became obsolete. If no alternative use were found, its cultivation would be abandoned and it would be lost as a cultigen, but may survive as a weed. Crops may have been abandoned until use was found for them. For instance, several medicinal crops and herbs are also grown as ornamentals, as are Viola tricolor and Digitalis purpurea. Some former medicinal species are nowadays grown only as ornamentals. Similarly reverse plants used in ritual became ornamentals. Many fencing or hedging plants, grown to stop domestic animals from running away and wild animals from entering protected areas, are used nowadays as ornamentals or for hedges. Anderson (1960) and Chang (1970) supposed that the first crops were not food plants. Anderson suggested that plants were first domesticated for body paints, hedges, poisons, chewing, fatigue drugs and ritual purposes.

Chang believes the early domesticated plants were used for making containers (bamboo trunks, fruits of bottle gourd), cordage or as herbs. These plants were useful and, when man became dependent on them, he started to cultivate them. Most experts on crop history, however, believe that food crops are among the first domesticants. Burkill (1952) listed the sequence in which he believed crops were domesticated:

- cereals
- pulses
- greens
- oil seeds
- 'roots'
- herbaceous fruits
- fibre
- woody plants, chiefly fruit trees
- various industrial plants.

Numerous species of wild grasses are adaptable to domestication; they yield well, grow gregariously, so that their caryopses could be collectively harvested, they have edible caryopses, their foliage is excellent for fodder, and the caryopses are good to store. Man did not overlook these advantages of grasses (Burkill, 1952). Pulses must have followed grasses in domestication. Subsequently, several plants collected for the leaves came into domestication as oil crops. Many woody plants received particular attention. Purseglove (1968) stated that cereals were first domesticated in arid and semi-arid regions, whereas in the wet tropics cultivation started with root and tuber crops. Archaeological research will eventually elucidate the correct sequence of domestication. It may differ from region to region and different kinds of crops may have been domesticated simultaneously.

The plant families have not contributed equally to the present supply of domesticated species. Among the 173 families (see table) 48 families are represented by only one item, 24 by 2 items, 10 by 3 items, and 4 by more than 100 items. The family with most items is the Gramineae (379, 15.2% of the total number of items); most of them coming from Region 8: Africa. This continent is well known for its forage grasses. The Leguminosae follow with 337 items (13.5%); Regions 2, 7, 8 and 10 are the main sources. Gramineae and Leguminosae contribute about one third of the number of items. Rosaceae rank third with 158 items (6.3%), most of them come from Regions 1 and 9. Solanaceae rank fourth with 115 items (4.6%), most of them come from Regions 10 and 11.

Region 2 has contributed the highest number: 331 items (12.5%), closely followed by Region 1 (295 items, 11.8%), and Regions 8 and 10 (each 292, 11.7%). These four regions contribute almost half of all items.

Table. Number of items per family per region, per family and per centre

Family	Region													
	1	2	3	4	5	6	7	8	9	10	11	12	uni-den-ti-fied	Total
Acanthaceae				1				2		1				4
Aceraceae												1		1
Actinidaceae	4													4
Agaraceae		1	1	1				6		2	17		1	29
Aizoaceae								3		1				4
Alismataceae	1													1
Alliaceae	9			1	3	4	2		2					21
Alstromeriaceae											1			1
Amaranthaceae	1	3		2			1	1		6	3	3	1	21
Amaryllidaceae							2							2
Anacardiaceae	2	7		1	1		1			5	4	1	1	23
Annonaceae		2						1		4	8			15
Apocynaceae		1		2			1	4		2			1	11
Aquifoliaceae	1									1				2
Araceae	1	7		4					1	8	2	1		24
Araliaceae	5	4										1		10
Aristolochiaceae									1					1
Asclepiadaceae		1		1			1		1			1		5
Averrhoeaceae		2												2
Azollaceae	1	1												2
Balanitaceae							1							1
Balsaminaceae	1													1
Basellaceae		1								2	1			4
Berberidaceae									1			1		2
Bignoniaceae								1			3			4
Bixaceae										1				1
Bombacaceae		4						1		1	1			7
Boraginaceae	1	1			1		2		1					6
Bromeliaceae										3	1			4
Burseraceae	1	4						2						7
Cabombaceae	1													1
Cactaceae										18	36			54
Campanulaceae	2								1			1		4
Cannabidaceae	4			1					2			1		8
Cannaceae								1		1				2
Capparidaceae							1							1
Caricaceae										3	1			4
Caryocaraceae										1				1
Caryophyllaceae							2		2					4
Casuarinaceae			1											1
Celastraceae	4													4
Chenopodiaceae	4		1	2	4	6	6		5	2	1	2	1	34
Chloranthaceae	1													1
Chrysobalanaceae										1				1
Cleomaceae								1						1
Combretaceae		4												4
Compositae	10	7		3	5	3	18	9	16	6	4	5		86
Convulvulaceae	2	1		1			1			2	3			10
Cornaceae						1								1
Corylaceae	4					3	1							8
Corynocarpaceae													1	1
Crassulaceae								1	2					3
Cruciferae	8			3		5	11	4	12	1			1	45
Cucurbitaceae	5	2		9	1	2	3	17	2	2	7	1	2	53
Cupressaceae								1				1		2
Cyperaceae	5	3					3		2	1			2	16
Datiscaceae					1									1
Dioscoreaceae	2	8		1			15			2	1			29

Family	Region													
	1	2	3	4	5	6	7	8	9	10	11	12	uni-den-ti-fied	Total
Dioscoreaceae	2	8		1			15			2	1			29
Dipsacaceae						2								2
Dipterocarpaceae		1												1
Ebenaceae	3	2			1						1	1		8
Ehretiaceae							1				1	3		5
Elaeagnaceae					1									1
Elaeocarpaceae	3	1									1			5
Ericaceae							1							1
Erythroxylaceae										2				2
Eucommiaceae	1													1
Euphorbiaceae	4	13		3			2	7		10	2	1	1	43
Euryalaceae	1													1
Fagaceae	5				1		1					2		9
Flacourtiaceae		6		2				1						9
Geraniaceae							2	7						9
Ginkgoceae	1													1
Gnetaceae		1												1
Gramineae	35	47	2	32	12	34	37	72	39	22	20	25	2	379
Grossulariaceae	3						1		6			2		12
Guttiferae		9		4					1	2				16
Hippocastanaceae					1		1							2
Hydrastidaceae												1		1
Hydrophyllaceae		1										1		2
Illiciaceae	2													2
Iridaceae	2					1	2				1			6
Juglandaceae	4				1	1			1	1	2	4		14
Labiatae	5	6			1		17	9	10		3	1		52
Laminariaceae	1													1
Lauraceae	2	3		1			1			2	3			12
Lecythidaceae										2				2
Leguminosae	14	45	9	23	6	20	49	54	33	44	14	10	6	337
Lemnaceae		1												1
Liliaceae	8	1		1	1	1	3	1	2			2		20
Limnanthaceae												1		1
Limnocharitaceae		1												1
Linaceae				1	1	1	1	1	1					6
Lythraceae								1						1
Magnoliaceae	1	1												2
Malpighiaceae										3	2			5
Malvaceae	6	4	5	8	2	6	2	14	1	9	9	1	3	70
Marantaceae								1		2				3
Martyniaceae												1		1
Melastomataceae								1						1
Meliaceae		3			1									4
Menispermaceae	1							2						3
Moraceae	3	6		4	2	2	1	4			2	1		25
Moringaceae				1				1						2
Musaceae	1	4	1	3				2						11
Myricaceae	1													1
Myristicaceae		2												2
Myrtaceae		10	40	2			3			13	5			73
Nelumbonaceae						1								1
Nyctaginaceae		1								1				2
Oleaceae	5			2	1		3							11
Onagraceae										1	1			2
Orchidaceae											2			2
Oxalidaceae										1				1
Paeoniaceae									1					1
Palmae	1	10		3			1	9		4	2			30
Pandaceae		4						1						5

Family	Region													
	1	2	3	4	5	6	7	8	9	10	11	12	uni-den-ti-fied	Total
Papaveraceae						1	1				1			3
Passifloraceae										17	1	1		19
Pedaliaceae	1			2				4						7
Pentaphragmaceae		1												1
Peperomiaceae										1				1
Perioplocaceae				1				1						2
Phytolaccaceae	1									3		1		5
Phytolaccaceae	1									3		1		5
Pinaceae		1					1							2
Piperaceae		5		2				2		1				10
Pistaciaceae							2							2
Plantaginaceae	1			1			2		1					5
Polygalaceae								1						1
Polygonaceae	8	1		1	1	1		1	5		2			20
Portulacaceae								4	1	1	2			8
Protaceae			3											3
Punicaceae						1								1
Ranunculaceae	2						2		3					7
Resedaceae				1		1	3		1					6
Rhamnaceae	3						3		2	1				9
Rosaceae	41	2		1	26	22	2	1	37	4	1	21		158
Rubiaceae	1	4		4		1		6	1	2				19
Rutaceae	12	15	1	4		1	5	3			2		1	44
Salicaceae					1				7			1		9
Sambucaceae									2					2
Santalaceae		1												1
Sapindaceae	3	5		1				1		3				13
Sapotaceae		3		3				3		5	6			20
Saurucaceae		1												1
Saxiphragaceae									1					1
Scrophylariaceae	1						1		3					5
Simaroubaceae		1								1	1			3
Simmondsiaceae											1			1
Solanaceae	1	2	6	4			2	12	4	47	31	5	1	115
Sterculiaceae								4		4	2			10
Stilagninaceae		1												1
Strychnaceae				1										1
Styraceae		1												1
Taccaceae		1												1
Tamaricaceae					1			1						2
Taxaceae	1													1
Tetragoniaceae	5													1
Theaceae				1										1
Thymelaeaceae	2									1				3
Tiliaceae	1			2				1						4
Trapaceae	3													3
Tropaeolaceae										3				3
Typhaceae	1													1
Ulmaceae					2		2							4
Umbelliferae	5	3		2	2	4	13		11	1				41
Urticaceae	1	1		2			1						2	7
Valerianaceae						1	2		4			1		8
Verbenaceae				1			1	2		1				5
Violaceae	1						1		1					3
Vitadaceae	2				1	2	1		1			7		14
Zingiberaceae	4	16		9				2						31
Total	295	311	70	166	82	129	246	292	231	292	225	113	27	2489
% of total	11.8	12.5	2.8	6.7	3.3	5.2	9.9	11.7	9.3	11.7	9.0	4.5	1.1	

Cradles of agriculture and regions of diversity

Geographic centres of plant domestication cannot be found without studying the origins, hearths or 'cradles', and spread of agriculture and of domestic plants.

Wild plants are still entering cultivation, whereas an important crop like the oil palm in West Africa is still largely semi-domesticated (Zeven, 1967; 1973). Other examples of semi-domesticates are secondary crops, i.e. crops that were first weeds in primary crops but were later themselves domesticated.

Sites of prehistoric farms have been discovered in Thailand, the Near East and Mexico. They showed that incipient agriculture existed in Thailand at about 11 000 B.C. (Gorman, 1969), in the Near East at about 9 000 B.C. (Cambel & Braidwood, 1970) and Mexico at about 6 000 B.C. (MacNeish, 1964a; 1964b). In other parts of the world no such early sites have yet been found, and it is generally accepted that from these cradles agriculture spread to other parts of the world. There are good arguments for independent origin of agriculture in China (Ho, 1969). But agriculture may have reached China and Japan, and S.E. Asia from Thailand, while agriculture probably reached Europe, Africa, W. and S. Asia from the Near East.

Alexander Von Humboldt was probably the first author to refer to the origin of crops. In his work Essai sur la Géographie des Plantes (1807) he said: "The origin, the first home of the plants most useful to man and which have accompanied him from remotest epochs, is a secret as impenetrable as the dwellings of all our domestic animals. We do not know what region produced spontaneously wheat, barley, oats and rye. The plants which constitute the natural riches of all inhabitants of the tropics, the banana, the pawpaw, the cassava, and maize have never been found in wild state" (cited by Hawkes, 1970). If he were alive now, Von Humboldt would be delighted to learn how much we know of the origin of cultivated plants.

The next study was by Alphonse De Candolle in "Géographie Botanique Raisonée" (1855). Then came Charles Darwin (1868) with his book "Variation of animals and plants under domestication". However Darwin was not interested in the origin of cultivated plants, but in evolution of animals and plants, whether in nature or under domestication.

De Candolle's thoughts on tracing the origins of cultivated plants were published in 1882 in his book Origine des Plantes Cultivées. His work is still largely up to date (Harlan, 1961). He based his investigations on:
- classical botany (plant geography, knowledge of adventive and ruderal species, understanding of history of development of whole floras),
- bio-archaeology (plant remains, pictorial records, especially from Egypt),
- palaeontology,
- philology.

He concluded that the region where a species was abundant was not necessarily its centre of origin. Perhaps De Candolle (1882) was the first to indicate regions where plant domestication might have taken place (Smith, 1968):
- China
- S.W. Asia and Egypt

- tropical Asia.

In De Candolle's time, it was quite natural to include Egypt as much of the knowledge of plant history came from that country.

After De Candolle, Nicolai Ivanović Vavilov suggested cradles of agriculture. At the height of his career he had more facilities than anyone before (Harlan, 1951). With his abundant energy, he exploited them to the full. During the Fifth International Genetics Congress at Berlin in 1926, Vavilov (1928) developed his theory of centres of origin or gene centres indicating that several regions of the world possess concentrations of variation of certain cultivated plants and that these regions overlap for several cultivated plants. These regions can be identified by the Differential Method, described by Burkill (1952):

- Take a map
- select major cultivated plants
- mark the sites where recognizable botanical varieties and races of these cultivated plants are found. The identification of the botanical varieties was done by investigating the morphology, cytology, genetics and resistance to diseases, pests and unfavourable climatic conditions of the plants
- Where those marks often coincide is a centre of origin. In such centres the greatest diversity of the cultivated crop is observed.

Vavilov concluded that a centre of origin was characterized by dominant alleles and that the frequency of recessive alleles increased and diversity decreased towards the periphery. The cause was inbreeding, geographical isolation and drift.

At the periphery, secondary gene centres may develop; new areas with a great diversity conditioned by recessive alleles. In 1926, Vavilov reported that Asia Minor lies in the Asiatic, Mediterranean, Balkan and Transcaucasian gene centres of wheat and other crops. In 1931, he extended this idea by distinguishing seven gene centres. In 1935, he raised this number to eight by splitting SW Asia into Central Asia and the Near East. Later Zohary (1970) proposed to reunite them. The centres recognized by Vavilov were:

I. China
II. India
IIa. Indo-Malaya
III. C. Asia, including Pakistan, Punjab, Kashmir, Afghanistan and Turkestan (USSR)
IV. Near East
V. Mediterranean coastal and adjacent regions
VI. Ethiopia
VII. S. Mexico and C. America
VIII. S. America (Peru, Ecuador, Bolivia)
VIIIa. Isle of Chiloe (Chile).

These centres lie between 20 and 45^{o} latitude north and south in mountainous regions and often in areas with a temperate climate. They are separated by great deserts or lie on different continents. According to Vavilov, agriculture in these eight regions developed independently, because of the differences in agricultural methods, implements and domestic animals.

Vavilov may have been influenced by Willis' Age and Area hypothesis (Willis, 1922): in comparing wild species with similar modes of dispersal, those with the wider distribution are the older, and that the longer a species has been present in an area, the more diverse the derived species and subspecies found there. Vavilov may also have been influenced by the agrogeographical work of Engelbrecht (Zeven, 1973). However time is not the only factor that influences the dispersal of a species and its increase of variation.

In the 1930s, Vavilov established an 'ecological passport' for the accessions of his large collections by sowing them at various sites ('geographical sowing') after which he estimated:
- differences in growth during the vegetative period
- differences in length of the various development stages, including growth rhythm
- economic characters, such as size of fruits and seeds
- vegetative characters
- resistance to different kinds of drought
- resistance to cold
- differences in flowering
- resistance to bacteria and viruses
- resistance to insects
- ecological growth form: xerophyte, hydrophyte, mesophyte.

The diversity was enormous but within limits and with certain regularities. Vavilov discovered parallelisms that are especially clear for plants of the same general group (annuals, herbaceous), characterized by the same area of distribution and following the same geographical route in their evolution. Since it seemed as though each species differentiated into different agro-ecological and geographical groups, he was able to establish the 'ecological passport' for annual cereals, grain legumes, oil and fibre flax. In 1940, Vavilov divided the Old World (excluding Africa south of the Sahara and tropical Asia) into 19 areas, each characterized by the plants with essentially the same 'ecological passport':

1. Syrian Group Agricultural Territory: chiefly foothills of Syria, Palestine and Jordania. Characteristics of cultivated and wild plants: relatively small; with small leaves, flowers and seeds; thin, stiff stems; non-shattering spikes or indehiscent pods; high maturing temperature; short vernalization stage. Examples: types of wild and domesticated Triticum species; barley; oats; peas; lentils; grass-peas; chick-peas; domesticated flax and vetch.

2. Anatolian Group Agricultural Territory: mountainous parts of Turkey. Characteristics: medium-size; thin, stiff stems; medium-sized spikes, fruits and seeds; resistant to drought; short development stages; requiring considerable warmth during last stage of development. Examples: as Group 1.

3. Armenian Xerophytic Mountain Group Agricultural Territory: arid, mountainous steppes of Soviet and Turkish Armenia. Characteristics: markedly xerophytic (small narrow leaves); small seeds. Examples: Triticum vavilovii (also resistant to shattering, and winterhardy); early dwarf, small seeded, xerophytic chick-peas; a large number of relatives of domesticated wheat; Secale vavilovii.

4. Caucasian Mesophytic High-Mountain Group Agricultural Territory: high mountain plateaux of Daghestan and Georgia, Northern America. Characteristics: thin stems; comparatively smooth awns; small or medium-sized seeds; short or medium vegetation period. Examples: original ecotypes of soft wheat; prototypes of European steppe winter and spring bread-wheats; Triticum carthlicum; a specific group of barley with narrow leaves; many xerophytic and mesophytic types of Secale montanum and S. cereale ssp. segetale (many with a great diversity of red and brown forms).

5. Daghestan-Azerbaijan Foothill Group Agricultural Territory: coastal regions of Daghestan and Azerbaijan. Characteristics: mesophytic; long vege-

tation period; tall; leafy; large seeds; rather resistant to leaf rust. Examples: giant forms of soft and durum wheats; barley, rye; peas, vetch, winter types of durum.

6. Transcaucasian Humid Subtropical Group Agricultural Territory: West Georgia and Black Sea coast, humid regions of Turkey and S. Azerbaijan (Lenkoran), N.Iran. Characteristics: hydrophytic, tall. leavy; late; rather resistant to various European fungus diseases, Examples: endemic Triticum ssp. such as T. macha and T. timopheevi, and some other diploid and tetraploid Triticum types; late types of prostrate fibre-flax sown in autumn and winter; transitory and very late spring varieties of cereals.

7. Iran-Turkestan Group Agricultural Territory: irrigated and unirrigated regions of Iran, Afghanistan, Soviet Central Asia (Uzbekistan, Tadjikistan, Turkmenia). Characteristics: low to medium-high; rather non-shattering rough spikes; weak stems subject to lodging; slow growth during early stages of development; drought-resistant during late stages; high temperature requirement at maturity; extremely susceptible to all European fungus diseases when sown in steppe or wooded steppe regions of Europe. Two subgroups:

a. Khiva Subgroup: near mouth of Amu-Darya river, late varieties of wheat, barley, flax and peas

b. Kashgar Subgroup: high plateaux near the Pamir, extremely cold-resistant varieties of soft wheat and relatively late varieties of flax (frequently with white flowers and seeds).

8. Pamir-Badakhstan Group Agricultural Territory: Soviet and Afghan Badakhstan (Pamir Agricultural District), C. and N. Kafirstan, at very high altitudes (even 3000 m or more). Includes types from Upper Himalayas and Tibet. Characteristics: mesophytic types; of medium height; broad leaves; short vegetative period; extremely susceptible to all European fungal diseases. Furthermore a giant type of rye with large anthers and pollen grains, big kernels and large spikes; liguleless, soft and compactum wheat; large broad-leaved, naked, six-rowed barley; small seeded, early peas, beans and grass-peas.

9. Indian Group Agricultural Territory: N. India. Characteristics: as those for the Pamir-Badakhstan Group; despite the diversity in ecological circumstances quite uniform; not bushy; thin, stiff stems; small narrow leaves; early; short; development stages and rapid development rhythm; resistant to drought; need high temperatures, especially during last stages of development; rapid filling-out of seeds; small seeds (in cereals, flax and grain legumes); spikes of wheat and barley smooth with non-shattering grain.
In Kashmir, a subgroup has been established based on a special wheat type characterized by medium height, thin stems, long narrow leaves, small kernels, rather smooth awns, winter habit, and less susceptibility to brown rust than the plants of Group 7. (The reason why Group 8 and 9 have been separated, despite identity of characteristics, was not stated.)

10. Arabian Mountain Group Agricultural Territory: Yemen, where high-mountain agriculture is subject to the influence of the surrounding deserts. Characteristics: short spring annuals with extremely rapid growth; thin stiff stems; narrow leaves; relatively large seeds. No examples are given.

11. Ethiopian (Abyssian) Group Agricultural Territory: Ethiopia and Eritrea. Divided into two subgroups;

a. varieties sown at beginning of main rainy season; cosmopolitan, hydrophytic types of tall large-seeded varieties of barley and peas. (Ethiopian wheats, though not notably cosmopolitan, may be included here.)

b. varieties sown at the end of the rainy season: flax, chick-peas, lentils, beans, grass-peas, and an Arabian type of pea (xerophytic, early, low, small-leaved, small-seeded). Origin: very probably linked with India and mountainous Arabia.

12. Chinese-Japanese Group Agricultural Territory: China and Japan. Very likely, the original material was imported from Asia Minor by way of India several millenia ago, but very important new characters have developed in this group. Characteristics: short development stages; low or medium height; extremely small seeds; rapid filling of grains. Examples: rapidly filling wheats with small kernels, awnless or awnletted.

13. Mediterranean Group Agricultural Territory: Mediterranean Area. Characteristics: rather tall, bush; large spikes; long awns; large light-coloured seeds; high yields; usually solid straw, short first development stage; resistant to low air humidity, requiring much warmth at maturity; resistant to fungal diseases. (No examples were given.)

14. Egyptian Group Agricultural Territory: Egypt. Characteristics: barley and durum with short stiff stems, medium-sized spikes and short first development stages. Similar types have been found on Cyprus.

15. South European Group Agricultural Territory: S. France, N. Italy, part of Yugoslavia, Bulgarian coast. Characteristics: tall plants; large leaves; big fruits; high yields. Examples: Triticum turgidum sensu stricto, soft wheats; in Lombardy, giant forms of oats, chick-peas, horse beans, and a polonicoid wheat have been found.

16. European Steppe Group Agricultural Territory: European Steppe from Tirol to the Urals; transferred to N. America, especially to the prairies. Examples: xerophytic spring and winter types of cereals and grain legumes, the winter types winter-hardy, the spring types drought-resistant; rather small seeds, weak straw, narrow leaves. (Vavilov divided this Group into two subgroups, but gave no ground for them.)

17. West European Group Agricultural Territory: W. Europe including S. Finland and S. Sweden. Characteristics: tall hydrophytic plants; thick; stiff stems; large broad leaves; large dense, highly productive spikes; medium-sized or large grain; ripening late. Local varieties have lax spikes, and are tall and early.

18. Central European Group Agricultural Territory: forest and wooded steppe of C. Europe. Characteristics: high-yielding mesophytes. Examples: long-fibre flax, high-yielding peas, awnless soft wheats.

19. Northern (Boreal) Group Agricultural Territory: N. European Soviet Union, Siberia, N. Scandinavia. Characteristics: mesohydrophytic; precocity; medium-sized; low warmth requirement; cold-resistant. Examples: self-compatible rye and very early types of forage barley.

Vavilov worked on his concept of gene centres, modifying it, until his death. These agro-ecological groups need not coincide exactly with gene centres. The purpose of all his effort is obvious. There are groups of plants possessing certain characteristics not present in other groups. So when looking for a certain property in a species, it is not necessary to study its entire area of distributuion, but it is sufficient to look for it in the group(s) where this property has already been found.

The gene microcentres of Harlan (1951) are a further breakdown in geobotanical patterns of variation. They are small areas in which evolution is still proceeding at a rapid rate. For wheat, Harlan identified three microcentres in Turkey. Undoubtedly many more exist elsewhere. With the introduction of high-yielding foreign wheat varieties, these microcentres are disappearing. Harlan also identified gene microcentres in Turkey for a number of other crops. He found that such centres frequently coincide. They may be in the plains or in mountainous regions, near civilization or remote from it, in areas with very primitive or more advanced husbandry.

With increasing knowledge of cultivated, weedy and wild plants, it is becoming evident that some parts of Vavilov's theory had to be changed (reviewed by Kuckuck, 1962). Nevertheless it still forms a good basis to search for wild or semi-wild relatives of particular crops. The large collections made by Vavilov and his introduction of a genetic element in investigation still render these discussions pertinent. One point in Vavilov's theory was that a primary centre was marked by a high frequency of dominant alleles. Gökgöl (1941) showed that it was impossible to indicate such a centre for wheat. Brieger (1963) did not find one for maize, Zeven (1967; 1972) not for oil palm and Hanelt (1972) not for Vicia faba. Besides it has been pointed out that a great diversity may also arise from the variation of the environment. Hence the relation between mountain regions and centres of origin. Such a great diversity may also develop when two populations of a (partial) cross-fertilizing species meet, as has been shown for Carthamus tinctorus. Vavilov's theory that where the greatest diversity is found is also the centre of origin, is no longer tenable, as was shown for crops such as Triticum dicoccum and Hordeum vulgare in Ethiopia. These crops show a great diversity there, but no wild relatives are present.

Kuckuck (1963) concluded that Vavilov would certainly have altered his theories with present knowledge. Indeed, he introduced changes as his research progressed.

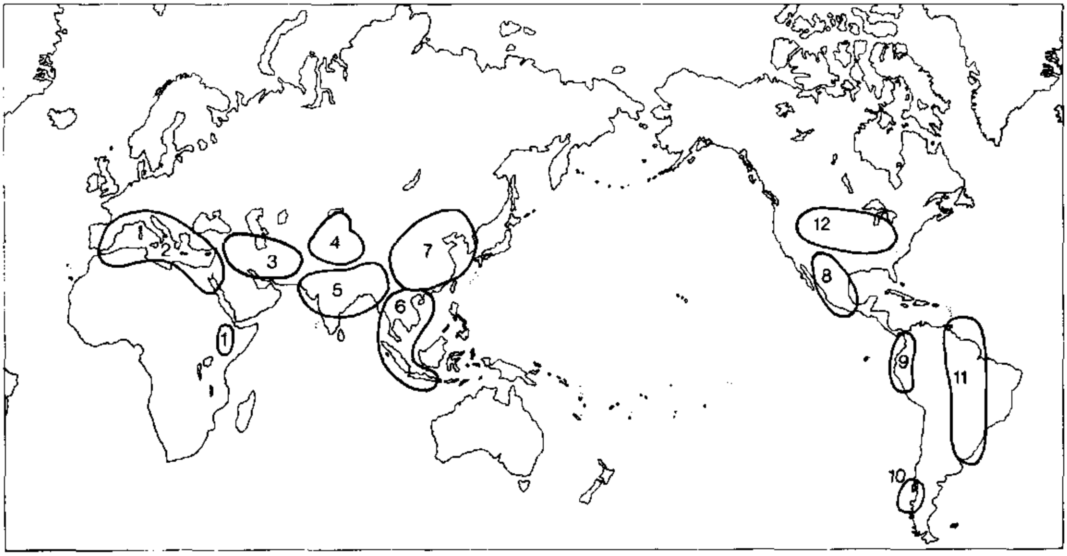
The number of cradles of agriculture has been extensively discussed. Vavilov believed in several, others suggested two (Sauer, 1952); one for the Old World (Burma and adjacent area) and one for the New World (C. America). Darlington (1952, 1969) also suggested two: the Fertile Crescent of the Near East and Mexico. From these nuclear areas agriculture was supposed to have spread across the Old World and the New World, respectively. After the introduction of agriculture, new centres of plant domestication developed. Thus, Darlington & Janaki Ammal (1945) distinguished twelve 'centres of origin':

1. Ethiopia
2. Mediterranean coast
3. Iran, incl. the Caucasus and E. Turkey
4. Afghanistan
5. Indo-Burma
6. Siam-Malaya-Java
7. China
8. Mexico
9. Peru
10. Chile
11. Brazil-Paraguay
12. United States

As compared with the list of Vavilov (1926), they proposed continental Chile instead of the Isle of Chiloe, and added the Brazil-Paraguay and the United States centres.

They considered the Mediterranean centres as diffuse, for cultural rather than botanical reasons. "The Mediterranean, a barrier to wild plants, has been a means of dispersal and a bond of union for plants of established cultivation".

In 1956, Darlington added Europe (for no indicated reason), Central Africa (perhaps based on Portères' views - see below) and C. America (already mentioned by Vavilov). He also switched inexplicable to 'region', though the captions of his table and figure still mention 'centres'. This resulted in the following centres:



Gene centres of cultivated plants of Darlington & Janaki Ammal (1945) derived from Vavilov

1. S.W. Asia
2. Mediterranean
2a. Europe
3. Ethiopia
3a. C. Africa
4. C. Asia
5. Indo-Burma
6. S.E. Asia
7. China
8. Mexico
8a. United States
8b. C. America
9. Peru
9a. Chile
9b. Brazil-Paraguay

In 1950, Portères suggested independent cradles of agriculture in Africa south of the Sahara, one in E. Africa, the other in Tropical W. Africa. He divided the latter into:
- the Senegambian 'Subcradle',
- the Central Niger 'Subcradle',
- the Benin 'Subcradle' and
- the Adamawa 'Subcradle'.

Other African cradles of agriculture are in N. Africa and Ethiopia. In 1962, he changed his concept by dividing and subdividing Africa into:

A. West African Cradle
  I. Tropical Sector
    a. Senegambian Subsector
    b. C. Niger Subsector
    c. Chad-Nilotic Subsector
  II. Subequatorial Sector

B. Nilo-Abyssinian Cradle
  I. Nilotic Sector
  II. Abyssinian Sector

C. E. African Cradle

D. C. African Cradle

The Nilo-Abyssinian Cradle coincides with Vavilov's Ethiopian and part of the Mediterranean Centre of origin. The last two cradles have not been further elaborated. Portères (1950; 1962) decided on a W. African Cradle because of the presence of several crops typical to that area. In this he was supported by Murdock (1959), who established four regional agricultural complexes:

1. S.W. Asian Agricultural Complex, developed by Caucasoids
2. SE. Asian Complex, developed by Mongoloids
3. C. American Complex, developed by American Indians
4. W. African Complex, developed by the W. African Negroes.

His decision on an independent West African Agricultural Complex is based on grounds similar to those of Portères.

Anderson (1960) started from quite another characteristic, in dividing agriculture into floral and non-floral seed-crop agriculture in C. Africa and a 'pole' of floral agriculture in Indonesia. He supposed that the floral type of agriculture spread into Oceania, China and Japan, India and Afghanistan, and the non-floral type remained in Africa. The almost complete lack of interest in flowers and ornamental plants among the African peoples is really astonishing, whereas in the region of the floral type even the poorest man grows some ornamentals (Anderson, 1960). This is not due to an absence of ornamental species in Africa. Many species are commonly grown elsewhere now. The claim of an African cradle of agriculture has been refuted by Wrighley (1960), Clark (1962), Baker (1962), Harris (1967) and Harlan (1967). Baker (1962) summarized his objections as follows:
- few of the domesticates are definitly known to originate from W. Africa
- several of the domesticates have so little differentiated from their wild progenitors that they cannot be of great antiquity as cultivated plants
- if cultivation had been practised locally for seven millenia, an associated weed flora rich in indigenous species would have evolved.

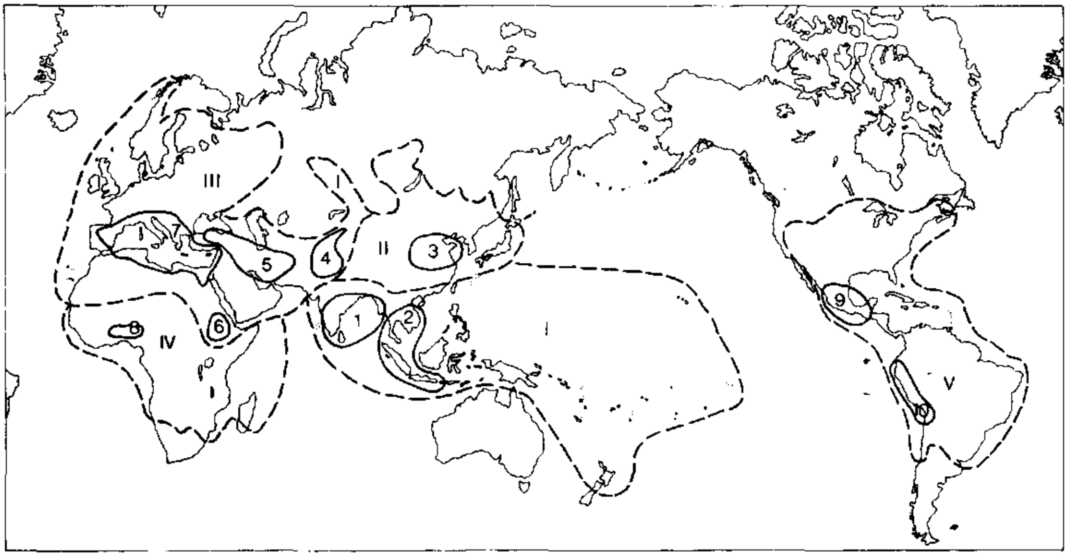
Harris (1967) concluded that typically W. African crops are local additions to an intrusive agricultural complex, rather than compounds of an ancient indigenous one. After the introduction of agriculture into N. Africa it spread into the Sahara. With the desiccation of this area in the third millenium BC, agriculture became established in the savanna zone stretching from the Atlantic to Lake Chad and further to Cape Horn in E. Africa. In this centre, the many typically African plants, listed by Harlan (1971) were domesticated.

Kupzov (1955, cited by Darlington 1956) showed regions of the world that belong to certain hearths of agriculture. He identified ten, grouped into 5 'main agricultural regions':

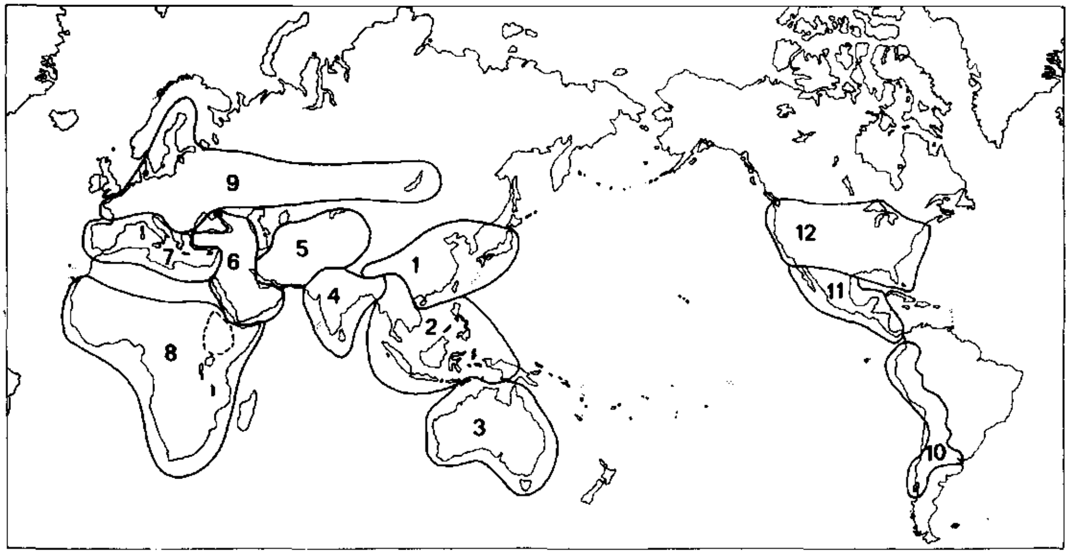
Hearth of agriculture	Main agricultural region
1. Indian 2. Indonesian	I. Australoid
3. Chinese	II. Mongoloid
4. C. Asiatic 5. Near East 6. Ethiopian 7. Mediterranean	III. Europoid
8. Nigerian	IV. Negroid
9. Mexican 10. Peruvian	V. Americanoid

Except for Nigeria they derive from a neolithic stage.

Zhukovskij (1965) was the first to refer to Siberia as a gene centre for crops. Many Malus, Prunus, Pyrus and other species were domesticated there. Further, it is a rich source of wild relatives of these species.



Primary regions of agriculture (——) and regions of expansion (---) of Darlington (1956) derived from Kupzov (1955)



Megacentres of cultivated plants of Zhukovskij (1968)

In 1968, he heralded his idea about 'megagene centres'. As so many crops originate outside one of Vavilov's centres of origin, it was necessary to enlarge the areas in which species were domesticated. These megacentres engulf much of the world's land surface and extend over vast areas. They are:

1. China
2. Indochina-Indonesia
3. Australia-New Zealand
4. Indian Subcontinent
5. C. Asia
6. W. Asia
7. Mediterranean coastal and adjacent regions
8. Africa (8a Ethiopia)
9. Europe-Siberia
10. C. America
11. Bolivia-Peru-Chile
12. N. America

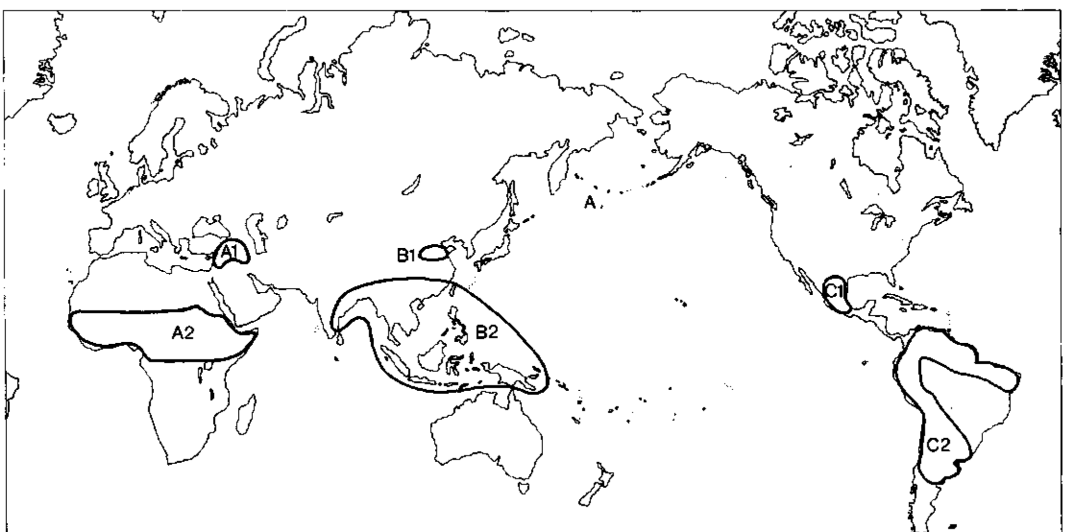
Megacentres 1, 2, 4, 5, 6, 7, 8a, 10 and 11 as recognized by him, are based on Vavilov's concepts though much enlarged. Zhukovskij proposed as new ones 3 (Australia-New Zealand), 8 (whole Africa) and 9 (Siberia). Megacentre 12 (N. America) had already been presented by Darlington & Janaki Ammal (1945) and 9 (Europe) by Darlington (1956). Zhukovskij (1968) did not draw boundaries between 2 and 4, 5 and 6.

In 1970, Zhukovskij made some amendments; some megacentres were enlarged and boundaries were drawn between 2 and 4, and 5 and 6. Obviously the greater the number of investigated crops, the larger the areas. Therefore Harlan (1971) developed the idea of centres and non-centres. He suggested that agriculture began independently in three areas and that there was a system composed of a centre and a non-centre, many indigenous plant species were domesticated, after agriculture was introduced. Harlan (1971) preferred the term 'non-centre' because of the large area involved. His classification was:

Centre	Non-centre
A1. Near-Eastern	A2. African
B1. Chinese	B2. SE. Asian and S. Pacific
C1. C. American	C2. S. American

Major crops domesticated in the 'non-centres' may sometimes have spread to their centres in early times.

Zhukovskij's (1970) classification has been used as basis for the following list, though possibly some megacentres still have to be enlarged. This



Centres and noncentres of agricultural beginnings of Harlan (1971) holds especially for S. America, where a shift of the eastern boundary may include Brazil and Paraguay and the land west of these countries, as proposed by Darlington & Janaki Ammal (1945).

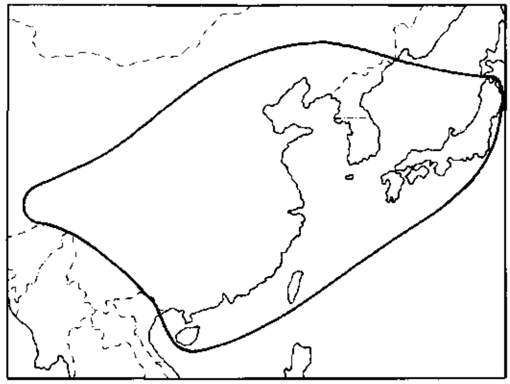
We preferred the term Region to Megacentre.

Future research will show whether there have actually been three cradles of agriculture:

1. E. Asia (China and Burma)
2. the Near East (Fertile Crescent)
3. C. America,

and how agriculture spread from these cradles over the world.

1 Chinese-Japanese Region



Vavilov called the Chinese-Japanese Region the 'East Asian Centre of Origin'. For several crops, Japan is a secondary centre of diversity. The Chinese-Japanese Region is the primary region of diversity for several fruit-crops from the Amur-Ussuri Region. Li (1966, quoted by Chang 1970) divides China into two regions: (1) N. China with a seed and vegetable agriculture; (2) S. China, which forms a buffer zone between N. China and Region 2, with its vegetatively produced crops. Chang (1970) and Harlan (1971) suggest an independent origin of agriculture in the N. China Region, which resulted in a wholly original assemblage of cultivated plants. Harlan calls the B1 North Chinese Centre of Origins for Agriculture.

The earliest known site of agriculture in China is at Yang-Shao. It is strictly Chinese, with no appreciable foreign influence before 1300 BC. It is at present assessed to date back as far as the 4th millenium BC. Older agricultural sites will probably be found in China (Ho, 1977).

China contributed several major crops. These include several species of fruit trees, Camelia sinensis, Corchorus sinensis, Glycine max, Panicum miliaceum and Setaria italica. It is a secondary centre of diversity for Oryza sativa and other crops.

Actinidiaceae

ACTINIDIA ARGUTA Sieb.& Zucc. Tara vine. 2n=c. 116. China, Japan, Korea and the Primorye Territory, USSR. Very frost resistant. Used in crosses with A. chinensis* (Schroeder & Fletcher, 1967).

ACTINIDIA CHINENSIS Planch. Chinese gooseberry, Strawberry peach, Yang tao. 2n=c. 116, c. 160. W. and C. China. Extensively cultivated in the Yangtse valley and elsewhere for its large, fragrant, juicy fruits. Luther Burbank used it as a pollen donor with the frost resistant A. arguta*.

ACTINIDIA KOLOMICTA Maxim. Kolomikta. 2n=c. 112. NE. China and the Primorye Territory, USSR. Very winterhardy. With delicious berries containing much Vitamin C. It is cultivated.

ACTINIDIA POLYGAMA Miq. Silver vine. 2n=c. 58, c. 116. N. and W. China, Korea and Japan. A polygamous, trioecious ornamental. In Japan the leaves are boiled and eaten.

Alismataceae

SAGITTARIA SAGITTIFOLIA L. Arrowhead. 2n=22. Europe and Asia. A herb cultivated in China and Japan for its edible corms.

Alliaceae

ALLIUM CHINENSE G. Don (syn. A. bakeri Regel). Rakkyo, Ch'iao T'ou. 2n=(x=8) 16, 24, 32. China (Li, 1970). Cultivated in China, Japan, California and elsewhere by the Japanese and Chinese.

ALLIUM FISTULOSUM L. Welsh onion, Cibol, Stone leek, Spring onion. 2n=16. Siberia and China (Li, 1970). Cultivation started probably in N. China. Cultivated in China and Japan. Related to A. altaicum Pall. (2n=16) from N. Mongolia. A. wakegii Araki. (2n=16) and A. microbulbum Prokh. The latter is considered a hybrid of A. fistulosum* and A. altaicum. Cultivars with blue-green leaves and white bulb are sometimes separated as A. bouddbae O. Deb. (2n=16) (Purseglove, 1972).

ALLIUM LEDEBOURIANUM Roem. & Schult. Asatsuki. 2n=16. From USSR to Japan. Cultivated in Japan (Kihara, 1969).

ALLIUM MACROSTEMON Bunge. Chinese garlic. Chromosome number varying with parts of the plant from diploid (2n=2x=18) to hexaploid (2n=2x=72). Including aneuploids. Ancient Chinese garden plant with very big bulbs. Introduced in W. Georgia (USSR) during the Middle Ages.

ALLIUM NIPPONICUM Franch. & Savat. 2n=16, 32. Formerly cultivated in China but now it only grows wild there (Li, 1969).

ALLIUM RAMOSUM L. Chinese leek. 2n=32. N. China and Siberia. Cultivated in N. China. An autotetraploid. It differs from A. porrum*.

ALLIUM SATIVUM L. Garlic. 2n=16, genome formula SS. C. Asia (p. 81). Var. pekinense Makino sometimes considered a native of N. China. Cultivated in N. China and Japan (Li, 1969).

ALLIUM SCHOENOPRASUM L. Chive. 2n=16, 16 + 1B, (24, 32). Europe, Asia and N. America. Very polymorphous. Domesticated in USSR (region not given) (Kazakova, 1971). Cultivated over the whole world.

ALLIUM TUBEROSUM Rottl. ex Spreng. (syn. A. odoratum L.). Kui ts'ai, Nira, Chinese chive. 2n=16, 32. Primary centre of origin unknown, as it easily runs wild (Jones & Mann, 1963). At present from E. Mongolia to Japan, the Philippines and through Thailand to N. India. Its tetraploid type may derive from an autotetraploidization of a diploid species or from an amphiploidization of a hybrid of two diploid species. Cultivated in China for its edible leaves and young inflorescenses, and as an ornamental.

Amaranthaceae

AMARANTHUS GANGETICUS*

Anacardiaceae

RHUS SUCCEDANEA L. Waxtree. 2n=30. China and Japan.

RHUS VERNICIFERA DC. (syn. R. verniciflua Stokes). Varnish tree. 2n=30. China and Japan. It is the source of a varnish, Japanese lacquer.

Aquifoliaceae

ILEX INTEGRA Thunb. 2n= . Japan. A tree cultivated for its bark which is pounded and used as bird lime.

Araceae

COLOCASIA ESCULENTA (L.) Schott var. antiquorum (Schott) Hubbard & Rehder (syn. C. antiquorum Schott, C. esculenta var. globulifera Engl. & Krause). Eddoe, Taro, Dasheen. 2n=2x=28, 3x=42. SE. Asia (p. 49). Many socalled wild specimens are probably derivatives of run wild plants. From SE. Asia it spread to China and Japan where var. antiquorum developed. In 500 AD. some cultivars are mentioned in China (Li, 1969). At present many cultivars are described. Some of them are triploid (Bai et al., 1971). Their vernacular names are also used for Xanthosoma spp. Dasheen is a corruption of 'eddo de la China'. In Japan a secondary centre of diversity developed.

Araliaceae

ARALIA CORDATA Thunb. Udo. 2n=28. Japan. Cultivated in Japan as a vegetable (Kihara, 1969).

PANAX GINSENG C.A. Meyer. Ginseng, Chinese ginseng, Korean ginseng. Ussuri region, China, Manchuria and Korea. Exterminated in the Chinese provinces Shansi and Shensi. There it was cultivated for a long time in SE. Manchuria, N. Korea, Japan and also USA and USSR (Baranov, 1966). Radix Ginseng comes from the cultivated ginseng, and Radix Ginseng Sylvestris from the wild (Hu, 1976).

PANAX PSEUDO-GINSENG Wall. San-ch'i. 2n= . China. Wild and cultivated for its roots used in medicine (Hu, 1976).

PANAX REPENS Max. (syn. Aralia repens Max.). China and Indochina. A herb cultivated in Yunaran, China and elsewhere for its medicinal roots.

TETRAPANAX PAPYRIFERUM (Hook.) Koch. Rice-paper plant. 2n=24. N. Formosa and S. China (Hunan, Szechwan, Yunnan, Kweichow, Kwangsi and Kwangtung provinces). Cultivated in the (sub)tropics as an ornamental (Perdue & Kraebel, 1961).

Azollaceae

AZOLLA PINNATA R. Brown. Water velvet, Water fern, Mosquito fern. 2n= . Domesticated in China and Vietnam (p. 50) and grown for its symbiosis with the N-fixing alga Anabaena axollae Strassburger. In China, several cultivars have been developed: Red azolla, Green azolla, Wild azolla-Whole river red and Vietnam azolla. See further p. 50.

Balsaminaceae

IMPATIENS BALSAMINA L. Balsam, Garden balsamine. 2n=14. Indo-Malaya and China. Cultivated in China as a cosmetic plant and elsewhere as an ornamental.

Boraginaceae

LITHOSPERMUM OFFICINALE L. Var. erythrorhizon (Sieb. & Zucc.) Hand.-Mazz. (syn. L. murasaki Sieb., L. erythrorhizon Sieb. & Zucc.). 2n= 28. Cultivated in N. China and Japan for a red dye. Ssp. officinale is cultivated in Bohemia (p.).

Burseraceae

CANARIUM ALBUM (Lour.) Raeusch. White Chinese olive. 2n= . China. Cultivated in S. China and Cochinchina.

Cabombaceae

BRASENIA SCHREBERI J.F. Gmel. Watershield, Junsai. 2n=28. Asia, Africa, Australia and N. America. Cultivated in Japan as a vegetable (Kihara, 1969).

Campanulaceae

CODONOPSIS TANGHEN Olivier. Szechuan tang-sêng. 2n= . China. Cultivated for seng.

PLATYCODON GRANDIFLORUM DC. Chinese bellflower. 2n=(16), 18, (28). Cultivated in China and Japan as a medicinal crop.

Cannabidaceae

CANNABIS SATIVA L. Hemp. 2n=20. Its origin is described on p. 149. In NE. Asia including Japan, Korea and the Peking area exceptionally tall plants are grown (Small et al., 1975).

HUMULUS JAPONICUS Sieb. & Zucc. 2n=16 in male plants and 17 in female plants with an X-Y_1-Y_2 sex chromosome system. E. Asia (Japan, Taiwan, China, Korea and Manchuria). Naturalized in E. N. America, Europe and sporadically elsewhere. An annual aggressive weed (Small, 1978).

HUMULUS LUPULUS L. Hop. 2n=2x=20 with X-Y sex chromosome system. Var. cordifolius (Miquel) Maximowicz (syn. H. cordifolius Miquel) is wild and cultivated in Japan and China. A perennial mainly propagated by rhizomes (Small, 1978a).

HUMULUS YUNNANENSIS Hu. 2n= . Dioecious. Yunnan, China. It looks similar to the female plant of H. lupulus and is often confused with it.

Celastraceae

EUONYMUS JAPONICUS Thunb. (syn. E. pulchellus Carr.). 2n=32. S. Japan. A shrub. Cultivated in Spain and elsewhere for rubber.

TRIPTERYGIUM WILFORDII Hook.f. 2n= . China, Japan and Taiwan. Cultivated in Chekiang, China as a source of insecticide.

Chenopodiaceae

KOCHIA SCOPARIA (L.) Schrader. Summer cypres. 2n=18. S. Europe and Asia. Cultivated in Japan and China as a potherb, and as an ornamental.

SALSOLA KOMAROVII (Iljin.) Oka-hijiki. 2n=36. Japan. Cultivated there (Kihara, 1969).

SALSOLA SODA L. 2n=18, 36. Mediterranean area and Asia. A herb cultivated in Japan.

SUAEDA GLAUCA Bunge. Matsuna. 2n= . Japan. Cultivated there (Kihara, 1969).

Chloranthaceae

CHLORANTHUS SPICATUS (Thunb.) Mak. (syn. Ch. inconspicuus Swartz.). 2n=30. China. Cultivated in China, Indochina and Japan as a tea aroma.

Compositae

ARCTIUM LAPPA L. 2n=32, 36. Europe and Asia. Cultivated in China and Japan as a root vegetable and in China and Europe (p.) as a medicinal plant.

ARTEMISIA CAPILLARIS Thunb. 2n=18, (36). E. Asia. Cultivated there and elsewhere as a medicinal plant.

CHRYSANTHEMUM CORONARIUM L. Garland chrysanthemum, Crown daisy. 2n= . China. Cultivated in S. China (Li, 1970), later in whole China and Japan and elsewhere. Used as a vegetable.

CHRYSANTHEMUM SEGETUM L. 2n=18. Europe and Asia. Cultivated especially in China. Leaves are used as a vegetable in the Near-East, Malaya and Indochina.

CHRYSANTHEMUM SINENSE Sab. (syn. Pyrethrum sinense DC.). 2n= . China and Japan. Cultivated there as a vegetable.

GYNURA PINNATIFIDA DC. (syn. G. japonica Mak.). San ch'i, Tien ch'i. 2n=20. China. A perennial herb cultivated for its medicinal properties.

LACTUCA DENTICULATA Maxim. 2n=10, (20). It was cultivated in China.

LACTUCA INDICA L. Indian lettuce. 2n=18. India, Japan, Philippines and Indonesia. Cultivated in China, Japan and other countries. Many varieties exist in China.

PETASITES JAPONICUS F. Schmidt. Fuhi. 2n=87. Sachalin and Japan. Cultivated for its flower buds and leaf stalks (Uphof, 1968; Kihara, 1969).

XANTHIUM STRUMARIUM L. Cocklebur. 2n=36. In China it was used as vegetable. Now it is a weed in fields and along roadsides (Li, 1969).

Convolvulaceae

CALYSTEGIA SEPIUM (L.). R.Br. 2n=22, (24). Subtropics and tropics. A perennial herb cultivated in China for its roots which are used as a vegetable.

IPOMOEA AQUATICA Forsk. (syn. I. reptans Poir.). 2n=30. Throughout the tropics. Var. aquatica is an aquatic plant and a paddy vegetable in S. India and SE. Asia. Propagated by cuttings. Cultivated in fishponds to provide spinach, pig and fishfood (Purseglove, 1968). Var. reptans is an upland vegetable in SE. Asia propagated by cuttings or seed.

Corylaceae

CORYLUS CHINENSIS Franchot. 2n= . China. Cultivated especially in the Szechuan and Yunnan provinces.

CORYLUS HETEROPHYLLA Fischer. Siberian hazel nut. 2n=28. N. China, Japan, Korea and the Primorye Territory, USSR. Cultivated in China. The seed has a medium-good taste. The shell is very hard.

CORYLUS MANSHURICA Maxim. Manchurian hazel. 2n= . China, Japan and the Primorye Territory, USSR. Cultivated in China.

CORYLUS SIEBOLDIANA Blum. Siebold's hazel. 2n=28. Japan. Cultivated there.

Cruciferae

BRASSICA CAMPESTRIS L. 2n=20, genome formula AA. See p. 150 for the origin of this species. In Region 1 four (sub)species developed. Ssp. chinense (L.) Makino (syn. B. chinensis*) is an annual, fast-growing, precocious, leafy vegetable. The juicy leaves only contain 3.5-4% dry matter. Ssp. nipposinica (Bailey) Olsson (syn. B. japonica Sieb., B. rapa var. laciniifolia (Bailey) Kitam). It has finely dissected deep-green leaves (7% of fresh leaves is dry matter). It grows slowly and has little winterhardiness. Ssp. pekinensis (Lour.) Olsson (syn. B. pekinensis Rupr.) is one of the oldest vegetables in China. It forms large, compact heads. Ssp. narinosa (Bailey) Olsson, Broad-beaked mustard forms a tight rosette of small, curley leaves (see B. narinosa*).

BRASSICA CHINENSIS L. (syn. B. campestris L. ssp. chinensis (L.) Makino). Chinese cabbage, Celery cabbage, Pak-choi. 2n=20, genome formula AA. Primary centre China where it was domesticated. Cultivated in SE. Asia and elsewhere. It is a vegetable, a salad and an oil crop (var. oleifera). Var. pekinensis (Rupr.) (syn B. pekinense Rupr.), pe-tsai. (2n=20) has blanched heart (see B. campestris*). Var. parachinensis Bailey (Sinsk.) is B. parachinensis Bailey, mok pak-choi. B. japonica* has also the same genome formula. This genome is related to the Ad genome (n=7) of B. adpressa Boiss. (2n=14), the F genome (n=8) of B. fruticulosa Cyr. (2n=16) and the T genome (n=10) of B. tournefortii Gouan (2n=20) (Mizushima, 1969). Prakash & Narain (1971) concluded that the genomes of B. tournefortii are younger than the A genome, and that this species has evolved from the oleiferous plants of the species carrying the A genome.

BRASSICA NARINOSA L. (syn. B. campestris L. ssp. narinosa L.). Kou T'sai, Broad-beaked mustard, Chinese Savoy. 2n=20. Only known as a cultigen. Cultivated in E. China esp. around Shanghai. Introduced to Japan and later to the USA (Helm, 1963b). Related to B. chinensis* and other A genome carrying diploid Brassica-species. It has entire, deep darkgreen leaves.

BRASSICA OLERACEA L. Chinese kale. 2n=18, genome formula CC. Formerly described as B. alboglabra Bailey, but Phelan & Vaughan (1976) showed that Chinese kale belongs to B. oleracea, however Snogerup (1979) suggested that this vegetable may derive from introductions of B. cretica* ssp. nivea.

NASTURTIUM INDICUM DC. 2n= . In China it was cultivated as a vegetable. Near Saigon var. apetala Gagnep. is grown as a medicinal crop.

PUGIONUM CORNUTUM Gaertn. 2n= . A herb cultivated as a vegetable in Mongolia.

RAPHANUS SATIVUS L. Radish, Small radish. 2n=18, genome formula RR. This is a very polymorphic species including biennials with large, fleshy roots and annual forms. Japan and the opposite coastal areas of the mainland are suggested as primary centre. If so the radish would have derived from the wild R. raphanistrum L. (2n=18) and spread over the Old World probably introgressing with other ecotypes and other wild species as R. maritimus Smith (2n=18) and R. rostratus DC. Wein (1964) suggested that R. maritimus is the parent of radish, while R. landra Moretti (2n=18) is the parent of the small radish. He indicated the E. Mediterranean region as its gene centre (p. 107).

In Japan and China large rooted forms: daikon (R. acanthiformis de la Blanch., R. sativus var. acanthiformis Mak., var. macropus Mak., var. longipinnatus Bailey) have been developed. A giant form, the Sakurajuma Daikon (f. gigantissimus), is cultivated in Japan. The roots weigh up to 20 kg. Vavilov (1949/50) called these giant cultivars, the champions of plant breeding.

Var. oleiformis* Pers., the oil-seed radish is cultivated in China and Japan and also elsewhere.

WASABIA JAPONICA (Miquel) Matsumura (syn. Eutrema wasabi (Sieb.) Maxim.). Wasabi, Japanese horseradish. 2n=28. Cultivated for its pungent rhizomes.

Cucurbitaceae

CUCUMIS MELO L. Melon, Muskmelon, Canteloupe. 2n=24. Centre of origin in Africa (p. 124). Secondary centre in China. Chinese and Japanese melons have small fruit and an unpleasant strong taste. The genotypes are convar. chinensis (Pang.) Greb., convar. monoclinus (Pang) Greb., ssp. conomon (Thunb.) Greb. (syn. C. conomon Roxb.), oriental pickling melon.

CUCUMIS SATIVUS L. Cucumber, Gherkin, 2n=14. Centre of origin in India (p. 72). Secondary gene centre a mesophytic type with elongated fruits arose in the Far East. Sources of resistance to powdery mildew are found there.

HODGSONIA MACROCARPA Cogn. (syn. H. heteroclita Hook.f. & Thomson, Trichosanthes kadam Miq.). Lard fruit. 2n= . Cultivated in Yunnan and elsewhere in China for its oily seeds.

TRICHOSANTHES CUCUMEROIDES Max. Japanese snake gourd. 2n=44. The chromosomal number suggests and autoploidization or alloploidization, which may have happened in Japan or China where their roots are used to prepare starch.

TRICHOSANTHES JAPONICA Regel. 2n=22. Japan. There starch is prepared from the roots.

Cyperaceae

CAREX DISPALATA Boott. 2n=78, 84. Japan. Cultivated there in rice fields for its leaves which are made into hats.

CYPERUS CEPHALOTUS Vahl. (syn. C. natans Buch-Ham.). 2n= . Trop. Asia and Australia. A perennial herb cultivated in the rice fields in Japan for mat making (Uphof, 1968).

CYPERUS GLOMERATATUS L. Wangul. 2n= . Korea. Old fibre crop. Rarer than C. iwasakii*.

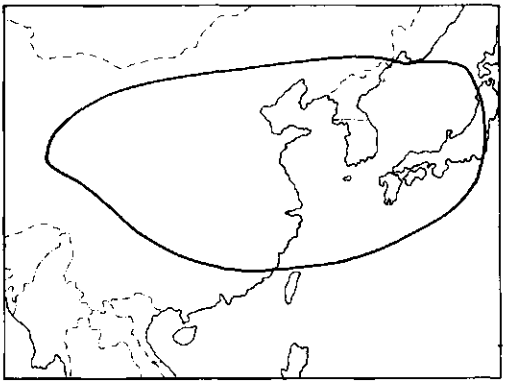
CYPERUS IWASAKII M. Wangul. 2n= . Korea. Old fibre crop. Much more common than C. glomeratatus*.

ELEOCHARIS DULCIS (Burm.f.) Trinius (syn. E. plantaginea R.Br.). Water chestnut. 2n= . W. Africa, upto India, China, Japan, Philippines, Fiji and New-Caledonia. A herb. Cultivated in S. China for its tubers. Probably derived from E. tuberosa Schultes which grows wild in trop. Asia.

Dioscoreaceae

DIOSCOREA JAPONICA Thunb. 2n=40. Japan. Cultivated in Japan, China and neighbouring islands. Some taxonomists include this species in D. opposita*.

DIOSCOREA OPPOSITA Thunb. (syn. D. batatas Decne.). Chinese yam, Cinnamon vine. 2n=c. 140, c. 144. China. Cultivated in China, S. Japan, Taiwan and the Ryukyu islands.



Dioscorea opposita (Harris, 1972)

Ebenaceae

DIOSPYROS KAKI L.f. (syn. D. chinensis Blume). Kaki, Japanese persimmon. 2n=c. 54-56, 90. Mountains of C. China. Centre of origin and primary centre of diversity in China. Secondary centre is Japan. Cultivated in Mediterranean countries and USA for its edible fruits.

DIOSPYROS LOTUS L. Caucasian persimmon. 2n=30. Subtropical China, in Talysk and W. Georgia, USSR and adjacent Iran (p. 82). All three are countries of primary diversity. Naturalized in the Balkan peninsula and elsewhere. The fruit is excellent when dried.

DIOSPYROS MAJOR (Forst.f.). Bakh. (syn. D. andersonii P.S. Green). 2n= . Pacific islands. Cultivated for its fruits which produce oil that can be used to scent other oils. The seeds are edible (Smith, 1971).

Elaeagnaceae

ELAEAGNUS MULTIFLORA Thunb. Cherry eleagnus 2n= . China, Japan and Korea. Cultivated for its edible nuts (Mansfeld, 1959).

ELAEAGNUS PUNGENS Thunb. 2n=28. N. China and Japan. Cultivated for its edible fruits.

ELAEAGNUS UMBELLATA Thunb. 2n=28. China, Korea and Japan. Cultivated for its edible nuts (Mansfeld, 1959).

Eucommiaceae

EUCOMMIA ULMOIDES Oliver. Gutta percha tree, Tuchung. 2n=34. The upland regions of W. and C. China. Cultivated as a medicinal plant. A polygamous plant, dioecious forms have been found.

Euphorbiaceae

ALEURITES CORDATA (Thunb.). R.Br. Tung oil tree. 2n=22. Primary gene centre: Japan. Cultivated there and in Taiwan. Its crossability with A. fordii* and A. montana* points to an affinity.

ALEURITES FORDII Hemsl. Tung oil tree. 2n=22. C. China, between 26° and 33°N. Hybrids may occur between wild and cultivated forms. Secondary gene centre of cultivated tung trees probably in USA (p. 202). Cultivated in other American countries, in USSR and Madagascar. With A. montana* natural hybrids may occur. It also crosses with A. cordata.

ALEURITES MONTANA (Lour.) Wils. Tung oil tree. 2n=22. China south of 25°N. Cultivated in Malawi, Brazil and elsewhere. With A. fordii* natural hybrids may occur. It also crosses with A. cordata*.

SAPIUM SEBIFERUM Roxb. *Chinese tallow tree.* 2n=36. Cultivated in the tropics.

Euryalaceae

EURYALE FEROX Salisb. 2n=58. Tropical Asia. Cultivated in S. China.

Fagaceae

CASTANEA CRENATA Sieb. & Zucc. Japanese chestnut. 2n=22, 24. Japan. Cultivated in Japan and in USA for its nuts.

CASTANEA MOLLISSIMA Blume. Chinese chestnut. 2n=24. N. and W. China. Cultivated in China and elsewhere for its nuts. It is source of resistance to Endothia parasitica, a fungus causing damage to chestnut (C. sativa) in USA.

QUERCUS ALIENA Blume. 2n= . Japan, Korea and C. China. Cultivated as food for the Japanese oak spinner (Mansfeld, 1959).

QUERCUS DENTATA Thunb. Daimyo oak. 2n=24, 48. Japan, Taiwan, Korea and Manchuria and W. and N. China. Cultivated as food for the Japanese oak spinner and also used for timber (Mansfeld, 1959).

QUERCUS MONGOLICA Fisch. Mongolian oak. 2n=24. N. China, Korea and N. Japan. Cultivated as food for the Japanese oak spinner and also for timber.

Ginkgoaceae

GINKGO BILOBA L. Gingko, Maidenhair tree. 2n= . E. China. Cultivated in China and Japan as an ornamental. The seeds are eaten.

Gramineae

ARUNDINARIA AMABILIS McClure. Tonkin bamboo, Tonkin cane. 2n= . Only known as cultigen and may have originated in Vietnam. Secondary gene centre: China - Province Guandun and adjacent regions of Guancy. Cultivated for its stems which have many technical properties. Used for hand work, including fishing rods.

AVENA SATIVA L. convar. nuda Nord. (syn. A. nuda L.). *Naked oats.* 2n=42, *genome formula* AACCDD. The origin of oats has been described on p. 109. Cultigen of NE. China and Mongolia, the Tibetan-Himalaya highlands, in Turkestan and W. China. It is characterized by 5 to 7 florets per flower and by big seeds.

BAMBUSA GLAUCESCENS (Willd.) Sieb. ex Munro. (syn. B. nana Roxb.). Hedge bamboo. 2n=72. China and Japan where it is cultivated. In Indochina it is grown as a border plant.

BAMBUSA MULTIPLEX Raeusch. 2n=72. Cochin China and Japan. A shrubby, woody grass. Cultivated in trop. Asia for various purposes.

BAMBUSA STRICTUS Nees. 2n=70, 72. India (p. 73) and provinces Guancy, Guandun, China and in Hongkong, in tropical evergreen forests. Stems are about equal to those of the best Indian species B. arundinaceae*. Secondary centres: Indochina (p. 53) and S. China.

BAMBUSA TEXTILIS McClure. 2n= . Province Guancy, China.

BAMBUSA TULDOIDES Munro. 2n= . S. China. Cultivated for various purposes.

CHIMONOBAMBUSA QUANDRANGULARIS (Fenzi.) Mak. 2n=48. Continental China and Taiwan. Cultivated in Japan, China and Taiwan and occasionally on the shores of the Black Sea in Caucasus, USSR.

ECHINOCHLOA CRUS-GALLI L. Barnyard grass. 2n= 36, (42, 48), 54, (72). Japan and China. Close affinities with the cultivated E. frumentacea*. The hexaploid type, 2n=6x=54 is an allopolyploid with E. oryzicola Vasing., 2n=36 as one parent. According to Yabuno (1968) this species has the same genomic constitution as E. utilis (see E. frumentacea*).

ECHINOCHLOA CRUS-PAVONIS Schult. 2n=36, 54. Subtropics and tropics. A grass cultivated in Yunnan, China.

ECHINOCHLOA FRUMENTACEA (Roxb.) Link. (syn. Panicum frumentacea Roxb.). Japanese millet.

Billion dollar grass, Sanwa millet. 2n=36, 54, (56). China. Primary centre in China. Cultivated in Korea, China, USSR and N. America for human consumption, and as a fodder crop. Closely related to E. crus-galli*. Ohwi and Yabuno separated E. utilis Ohwi & Yabuno (2n=54) from E. frumentacea because they found differences in the genomic constitution, geographical distribution and panicle morphology of these two species (Yabuno, 1968). Yabuno considers that the genome formulas of E. utilis and E. crus-galli* are the same and that the genome formulas of E. frumentacea and E. colona are also the same.

ELYMUS ARENARIUS L. Sea lyme grass, Sand elymus. 2n=56. Europe and Asia. A perennial grass. Cultivated in Japan for its culms and elsewhere as a dune stabilizer.

HORDEUM VULGARE L. ssp. humile Vav. & Bacht. 2n=14. Barley. The origin of barley is described on p. 91. Japan and C. China. Ssp. humile is short, has small leaves, hexastichious ears which are apically awned or awnless.

LINGNANIA CHUNGII McClure. 2n= . S. China (Provinces Junjan and Guancy) in tropical evergreen forests.

MISCANTHUS SACCHARIFLORUS (Maxim.) Hack. 2n=4x=76. E. Siberia, N., C. and NW. China, Mongolia, Manchuria, Korea, Japan. Erect types near Hongkong were cultivated as 'arrow plants'. This species probably played a role in the development of Chinese sugar-canes (Saccharum officinarum* Sinense group). It is also used as an ornamental (Grassl, 1977).

ORYZA SATIVA L. ecospecies japonica (syn. ssp. japonica Kato). Japonica rice. 2n=24, genome formula AA. Indochina. The origin of rice is discussed on p. 74. Ecospecies japonica consists of ecotypes japonica and nuda. Spread to Japan, Korea, N. China, Himalaya region, Egypt, Italy and Spain.

PANICUM MILIACEUM L. Proso millet, Shu. 2n=36, (40, 54, 72). Primary centre: N. China. From here it has spread upto Italy. In China it was an important cereal till the introduction of wheat and barley (Li, 1970). P. spontaneum Lyssev. (2n=) might be a weedy type of this species. It grows in Afghanistan, Kazakstan and may be wild in Mongolia (Mansfeld, 1959).

PASPALUM DISTICHUM L. 2n=40., genome formula X_5X_5WW, (48), 60. Lowlands of the world. In Japan, it is valued as a forage crop in ricefields. See also p. 202.

PHYLLOSTACHYS BAMBUSOIDES Sieb. & Zucc. Madake, Giant timber bamboo, Japanese timber bamboo. 2n=48. China where its primary gene centre is located. Secondary gene centre is Japan. Many forms occur there under the name 'Madake'.

PHYLLOSTACHYS DULCIS McClure. Sweetshoot bamboo. 2n= . C. China. It is cultivated there. The young shoots are edible.

PHYLLOSTACHYS HENONIS Mitf. 2n=48, 54. C. China (Szechwan). It is cultivated there. Secondary centre is in Japan. One of the forms developed under cultivation, is black bamboo, kenon bamboo ('Nigra', syn. Ph. nigra (Lodd.) Munro, which is cultivated for its young shoots.

PHYLLOSTACHYS MAKINOI Hayata. 2n=48. Taiwan. It is cultivated in Japan.

PHYLLOSTACHYS MEYERI McClure. 2n=48. China (Chzesian). Apparently cultivated in Japan where a strain with deformed internodes arose.

PHYLLOSTACHYS PUBESCENS Mazel ex de Lehaie. 2n=48. Mountains of SE. China. Secondary gene centre in Japan. This species has the largest plants in the genus. Used in the timber industry and for its shoots.

PHYLLOSTACHYS VIRIDIS (Young) McClure. 2n= China. It is cultivated there for pulping.

SACCHARUM OFFICINARUM L. Sugar-cane. 2n various. On New Guinea, the New Guinea Noble canes developed (p. 54) and via Indonesia and Philippines they reached S. China where they hybridized with a 4x Miscanthus species (probably M. sacchariflorus*) to produce the Tekcha clones of the new Sinense group. This must have taken place 705-220 BC. during the Yueh culture. The Tekcha clones have 2n=118. From these basic Sinense clones, younger clones originated with 2n=106-120. They crossed with Chinese S. spontaneum*, 2n=96 to produce still younger Sinense clones, including the 'S. sinense Roxb. clone'. During its migration to India it must have hybridized again with S. spontaneum and probably other grasses. Its migration to India (p. 75) may have been promoted by the red rot disease which affected the S. officinarum clones, which had reached N. India via S. India from Indonesia. This must have taken place ca 250 BC. In N. India, the Sinense group was described as the Pansahi group (Grassl, 1977).

SETARIA ITALICA L. (syn. Panicum italicum L.). Foxtail millet, Liang. 2n=18, genome formula AA. N. China. From here it spread throughout Asia and Europe in prehistoric times. In China it was an important cereal till the introduction of wheat and barley (Li, 1970). It derives from S. virides (L.) Beauv. (2n=18), genome formula AA. It is possible that S. pallidifusca Stapf & C.E. Hubbard (2n=36) is an allotetraploid with S. italica as one of the diploid parents.

SINOBAMBUSA TOOTSIK (Sieb.) Makino. 2n=48. Japan (Ryu-Kyu Islands).

SINOCALAMUS BEECHEYANUS (Munro) McClure. 2n=

. S. China. It is cultivated there.

SINOCALAMUS EDULIS (Odashima) Kenf. 2n= . China. Its shoots are edible.

SINOCALAMUS OLDHAMII (Munro) McClure. 2n= . Taiwan.

SORGHUM BICOLOR (L.) Moench. Chinese Amber Canes and Kaoliang. 2n=20. Sorghum was domesticated in Africa (p. 133). Chinese amber canes are found on the coast of China and Korea, and also in India and Burma. They very likely arrived in China and the Far East by sea traffic. They are related with the E. African sorgo. After introduction of sorghum from India into S. China it came into contact with S. propinquum (Kunth.) Hitchc., 2n= , and by hybridization kaoliang arose (Doggett, 1970).

TRITICUM AESTIVUM L. Thell. ssp. vulgare (Vill.) MK. (syn. T. vulgare Vill.). Bread wheat, Common wheat. 2n=42, genome formula AABBDD. Centre of origin: Transcaucasia and adjacent regions (p. 93). It arrived through Korea and Japan in about 300 BC. (Kihara, 1969). Secondary centre of diversity in both countries. The Chinese wheats are characteriized by very broad leaves, with 5 to 7 florets per spikelet, with squarehead ears, with day-length neutrality, with fast ripening grain, and by precocious forms. In the mountains of the Sinkiang Province of China very frost resistant wheats developed. Chinese and Japanese wheats cross easily with rye, probably because there was no selection pressure against this characteristic due to absence of Secale cereale-types. Some Japanese and Korean wheats are short and this character was introduced in wheat varieties of Italy, Japan, USA, Mexico and elsewhere.

ZEA MAYS L. Maize. 2n=20. Maize was domesticated in C. America (p. 190). Secondary centre: China (Brandolini, 1970). The mutant ceratina Collins originated in E. Asia. Cultivated in China, Japan, Manchuria, Burma and the Philippines.

ZIZANIA LATIFOLIA Turc. Manchuria water-rice, Gau Sun, Chiaopai. 2n=30, 34. China and adjacent regions. Cultivated as a cereal in N. China in ancient times. Later its cultivation moved to the south and its use as a cereal gradually decreased. It is cultivated as the vegetable Chiaopai or Gau Sun. The fungus Ustilago esculenta P. Henn. infects the leaf bases, which swell and are eaten.

Grossulariaceae

RIBES ALPESTRIS Decne. 2n= . Himalaya up to 3000 m. In China used as a hedge plant.

RIBES LONGERACEMOSUM French. 2n= . W. China. Cultivated there for its fruits. It could be used to improve the strig length of cultivar R. nigrum*.

RIBES USSURIENSE Jancz. 2n= . E. Asia. It is a source of resistance to black-current gall mite, Phytoptus ribes Nal., a pest of R. nigrum*. It easily hybridizes with R. nigrum.

Illiciaceae

ILLICIUM ANISATUM L. Japanese star anise. 2n=28. China, Korea and Japan. Cultivated for its medicinal seeds.

ILLICIUM VERUM Hook.f. (syn. L. religiosum Sieb. & Zucc.). Star anise. 2n=28. SE. Asia. Cultivated for its medicinal fruits. It is not known wild.

Iridaceae

BELAMCANDA CHINENSIS (L.) DC. Blackberry lily, Leopard flower. 2n=32. China and Japan. Cultivated there as a medicinal crop.

IRIS ENSATA Thunb. 2n=40. Temp. Asia upto Himalaya. Cultivated in China for its leaves (binding material).

Juglandaceae

CARYA CATHAYENSIS Sarg. Chinese hickory. 2n= . E. China. Cultivated in Yunnan, China (Mansfeld, 1959). It closely resembles C. tonkinensis Lecomte.

JUGLANS AILANTIFOLIA Carr. 2n= . Japan. Var. ailantifolia (syn. J. sieboldiana Maxim.), Siebolds walnut. Var. cordiformis (Maxim.) Rehd. (syn. J. cordiformis Maxim.). Cultivated in N. America.

JUGLANS DUCLOUXIANA Dode. 2n= . Mountain regions of Asia. Cultivated in China.

JUGLANS MANDSHURICA Maxim. Manchurian walnut. 2n=32. NE. China and the Primorye Territory, USSR. It is winterhardy and is used as rootstock.

Labiatae

ELSHOLTZIA CRISTATA Wildd. 2n= . China and Japan. A perennial plant introduced in other parts of Asia, Europe and America as an oilseed crop.

MENTHA ARVENSIS L. var. piperascens Mal. Japanese mint. 2n=96, genome formula $R^aR^aSSJJAA$. Japan. Cultivated in Japan, China and Brazil. It is the main source of menthol. Var. agrestis (2n=72, genome formula R^aR^aSSJJ) is very likely a hybrid of var. piperascens and M. japonica Makino (2n=48). It is a source of early maturity and rust resistance (Ikeda et al., 1970). M. arvensis is one of the parents of M. x gentilis (see M. cardiaca*).

PERILLA ARGUTA Benth. 2n= . China and Japan. Cultivated for various purposes. It is sometimes included in P. frutescens*.

PERILLA FRUTESCENS Britt. (syn. P. ocymoides L.). Suttsu, Perilla. 2n=38, 40. Himalayas, China and Japan. Primary centre: China. The red-leaved strains (syn. P. crispa (Thunb.) Nakai) are sometimes used as ornamentals and the green-leaved plants (P. crispa var. ocymoides) for the seed oil. Cultivated in China, Japan and Korea as a drug plant (Li, 1969) and formerly as a leafy vegetable.

STACHYS SIEBOLDII Miq. Chinese artichoke. Japanese artichoke. 2n= . It is one of the few tuber crops domesticated in China. Cultivated there, Japan, Belgium and France.

Laminariaceae

LAMINARIA JAPONICA Aresch. Haidai. 2n= . China. Cultivated as a food plant and as a source of iodine.

Lauraceae

CINNAMOMUM CAMPHORA (L.) Nees & Eberm. Camphor tree. 2n=24. China, Japan and Taiwan. Cultivated in these countries and other tropical countries.

CINNAMOMUM ZEYLANICUM Breyn. 2n=24. Sri Lanka and SW. India. Cultivation started in Sri Lanka in 1770. Cultivated now in several countries.

Leguminosae

ASTRAGULUS SINICUS L. (syn. A. lotoides Lam.). Genge, 2n=16. China. Cultivated there on rice soils as a soil improver.

CANAVALIA GLADIATA (Jacq.) DC. var. alba (Makino) Hisauchi (syn. C. ensiformis (L.) DC. var. alba Makino). Siro-nata-name. 2n=22. Cultivated in Japan (Sauer, 1964). Characterized by white seeds.

GLEDITSIA JAPONICA Miq. 2n= . Japan. Cultivated for fruit juice, which is used for washing.

GLYCINE MAX (L.) Merr. Soya, soybean. 2n=40. China. Available evidence suggests that soya was domesticated around the 11th Century BC. in E.N. China. Since the 1st Century AD., it became widely introduced and land races evolved in China, Korea, India and other parts of Asia. The species is today widely cultivated in most agricultural regions of the world (Hermann, 1962; Hymowitz, 1970).

GLYCINE SOJA Sieb. & Zucc. Wild soya. 2n=40. Widely distributed in N., NE. and C. China, adjacent USSR, Korea, Japan and Taiwan. The weedy G. gracilis Skvortz. occurs where G. soja and G. max are sympatric and represent derivatives of hybrids between wild and cultivated soybean (Hymowitz & Newell, 1980).

LESPEDEZA CUNEATA (Dum. Cours.) G. Don. (syn. L. sericea Benth.). Perennial lespedeza. 2n=(18), 20. E. Asia. Cultivated in the USA for erosion control.

LESPEDEZA STIPULACEA Maxim. Korean lespedeza. 2n=20. E. Asia. Cultivated in the USA for hay making.

LESPEDEZA STRIATA Hook. Common lespedeza, King grass. 2n=22. E. Asia. Cultivated in the USA in pastures and for hay making.

MUCUNA HASSJOO (Piper & Tracy) Mansf. (syn. Stizolobium hassjoo Piper & Tracy). Yokohama bean. 2n= . Japan and China. Cultivated there and in the USA for the seeds.

PHASEOLUS ANGULARIS Wight. Adzuki bean. 2n=22. Primary gene centre C. China. It is unknown wild. Cultivated in China, Manchuria, Korea and Japan. Secondary gene centre Japan.

PHASEOLUS VULGARIS L. var. chinensis (syn. Ph. chinensis Hort. ex Schur.). Asparagus bean. 2n=22. Its origin is discussed on p. 194. It reached China from the Americas after Columbus' voyage. In China a secondary gene centre arose. The main character, a parchment-like layer in the pod wall was lost and the pod became edible.

PUERARIA THUNBERGIANA (Sieb. & Zucc.) Benth. Kudzu. 2n=24. China and Japan. Cultivated as a cover crop, green manure and hay crop, in New Guinea and New-Caledonia as a tuber crop (p. 58).

VICIA UNIJUGA A.Br. (syn. Orobus lathyroides L.). Two-leaved vetch. 2n=12, (24, 36). E. Siberia, Manchuria and Japan. Occasionally cultivated.

WISTERIA BRACHYBOTRYS Sieb. & Zucc. 2n=16. A vine. Cultivated for its fibrous bark.

Liliaceae

ANEMARRHENA ASPHODELOIDES Bunge. 2n=22. N. China. A medicinal plant occasionally cultivated.

FRITILLARIA VERTICILLATA Willd. 2n=24. Var. thunbergii Baker. Cultivated in China as a medicinal plant.

LILIUM AURATUM Lindl. Gold band lily, Yamayuri. 2n=24. Japan. Cultivated there for its large bulbs (Kihara, 1969).

LILIUM CORDIFOLIUM Thunb. 2n=24. Japan. Cultivated there for its starchy bulbs.

LILIUM LANCIFOLIUM Thunb. Oni-yuri. 2n=24. Japan Cultivated there for its bulbs (Kihara, 1969).

LILIUM MAXIMOWICZII Regel. Ko-oni-yuri. 2n= 24. Japan. Cultivated there as a food crop (Kihara, 1969).

LILIUM TIGRINUM Ker-Gawl. Tiger lily. 2n=(24), 36. China. Cultivated there and in Japan for its edible bulbs.

OPHIOPOGON SPICATUS Kunth. 2n= . China. A herb cultivated in Chekiang as a medicinal plant.

Magnoliaceae

MICHELIA FIGO (Lour.) Spr. (syn. M. fuscata Andr.). Banana shrub. 2n=38. China. Cultivated there for its banana-scented flowers used for scenting hair oil.

Malvaceae

ABELMOSCHUS MANIHOT*

ABUTILON AVICENNAE Gaertn. (syn. A. theophrasti Medic.). Button weed, Chinese jute, Velvet weed, Butter print chingma. 2n=42. Cultivated in China (many local varieties), USSR and elsewhere for its fibre called jute or Indian mallow.

GOSSYPIUM ARBOREUM L. Tree cotton. 2n=26, genome formula A_1A_1. Arose in India (p. 77). Race sinense, Chinese cotton, Nanking cotton, developed in E. China. It is the earliest fruiting form of this species. It has short lint and requires a long daylength. First cultivated as an ornamental. At present it has a low breeding value.

HIBISCUS SYRIACUS L. Rose of Sharon. 2n=80, 80-84, 90, 92. China and Taiwan. Cultivated first in China as a hedge plant and later elsewhere as an ornamental.

MALVA SYLVESTRIS L. High mallow. 2n=42. Probably the early vegetable K'uei mentioned in Chinese literature. At present a weed in China (Li, 1970). Cultivated in Europe as a medicinal crop and ornamental.

MALVA VERTICILLATA L. (syn. M. crispa L., M. mohileviensis Graebn., M. pamiroalaica Ilj.). Mallow. 2n=c. 84, c. 112. E. Asia. It was an early Chinese domesticate there. About 500 AD. it was there an important vegetable with several varieties like purple and white stemmed, large and small leaves. During the 7-10th Century the cultivation in China declined. In 1848 it was only observed in remote areas. Introduced to Japan, where it is a weed now (Li, 1969). Also in W. Asia and Europe. Cultivated in Europe as a medicinal crop. This plant has often been described as M. crispa being a cultigen of M. verticillata.

Menispermaceae

COCCULUS THUNBERGII DC. 2n= . A woody vine cultivated in Japan for basket making.

Moraceae

BROUSSONETIA KAZINOKI Sieb. 2n=26, 39. A tree cultivated in Japan and Korea for its bark which is a source for paper production.

BROUSSONETIA PAPYRIFERA (L) Vent. Paper mulberry. 2n=26. China and Japan. In the Far East this tree is used for making paper and barkcloth (Purseglove, 1968).

MORUS ALBA L. White mulberry. 2n=28. China. Cultivated there and elsewhere for its leaves eaten by silk worms, for its fruits and for paper making. It is often planted as a roadside tree. cv Makado has 2n=3x=42.

Musaceae

MUSA BASJOO Sieb. & Zucc. 2n=22. Japan. Species of the Eumusa section. Used for making fibre.

Myricaceae

MYRICA RUBRA Sieb. & Zucc. (syn. M. nagi Thunb.). Chinese strawberry tree, Ioobai, Yama momo. 2n=16. Cultivated in China for its fruits.

Oleaceae

FRAXINUS CHINENSIS Roxb. 2n=92, 138. W. and C. China. Especially var. acuminata Lingelsh. (syn. F. koehneana Lingelsh.) is cultivated as a host plant of the insect Coccus pela for wax production.

LIGUSTRUM JAPONICUM Thunb. Japanese privet. 2n=44. A shrub. Cultivated in Japan for its seeds.

LIGUSTRUM LUCIDUM Ait. 2n=46. A tree cultivated in China as a host plant of the insect Coccus pela for wax production.

LIGUSTRUM OVALIFOLIUM Hassk. 2n=46. Japan. A shrub widely planted for hedges in Europe and elsewhere. It may have run wild there.

OSMANTHUS FRAGRANS Lour. 2n=46. Himalaya, China and Japan. A tree cultivated in E. Asia for its very scented flowers used to aromatize tea.

Palmae

TRACHYCARPUS FORTUNEI (Hook.) H. Wendl. Windmill palm, Chusan palm. 2n=36. China. Often planted in E. Asia for its fibres.

tivated in China (Uphof, 1968).

PRUNUS DAVIDIANA (Carr.) Franch. (syn. P. persica var. davidiana Maxim., Persica davidiana Carr.). Chinese wild peach. 2n=16. Vladivostok, SW. through Charbin upto Dacin-San and Ala-San (China). Cultivated as an ornamental. It is frost, drought and heat resistant. Probably it is valuable as a rootstock for Amygdalus persica* and Prunus domestica* (Zylka, 1970).

PRUNUS PSEUDOCERASUS Lindl. (syn. P. paniculata Edwards). 2n=32. W. Hupei, China. A tree cultivated there for its fruits.

PRUNUS SALICINA Lindl. Chinese plum, Japanese plum. 2n=16. Primary gene centre: the forests of N. China. Second gene centre: Japan. Cultivated in Japan, China and also in California. It crosses easily with the North American plum species. A new stone fruit 'cherry plum' was derived from crossing the wild P. cerasifera* with P. salicina var. Burbank. Because of its winterhardiness this fruit tree can be grown where apricot will not fruit.

PRUNUS SARGENTII Rehd. Sargent cherry, Mountain cherry. 2n=16. Japan, Manchuria, Korea and rarely in the Far East of USSR. Used as

Prunus davidiana

an ornamental. It is frost resistant and fast growing. The fruits are not very palatible.

PRUNUS SIMONII Carr. Apricot plum, Simon plum. 2n=16. Primary centre: probably N. China and Japan. No wild plants are found. Also cultivated there. Crossing with P. triflora Roxb.* (2n=16) from the same area has led to the development of cultivars which are especially grown in N. America.

PRUNUS TOMENTOSA Thunb. (syn. P. trichocarpa Bunge). Nanking cherry, Manchur cherry, Chinese bush cherry. 2n=16. N. and W. China, Japan, Himalaya, Turkestan and in the Far East of USSR. Cultivated as a fruit tree and ornamental in the Far East of USSR, N. China and Japan.

PRUNUS USSURIENSIS Kov. & Kost. (syn. P. triflora Roxb. var. mandshurica Skvoro.). Ussurian plum. 2n=16. Cultivated or run wild in Manchuria, E. of USSR and for some years also in Siberia and N. Kazakhstan (Zylka, 1970). It is a source of good fruit flavour and cold resistance. This species is sometimes considered as a subspecies of P. cerasifera*.

PYRUS BETULAEFOLIA Bgb. 2n=34. N. and C. China. Used as rootstock. Resistance against scab (Venturia) is found in this species.

PYRUS BRETSCHNEIDERI Rehd. 2n=34. Hupei and Shansi, China. Primary gene centre: N. China. There it was domesticated. It is the commonest cultivated pear in this region. The fruits are characterized by hard, crisp, white sweet flesh.

PYRUS CALLERYANA Dcne. 2n=34. China, Japan and Korea. Primary gene centre: the Tsinling mountain range, China. It is used as rootstock.

PYRUS PHAEOCARPA Rehd. 2n=34. N. China.

PYRUS PYRIFOLIA (Burm.) Nakai (syn. P. serotina Rehd.). Sand pear. 2n=34. Primary gene centre: the highlands of N. and C. China. Var. culta (Mak.) Nakai is drought resistant, but not very winterhardy. The leaves reach 15 cm in length. The fruits are outstanding for their preserving quality. It crosses easily with the wild European pear, P. communis*.

PYRUS USSURIENSIS Maxim. Ussuri pear. 2n=34. SE. Siberia upto the Manchurian-Chinese area. Primary gene centre: NE. China and the Primorye Territory, USSR, along the Ussuri river. The ancient var. culta is widely distributed over N. and C. China. It is adapted to cold, dry regions. It is the most winterhardy wild pear. As this species originated outside the Chinese centre proper it has no resistance to scab and other diseases. It probably played a part in the origin of P. communis*.

ROSA MULTIFLORA Thunb. 2n=14. E. Asia. Used as rootstock.

ROSA RUGOSA Thunb. 2n= . China and Japan. The rose hips are used by the Ainu. Used as an ornamental and in hedges as one parent to breed for rootstocks.

RUBUS ILLECEBROSUS Focke. Strawberry raspberry, Balloon berry. 2n=14. Japan. Cultivated in N. America.

RUBUS PHOENICOLASIUS Maxim. Wine raspberry. 2n=14. Japan and N. China. Cultivated for its fruits and as an ornamental.

RUBUS PUNGENS Oldhami. 2n= . Korea. Used in breeding with R. idaeus*.

Rubiaceae

GARDENIA JASMINOIDES Ellis (syn. G. florida L.). Cape jasmin. 2n=22. Probably S. China. Cultivated in E. Asia for perfumery oil.

Rutaceae

CITRUS ICHANGENSIS Swing. 2n=18. S. of Tsin 'lin range in W., C. and SW. China. It is very frost resistant. Therefore it has been crossed with cultivated Citrus species. Used as a rootstock.

CITRUS JUNOS Tan. Juzu. 2n=18. Han'su province, China at 1372 m altitude. It is frost resistant and therefore used as a rootstock. Its fruits are big but sour. It was already known in the time of Confucius (about 2500 years ago). Because of introgression, characters of 12 Japanese and 2 Chinese wild Citrus species are recognized in juzu.

CITRUS RETICULATA Blanco. (C. nobilis Andr. non Lour.). Mandarin, Tangerine. 2n=18. See for its possible origin p. 63. Secondary centre: Japan. New types such as the Satsuma (var. unshiu, syn. 'C. unshiu') and the Natsudaudau ('C. natsudaidai') arose through bud mutation and spontaneous hybridization. Satsuma tangerine (unshiu mikan) is probably a derivative of So-kitsu or Man-kitsu.

CLAUSENA LANSIUM (Lour.) Skeels. Wampi. 2n=18. It is a small-fruit tree of S. China. Cultivated in several tropical countries.

FORTUNELLA CRASSIFOLIA Swing. Meiwa kumquat. 2n=18. China and Japan. It is occasionnally cultivated.

FORTUNELLA HINDSII (Champ.) Swing. Wild kumquat. Hongkong kumquat. 2n=18, (36). The Tziulun mountains of Hongkong. It has no great value. The 4x form originated spontaneously (Cameron & Soost, 1969).

FORTUNELLA JAPONICA (Thunb.) Swing. (syn. Citrus japonica Thunb.). Round kumquat, Marumi kumquat. 2n=18. Primary centre Japan. This fruit tree is unknown in a wild state. It is occasionally cultivated.

FORTUNELLA MARGARITA (Lour.) Swing. (syn. Citrus margarita Lour.). Oval kumquat, Nagami kumquat. 2n=18. Japan. Cultivated in Japan, China and Florida, USA. Fortunella species cross easily with each other and with Citrus species.

PONCIRUS TRIFOLIATA (L.) Raf. Trifoliate orange. 2n=18, (36), N. China, also primary centre. This area is its centre of diversity. Cultivated in China as an ornamental, and in USSR and Japan it is used as a rootstock. Hybrids with sweet orange (Citrus sinensis) are citranges used as rootstocks, with sour orange (C. aurantium*) are citradias, crosses of citrange with kumquat (Fortunella margarita*) resulted in citrangequat. Other hybrids are citrandarin (P. trifoliata x C. reticulata) and citrangedin (citrange x calamondin (see C. reticulata)).

TRIPHASIA TRIFOLIA (Burm.f.) P. Wilson (syn. T. aurantiola Lour., T. trifoliata DC.). Lime berry, Trifoliate lime berry. 2n= . Centre of origin possibly China (Mansfeld, 1959). Cultivated for its edible fruits.

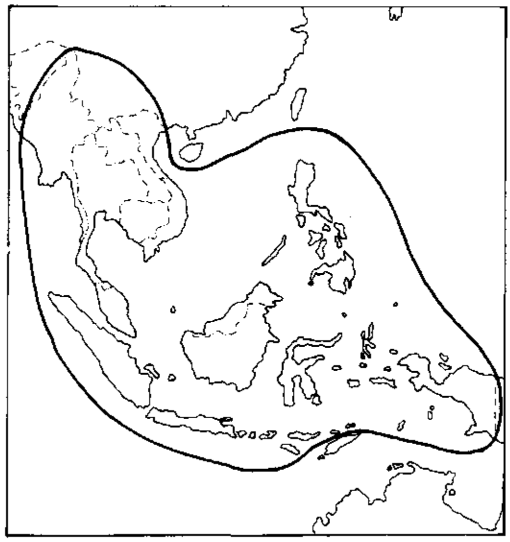
ZANTHOXYLUM PIPERITUM DC. Japanese prickly ash, Japan pepper, Sanshô. 2n=70, China and Japan. Cultivated there (Uphof, 1968; Kihara, 1969).

ZANTHOXYLUM SIMULANS Hance (syn. Z. nitidum DC., Z. bungei Planch.). 2n=32. China. A shrub cultivated in C. and S. China for its seeds. This seed is a source of Chinese pepper.

Sapindaceae

LITCHI CHINENSIS Son. Litchi, Lychee, Leechee. 2n=28, 30. S. China. Leenhouts (1978) described three subspecies: ssp. chinensis, ssp. philippensis (Radlk.) Leenh. and ssp. javensis Leenh. Ssp. chinensis is the cultivated litchi. It was first mentioned ca 100 BC. when Emperor Wu Ti tried to introduce it from N. Indochina into S. China. It is grown now in N. India, S. Africa, Florida and Hawaii. There are many races. Those from China can be grouped as Water litchi and Mountain litchi. Water litchis are grown in the lowland and have smooth fruits, while the Mountain litchi is used as stock or as a fruit-tree in hilly regions. Its fruits are smaller and more prickly. Leenhouts (1978) thinks that the Mountain litchis are similar to wild types. Ssp. philippensis is found in the Philippines, where it is not cultivated; its fruits bear sharp pyramidal warts and are not eaten. It is not a wild type (Leenhouts, 1978). Ssp. javensis has fruits like the original ssp. chinensis. It is occasionally grown in Indochina and W.

2 *Indochinese-Indonesian Region*



Vavilov called the Indochinese-Indonesian Region the Tropical Asian Centre of Origin. Darlington (1956) and Li (1966 cited by Chang, 1970) divided this region into S. Asia: Burma, Thailand and Indochina, and SE. Asia: Malayan Peninsula and the Malaysian Archipelago. Li described an agriculture based mainly on vegetatively propagated crops. Harlan (1971) considered this region as B2 Southeast Asian and South Pacific noncentre, as agriculture may have been introduced there.

The oldest known agricultural remains from Region 2 come from Spirit Cave 60 km N. of Mae Hongson, NW. Thailand (Gorman, 1969). This agrees with Sauer's (1952) conclusion that the Old World centre of development of agriculture was situated in the NW. part of Region 2 (about present day Burma). Spirit Cave was inhabitated from ca. 10 000 to 5 600 BC. Solheim (1972) proposed that horticulture may have developed in 20 000 - 15 000 BC. and there was a further domestication of plants and also of animals in 15 000 - 8 000 BC., resulting in large-scale agriculture and animal husbandry.

Another early archaeological site is at Non Nok Tha, NE. Thailand. It dates from around 5 000 BC.

In Spirit Cave remains of Prunus, Terminalia, Areca, Vicia or Raphia, Lagenaria and Trapa, and in another layer Piper, Madhuce, Canarium, Aleurites and Areca were found, and in a third layer Canarium, Lagenaria and Cucumis (Gorman, 1969). Further research is needed to support the taxonomic identifications. For instance Schultze-Motel (1972) does not accept that Vicia faba could have been present. Chang (1970) used the presence of Vicia faba, Lagenaria, Trapa and Cucumis as proof that these plants were actually cultivated.

The region is important for crops such as bamboos, tropical fruit trees, ginger, Cocos nucifera, Colocasia esculenta, Dioscorea spp., Musa spp., wild and weedy Oryza spp., Piper spp., and Saccharum officinarum.

Agavaceae

CORDYLINE TERMINALIS Kunth. Palm lily. 2n=ca 152. SE. Asia, Australia and most of Oceania. Cooked roots will keep for several weeks. During the 17th and early 18th Century, roots were fermented and distilled to produce spirits (Barrau, 1961).
One clone is extensively cultivated for the fleshy roots that contain laevulose (Ezumah, 1970).

Amaranthaceae

AMARANTHUS GANGETICUS L. 2n=34. Asia. Cultivated in India, Malaya, China and Japan as a spinach. See also A. mangostanus*.

AMARANTHUS MANGOSTANUS Juslen (syn. A. tricolor L. var. mangostanus Thell.) 2n=32. Trop. Asia. Cultivated as a pot-herb. In A. tricolor are sometimes included var. gangeticus and var. tricolor (syn. A. melancholicus L.). See A. gangeticus*.

AMARANTHUS PANICULATUS L. 2n=32. Used as a pot-herb and grain crop in SE. Asia. It might be conspecies with A. cruentus* (Sauer, 1950) or a synonym.

Anacardiaceae

BOUEA MACROPHYLLA Griff. 2n= . A fruit tree of the wet tropics of SE. Asia.

MANGIFERA CAESIA Jack. 2n=40. Primary centre Indonesia. This fruit tree is cultivated there and elsewhere.

MANGIFERA FOETIDA Lour. Bachang mango. 2n=40 Indochina and Malaysia. Cultivated in Java.

MANGIFERA ODORATA Griff. Kurwini mango. 2n= . Malaysia. Cultivated in Java. It is closely related to M. indica* (Rhodes et al. 1970).

SEMECARPUS ANACARDIUM L.f. (syn. Anacardium orientale L.). Cashew marking nut tree, Oriental cashew nut. 2n=60. Trop. Asia and Australia. Cultivated in the tropics.

SPONDIAS LAOSENSIS Pierre. 2n= . Trop. Asia. A tree cultivated for its fruits.

SPONDIAS PINNATA (Koen. & L.f.) Kurz (syn. S. mangifera Willd.). Hog plum. 2n= . Trop. Asia. A fruit tree whose flower clusters are also eaten.

Annonaceae

CANANGA ODORATUM Lamb. Ylang-ylang. 2n=16. Malaysia. Cultivated there and in other countries for the flowers which are a source of essential oils.

STELECHOCARPUS BURAHOL (Bl.) Hook.f. & Thoms. (syn. Uvaria burahol Bl.). Burahol. 2n= . Malaya and Java. Cultivated in Java for its fruits.

Apocynaceae

ERVATAMIA CORONARIA Stapf. (syn. Tabernaemontana coronaria Willd., T. divaricata R.Br.). Grape jasmine. 2n=22. Malaya. Cultivated there for various purposes.

Araceae

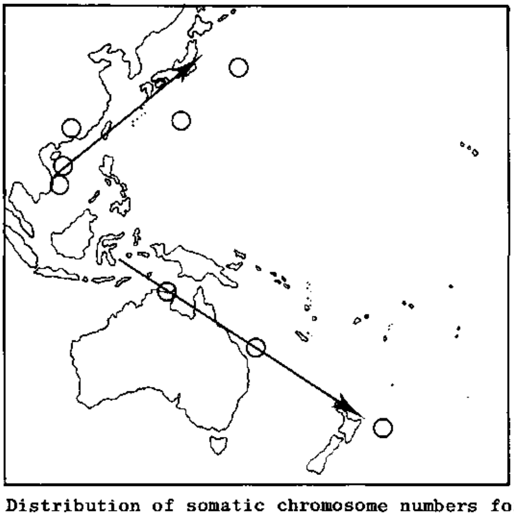
ALOCASIA INDICA (Roxb.) Schott. 2n=28. Centre of diversity SE. Asia. Cultivated there for its stem which is eaten and as an ornamental. Introduced to other countries such as India. This species is sometimes included in A. macrorrhiza*.

AMORPHOPHALLUS CAMPANULATUS (Roxb.) Blume. Elephant yam. 2n=28. SE. Asia. Cultivated in C. and E. Java and India (p. 71).

AMORPHOPHALLUS HARMANDII Engl. & Gehr. 2n= . Occasionally cultivated in Tonkin.

AMORPHOPHALLUS RIVIERI Dur. 2n=24, 26, 32, 39. Indochina. Var. konjac (Schott) Engl. Philippines. Cultivated in China and Japan (Mansfeld, 1959).

COLOCASIA ESCULENTA (L.) Schott. Dasheen, Taro, Cocoyam. 2n=2x=28, 3x=42. SE. Asia or NE. India (p. 71). It was introduced into China and Japan, where var. antiquorum developed. It is also grown in the Mediterranean region, W. Africa, the Pacific islands, New Guinea, Samoa and New Zealand. In SE. Asia, var. esculenta (syn. C. esculenta sensu



Distribution of somatic chromosome numbers for taro (Colocasia esculenta)(Yen & Weeler,1968) 0=3x.

Colocasia esculenta

stricto, C. esculenta var. typica A.E. Hill) developed.

Many wild populations are probably derivates of escapes from cultivation (Purseglove, 1972). Yen & Wheeler (1968) showed that the first introduction of taro into the Pacific, including the Philippines, composed of 2n=28 cultigens and 2n=42 cultigens were introduced later into Indochina-China-Ryu Kyu-Japan area and into Timor-New Caledonia-New Zealand area. Chromosome counts are needed of Indonesian taro cultigens.

CYRTOSPERMA CHAMISSONIS (Schott) Merr. (syn. C. edule Schott, C. merkusii (Hassk.) Schott.). 2n= . Indo-Malaysian area. Introduced into many Pacific islands. Cultivated for its tubers (Purseglove, 1972).

PISTIA STRATIOTES L. Water lettuce. Tropical duckweed. 2n=28. Subtropics and tropics of the Old and New Worlds. A floating plant. Cultivated in Java in fishponds for edible shrimps that live below the plants (Uphof, 1968).

Araliaceae

NOTHOPANAX FRUTICOSUM Miq. (syn. Panax fruticosum L., Polyscias fruticosa (L.) Harms). 2n=22, 24. SE. Asia and Polynesia. Cultivated in Java for its roots and leaves.

NOTHOPANAX GUILFOYLEI Merr. (syn. Panax guilfoylei Cogn., Aralia guilfoylei Bull.). 2n= . Probably the Pacific islands. Perhaps it is a cultigen of N. pinnatum* or a closely related species (Mansfeld, 1959).

NOTHOPANAX OBTUSUM Miq. (syn. Panax obtusum Blume, Polyscias obtusa (Bl.) Harms). 2n= . Probably SE. Asia. Cultivated in Java.

NOTHOPANAX PINNATUM Miq. (syn. Panax pinnatum Lam., Polyscias rumphiana Harms). 2n= . SE. Asia and New Guinea. Cultivated for its leaves.

Asclepiadaceae

GYMNEMA SYRINGIFOLIUM Boerl. Sajor pepe. 2n= . Cultivated in Malaya as a vegetable.

Averrhoaceae

AVERRHOA BILIMBI L. Bilimbi. 2n=22, 24. Malaya. Its fruits are very acid.

AVERRHOA CARAMBOLA L. Carambola. 2n=22, 24. Indonesia. Cultivated for its fruits. Some varieties have been developed.

Azollaceae

AZOLLA PINNATA R.Brown. Water velvet, Water fern. Mosquito fern. 2n= . Domesticated in Vietnam and China (p. 33) for its symbiosis with the N-fixing alga Anabaena azollae Strassburger and therfore used to enrich soils with N, especially of rice fields. For this purpose, it has already been grown for several centuries. In Vietnam, the cv. Beo Giong was developed. It dies at the time of the maximum tillering of the rice plants and its nutrients become available at this crucial stage. Other cultivars have been developed in China (p. 33). Water fern may also be used to suppress pest weeds and as fodder. In some areas like New Zealand, it is itself a pest weed, blocking water channels and pipes (Lumpkin & Plucknett, 1980).

Basellaceae

BASELLA RUBRA L. Indian spinach. Ceylon spinach. Malabar nightshade. 2n=44, 48. Probably S. Asia (Winter, 1963). Cultivated as a vegetable, now throughout the tropics. Formerly it may have been used for dyeing. The commonest synonyms are B. alba L. (2n=48), with white flowers, and B. cordifolia Lam. (2n=) with heart-shaped leaves.

Bombacaceae

CEIBA PENTADRA Gaertn., var. indica (DC.) Bakh. Kapok tree, Silk cotton tree. 2n=72, 80, 88. Secondary gene centre: SE. Asia. Introduced from Africa (p. 123) probably via India. Cultivated in SE. Asia (Zeven, 1969). The Indonesian cultivar Reuzenrandoe (giant kapok) bears some characteristics of the var. caribaea*.

DURIO KUTEJENSIS (Hassk.) Beccari. Lai. 2n= . Along the foothills of the central ranges of Borneo. It has now spread to E. and N. of Borneo.

DURIO OXLEYANUS Griffith. Kerantongan. 2n= . Malaya, Sumatra and Borneo. The fruits are eaten and seeds are dispersed around the (temporary) settlements. Occasionally cultivated. Other wild species of which the fruits are eaten are D. graveolens Beccari, tabelak (2n=), D. dulcis, lahong (2n=), and D. grandiflorus (Mast.) Kostermans & Soegeng, durian munjit (2n=). D. graveolens grows wild in Borneo, Malaya and Sumatra, D. dulcis in Borneo.

DURIO ZIBETHINUS Murray. Durian. 2n=56. W. Malaysia. Unknown wild. Cultivated throughout SE. Asia, W. Irian, Moluccas, Celebes, S. Philippines. Introduced to Indochina, Thailand, Burma, Sri Lanka and elsewhere. It is often semi-cultivated, i.e. semi-wild trees result from dispersal of seeds. In this way, durian groves have arisen.

Boraginaceae

TOURNEFORTIA ARGENTEA L.f. (syn. Messerschmidia argentea (L.f.) Johnston). Velvet leaf. 2n= . Trop. Asia. A shrub cultivated for its leaves which are used as smoking tobacco.

Burseraceae

CANARIUM COMMUNE L. Java almond. 2n= . Moluccas. Cultivated in many other tropical countries. The kernels are eaten and oil is extracted from them. Sometimes they are planted as shade trees and as ornamentals.

CANARIUM MOLUCCANUM Blume. 2n= . Moluccas, New Guinea and W. Polynesia. Cultivated in Malaysia.

CANARIUM OVATUM Engl. Pili, Pili nut. 2n= . S. Luzon (Philippines). The kernels contain 70-80% pili-nut oil.

CANARIUM PIMELA Koenig. Black Chinese olive. 2n= . E. Asia. Cultivated in S. China and Cochin China.

Combretaceae

QUISQUALIS INDICA L. Rangoon creeper. 2n= . SE. Asia. A woody vine. Cultivated as an ornamental, vegetable and as an anthelmintic.

TERMINALIA BELLIRICA (Gaertn.) Roxb. (syn. Myribalan bellirica Gaertn.). Bellirica, Terminalia. 2n=26, 48. India and Malaysia. Cultivated as a source of myrobalan which is used for tanning leather, for black dye and for making ink.

TERMINALIA CATAPPA L. Indian almond, Myrobalan, Almendro. 2n=24. Trop. Asia, N. Australia and E. Polynesia. Widely cultivated in the tropics. The kernels contain about 55% oil. Used for manufacturing edible fats, cosmetics and pharmaceutic preparations. Used for timber; leaves and bark are used for preparation of medicines. The fruits are edible.

TERMINALIA CHEBULA Retz. 2n=14, 24, 26, 48. India to Malaysia.

Compositae

BLUMEA BALSAMIFERA (L.). DC. 2n=20. Himalaya, India, Malaysia, S. China and Taiwan. Cultivated in Java as a medicinal crop.

BLUMEA MYRIOCEPHALA DC. 2n= . India, Vietnam, Malaya and Indonesia. Occasionally cultivated in Vietnam.

ENHYDRA FLUCTUANS Lour. (syn. E. helonchu DC., Hingtsha repens Roxb.). 2n=22. India, Indochina, Thailand, China and Indonesia. A water plant occasionally cultivated in Cambodia and Malaya for its leaves.

EUPATORIUM STOECHADOSUM Hance. 2n=40. Vietnam. Cultivated there.

PLUCHEA INDICA Less. 2n=20. Cuttings of this shrub are planted as hedges in Indonesia. Young leaves are eaten as a vegetable or used to prepare a medicinal tea.

SPILANTHES PANICULATA Wall. ex DC. 2n= . SE. Asia and New Guinea. Cultivated as a vegetable or salad.

VERNONIA ANTHELMINTICA Willd. Kinka oil iron weed. 2n=20, 54. Trop. Asia. It might be a source of epoxy fatty acids.

Convolvulaceae

IPOMOEA MAMMOSA Chois. 2n= . Abouana. Philippines. Cultivated in Indochina. Formerly it was erroneously believed that this species was the ancestor of I. batatas*.

Cucurbitaceae

BENINCASA HISPIDA (Thunb.) Cogn. (syn. B. cerifera Savi). Wax gourd, White gourd. 2n=24. Java. Cultivated throughout Trop. Asia (Purseglove, 1968). It was already mentioned as a vegetable in China in 500 AD. (Li, 1969).

TRICHOSANTHES ANGUINA L. Edible snake gourd. 2n=22. Trop. Asia from India (p. 73) to Australia.

Cyperaceae

FIMBRISTYLIS GLOBULOSA (Retz.) Kunth. 2n= . Trop. Asia, Sri Lanka, India, Malaysia and

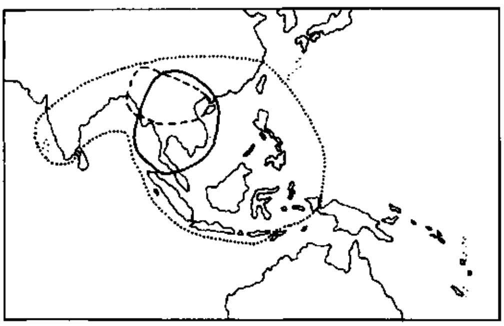
Mariannes. Cultivated on Malaysia for mat-making etc.

LEPIRONIA ARTICULATA (Retz.) Domin. (syn. L. mucronata Rich.). 2n= . SE. Asia, Malaysia, Australia and Fiji. Cultivated in Indonesia.

SCIRPODENDRON GHAERI (Gaertn.) Merr. (syn. S. costatum Kurz.). 2n= . Trop. Asia, Samoa and Australia. Cultivated in Sumatra for mat making.

Dioscoreaceae

DIOSCOREA ALATA L. Greater yam, Water yam, Winged yam, Ten months yam. 2n=(20), 30, 40, 50, 60, 70, 80. SE. Asia, in the Assam-Burma region it is the cultigen of D. hamiltonii Hook., 2n= , or D. persimilis Prain & Burk, 2n= , or a similar species (Burkill, 1935). Some types have been described as D. atropurpurea Roxb., 2n= , and D. purpurea Roxb., 2n= . It is virtually sterile (Ayensu & Coursey, 1972).



Dioscorea alata (—), D. esculenta (---) and D. hispida (···) (Harris, 1973)

DIOSCOREA BULBIFERA L. Potato yam, Aerial yam, Bulbil-bearing yam. 2n=36, 40, 54, 60, 80, 100. Trop. Asia and Africa. Possibly it was domesticated in Asia as well as Africa (p. 125). Cultivated in Trop. Asia, Africa, Oceania and the W. Indies. The tubers and bulbils are edible. The African form (p. 125) has been described as D. latifolia Benth., 2n= . There are many types which often have been described as species e.g. D. heterophylla Roxb., 2n=

DIOSCOREA ESCULENTA (Lour.) Burk. Lesser yam, Asiatic yam, Potato yam, Fancy yam, Chinese yam. 2n=40, 60, 80, 90, 100. Indochina. Cultivated in S. China, and later throughout the tropics. Most flowers are male (Ayensu & Coursey, 1972).

DIOSCOREA FLABELLIFOLIA Prain. & Burk. 2n= . Malaya. Occasionally cultivated there.

DIOSCOREA HISPIDA Roxb. (syn. D. hirsuta Dennst, D. triphylla L.). 2n=40, (80). India (p. 73) and SE. Asia. Closely related to the African D. dumentorum (Coursey, 1967).

DIOSCOREA NUMMULARIA Lam. 2n= . SE. Asia. Cultivated there and in Indonesia and Oceania. It closely resembles D. cayenensis*.

DIOSCOREA QUARTINIANA A. Rich. 2n= . Throughout Trop. Asia. Cultivated in E. Nigeria (Coursey, 1967).

DIOSCOREA PENTAPHYLLA L. 2n=40, 80, 144, c. 144. SE. Asia. Cultivated throughout Indonesia and the Pacific islands.

Dipterocarpaceae

SHOREA STENOCARPA Burck. 2n= . Malaya. Cultivated for its seeds, a source of a Borneo tallow.

Ebenaceae

DIOSPYROS DISCOLOR Willd. (syn. D. blancoi How.). Malobo, Velvet apple. 2n= . Malaysia and Philippines. Occasionally cultivated for its edible fruits.

MABA MAJOR Forst.f. 2n= . Cultivated for its fruits on the Friendship Islands.

Elaeocarpaceae

ELAEOCARPUS FLORIBUNDUS Blume. 2n= . From Bangladesh to Java. Cultivated in Bengal and Assam for its fruits.

Euphorbiaceae

ALEURITES MOLUCCANA Willd. Tung oil tree. 2n=44. Autotetraploid. Indonesia. Its wild parent is not known. Crosses between this species and A. montana did not succeed (Wit, 1969b).

ALEURITES TRISPERMA Blanco. Tung oil tree, Banucalang. 2n=22. Philippines. Cultivated there, in Malaya and Indonesia. Crosses with A. montana did not succeed (Wit, 1969b).

BACCAUREA DULCIS Muell.-Arg. Tjoopa. 2n= . Malaya and Indonesia. Cultivated there for its fruits (Uphof, 1968).

BACCAUREA MOTLEYANA Muell.-Arg. Rambai. 2n= . SE. Asia. Cultivated there for its fruits (Uphof, 1968).

BACCAUREA RACEMOSA Muell.-Arg. 2n= . Malaysian Archipelago. Cultivated there for its fruits.

GLOCHIDION BLANCOI Lowe. 2n= . A tree cultivated in Far East and Philippines for the young leaves and shoots (Terra, 1967).

HEVEA BRASILIENSIS (Willd.) Muell.-Arg. Brazilian hevea, Para rubber tree. 2n=36. Amazon basin (p. 169). A secondary gene centre: Malaya. Domesticated in SE. Asia at the end of the 19th Century (Purseglove, 1968).

MANIHOT ESCULENTA Crantz. Cassava. 2n=36. America (p. 170 and 190). Secondary centre of diversity in Indonesia.

PLUKENETIA CORNICULATA Smith. (syn. Pterococcus corniculatus Pax & Hoffm.). *Painapaina*. 2n= . SE. Asia. Cultivated as vegetable.

PHYLLANTHUS DISTICHUS (L.) Muell.-Arg. (syn. Ph. acides (L.) Skeels. Otaheite gooseberry. 2n=26, 28. India and Madagascar. Cultivated in the tropics for its fruits (Purseglove, 1968).

PHYLLANTHUS EMBLICA L. Emblic, Myrobolan. 2n=28, 98. Trop. Asia. Cultivated in the Old and New Worlds for its fruits (Uphof, 1968).

SAUROPUS ALBICANS Blume (syn. S. androgynus Merr.). 2n= . Cultivated as a vegetable in SE. Asia.

TRIGONOPLEURA MALAYANA Hook.f. Gamber ooran. 2n= . Malaysian Archipelago. Cultivated there for its leaves which substitute for Uncaria gambir*.

Flacourtiaceae

FLACOURTIA RAMONTCHI L'Hér. Botoko plum, Madagascar plum, Governor's plum, Ramontchi. 2n=22. Malaya and Madagascar. Cultivated in the tropics for its fruits.

FLACOURTIA RUKAM Zoll. & Mor. Rukam. 2n= . Malaysia and Philippines. A tree cultivated for its fruits.

HYDNOCARPUS ALCALAE C. DC. 2n= . Philippines. Cultivated for its seeds which are a source of oil used to cure leprosy.

HYDNOCARPUS ANTHELMINTHICUS Pierre ex Lanessan. 2n=24. Indochina and Thailand. Cultivated in many tropical countries for the seeds which are a source of oil used to cure leprosy.

HYDNOCARPUS KURZII (King) Warb. 2n= . Ssp. kurzii in Burma Highlands and Assam. Ssp. australis in Burma Lowlands and N. Siam. Ssp. kurzii is cultivated in many trop. countries for the seeds which are a source of oil used to cure leprosy.

PANGIUM EDULE Reinw. Pangi. 2n= . Malaysia. Cultivated in Java.

Gnetaceae

GNETUM GNEMON L. Bulso. 2n= . From Assam to Malaysia and Fiji. Var. ovalifolium (Poir.) Bl. is considered the wild type while var. gnemon is the cultivated type planted in Java. Introduced to Java, Sumatra and elsewhere. Cultivated in SE. Asia for its seeds and leaves. A large dioecious shrub.

Gramineae

ANDROPOGON ACICULATUS Retz. (syn. Chrysopogon aciculatus Trin.). 2n= . The tropics. Cultivated in Vietnam for its roots which contain *Chiendent grenille à brosse* (Uphof, 1968).

BAMBUSA ARUNDINACEA (Retz.) Willd. Spiny bamboo. 2n=70. Primary centre: India and Burma (p. 73). Secondary centre: Malaysia and E.Java.

BAMBUSA CORNUTA Munro. 2n= . Java. A woody grass cultivated for its tender shoots, which are used as a vegetable.

BAMBUSA SPINOSA Roxb. 2n= . Philippines and Indonesia. A woody tall grass cultivated as a timber bamboo and also for its young shoots used as a vegetable.

BAMBUSA STRICTUS Nees. 2n=70, 72. India and Burma (p. 73). Secondary centres: Indochina and S. China (p. 37).

BAMBUSA TULDA Roxb. 2n= . India, Burma (p. 73) and Tahiti. Secondary centre: Java.

BAMBUSA VULGARIS Schrad. ex Wendl. 2n=72. Probably Malaysia or India. It is unknown in the wild. Cultivated in the tropics for its young shoots and for its stems.

COIX AQUATICA Roxb. 2n=10. S. Asia. Grown as fodder in India, also collected as a wild cereal in Orissa, India.

COIX GIGANTEA Koenig ex Roxb. 2n=20, 40. S. Asia. Involucres are used as beads and poultry are fed on the grains in NE. India.

COIX LACRYMA-JOBI L. Job's tears, Adley. 2n=20, genome formula BB. S. Asia. Wild races have indurated involucres of various colours used as beads. Domesticated races have soft involucres and are widely grown as cereals in NE. India and SE. Asia. Cultivated kinds are often referred to as C. Ma-yuen Romanet (Arora, 1977; Jain & Banerjee, 1974; Kaul, 1973).

CYMBOPOGON CITRATUS (DC.) Stapf (syn. Andropogon citratus DC.). Lemon grass. 2n=40, 60. Probably Malaysia or Sri Lanka. Unknown wild. Cultivated in S. Asia, Indochina and elsewhere for its lemon grass oil.

CYMBOPOGON NARDUS (L.) Rendle (syn. Andropogon nardus L.). Citronella grass. 2n=20, (40, 60). Cultivated in Indonesia, Sri Lanka and elsewhere for its citronella oil. There are two types of oil: (1) Sri Lanka type obtained from var. lenabatu which is cultivated in S. Sri Lanka; (2) Java type obtained from var.

mahapengiri (syn. C. winterianus Jowett, 2n= 20). The latter was introduced into Java from Sri Lanka early in 20th Century. It is now widely distributed throughout the tropics. The wild type in Sri Lanka has a different oil composition (Wijesekera et al., 1973).

DENDROCALAMUS ASPER (Schult.) Becker ex Heyne (syn. Bambusa asper Schult.). 2n= . Probably from the Malay Peninsula and adjacent areas. Unknown wild. Secondary centre: Malaysian Archipelago. It has strong stems and edible shoots.

DENDROCALAMUS BRANDISII Kurz. 2n=72. Burma, Thailand, Cambodia and Vietnam. Its stems are used as building material.

DENDROCALAMUS MERRILLIANUS Elm. 2n= . Primary centre: Philippines. Its stems are used as building material.

DINOCHLOA GIGANTEA Munro. 2n= . Lower Burma. Primary centre: Lower Burma. Its stems are used as building material. The plant of this species is the largest among the bamboos.

DINOCHLOA MACLELLANDII Kurz. 2n= . Cambodia, Laos and Vietnam. Its stems are used in the basket industry.

DINOCHLOA PENDULUS Ridb. 2n= . Malay Peninsula. Its stems are used for baskets.

GIGANTOCHLOA APUS (Schult.) Kurz. 2n= . Burma and Indochina. Several species are cultivated in Java, Borneo and Philippines and on the Malay Peninsula (Tenasserim). Secondary centre: Java.

GIGANTOCHLOA LIGULATA Gamble. 2n= . N. part of Malay Peninsula and Thailand. The timber is used and the shoots are eaten.

GIGANTOCHLOA MAXIMA Kurz. 2n= . Unknown wild. Secondary centre: Java. Its stems are an excellent material for building.

GIGANTOCHLOA SCORTECHINII Gamble. 2n= . Malay Peninsula. Its stems are used as building material.

GIGANTOCHLOA SCRIBNERIANA Merr. 2n= . Laos and Cambodia. Its stems are used as building material.

GIGANTOCHLOA VERTICILLATA (Willd.) Munro. 2n= . SE. Asia. Cultivated in W. Africa, W. Indies, Fiji and elsewhere (Purseglove, 1972).

ISCHAEMUM INDICUM (Houtt.) Merr. Batiki blue grass. 2n= . SE. Asia. Cultivated in W. Africa, W. Indies, Fiji and elsewhere (Purseglove, 1972).

MISCANTHUS FLORIDULUS (Lab.) Warb. 2n=38. New Guinea. This species together with M. sinensis* from Fiji played a role in the origin of the Edule group of Saccharum officinarum* (Grassl, 1977).

ORYZA GRANULATA Nees & Arn. (incl. O. meyeriana Baill.). 2n=24, 48. Malaya. It belongs to the 'officinalis' group of Oryza.

ORYZA LONGIGLUMIS Jansen. 2n=48. New Guinea.

ORYZA MINUTA Presl. 2n=48, genome formula BBCC. This wild species has the same genomes as the African O. eichingeri*. It belongs to the 'officinalis' group.

ORYZA NIVARA Sharma & Shastry. 2n=24. S. and SE. Asia and N. Australia. This is the wild annual close relative of O. sativa*.

ORYZA OFFICINALIS Wall. 2n=24, genome formula CC. This wild species is the parent of the species belonging to the 'officinalis' group.

ORYZA PERENNIS Moench. 2n=24, genome formula AA. The distribution of this wild species is discussed on p. 74. In Oceania, the Oceanian race (2n=24) of this species developed. See also O. rufipogon* and index.

ORYZA RIDLEYI Hook.f. 2n=48. SE. Asia.

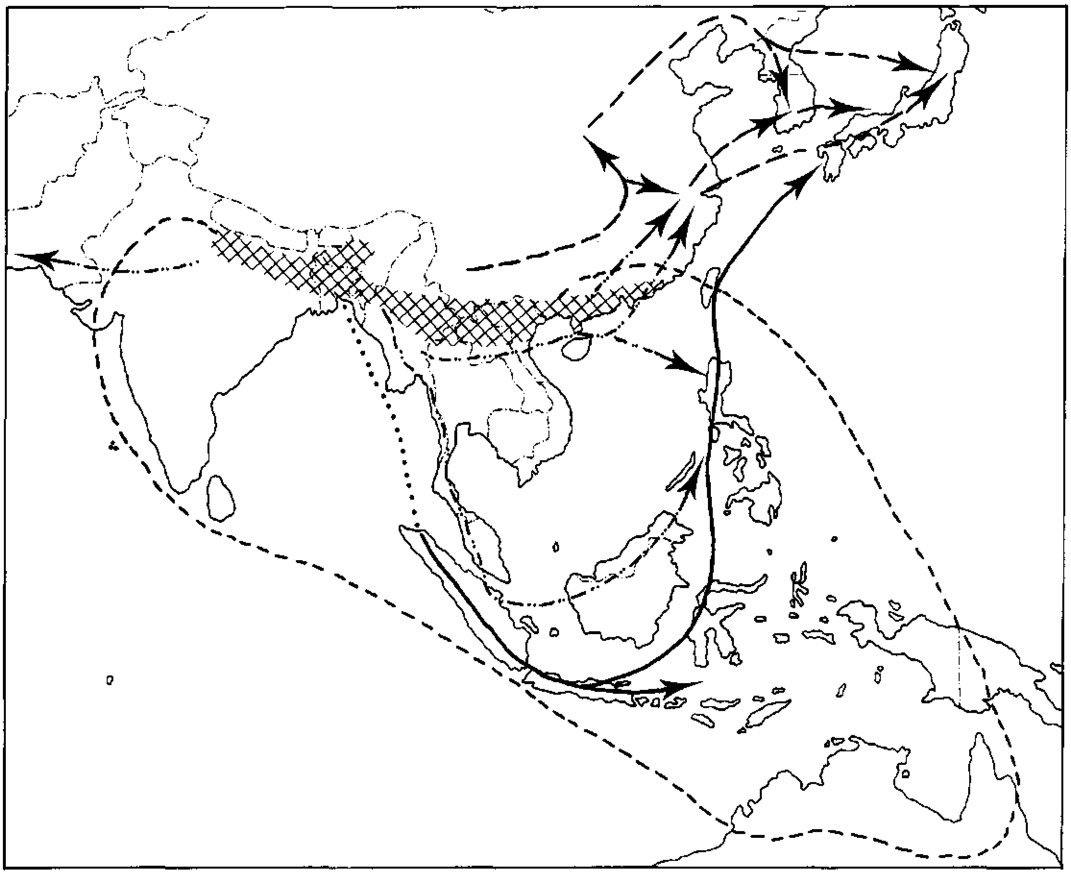
ORYZA RUFIPOGON Griff. (syn. O. montana Lour.). 2n=24. Several SE. Asian countries. It is a pernicious weed of rice land. It easily crosses with rice. It might be a hybrid product of natural crosses of rice and O. perennis* and would then be of the same nature as O. sativa var. fatua*. According to recent views of taxonomists, O. rufipogon includes O. perennis*, O. fatua*, O. sativa f. spontanea*, O. perennis ssp. balunga*, O. perennis ssp. cubensis*. See also O. nivara*.

ORYZA SATIVA L. Rice. 2n=24, genome formula AA. Primary centre: SE. Himalaya area (p. 74). Ecotype Tjereh and Bulu developed in Indonesia. Tjereh belongs to the ecospecies 'aman' (ssp. indica Kato) (Morinaga, 1968).

ORYZA SCHLECHTERI Pilger. 2n= . New Guinea.

PASPALUM SCROBICULATUM*

SACCHARUM OFFICINARUM L. Sugar-cane, Noble-cane. 2n=40II=80. New Guinea. Modern clones resulting (2n=100-125) from hybridization. Sugar-cane derives form S. robustum Brandes & Jeswiet ex Grassl, which grows wild in New Guinea, Celebes, Borneo up to New Hebrides. Basic types of N. coast of New Guinea, Celebes and Borneo have 2n=60, while those from southern coast of New Guinea have 2n=80. The first basic type may have originated in Borneo The second basic type may have been the wild parent from which primitive sugar-cane developed.



Dispersal of races Oryza sativa across Asia. Area of origin (grey), "Indica" (·.-··), "Japonica" (---), "Javanica" (—), extend of wild relatives (····) (Chang, 1976).

S. robustum is cultivated for its large stalks used for fences and for construction. During the domestication of sugar-cane, geographic types may have hybridized. Through selection, sugar-cane has a much lower fibre content, increased juiciness and sugar content throughout the stalk. These are the New Guinea Noble canes which must have originated ca 700 BC. On New Guinea, these Noble canes hybridized with Miscanthus sinensis . With hybridization, and backcrossing and perhaps other intergeneric hybridization (Roach, 1972), the Edule group of canes developed (Grassl, 1964, 1967, 1968, 1977). This group has also been described as S. edule Hassk. The Edule canes have been subdivided into Vitho canes (syn. Erianthus maximus Brongn. and E. pedicelare Trin.), 2n=87-100 and Nduruka canes (syn. S. edule Hassk.), 2n=70.

From Fiji, sugar-cane was taken to Hawaii, which lies outside the Miscanthus area. There the Hawaiian (Original) Noble canes developed, which are thicker and are used as chewing canes and as ornamentals.

The New Guinea Noble canes were also transported northwards and northwestwards to other parts of Indonesia, Philippines, S. Japan, S. China (p. 38) and India (p. 75).

SACCHARUM SPONTANEUM L. Wild sugar-cane. 2n=(x=10)40-128. SE. Asia. In Philippines three groups are found: 2n=56, 2n=72 and 2n=80. Plants with 2n=80 occur in many habitats for instance on mountains and river banks, and in grassland (Rithidech & Ramirez, 1974). In the Indo-Gangetic Plain, plants with 2n=40-72 are found (Mehra & Sood, 1974). In Indonesia and especially in Java and Sumatra, plants with 2n=112 occur. They may be of hybrid origin, deriving from S. officinarum (2n=80) x S. spontaneum (2n=64). Used as fencing for pigs by the Austronesians from SE. Asia.

SCHIZOSTACHYUS BRACHYCLADUS Kurz. 2n= . Java and E. Malaysia. Secondary centre: the Malay Peninsula.

SCHIZOSTACHYUS GRANDE Ridl. 2n= . Malay

Peninsula.

SCHIZOSTACHYUS LULAMPAO Merr. 2n= . Centre of origin Philippines. Used in the paper industry.

SCHIZOSTACHYUS ZOLLINGERI Steud. 2n= . Malay Peninsula, Java and Sumatra.

SINOCALAMUS LATIFLORUS (Munro) McClure (syn. Dendrocalamus latiflorus Munro.) 2n= . Burma, Thailand, Taiwan and Philippines. Its stems are used as building material. The young shoots are eaten. They are also canned and exported.

TRITICUM TURGIDUM (L.) Thell. Durum wheat (syn. T. durum Desf.). 2n=28, genome formula AABB. For origin see p. 94. In India a secondary centre of diversity (Jain et al., 1976).

VETIVERIA ZIZANIOIDES Stapf (syn. V. odorata Virey, Andropogon muricatus Retz.). Vetiver. 2n=20. A grass of Trop. Asia. Cultivated for volatile oils in its rhizomes and as a hedge plant.

ZEA MAYS L. Maize. 2n=20. Domesticated in C. America (p. 190). Secondary centre arose in S. and SE. Asia (Brandolini, 1970).

Guttiferae

CALOPHYLLUM INOPHYLLUM L. Alexandrian laulal, Undi. 2n=32. Coastal regions from E. Africa upto Australia and Polynesia. Often planted. In India it has a rather restricted economic importance. The kernel yields Domba oil.

GARCINIA ATROVIRIDES Griffith. Gelugur. 2n= . Assam and Malaya. Occasionally cultivated.

GARCINIA COCHINCHINENSIS (Lour.) Choisy. 2n= . Cochin China. Cultivated for its fruits.

GARCINIA DULCIS (Roxb.) Kurz. Baniti. 2n= . Philippines to Java. The bark yields a green dye and the fruits are edible. Occasionally cultivated in Java.

GARCINIA INDICA Choisy. Kokum, Kokan, Ktambi. 2n=48, c. 54. Trop. Asia. Cultivated for its fruits. In India, it is a minor oil-seed plant (p. 75).

GARCINIA MANGOSTANA L. Mangosteen. 2n=c. 76, 96. Malaysia. It is considered to be the most delicious of all tropical fruits. It is derived from wild G. silvestris, which is also found in India (p. 75).

GARCINIA MULTIFLORA Champ. (syn. G. tonkinensis Vesque). Cây giôc, Bira tai. 2n= . N. Vietnam, Laos, Hainan and Hongkong. Cultivated in N. Vietnam for its fruits.

GARCINIA PEDUNCULATA Roxb. Tikul. 2n= . Bengal and Silhat (Bangladesh). Cultivated for its fruits.

GARCINIA TINCTORIA (DC.) W.F. Wight. Matau, Gamboge tree. 2n=c.80. India (p. 75) and Malaya. Cultivated in the tropics for its fruits.

Hydrophyllaceae

HYDROLEA ZEYLANICA Vahl. 2n= . Trop. Asia. Cultivated in Java for its young leaves.

Labiatae

COLEUS AMBOINICUS Lour. (syn. C. aromaticus Benth.). Indian borage, Dacon ajenton 2n=68. Indonesia. Cultivated in SE. Asia and W. Indies for its aromatic leaves. These leaves are used in stuffings and for flavouring meats. They may substitute for sage (Salvia officinalis*) and borage (Borago officinalis*) (Purseglove, 1968).

COLEUS PARVIFLORUS Benth. (syn. C. tuberosus Benth.). 2n=56, 64. This tuber crop is cultivated in SE. Asia.

OCIMUM GRATISSIMUM L. 2n=40, 48, 64. Trop. Asia, esp. India. Cultivated in India as medicinal crop.

OCIMUM SANCTUM L. Holy basil. 2n=64. Shrub of trop. Old World. Cultivated as a sacred plant in India and elsewhere.

ORTHOSIPHON STAMINEUS Benth. (syn. Ocimum grandiflorum Blume). 2n= . SE. Africa to Australia. A shrub cultivated in Java as medicinal plant.

POGOSTEMON CABLIN (Blanco) Benth. Patchouli. 2n= . Philippines. Cultivated for its essential oil.

Lauraceae

CINNAMOMUM BURMANI Blume. Batavia cinnamon. 2n= . Malaysia. Cultivated there.

CINNAMOMUM CASSIA Blume (syn. C. aromaticum Nees). Cassia cinnamon, Chinese cinnamon. 2n= . Cultivated in S. China for its bark and flower buds. Cassia oil is obtained from the leaves (Purseglove, 1968).

LITSEA CALOPHYLLA (Miq.) Mansf. (syn. L. tetranthera Mirb., L. sebifera Blume). 2n= . Malaya and Indonesia. Cultivated esp. in Bangka, Indonesia for its fruits.

Leguminosae

ALBIZIA LEBBECK Benth. Lebbek, Indian walnut. 2n=26. Trop. Asia to N. Australia. Cultivated in tropics and subtropics as fodder crop and as shade tree.

ALBIZIA MOLUCCANA Miq. (syn. A. falcata (Stickm.) Backer). 2n= . Malaya. Cultivated there and elsewhere as shade tree and as green manure.

ALBIZIA MONTANA (Jungh.) Benth. 2n= . Malaysia. Cultivated as green manure and shade tree.

ALBIZIA SUMATRANA. 2n= . Indonesia. Cultivated in Zaïre as soil cover, green manure and shade tree.

CANAVALIA GLADIATA (Jacq.) DC. Sward bean. 2n=22, 44. Old World. Probably derived from C. gladiolata Sauer (2n=22), which occurs in the Burma-Yunnan area (Sauer, 1964). Wild in Trop. Asia and Africa. Cultivated in Asia, especially in India as food, forage and cover crop or as green manure. In some areas, it has naturalized (Purseglove, 1968). In Japan, the white-seeded cultigen (var. alba) is cultivated (p. 40).
C. polystacha (Forsk.) Schweinf. (2n=). Cultivated from SW. China upto Ethiopia/Somalia as pulse and seed. It is also considered the parental type of C. gladiata.

CASSIA DIDYMOBOTRYA Fresen. Candelabra tree. 2n=28. A shrub used as green manure in Malaya and Sri Lanka.

CASSIA HIRSUTA L. 2n=28, 56. Vigorous bush used in Malaya, Indochina and Uganda for soil cover. C. intermedia Sharma, Vivek. & Rathak (2n=) is a natural hybrid of C. occidentalis L., (2n=26, 28) and C. hirsuta (Sharma et al., 1974).

CASSIA LESCHENAULTIANA DC. 2n=48. Shrub used in India and Indonesia as green manure.

CASSIA MIMOSOIDES L. 2n=16, (32). Trop. Asia and Africa. Tree used in Indochina and Indonesia as green manure.

CASSIA OCCIDENTALIS L. Coffee senna, Negro coffee, Stink weed. 2n=26, 28. Tropics. Used in Indochina as green manure.

CASSIA PUMILA Lam. 2n= . Cover crop in Indochina.

CASSIA SIAMEA Lam. (syn. C. florida Vahl.). 2n=28. India, Malaya and Indonesia. Cultivated in Malaya and India as fodder crop. Introduced on Cuba as green manure.

CASSIA TORA L. Sickle senna, Wild senna. 2n=26, (28, 56). Tropics. Occasionally cultivated as a green manure in China and Indonesia.

CLITORIA LAURIFOLIA Poir. (syn. C. cajanifolia Barth). 2n=24. Tropics. Occasionally cultivated in Sri Lanka and Indonesia and formerly in Tanzania as green manure.

CROTALARIA ALATA Ham. 2n=16. Malaysian Archipelago. Excellent green manure.

DERRIS DALBERGIOIDES Baker. 2n= . Used as shade tree in SE. Asia.

DERRIS ELLIPTICA Benth. Derris. 2n=22, 24, 36. From E. India to New Guinea except S. Malaya. Clones are distributed locally except one which is found in many places in SE. Asia. This clone has a high content of rotenone (Toxopeus, 1952).

DERRIS MALACCENSIS Prain. Derris. 2n=22, 24. Malaysian Archipelago, where also cultivated types are found. Like D. elliptica*, it is a source of rotenone (Toxopeus, 1952).

DERRIS MICROPHYLLA (Miq.) Jackson. 2n= . Used as shade tree in SE. Asia. Introduced into Indochina.

DERRIS ROBUSTA Benth. 2n= . Used as a shade tree in SE. Asia.

DESMODIUM GYROIDES DC. 2n=20, 22. Trop. Asia. A shrub used as a green manure.

INDIGOFERA TEYSMANNII Miq. 2n=32. SE. Asia. It is a green manure.

INOCARPUS EDULIS Forst. Tahiti chestnut. 2n=20. From Malaysia to Polynesia, where it is cultivated for seeds and as shade tree.

MELILOTUS SAUVEOLENS Ledeb. (syn. M. graveolens Bunge). Daghestan sweet clover. 2n=16. E. Asia and Indochina. Cultivated in USA. Some annuals are found in this biennial plant.

MIMOSA SEPIARIA Benth. 2n= . Trop. Asia. Used for hedges (Mansfeld, 1959).

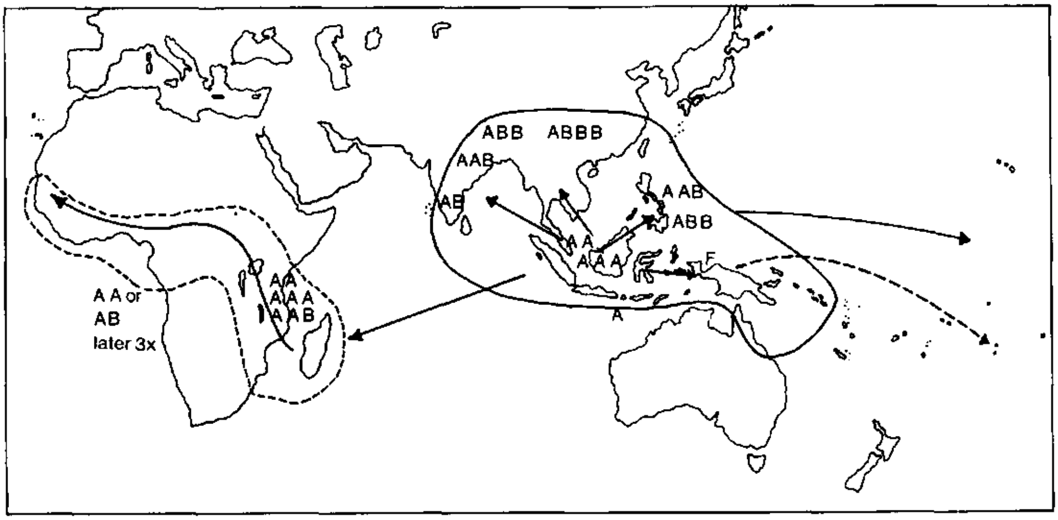
MUCUNA ATERRIMA (Piper & Tracy) Holland (syn. Stizolobium aterrima Piper & Tracy). Mauritius bean, Bengal bean. 2n=22. Trop. Asia. Cultivated there and elsewhere as a green manure and soil cover.

MUCUNA CAPITATA (Roxb.) Wight & Arn. 2n= . India and Java. Cultivated as a vegetable and for its seeds.

MUCUNA COCHINCHINENSIS (Lour.) A. Cheval. (syn. M. nivea DC., Stizolobium niveum O. Kuntze). 2n=22. Cochin China. Cultivated in tropics as vegetable, for seeds, as green manure and soil cover.

MUCUNA DEERINGIANUM (Bort.) Small. (syn. Stizolobium deeringianum Bort.). Florida velvet bean. 2n=22. Probably trop. Asia or Malaysia. Cultivated as cover crop, green manure and forage crop.

MUCUNA PRURIENS DC. var. utilis Wahl. (syn. Stizolobium aterrimum Piper & Tracy). Bengal



Distribution of wild bananas (—) and cultivation in Africa (---). Origin and movements of Eumusa groups (AA-ABBB) and of Australimusa series (open arrow) (Simmonds, 1962).

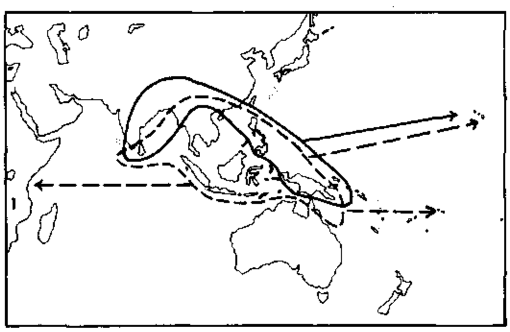
AAB group. Its major centre of origin lies in India (p. 68), while a clone (Maio maoli) may have arisen in Philippines (Simmonds, 1964).

The third hybrid group is the triploid AAB group. S. India is a major centre of origin. It is quite likely that a second centre is found in Philippines.

The fourth hybrid group, consisting of one clone, is the tetraploid ABBB group. Its centre of origin very probably lies in Indochina (Simmonds, 1964).

MUSA* cultivars of the ABB group. 2n=33. Most ABB cultivars originated in S. India (p. 68). However it is possible that after the cultivated M. acuminata (AA) reached Philippines, hybrids arose with M. balbisiana*.

MUSA* BALBISIANA



The wild Musa balbisiana (—) and M. acuminata (---) types (Simmonds, 1962).

MUSA* TEXTILIS Nee. Abaca, Manilla hemp. 2n=20. Philippines. A tall perennial. Cultivated there and elsewhere in the tropics for its fibre. Canton fibre is obtained from a natural completely sterile hybrid (2n=21) of M. textilis x M. balbisiana*.

Myristicaceae

MYRISTICA ARGENTEA Warb. Papuan nutmeg. 2n= . New Guinea, where it is also occasionally cultivated (Flach & Cruickshank, 1969).

MYRISTICA FRAGRANS Houtt. Banda nutmeg. 2n=42, 44. Centre of origin: Moluccas. It is not found there wild. From there, it spread throughout the tropics (Flach & Cruickshank, 1969).

Myrtaceae

EUGENIA AQUEA Burm.f. (syn. Syzygium aqueum (Burm.f.) Alston). Watery roseapple. 2n= . Bangladesh, Burma, Sri Lanka, Sumatra and Moluccas. It is also cultivated.

EUGENIA CARYOPHYLLUS (Sprengel) Bullock & Harrison (Syzygium aromaticum (L.). Merr. & Perry). Clove tree. 2n= . The wild clove tree, sometimes named E. obtusifolia Reinwardt (Caryophyllus sylvestris T. & B.), grows on many islands of Moluccas and in New Guinea. It has bigger leaves and flower buds, and is less aromatic than the cultivated tree. Cultivated for a long time.

Some variation exists in and outside its centre of origin.

EUGENIA FORMOSA Wall. (syn. Syzygium mappaceum (Korth.) Mansf.). 2n= . Trop. Asia.

Tree cultivated in Cochin China for fruits.

EUGENIA JAMBOLANA Lam. (syn. Syzygium cumini (L.). Skeels, Eugenia obtusifolia Roxb., E. cumini (L.) Druce). Java plum, Jambolan plum. 2n=33, 44, 46, 55. India to Malaysia, China and N. Australia. It is cultivated there and elsewhere. In India, a large-fruited type is cultivated (Mansfeld, 1959).

EUGENIA JAMBOS L. (syn. Syzygium jambos (L.) Alston). Roseapple. 2n=28, 33, c.42, 44, 46, c.54. Tree cultivated for a long time in Indo-Malaysia. Its centre of origin is not known.

EUGENIA JAVANICA Lam. (syn. Syzygium semarangense (Bl.) Merr. & Perry). 2n=33, 42, 44, 45, 66, 88, 110. Malaysia to India. Much cultivated in Java.

EUGENIA MALACCENSIS L. (syn. Syzygium malaccensis (L.) Merr. & Perry). Pomerac, Malay apple. 2n=22. Malaya. Some varieties are known.

MELALEUCA QUINQUENERVIA L.f. (syn. M. leucadendra L.). Cajéput tree. 2n= . Australia to Burma. Planted in forestry projects in Philippines, Hawaii and elsewhere. Also planted to drying out swamps, and as ornamental.

PIMENTA ACRIS Kostel. 2n=22. Indonesia. Cultivated there for oil distilled from the leaves (Purseglove, 1968).

RHODOMYRTUS TORMENTOSA Wight. Downy rose-myrtle. 2n= . India and Malaysia. A shrub cultivated in the (sub)tropics for its fruits.

Nyctaginaceae

PISONIA ALBA Span. Maluko, Lettuce tree. 2n= . Malaya. Wild tree is called P. sylvestris Teijsm. & Binn. (syn. P. grandis R. Br.) (2n=). Cultivated for leaves, which are used as vegetable.

Palmae

ARECA CATECHU Merr. Betelnut palm. 2n=32. Trop. Asia. Cultivated for nuts.

ARENGA PINNATA (Wurmb.) Merr. Sugar palm. 2n=26, 32. Primary centre: the Indonesian-Hindustani gene centre (p. 78). Possible secondary gene centre: India.

BORASSUS FLABELLIFER*

CALAMUS CAESIUS Blume. 2n= . Malaya, Borneo and Sumatra. Cultivated for stems.

COELOCOCCUS ARMICARUM Warb. Polynesian ivory-nut palm. 2n= . Carolina Islands. Cultivated in Philippines for its ivory-like nuts.

METROXYLON SAGU Rottb. Sago palm. 2n= . Malaya, Moluccas and New Guinea. Sago is obtained *from the marrow of the stem. This spe*cies is occasionally split in M. sagu - the wild type and M. rumphii (Willd.) Mart. (2n=) - the cultigen.

NYPA FRUTICANS Wurmb. (syn. Nipa fruticans Thunb.). Nipa palm. 2n=16. SE. Asia upto Australia. Cultivated on Sumatra for its leaves and for wine production. Introduced to the mangrove area of S. Nigeria, where it has run wild (Zeven, 1973).

PRITCHARDIA GAUDICHAUDII H. Wendl. 2n= . Sandwich Islands. Cultivated there for its leaves which are used for thatching.

PRITCHARDIA PACIFICA Seem & Wendl. 2n=36. Fiji and Samoa. Cultivated for its leaves, which are used for thatching.

SALACCA EDULIS Reinw. 2n= . Malaysian Archipelago. Cultivated on Java for its edible fruits.

Pandaceae

PANDANUS AMARYLLIFOLIUS Roxb. (syn. P. odorus Ridl.). 2n= . Cultivated in Malaya for its fragrant leaves.

PANDANUS BROSIMAS Merr. & Perry. 2n= . Cultivated in the highlands of New Guinea for its seeds, which have a pleasant flavour and are rich in oil (Purseglove, 1972).

PANDANUS SPURIUS Miq. (syn. P. moschatus seu laevis Rumph., R. moschatus Rumph. ex. Miq., P. tectorius Soland. var. moschatus (Rumph. ex Miq.) Merr., P. laevis Lour., P. odoratissimus L.f., P. inermis Roxb.). Thatch screw pine, Putat, Pudak. 2n=c.51, 54, 60. Cultivated in SE. Asia to the extremes of Polynesia for its leaves for thatch and for its fruits. The cultivar is one clone, probably originated as a bud sport on a staminate plant of some wild species of section Pandanus. Perhaps the mutation occurred on a specimen of P. spurius some millenia ago (St. John, 1965).

PANDANUS WHITMEEANUS Martelli. Paogo. 2n= . Cultivated in New Caledonia, New Hebrides and elsewhere. On Futuna, it is used only for personal adornment. The fruit oil is used to perfume coconut oil (St. John & Smith, 1971).

Pentaphragmaceae

PENTAPHRAGMA BEGONIAEFOLIUM Wall. 2n= . A fleshy herb cultivated as vegetable in Malaya (Terra, 1967).

Pinaceae

PINUS MERKUSII Jungh & de Vriese (incl. P. merkusiana Corling & Gaussen). Merkus pine.

2n= . Burma to Philippines and south to Sumatra. Planted in tropics as a source of turpentine and paper, and to control erosion.

Piperaceae

PIPER BETLE L. Betel pepper, Betle vine, Betal, Sirih. 2n=32, 64, (78). C. and E. Malaysia. Cultivated in the tropics. The leaves are chewed together with betelnut (Areca catechu*).

PIPER CUBEBA L.f. Cubeb, Cubebe, Tailed pepper. 2n=24. Cultivated there and in neighbouring countries.

PIPER METHYSTICUM Forst. Kava pepper. 2n= . Polynesia. Cultivated there. The roots and rhizomes are used to prepare a non-alcoholic beverage. In small amounts it is a stimulant; in large amounts a narcotic.

PIPER RETROFRACTUM Vahl (syn. P. officinarum DC.). Javanese long pepper. 2n= . Malaysia. It resembles P. longum*. Cultivated for its spike, which is used as a spice.

PIPER SAIGONENSE C. DC. Lolo. 2n= . Indochina. Cultivated there occasionally. Closely related to P. lohot C. DC., which comes from Tonkin district.

Polygonaceae

POLYGONUM ODORATUM Lour. 2n= . Indochina. Cultivated as a pot-herb in Vietnam.

Rosaceae

RUBUS ALBESCENS*

RUBUS ROSAEFOLIUS Smith. Cape bramble, Mauritius raspberry. 2n= . Tropical Asia. Introduced in other continents. Cultivated. It is considered a parent of R. probus Bailey, Queensland raspberry, a shrub from Australia. The other parent is R. ellipticus Smith, the Yellow Himalayan raspberry from E. India.

Rubiaceae

MITRAGYNA SPECIOSA Korth. 2n= . Malaya and S. Thailand. Cultivated as a substitute for opium.

MORINDA TRIFOLIA L. Indian mulberry. 2n= . Indonesia and Malaya. Cultivated on Java as a dye crop.

OLDENLANDIA UMBELLATA L. Indian madder. 2n= 36. Trop. Asia. Cultivated as a dye plant.

UNCARIA GAMBIR (Hunt.) Roxb. Gambier. 2n= . Malaya. Formerly cultivated in SE. Asia. Its leaves and young branches contain a tannin.

Rutaceae

AEGLE MARMELOS (L.) Corr. Indian bael, Bengal fruit. 2n=18, (36). Cultivated in SE. Asia and some other trop. countries for its fruits, which are used medicinally.

CITRUS AURANTIFOLIA (Christm.) Swing. Lime. 2n=18, (27). Probably Malaysian Archipelago or N. India. It may derive from a cross of C. medica* with a biotype of the primitive subgenus Papeda (Scora, 1975). Wild trees are reported to grow in N. India. Spread througout tropics. The cultivar Tahiti is triploid. Interspecific hybrids have been obtained. Mandarin lime is probably a hybrid with C. reticulata*, sweet lime with C. medica* and limequat with Fortunella margarita*. The nakoor lime (named C. nakoor) is a complex natural hybrid with some Papeda group parentage. The Rangpur lime belongs to C. reticulata*.

CITRUS AURANTIUM L. Sour orange, Seville orange, Bigarade. 2n=18. Probably SE. Asia or Cochin China. Unknown wild. It may derive from C. reticulata* x C. grandis* (Scora, 1975). Spread throughout (sub)tropics. In some areas, it has run wild. Ssp. bergamia (Risso & Poit.) Wight & Arn., Bergamot (2n= 18) is cultivated especially in Calabria, S. Italy for the production of bergamot oil (p. 105). Crosses with C. sinensis* (Sweet orange) gave Bitter sweet orange. The var. myrtifolia Kergawl., Myrtle-leaved orange is a bud mutant. Its fruits, Chinottos, are candied in Italy and S. France.

CITRUS GRANDIS (L.) Osbeck (syn. C. decumanus L. 2n=18, 21; C. maxima (Burm.) Merr. 2n=18, 36). Pummelo, Shaddock. 2n=18, 36. Probably SE. Asia. Primary centre of diversity: SE. Asia. Spread to China, India and Iran, and later to other tropical countries (by Captain Shaddock to Barbados in 17th Century). Unknown wild. The best fruits come from Thailand where the plants are cultivated on ridges surrounded by brackish water. Self-incompatible and monoembryonic perennial. Introgression with C. reticulata* occurs (Scora, 1975).

CITRUS HYSTRIX DC. Mauritius papeda. 2n= . Philippines and Burma to Malaya. A small type cultivated for its fruits.

CITRUS JAMBHIRI Lush. Rough lemon. 2n= . It derives from C. medica* x C. reticulata* (Scora, 1978).

CITRUS LIMETTA Risso. Sweet lemon. 2n=18. Trop. Asia. Small tree cultivated in some countries.

CITRUS LIMON (L.) Burm.f. Lemon. 2n=18, 36. Centre of origin somewhere in SE. Asia. The area east of Himalayas in N. Burma and S. China has been suggested. Unknown wild. Has a complex origin (Torres et al., 1978). A secondary centre: the Mediterranean Region (p. 118). Scora & Malik (1970) suggested that this species might be a stabilized hybrid of C. medica* - C. aurantifolia* assemblage. Cultivated in several (sub)tropical regions.

CITRUS MEDICA L. Citron. 2n=18. Subtrop. Asia. A basic Citrus species (Torres et al., 1978). It may be one of the parents of C. limon* and C. jambhiri*. Monoembryonic.

CITRUS MITIS Blanco. Calamondin. 2n=18. Philippines. It derives from C. reticulata var. austera x Fortunella sp. A tree occasionally cultivated in (sub)tropics. Hybrids of this species have been produced, for instance Calarin and Calashu are hybrids with C. reticulata* (Satsuma). Calamondin is a hybrid of C. reticulata x Fortunella sp.

CITRUS PARADISI Macf. Grapefruit. 2n=18. SE. Asia. Unknown wild. Probably derived from C. grandis* x C. sinensis* (Torres et al., 1978). Chiranja is a hybrid with C. sinensis and citrumelo with Poncirus trifoliata*.

CITRUS RETICULATA Blanco (C. nobilis Andr. non Lour.). Mandarin, Tangerine. 2n=18. Probably Philippines, or Cochin China. Unknown wild. Secondary centre arose in Japan (p. 45). Minessy et al. (1970) found close relationship with C. sinensis* 'Balady Blood'. Its relationship with C. paradisi* 'Duncan' and 'March' is moderate and with C. grandis* remote. Var. austera Swing is the sour mandarin. It probably includes the Rangpur lime (Purseglove, 1968).

Hybrids with other species have been made. For instance Oranguma is an artificial hybrid of Satsuma x C. sinensis* (Orange), and Tangor is a natural hybrid of the same parents. Its origin is in Thailand. Tangor has been described as C. nobilis Lour. Citrandarin derives from Poncirus trifoliata* x C. reticulata, calamondin (see C. mitis) from C. reticulata x Fortunella sp., and chironja from orange x C. reticulata.

CITRUS SINENSIS (L.) Osbeck (syn. C. aurantium L. var. sinensis L.). Sweet orange. 2n=18, (27, 36). Probably S. China or Cochin China. Unknown in wild. It may derive from C. reticulata* x C. grandis* (Scora, 1975). Secondary centres: Israel and Spain (p. 118). It was already mentioned in Chinese sources dated 2200 BC. It has the same origin as C. aurantium* but the wide genetic variation of C. reticulata causes differences in the derived species. It is widely distributed in the (sub)tropics. There are many cultivars. Citrange is a hybrid with Poncirus trifoliata* and chironja is a spontaneous hybrid with C. paradisi*. It originated in Puerto Rico. By apomixis, it breeds true.

MURRAYA EXOTICA L. Limonia. 2n=18. Trop. Asia. Used for hedges.

MURRAYA PANICULATA (L.) Jacq. Cosmetic bark-tree, Orange jasmine. 2n=18. SE. Asia. Cultivated in the tropics as an ornamental and for hedges. The wood (Satinwood) is used in Java to make cutlery.

Santalaceae

SANTALUM ALBUM L. (syn. Sirium myrtifolium L.). Sandel wood. 2n=10. E. India to Malaysia. Cultivated there and elsewhere for scented wood.

Sapindaceae

ERIOGLOSSUM RUBIGINOSUM (Roxb.) Blume (syn. E. edule Bl.). 2n= . Trop. Asia to New Guinea and Australia. A small tree cultivated in Indonesia and elsewhere.

NEPHELIUM LAPACCEUM L. Rambutan. 2n=22. Malaysian Archipelago. Cultivated for its delicious fruits. Many varieties have been developed.

NEPHELIUM MUTABILE Blume. Pulasan. 2n= . Malaysia. Cultivated in SE. Asia and in other countries.

POMETIA PINNATA Forst. Matoa, Taun. 2n= . Malaysia, Indonesia, Papua New Guinea and Pacific islands. A forest tree used for timber and for its fruits. Cultivated for its edible fruits. On W. Irian alongside the banks of the Sentani Lake.
This crop will probably be replaced by higher -yielding exotic fruit trees (Rappard, 1961).

SAPINDUS RARAK DC. 2n= . Cochin China and Malaysia. Planted in Java, India and elsewhere for its fruits.

Sapotaceae

MANILKARA ELENGI (L.) Chev. 2n= . Origin uncertain (Uphof, 1968). Cultivated in the Malaysian Archipelago.

PALAQUIUM GUTTA (Hook.) Burck. Gutta percha. 2n=24. Malaysia. It is tapped for its latex. In general, the tree is first felled.

PAYENA LEERII (Teijsm. & Binn.) Kurz. 2n= Burma and W. Malaysia. Cultivated on Java as a source of gutta percha.

Saururaceae

HOUTTUYNIA CORDATA Thunb. 2n=56, 96, c.96, 100-104. Indochina and China. Cultivated in Vietnam for salad and as medicinal crop.

Solanaceae

LYCINUM CHINESE Mill. Chinese wolfberry. 2n=24. E. Asia. Cultivated in Java as vegetable.

SOLANUM UPORO Dunal. 2n= . Polynesia. Cultivated in Fiji for its fruits.

Stilagninaceae

ANTIDESMA BUNIUS (L.) Spreng. Bignay, China laurel. 2n=117. India to Australia. Cultivated in Malaysia and elsewhere for its fruits (Purseglove, 1968).

Styraceae

STYRAX BENZOIN Dryander. 2n= . Malaysian Archipelago. Planted in Sumatra.

Taccaceae

TACCA PINNATIFIDA Forst. (syn. T. involucrata Schum. & Thonn., T. leontopetaloides (L.) Kuntze). Tacca pin, Tahiti arrowroot. 2n=30. SE. Asia (Massal & Barrau, 1956). Possibly domesticated by Polynesians for its starchy roots and introduced into Malaysia and Madagascar. Also found from Ethiopia to W. Africa.

Umbelliferae

CARUM ROXBURGHIANUM Benth. (syn. Trachyspermum roxburghianum (DC) Wolff). Ajmud. 2n(wild)=(20, 40) 42, (44); (cultivated)=20. Trop. Asia. Cultivated in Indochina, Sri Lanka and India.

LIGUSTICUM MONNIERI Calest. (syn. Selinum monnieri L.). 2n= . E. Europe, Siberia, China and Vietnam. Occasionally cultivated in N. Vietnam.

OENANTHE JAVANICA DC. (syn. O. stolonifera Wall.). Oriental celery, Water dropwort, Batjarongi. 2n=20. From Indochina to Malaya, Philippines, China, Korea, Japan and Australia. Cultivated in Indochina, Japan, China (Kihara, 1969) and Java. A leafy vegetable that often occurs as a weed.

Urticaceae

LAPORTEA DECUMANA Wedd. 2n= . Moluccas. Cultivated as a medicinal plant.

Zingiberaceae

ALPINIA CONCHIGERA Griff. (syn. Languas conchigera Burk.). 2n= . Malaya. It is a common village plant there.

ALPINIA GALANGA (L.) Willd. Langwas, Greater galangal. 2n=48. Trop. Asia. Cultivated for its rhizomes. It is a common village plant. Several varieties have been observed.

ALPINIA MALACCENSIS (Burm.f.) Rosc. 2n=48. Malaysian Archipelago and E. India. This perennial herb is cultivated.

AMOMUM CARDAMOMUM Willd. Cardamon. 2n= . Malaysia. Cultivated there.

AMOMUM KEPULAGA Sprague & Burk. Round cardamon. 2n= . Cultivated in Malaysia and Java.

AMOMUM KRERVANH Pierre. Krervanh. 2n= . Cambodia. Cultivated in Indochina.

AMOMUM MAXIMUM Roxb. Java cardamon. 2n= . Malaysia. Cultivated in Java.

BOESENBERGIA PANDURATA (syn. Gastrochilus pandurata Ridl.). 2n= . Malaya and Java. Cultivated over wide area for its rhizome.

CURCUMA HEYNEANA Valeton. 2n= . Java. The rhizomes are a source of an arrowroot.

CURCUMA PIERREANA Gagn. 2n= . Malaya. Cultivated in Annam (Vietnam).

CURCUMA XANTHORRHIZA Roxb. 2n= . Amboina. Occasionally cultivated in Java and Malaya.

KAEMPFERIA GALANGA L. 2n=22, 54. Trop. Asia. Widely cultivated for its rhizomes.

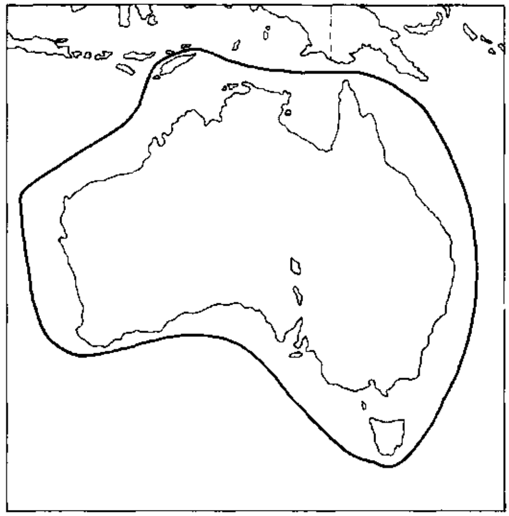
KAEMPFERIA ROTUNDA L. 2n=33, 54. Trop. Asia. Cultivated for its rhizomes.

PHAEOMERIA MAGNIFICA Schum. (syn. Alpinia magnifica Rosc., A. speciosa D. Dietr., Amomum magnificum Nenth.). 2n= . Malaya. Cultivated there.

ZINGIBER CASSUMUNAR Roxb. Cassumunar ginger. 2n=22. Cultivated in Cochin China and Malaya. In Malaya as a village medicinal crop.

ZINGIBER ZERUMBET (L.) Smith. Zerumbet ginger. 2n=22. Trop. Asia. Cultivated in Cochin China, Cambodia and elsewhere.

3 Australian Region



The Australian Region was not described by Vavilov, but it was marked out by Zhukovskij (1970) because of the domestication of several plant species to important crops or the use of wild species as breeding parents. The main crops derived from this Region are Eucalyptus species. Wild species useful for tobacco breeding are Nicotiana debneyi and N. goodspeedii. It is a secondary centre of diversity for Trifolium subterraneum.

Agavaceae

PHORMIUM TENAX J.R. et G. Forst. New Zealand flax, New Zealand hemp, Harakaka lily, Formio. 2n=32. New Zealand. Cultivated there. Introduced into S. America and other countries. The only other species of this genus Ph. colensoi Hook., mountain flax (2n=32) produces a weak fibre. It might be used as a breeding parent.

Casuarinaceae

CASUARINA EQUISETIFOLIA Forst. Swamp oak, Bull oak, Polynesian iron wood, Horsetail tree. 2n=18. It is often cultivated as soil stabilizer.

Chenopodiaceae

ATRIPLEX SEMIBACCATA R.Br. Australian saltbush, Berry saltbush. 2n=18. Australia. Cultivated as fodder crop on the saline soils of California and Arizona, USA.

Gramineae

HOLCUS LANATUS L. Yorkshire fog, Soft meadow grass, Woolly softgrass, Velvet grass. 2n=14. See p. 153. A secondary centre of diversity has developed in New Zealand (Jacques, 1974).

ORYZA AUSTRALIENSIS Domin. 2n=24, genome formula EE. Australia. All research into the affinity of the species to other Oryza species uses plants derived from one collection (Chang, 1970).

Leguminosae

ACACIA CYANOPHYLLA Lindl. 2n=26. Australia. Cultivated as an ornamental and in Europe to stabilize coastal dunes.

ACACIA DEALBATA Link. Silver wattle. 2n=26. SE. Australia and Tasmania. Cultivated as an ornamental, for its timber and as soil stabilizer. It is the familiar florist's mimosa.

ACACIA LONGIFOLIA (Andrews) Willd. (syn. A. cibaria F.V. Muell.). 2n=26. New South Wales, Australia. Cultivated as ornamental and as stabilizer of coastal dunes in Europe.

ACACIA MEARNSII De Wild. Black wattle. 2n=26. Cultivated in several countries mainly for its tannin and as ornamental. Sometimes the names A. decurrens (Wendl.) Willd. or A. mollissima Willd. are wrongly used for black wattle.

ACACIA PYCNANTHA Benth. Golden wattle. 2n= . South Australia and Victoria, Australia. Cultivated for tannin and as ornamental.

GLYCINE CANESCENS F.J. Herm. 2n=40. A close relative of G. max*, being a possible source of resistance to powdery mildew, Microsphaera diffusa Cka. & Pk.

LUPINUS COSENTINI Guss. (syn. L. varius L. ssp. varius Franco & P. Silva). Western Australia blue lupin, Sandplain lupin. 2n=32. Along the coast of Morocco and scattered in W. Mediterranean region. Introduced into W. Australia about 1850 as a source of flour. Cultivated for summer sheep feed and soil improvement. It is now widely naturalized (Gladstones, 1970).

PHASEOLUS LATHYROIDES L. Phasemy bean. 2n=22. Queensland, Australia. Used in E. Africa in pastures (Whyte et al., 1953). This species and Vigna radiata* possess a high homology of chromosomes, which points to a close relation (Biswas & Dana, 1975).

TRIFOLIUM SUBTERRANEAUM L. Subterranean clover, Sub clover. 2n=16. Primary centre in the Mediterranean Region (p. 115). Secondary centre: Australia.

Malvaceae

GOSSYPIUM AUSTRALE F.V. Muell. 2n=26, genome formula C_3C_3. N. Australia.

GOSSYPIUM BICKII Prokh. 2n= , genome formula G_1G_1. Queensland, Georgina River.

GOSSYPIUM ROBINSONII F.V. Muell. 2n=26, genome formula C_2C_2. W. Australia.

GOSSYPIUM STURTIANUM J.H. Willis. 2n=2x=26, genome formula CC. C. Australia.

GOSSYPIUM STURTII F.V. Muell. 2n=26, genome formula C_1C_1. C. and S. Australia.

Musaceae

MUSA (Australimusa). Fe'i banana. 2n=20. The fe'i banana originated from one or more wild Australimusa species in New Guinea-Solomon Islands area. Probably carried by man in an easternly direction. Cultivated especially in Tahiti, where many bunches are harvested from semi-wild plants. Some clones have been described as M. fehi Bert. ex Vieill., M. aiori Sagot, M. seemanii F.V. Muell. and M. troglodytarum L. (Simmonds, 1964).

Myrtaceae

EUCALYPTUS ALBA Reinw. ex Blume. 2n=22. Timor and Flores and to the south of New Guinea. Cultivated in Brazil. The wood is reddish-brown. The cork contains much tanning material.

EUCALYPTUS AMYGDALINA Labill. (syn. E. salicifolia Cav.). Willowleaf eucalyptus, Peppermint tree. 2n=22. Tasmania. Cultivated in

Gossypium sturtii

Chile, Zaïre and W. Georgia (USSR). Closely related to E. regnans*.

EUCALYPTUS ASTRINGENS Maiden. Brown mallet. 2n=22. SW. Australia. Cultivated in Morocco, S. Africa and Cyprus. The bark used for the tanning industry. It is very drought-resistant.

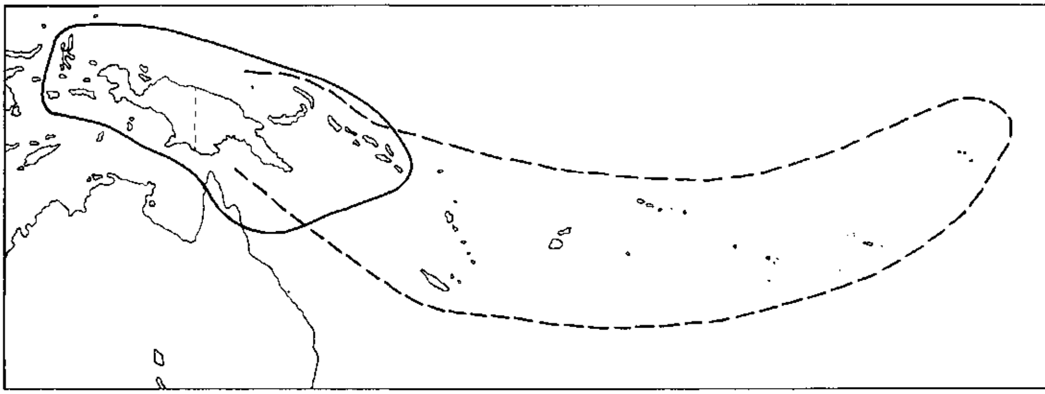
EUCALYPTUS BOTRYOIDES Smith. Blue gum, Bangalay eucalyptus, Bastard mahogany. 2n=22. Coastal areas of SW. Australia. Cultivated in Algeria and Zaïre. E. trabutii Vilm. (2n=22), is a hybrid of E. botryoides ♀ and E. camaldulensis* ♂ arisen in Italy.

EUCALYPTUS BROCKWAYI Gardn. 2n=22. S. Australia. Its area of distribution is limited. Cultivated in N. Africa. Extremely drought-resistant.

EUCALYPTUS CAMALDULENSIS Dehn. Longbeak eucalyptus, Australian kino, Red gum. 2n=22. Australia, excluding Tasmania. It is cultivated almost in all countries that grow Eucalyptus. Secondary centres: the Mediterranean region (p. 117), Brazil (p. 127) and Argentina (p. 127). In cultivation, many spontaneous hybrids have arisen. E. trabutii Vilm. (2n=22) is a hybrid of E. botryoides ♀ and E. camaldalensis ♂. A new form developed in Israel (p. 117).

EUCALYPTUS CINERA F.V. Muell. 2n=22. S. areas of New South Wales, Australia. Used as ornamental. It is a valuable source for breeding cold-resistant forms of Eucalyptus.

EUCALYPTUS CITRIODORA Hook. Spotted gum, Lemon-scented gum. 2n=(20), 22, (28). N. coast



Wild Australimusa (—) and Fe'i bananas (---)(Simmonds, 1962).

of Queensland, Australia. Cultivated in many (sub)tropical countries for essential oil rich in citronellal.

EUCALYPTUS CLADOCALYX F.V. Muell. (syn. E. corynocalyx F.V. Muell.). Sugar gum. 2n=22. S. Australia. Cultivated in Australia, Mediterranean area and in some African countries. The wood is of excellent technical value.

EUCALYPTUS COCCIFERA Hook.f. 2n= . Tasmania. Because of its hardiness, it is used for breeding types for W. Georgia (USSR).

EUCALYPTUS CREBRA F.V. Muell. 2n= . Queensland, reaching New South Wales, Australia. Cultivated in several countries of Africa, India and Argentina. Some spontaneous hybrids are known.

EUCALYPTUS CYPELLOCARPA L. Johnst. (E. goniocalyx pl. anct.). 2n=22. SW. Australia attaining 900-1200 m altitude. Cultivated in Mediterranean area, S. America and on Hawaii.

EUCALYPTUS DALRYMPLEANA Maiden. Mountain gum. 2n=22. SE. Australia, attaining 1350 m altitude and in C. Tasmania attaining 900 m altitude. Cultivated on the coasts of the Black Sea in the Caucasus. It is a promising economic species on Hawaii and in China. It is considered to be of hybrid origin. Natural and artificial hybrids are known. It can be used in breeding better types.

EUCALYPTUS DELEGATENSIS R.T. Baker. (syn. E. gigantea Hook.f.). Alpine ash, Woollybutt, Red mountain ash, White top stringbark. 2n= . The mountains of SE. Australia up to 1350 m and in Tasmania up to 900 m. Cultivated in New Zealand, Hawaii and W. Georgia (USSR). Used for cultivation and as breeding parent in USSR.

EUCALYPTUS DIVERSICOLOR F.V. Muell. Karri. 2n=22. Coasts of SE. Australia. Cultivated in countries of Mediterranean area, in Africa and New Zealand. It is one of the most valuable economic species.

EUCALYPTUS EUGENIOIDES Sieb. (syn. E. scabra Dum-Cours.). White stringybark, Pink blackbutt. 2n= . Coasts areas of SE. Australia. Cultivated in S. Africa, Kenya, India and Hawaii. The wood is used in industry. Some natural hybrids are known.

EUCALYPTUS GLAUCESCENS Maiden & Blakely. 2n= . Mountains of SE. Australia. Its distribution is very limited. Used for crossing with species of poor hardiness.

EUCALYPTUS GLOBULUS Labill. Fever tree, Blue gum. 2n=20, 22, 28. SE. Tasmania. Cultivated. Secondary centre: the Mediterranean region. Used for wood and oil. Spontaneous hybrids are known under cultivation in Tasmania.

EUCALYPTUS GOMPHOCEPHALA A.DC. 2n=22. SW. coasts of West Australia. Cultivated in countries of the Mediterranean region. Africa esp. Cameroon, Hawaii and New Zealand. It has the heaviest and strongest wood among all Eucalyptus species. In Algeria, some spontaneous hybrids are known.

EUCALYPTUS GRANDIS Hill. ex Maiden. 2n= . Coast areas of the N. part of New South Wales and SE. Queensland up to 650 m. Cultivated in Cameroon, Nigeria and Madagascar. It is thought that E. 'saligna' or E. 'saligna/grandis' are African strains developed after introduction of Queensland material (Larsen & Cromer, 1970).

EUCALYPTUS GUNNII Hook.f. 2n=22. Cultivated in USSR, Great Britain, Japan and Hawaii. Used for industry and breeding on the Caucasus coasts of the Black Sea.

EUCALYPTUS LEUCOXYLON F.V. Muell. (syn. E. conoidea Benth.). White ironbark, White gum.

2n=22. C. areas of Victoria and South Australia. In the latter area, it is rare. Cultivated in the Mediterranean area esp. Cyprus and S. America esp. Argentina. Used for its wood and oil. Some geographic races and spontaneous hybrids have been described.

EUCALYPTUS MACARTHURI Dean & Maiden. 2n=22. C. New South Wales, Australia. Cultivated in Africa esp. Zaïre, Hawaii, New Zealand, S. France and W. Georgia, USSR. It produces an essential oil. Some spontaneous hybrids are known. In the USSR many (poly)hybrids have been produced.

EUCALYPTUS MACULATA Hook.f. (syn. E. variegata F.V. Muell.). Spotted gum. 2n=22. Coastal areas of SE. Queensland, New South Wales and E. Victoria. Cultivated in Africa esp. Cameroon, Zaïre, Kenya and Madagascar; the Mediterranean region esp. Spain, France; Chile and Uruguay. The wood is very valuable.

EUCALYPTUS MAIDENII F.V. Muell. Maiden's gum, Spotted blue gum. 2n=22. Mountains of SE. Australia. Cultivated in Africa esp. Cameroon, Congo and Kenya; the Mediterranean area esp. Italy and Spain; Brazil and New Zealand. Its wood is valuable, containing essential oil. Some spontaneous and artificial hybrids have been reported.

EUCALYPTUS MELLIODORA A. Cunn. Yellow box. 2n=22. Australia. Cultivated in the Mediterranean area, in Africa esp. Zaïre and Eritrea. Used for its wood and as an ornamental tree. It is extremely melliferous. There are geographic races and spontaneous hybrids known.

EUCALYPTUS MICROCORYS F.V. Muell. Fallow wood. 2n= . Coastal areas of the N. part of New South Wales and SE. Queensland. Cultivated in Mediterranean area and Africa esp. Zaïre and Eritrea. Used for wood. Some spontaneous hybrids are known.

EUCALYPTUS NIPHOPHILA Maiden & Blakely. 2n= . Alpine zone of SE. Australia, up to 2000 m. It tolerates -24°C and hence is of great importance for hybridization with valuable economic species.

EUCALYPTUS PANICULATA Sm. (syn. E. fergusoni R.T. Baker). Grey ironbark. 2n=22. The coasts of New South Wales. Cultivated in Africa esp. Kenya and Tripoli; Mediterranean area, esp. Spain and Tripolitania; S. America, esp. Paraguay and Uruguay, and India. The wood is especially strong, heavy and durable.

EUCALYPTUS PAUCIFLORA Sieb. ex Spreng. 2n= Sub-alpine zone of E. Victoria and the mountains of New South Wales and Tasmania, up to 1650 m. Cultivated in England, France, Japan and W. Georgia (USSR). On the fringe of its area, it is very hardy. It is valuable in breeding hardy strains. Some geographic races and spontaneous hybrids are known.

EUCALYPTUS PERRENIANA F.V. Muell. ex Rodway. 2n= . Tasmania. Cultivated in the USSR. It is hardy (it tolerates -13°C).

EUCALYPTUS REGNANS F.V. Muell. Mountain ash, Swamp gum, Australian oak. 2n= . Mountains of S. Victoria up to 900 m and in Tasmania up to 600 m. Cultivated in Kenya, New Zealand and other countries. This is the biggest and most valuable species in this genus. Some trees are recorded up to 96 m high. It is closely related to E. amygdalina*.

EUCALYPTUS RESINIFERA Smith (syn. E. spectabilis F.V. Muell., E. hemilampra F.V. Muell.). Kino eucalyptus, Red mahogany, Forests mahogany. 2n=22. Coastal zone of S. Queensland and C. part of New South Wales. Cultivated in Argentina, Sri Lanka, Ethiopia, Cameroon and other countries. The wood is very valuable.

EUCALYPTUS ROBUSTA Smith. Beakpod eucalyptus, White mahogany, Swamp mahogany. 2n= . Coasts of S. Queensland as far as S. of New South Wales, Australia. Cultivated in Mediterranean area, Africa esp. Cameroon, Zaïre and Kenya; Argentina, India and other countries. Often cultivated on swampy grounds. The wood is economically valuable.

EUCALYPTUS SALIGNA Sm. Sydney blue gum, Saligna gum. 2n=22. Coasts and slopes of mountains in New South Wales and SE. Queensland. Cultivated in Africa, esp. Cameroon, Kenya and Zimbabwe; S. America esp. Argentina and Brazil. After E. globulus*, the most widely distributed species in cultivation. The wood is extremely valuable. This is the most rapidly growing species in the genus.

EUCALYPTUS SIDEROXYLON A. Cunn. ex Benth. Red ironbark. 2n=22. The W. slopes of New South Wales upland and in the N. part of Central Victoria, Australia. Cultivated in Africa esp. Cameroon, Kenya, Zaïre and Rhodesia; the Mediterranean area, esp. Spain, Portugal, Algeria, Morocco, Cyprus and Israel; Japan, USA and New Zealand. Its wood is economically very valuable. It contains essential oil. Some spontaneous hybrids are known.

EUCALYPTUS TERETICORNIS Smith. (syn. E. subalatum Cunningh.) Red gum, Flooded gum, Grey gum, Blue gum. 2n=22. Almost the whole coast of E. Australia. Cultivated almost in all the countries of the world where Eucalyptus is grown. The wood is very valuable. In USSR, interspecific hybrids are produced. The strains 'C' of Zanzibar and 'Mysore Hybrid' of India belong to this species (Larsen & Croner, 1970).

EUCALYPTUS VIMINALIS Labill. (syn. E. mannifera Cunning, E. persicifolia Lodd.). Ribbon eucalyptus, White gum, Swamp gum. 2n=22. SE. Australia and E. Tasmania. Cultivated in Mediterranean area, in countries of C. and S. Africa, India, New Zealand and USA. In subtropical areas of USSR, it is the commonest Eucalyptus species. The wood is of moderate value. An essential oil is obtained. Many spontaneous and artificial hybrids are known.

LEPTOSPERMUM LAEVIGATUM F.V. Muell. Australian tea-tree. 2n=22. Australia. Cultivated there for the reclamation of moving sand. Dried leaves are used for tea-making.

MELALEUCA PREISSIANA Schan. 2n=   . Australia. Var. leiostachya Schan. (syn. M. parviflora Lindl.) is a soil stabilizer.

Proteaceae

HAKEA SALICIFOLIA (Vent.) B.L. Burtt. 2n= SE. Australia and Tasmania. Cultivated for reclamation of arid land in Spain and Portugal. It has run wild in those countries.

HAKEA SERICEA Schrader. 2n=20. E. Australia. Cultivated for reclamation of arid land in Portugal and Spain. It has run wild in those countries.

MACADAMIA INTEGRIFOLIA L.S. Smith. (syn. M. ternifolia F.V. Muell., M. ternifolia var. integrifolia and M. tetraphylla L.A.S. Johnson). Queensland nut, Macadamia nut, Australian bush nut, Australian hazelnut. 2n=28, 56. E. Queensland, Australia. Cultivated in Hawaii. M. integrifolia is known as the smooth-shell type and M. tetraphylla as the rough-shell type. M. ternifolia is now considered to apply correctly only to a species with bitter cyanogenic seeds less than 25 mm in diameter, inedible and never cultivated (Kraus & Hamilton, 1970).

Rutaceae

EREMOCITRUS GLAUCA (Lindl.) Swing. 2n=18. This tree is capable of withstanding 6 months drought. It easily crosses with Citrus species giving fertile hybrids.

Solanaceae

DUBOISIA HOPWOODII F.V. Muell. Pituri, Pitchery. 2n=   . Australia. Cultivated for some decades to yield atropine.

DUBOISIA LEICHHARDTII R.Br. 2n=60. Australia. Cultivated for some decades for atropine.

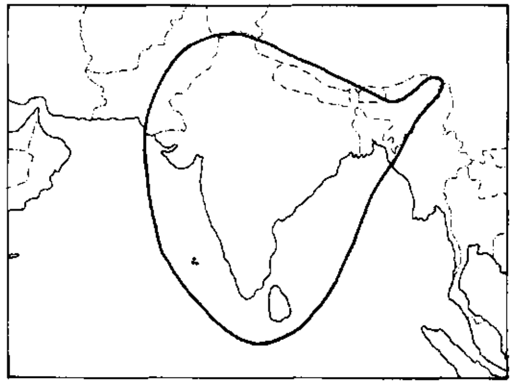
DUBOISIA MYOPOROIDES R.Br. Corkwood, Mgmeo. 2n=60. Australia. Cultivated for atropine.

NICOTIANA DEBNEYI Domin. 2n=48. Australia. Used as a source of resistance to blue mold caused by Perenospora tabacina Adam.

NICOTIANA GOODSPEEDII Wheeler. 2n=40. New South Wales to SE. of West Australia. It has a short growing period. It is very resistant to Peronospora tabacina Adam. Some natural introgression with the closely related N. exigua Wheeler, 2n=32, N. nuaveolens Lehm., 2n=(24), 32, (48, 64), and N. rotundifolia Lindl., 2n=44.

SOLANUM LACIANIATUM Aiton. Cut-leaved nightshade. 2n=92. Australia and New Zealand. Cultivated in Europe and elsewhere for its foliage, which is a source of steroid precursors.

4 Hindustani Region



The Hindustani Region of diversity was included by Vavilov in his Tropical South Asian Centre of Origin. Zhukovskij (1968) distinguished this centre only by number (IV), but in 1970 he indicated a distinction between this and the rest of S. Asia. He based his distinction on the existence of species specific for this Region 4.

Although this region is near known old farming sites in Thailand, agriculture must have been introduced from the NW. adjacent area. Early farming sites have so far revealed few details of native cultivation. At Mūan-jo Daro (Mohenjodaro) and Harappa on the River Indus in Pakistan, almost on the boundary between Regions 4 and 5, a site of the Harappan culture was discovered dating from 2500 - 2000 BC. Some remains of Gossypium arboreum were discovered. At a site, Navdatoli-Mahesvar on the Narbada River, in C. India, dating from 2000 BC., remains of wheat, peas, broad beans, lentils, Lathyrus sativus and rice were found. Except for rice, these crops were domesticated outside India.

Important crops of the region include bamboos, fruit trees, Cucurbita sativa, Mangifera indica, Musa sp., Oryza sativa, Phaseolus mungo, Piper sp., Saccharum sinense and Vigna sinensis.

Species of this region have influenced the development of crops elsewhere, mainly by active distribution between this region and areas such as Ancient Egypt, Assyria, Sumeria and the Hittite Empire. Exchange also took place with Africa. Crops were distributed especially to the Mediterranean area by the Arabs in the 8th-10th Centuries AD. Such crops include citrus trees, cotton species, jute, rice and sugar-cane.

Acanthaceae

BARLERIA PRIONITIS L. 2n=30, 40. Trop. Africa and Asia. Cultivated in India as a medicinal crop.

Agavaceae

SANSEVERINIA HYACINTHOIDES (L.) Druce (syn. S. zeylanica Willd.). Ceylon bowstring hemp. 2n= . Sri Lanka. A fibre plant cultivated there.

Alliaceae

ALLIUM AMPELOPRASUM L. Levant garlic, Perennial sweet leek. 2n=16, (24), 32, genome formula AAA'A'', (40, 48). S. Europe, Asia Minor, Caucasus to Iran and N. Africa. Some cultivation in Germany and France (p. 148), Iran (Taree irani, 2n=32; Tahbaz, 1976) and in Kashmir (Koul & Gojil, 1970). The wild and cultivated types are both extremely variable. This species is related to A. sativum*, A. porrum*, A. kurrat* and A. scorodoprasum*.

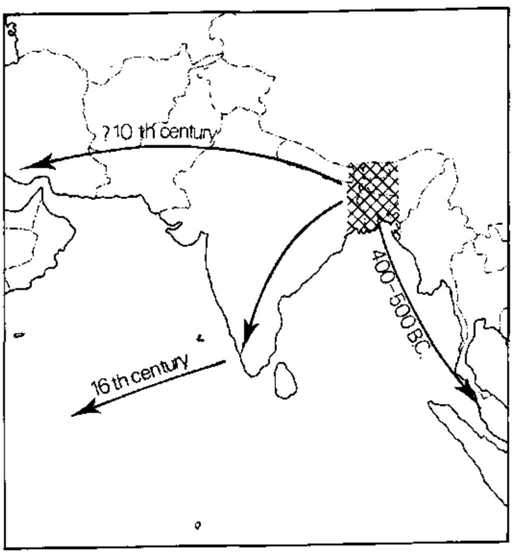
Amaranthaceae

AMARANTHUS ANGUSTIFOLIUS Lam. 2n=32, (34). S. and C. Europe, SW. Asia up to India and Turkestan and to Africa. In India var. polygonoides Thell. is cultivated.

CELOSIA ARGENTEA L. Quail grass. 2n=(36), 72. India. Var. cristata Kuntze (syn. C. cristata L.). Cockscomb grass. 2n=36. It is a pot-herb, fodder and fibre crop and an ornamental.

Anacardiaceae

MANGIFERA INDICA L. Mango. 2n=40. Assam and the Chittagong Hills. Spread to many tropical countries. Rhodes et al. (1970) classified cultivars into:
1. polyembryonic group with oblong fruits, common in SE. Asia,
2. monoembryonic group with roundish fruits common in India and
3. a group intermediate in fruit shape, also common in India.
4. the Sandersha-Haden complex, consisting of hybrids developed in Florida and Hawaii. M. odorata* and M. zeylanica Hook.f. are not closely related. Natural cross-fertilization ranges from 5 to 62%. A secondary centre of diversity has developed in Florida (p. 199).



Centre of domestication and routes of migration of Mangifera indica (Singh, 1976).

Apocynaceae

NERIUM INDICUM Mill. (syn. N. odorum Soland.). 2n=22. Trop. Asia, especially India. Cultivated as a medicinal plant.

RAUVOLFIA SERPENTINA Benth. 2n=(20), 22, (24, 44). India, Sri Lanka, Burma and from Thailand to Java. Because of the high demand for this medicinal crop, it became (nearly) extinct in some areas. To provide sufficient roots, some hospitals in India set up small gardens of it. Its cultivation could be extended to India and elsewhere (Dutta et al., 1963).

Araceae

ALOCASIA CUCULLATA (Lour.) Schott. Giant taro. 2n=28. India and Sri Lanka. Cultivated for its corms.

ALOCASIA MACRORRHIZA (L.) Schott. Giant alocasia. 2n=26, (28). Probably Sri Lanka. Spread in the Malaysian Archipelago and to India and further to Trop. America. Several varieties are cyanogenic. A. indica is often included in this species.

AMORPHOPHALLUS CAMPANULATUS Blume. Whitespot giant arum, Oroy. 2n=(14), 28. Trop. Asia (p. 49). Cultivated in India and elsewhere as a tuber crop.

COLOCASIA ESCULENTA (L.) Schott. Taro, Dasheen. 2n=2x=28, 3x=42. The centre of domestication is not certain. Some authors suggest Malaysia, others like Kuruvilla & Singh (1981) NE. India, Assam or Upper Burma. These authors found 2x cultivars in the plains of India and 2x and 3x cultivars in the hills of NE. India.

Asclepiadaceae

MARSDENIA TINCTORIA R.Br. 2n= . Himalaya to China, Malaysia. Cultivated in India as a dye plant.

Cannabidaceae

CANNABIS SATIVA L. Hemp. 2n=20. Centre of origin C. Asia (p. 149). Spread to India in early times. The Indian type is cultivated for its narcotic properties. Thence it must have spread to the Middle East and elsewhere. 'C. ruderalis Janesch' is a weedy non-toxicant type.

Chenopodiaceae

BETA VULGARIS L. Indian spinach. 2n=18, genome formula VV. For origin see p. 104. Indian spinach is cultivated mainly for its leaves and occasionally for its roots. There is a red-leafed and a green-leafed type. As it differs in chromosome pattern and for its phenolic compounds from table beetroot, Basu & Mukherjee (1975) described it as B. palonga. However, more research is needed. It very likely derives from early introductions from the Near East via Afghanistan, whereas the table beetroot was introduced later from Europe (Basu & Mukherjee, 1975).

KOCHIA INDICA Wight. 2n=18. Introduced into Egypt where it is cultivated as a forage crop.

Compositae

INULA RACEMOSA Hook.f. 2n=20. Cultivated on a small scale in the Labaul Valley in NW. Himalaya for its aromatic roots. Cultivation is reported from N. Africa, Asia Minor, Ethiopia, Iran, E. India and some European countries.

SAUSSUREA LAPPA Clarke. 2n=26. Grown in the

Valley of Kashmir and adjacent area for its aromatic roots.

VERNONIA AMYGDALINA Delile. Bitterleaf. 2n= . Trop. Africa. Occasionally cultivated.

Convolvulaceae

IPOMOEA ERIOCARPA R.Br. 2n= . India. Used as a spinach and as a green fodder.

Cruciferae

BRASSICA CAMPESTRIS L. 2n=20. genome formula AA. See p. 150 for the origin of this species. In Pakistan/India the var. toria Duthrie & Fuller, Indian rape, Toria, and var. sarson Prain, Indian colza, Brown sarson are cultivated. Brown sarson can be divided into (1) self-compatible and (2) self-incompatible types. These two types can be differentiated by disruptive selection for flowering time, genetic drift in isolated populations, and chromosomal inversions suppressing recombination in connection with a recessive mutation of a major gene, independent of the S locus but inactivating that locus (Swamy Rao, 1971). A considerable diversity is observed in Bihar and E. Utter Pradesh (Anand et al., 1975).

ERUCA VESICARIA (L.). Cav. (syn. E. sativa L.). 2n=22. Mediterranean Region (p. 107) and Asia. Cultivated in India for jamba oil.

RAPHANUS SATIVUS L. Serpent radish, Snakelike radish, Rat-tailed radish, Tree radish from Java. 2n=18. Cultivated from Java to NW. India. The plant requires a short daylength to develop roots. Var. mougri Helm (syn. R. caudatus L., R. sativus var. indicus Sinsk. is characterized by small long fleshy fruits and glabrous leaves. Var. oleiformis Pers.* is also grown in India.

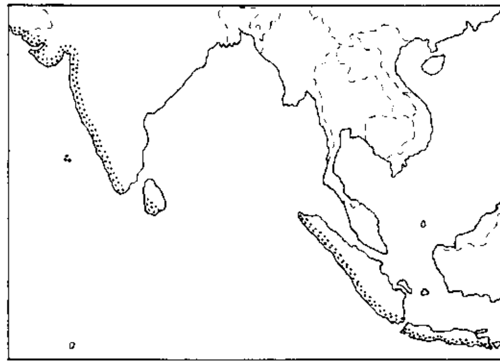
Cucurbitaceae

CITRULLUS COLOCYNTHIS*

CITRULLUS LANATUS (Thunb.) Mansf. Water melon. 2n=22. Var. fistulosis (Stocks) Duthie & Fuller (syn. C. fistulosis Stocks), Round melon (2n=24) is cultivated in India for its round fruits. It differs in chromosomal number and leaf phenolics from C. lanatus and should probably be raised to a species (Kaur et al., 1973).

COCCINIA CORDIFOLIA Cogn. (syn. C. indica W. & A.). Ivy gourd, Small gourd. 2n=24, (36). Trop. Asia, and Red Sea area to Sudan. In S. India, forms occur with long less bitter fruits.

CUCUMUS SATIVUS L. Cucumber, Gherkin. 2n=14. Primary gene centre probably the Himalayas. Introduced into Europe. Near East, China and elsewhere. Secondary gene centres in China and Near East (p. 36 and 89). In India, cucum-



Raphanus sativus var. mougri (Sinskaya, 1931).

bers have been cultivated for at least 3 000 years (Leppik, 1965). Three varieties have been described: (1) var. hardwickii (Royle) Alef. (syn. C. hardwickii Royle) (a weedy type); (2) var. sikkimansis Hook. (the 'Indian type'); (3) var. squamosus Gab. Sources of resistance to powdery mildew Sphaerotheca fuliginea (Schlecht. ex Fr.) Poll are found in cucumber material from China, Japan, Indonesia and India.

CUCURBITA MAXIMA Duch. ex Lam. Pumpkin. Winter squash. 2n=40. Its origin is described on p. 169. Secondary centre in India and adjacent areas.

LUFFA ACUTANGULA (L.) Roxb. Sponge gourd, Angled loofah, Sinkwa towel gourd. 2n=26. Probably India. Primary gene centre probably there. It was found in Karakoram/Hindu Kush in 1955 (Tozu, 1965). Cultivated in China and Japan.

Dutt & Roy (1971) suggested the following evolution of the various related Luffa species. They considered the wild monoecious L. graveolens Roxb. (2n=26) as the primary species. From it, two species derived: the wild dioecious L. echinata Roxb. (2n=26) and the cultivated monoecious L. aegyptica*. They considered dioecism as a derived factor that arose after divergence from the monoecious L. graveolens.

From L. aegyptica, the monoecious type of L. acutangula and later the hermaphrodite type of that species arose, which is also called L. hermaphrodita*.

LUFFA AEGYPTIACA Tull. (syn. L. cylindrica (L.) Roem.). Smooth loofah, Suakwa, Sponge gourd, Vegetable gourd. 2n=26. Domesticated probably in tropical Asia, possibly in India. Cultivated in almost all tropical regions where it may have run wild. Used for producing vegetables or sponges. It is also used for a medicine and for insulation.

This species includes L. racemosa Roxb. (2n =) with L. hermaphrodita* the only two 'species' with bisexual flowers.

LUFFA HERMAPHRODITA Singh & Bhandari. Satputia. 2n= . Cultivated in Bihar and Bengal, India. It crosses easily with L. acutangula*, the F_1 being monoecious. It is similar to L. acutangula* and to L. cylindrica (see L. aegyptiaca*), but has bisexual flowers, oblong-ellipsoidal fruits and smooth shiny black seeds. It may be a hybrid of one of those two species. Types described as L. racemosa Roxb. and included in L. cylindrica are also bisexual (Singh & Bhandari, 1963).

Dutt & Roy (1971) included L. hermaphrodita in L. acutangula*. They condidered it as the hermaphrodite type of that latter species.

TRICHOSANTHES CUCUMERINA L. (syn. T. anquina L.). Snake gourd. 2n=22. India to Australia. Cultivated for a long time in India.

Dioscoreaceae

DIOSCOREA HISPIDA*.

Euphorbiaceae

BACCAUREA SAPIDA Muell.-Arg. 2n= . Malaysia, India and China. Cultivated by Hindus for its fruits.

CROTON TIGLIUM L. Purging croton. 2n= . SE. Asia. Cultivated now in India and Sri Lanka for its seeds (Purseglove, 1968).

Flacourtiaceae

DORYALIS (DOVYALIS) HEBECARPA (Gardn.) Walb. (syn. Aberia gardneri Clos.). Ceylon gooseberry. 2n= . Trop. Asia especially India and Sri Lanka. Cultivated for its berries.

HYDNOCARPUS LAURIFOLIUS (Dennst.) Sleumer (syn. Hydnocarpus wightianus Blume). 2n=24. India. Cultivated in several trop. countries for its oil, used to cure leprosy.

Gramineae

BAMBUSA ARUNDINACEA (Retz.) Willd. Spiny bamboo. 2n=70. India. Cultivated there. In forests bordering rivers and on mountains up to 900 m. Much cultivated in Java, rarely in Indochina. Secondary gene centre in Java (p. 53). Used as building material and in the paper industry. This is one of the largest bamboo species. Its stems can be 30 m long.

BAMBUSA POLYMORPHA Munro. 2n=72. Bangladesh. Cultivated there and in Burma. Used as building material and in the paper industry.

BAMBUSA STRICTUS Nees. 2n=70, 72. In India (except Assam) and Burma. Secondary centres in Indochina (p. 53) and S. China (p. 37). In dry areas of forests. It is drought-resistant.

BAMBUSA TULDA Roxb. 2n= . India. Burma (p. 53) and Tahiti. Secondary centre Java.

CEPHALOSTACHYUM CAPITATUM Munro. 2n= . Burma and Himalaya. Its shoots are edible.

CYMBOPOGON FLEXUOSUS (Nees ex Steud.) Wats. (syn. Andropogon flexuosus Nees). Malabar grass, Cochin grass. 2n=20(+1-2B), 40(+1-2B), x=10. India. Cultivated for its essential 'East India lemon-grass oil'. Var. coimbatorensis Gupta (2n=40) is a cultigen.

CYMBOPOGON MARTINI (Roxb.) Wats. Roshagrass, Palmarosa, Ginger grass. 2n=20, 40(+1-2B), x =10. E. India. Cultivated in India and Indonesia for palmarosa oil and ginger grass oil. The cultigen var. motia (syn. C. motia Gupta, syn. var. martinii), 2n=20, produces palmarosa oil, while var. sofia Gupta, 2n=40(+1-2B) produces ginger grass oil.

CYMBOPOGON PENDULUS Wats. 2n=20, 60. India. Recently taken into cultivation (Jagadishchandra, 1975).

CYNODON DACTYLON (L.) Pers. Bermuda grass. 2n =(x=9) 18, genome formula AA; 36, genome formula AABB; 45, 54, genome formula AAAABB. Widely distributed in the Old World tropics. Malik & Tripathi (1968) and Harlan & de Wet (1969) indicate that the two diploid genomes of the tetraploid are essentially homologous. Var. aridus Harlan & de Wet (2n=18) and var. afghanicus Harlan & de Wet are excellent fodders tolerant to drought. Several selections of var. dactylon are grown as lawn grasses. Var. elegans Rendle is a major natural grass of Africa, and var. coursii (Camus) Harlan & de Wet is a major fodder in Madagascar (Harlan et al., 1970). See p. 128.

DENDROCALAMUS HAMILTONII Nees & Arn. 2n= . C. and E. Himalaya up to 900 m and Upper and Lower Burma up to 1 200 m altitude. Used as building material and in the paper industry. It grows in humid areas along rivers and in low places, and forms large thickets.

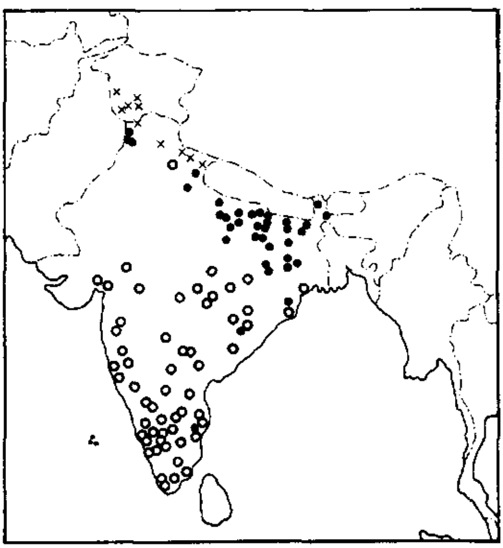
DENDROCALAMUS LONGISPATHUS Kurz. 2n=72. Bangladesh and Burma (Arakan). Used for paper making. It is found in humid mixed forests along rivers on fertile clay soils.

DIGITARIA CRUCIATA (Nees) A. Camus. 2n= . Var. cruciata grows wild in a large area of E. India and China. Probably domesticated in the 19th Century in the Khasi Hills, E. India, by selecting var. esculenta Bor with longer stems, longer spikes, larger inflorescences and much bigger grains. It grows slowly and yields little. Its advantage is the production of straw in an area where little grass grows (Bor, 1955; Singh & Arora, 1972).

DIGITARIA SANGUINALIS (L.) Scap. Manna. 2n= 18, 36, 54, 72. Cultivated in Kashmir and adjacent Afghanistan, and in SE. Europe. The species is a weed of temperate regions in all continents (Portères, 1955a). Cultivated kinds differ little from their close wild relatives in floral morphology.

ECHINOCHLOA COLONA (L.) Link. Shama millet, Jungle rice. 2n=(36, 48), 54, (72). Cultivated in India as a fodder grass and as a cereal. Formerly it was grown also in Egypt. Yabuno (1968) considered the genome formula of this species to be the same as that of E. frumentacea*.

ELEUSINE CORACANA (L.) Gaertn. Finger millet, Ragi. 2n=36. Introduced from Africa (p. 129). Kempanna (1969) recognized various types in India. Hilu & de Wet (1976) described how the African lowland race must have reached India from the south or south-west. The introduction must have taken place by sea routes c. 1000 BC. In S. India, the crop developed a secondary centre of diversity. Thence it spread to the north. In NE. India, the Indian race developed and in N. India the North Indian type. It is not clear whether the last taxon evolved from the lowland race or from the Indian race or from both.



Various types of Eleusine coracana in India, (o) lowland race, (•) Indian race,(×) Indian highland type (Hilu & de Wet, 1976).

MELOCANNA BACCIFORA (Roxb.) Kurz. 2n= . Burma from Garo to Arakan. Primary centre: Bangladesh. Its stems are used as building material.

NEOHOUZEAUA DULLOSA (Munro) A. Camus. 2n= . S. and SE. Burma. It has a very long fibre and is used widely to produce paper.

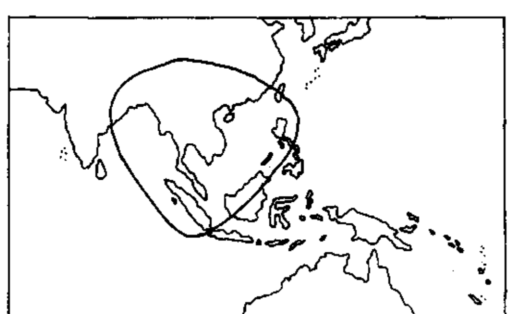
OCHLANDRA TRAVANCORICA Bedd. 2n=c. 72. Primary centre: the Travancore Mountains and Tinneville (altitude 900 - 1 650 m). It is used in the paper industry.

ORYZA MALAMPUZHAENSIS Krish. & Chand. 2n=48. India.

ORYZA RUFIPOGON Griff. Perennial wild rice. 2n=24. The more commonly accepted epithet O. perennis Moench probably does not refer to Asiatic wild race (Tateoka, 1964). Widely distributed in Asia and Australia. As recognized by Chang (1976a, b), it includes the annual O. nivara Sharma & Shastry (1965a, b). The perennials are weakly rhizomatous with extra vaginal branching and are adapted to continuously flooded habitats. Cytogenetic studies suggest that under cultivation this perennial (Nayar, 1973) gave rise to the annual cultivated O. sativa (Chang, 1964). Spontaneous annuals of Asia (O. sativa var. fatua Prain) are probably weedy derivatives of hybrids between O. sativa and O. rufipogon (Oka and Chang, 1961), whereas Oceanic annuals may represent truly wild O. nivara (Oka, 1974).

ORYZA SATIVA L. Rice. 2n=24, genome formula AA. S. Asia. The antiquity of rice cultivation is uncertain. Rice was probably collected as a wild cereal across the humid tropics of Asia. In parts of India and in Sri Lanka, perennial wild rice is still harvested as a cereal (Vishnu-Mittre, 1974). The oldest known rice remains in the archaeological record (Allchin, 1969; Solheim, 1972) are from Mohenjodaro in Pakistan (2500 BC.), India (2300 BC.) and Thailand (3500 BC.). According to esterase isozyme genotypes, the centre of diversity of rice is in Assam-N. Burma-Yunnan. In Assam, types resembling the African O. glaberrima* are found (Seetharam & Ghorai, 1976).

Three races of rice are commonly recognized. (1) The basic tropical race indica probably originated over a broad region spreading from the Ganges Plains of India to Vietnam and S. China (Chang, 1976a, c). It includes the floating rices of South Asia. (2) Race indica was introduced into the Yellow River (Huang Ho) Valley and the lower Chang (Yangtze) River



Centre of origin of rice (Chatterjee, 1951).

Basin, where the temperate race japonica evolved. Race japonica was introduced to Korea, and later Japan around the 3rd Century BC. (Morinaga, 1968). (3) Race Indica also spread SE. into the Malaysian Archipelago, where the large-grained race javanica evolved, which is widely cultivated across the islands of SE. Asia. The wet rice cultivation of Philippines, Malaysia and Indonesia is quite a recent introduction (Spencer, 1963).

PANICUM ANTIDOTALE Retz. Blue panic grass, Giant panic grass. 2n=2x=18. India, W. Saudi Arabia. Introduced into Australia as a forage grass.

PANICUM SUMATRENSE Roth ex Roem. & Schult. (syn. P. miliare Lamk.). Little millet. India and Sri Lanka. P. psilopodium Trin. (2n=54) might be its ancestor (Mansfeld, 1959). It is possible that cytotypes with 36 chromosomes occur.

PASPALUM SCROBICULATUM L. Khodo millet. 2n=20, 40. C. India. Widely cultivated in the Indian Plains as a cereal. Its closest wild relative, P. orbiculare Forst., is widely distributed and collected as a wild cereal across S. Asia.

SACCHARUM OFFICINARUM L. Sugar-cane. 2n various. Sugar-cane originated in New Guinea (p. 54) about 600-500 BC. New Guinea Noble canes must have reached S. India via Indonesia. It was transported northwards to reach N. India ca 400 BC. C. 250 BC., it was severely attacked by red rot disease, which must have promoted the introduction of Sinense sugar-cane from China (p. 38). During migration, it hybridized with S. spontaneum*, as also happened in Orissa and Bihar (Parthasarathy, 1946; 1948; Bremer, 1966). Originally the Sinense group of sugar-canes were named Pansahi sugarcane.

In N. India (Punjab to Assam), the Barberi group (S. barberi Jesw.) of sugar-canes developed. Its origin is not yet fully understood. The group can be classed into subgroups: (1) Mungo, 2n=81, 82, 83, without S. spontaneum introgression; (2) Dhaulo, 2n=82, 83; (3) Nargori, 2n=105-124 with Sinense introgression; (4) Saretha, 2n=91.

SACCHARUM SPONTANEUM L. Wild sugar-cane, Kassoer, Thatch grass, Bagberi, Djarb, Khus. 2n =40-128, with euploids 40, 48, 64, 80, 96, 104, 112, 128 and possibly 54. Probably India in the foothills of the Himalaya Mountains. Now it is distributed in innumerable groups of various ranks and significance from Africa over Asia to Japan and the Solomon Islands. One group (2n=112) is found in Indonesia (p. 55), while another one (2n=104-128) occurs in E. Africa (p. 133). Recently introduced into New Guinea and hence its influence there is still limited.

S. spontaneum is used as a source of disease resistance of S. officinarum*. In N. India, it has hybridized with S. sinense* group Saretha.

SINOCALAMUS GIGANTEUS (Walb.) Keng. 2n= . India, Indochina and S. China. Cultivated there. Used as building material. It is one of the largest bamboos.

SORGHUM BICOLOR (L.) Moench. Juar, Jowar. 2n=20. Primary gene centre: Africa (p. 133). Secondary centre: India. No hybridization has occurred with wild sorghums, because they are tetraploids (Doggett, 1970).

TRITICUM AESTIVUM (L.) Thell. ssp. sphaerococcum (Perc.) MK. (syn. T. sphaerococcum Perc.). Indian dwarf wheat. 2n=42, genome formula AABBDD. Transcaucasia and adjacent regions (p. 93). Ssp. sphaerococcum is indigenous to NW. India, Pakistan and adjacent parts of Afghanistan. It is characterized by short, non-lodging culms, erect leaves, globular grains and susceptibility to diseases.

VETIVERIA ZIZANIOIDES (L.). Nash. Vetiver. 2n=20. Sri Lanka, India up to Burma. A grass cultivated in the tropics for its essential oil.

ZEA MAYS L. 2n=20. Domesticated in C. America (p. 190). Secondary centre: S. Himalayas (Brandolini, 1970), where flint maize (indurata Sturt.) is common.

Guttiferae

GARCINIA INDICA*.

GARCINIA SILVESTRIS Boerl. Wild mangosteen. 2n= . Malaysia (p. 56) and India. Parental species of G. mangostana*.

GARCINIA TINCTORIA*.

MESUA FERREA L. Nahor, Nagas tree, Indian rose chestnut, Ironwood. 2n=32. Trop. Asia, India and Malaysia. Cultivated in India as a timber tree and for its flowers and fruits. The flowers are used in the perfume industry, the fruits are edible and the seeds contain oil for lamps.

Lauraceae

CINNAMOMUM TAMALA Nees & Eberm. 2n= . India. A tree, whose bark is used as a substitute for the spice from C. zeylanicum*.

Leguminosae

ALBIZIA STIPULATA Boiv. (syn. A. chinensis (Osb.) Merr.). 2n= . Cultivated in India and Sri Lanka for its high-quality fodder. Elsewhere it is cultivated as a shade tree, green manure and cover crop.

BAUHINIA PURPUREA L. Camel's foot. 2n=28. China to India. A tree cultivated in India for various purposes and in Trop. Africa as a fodder plant.

CAJANUS CAJAN (L.) Millsp. Pigeon pea. 2n=22, 44, 66. India, where wild plants of this species and the closely related wild Atylosia cajanifolia Haines, 2n= occur (De, 1974; van der Maesen, 1980). De (1976) suggests the forests of Upper W. Ghats as the domestication centre of pigeon pea. A secondary centre of diversity developed in Africa.

The cultivars can be grouped into two groups: (1) var. bicolor DC. primarily large long-lived late maturing with red or purple stained flowers and hairy purplish pods containing 4-5 usually purple-mottled or dark seeds; (2) var. flavus DC. mostly smaller and early maturing with all-yellow flowers and light-green pods containing 2-3 seeds.

CANAVALIA ENSIFORMIS (L.) DC. Jack bean, Horse bean. 2n=22. S. America (p. 173). Secondary centre: India.

CASSIA AURICULATA L. Tanner's cassia. 2n=14, 16, 28. Cultivated there for tanning material, obtained from the bark (Purseglove, 1968).

CASSIA FISTULA L. Indian laburnum, Purging cassia. 2n=24, 26, 28. India. Cultivated in the tropics for its pods, the pulp around the seeds being used as a purgative (Purseglove, 1968).

CASSIA SIAMEA*.

CICER ARIETINUM L. Gram, Chick-pea. 2n=14, 16, (24, 32, 33). Probably W. Asia (p. 96). Probably a secondary centre in India. Introduced into India in early times and now much cultivated there. Strains with fine dark-brown and black seed have been cultivated for a long time. 'Kabuli' types were introduced from Afghanistan about 1700 (van der Maesen, 1972).

CROTALARIA BURHIA Buch.-Ham. 2n=16. This fibre crop comes from E. India.

CROTALARIA JUNCEA L. Sunn hemp, Sann hemp. 2n =16. Probably India. Unknown wild. A bast-fibre crop. Cultivated in many tropical countries as a green manure (Purseglove, 1968).

CYAMOPSIS TETRAGONOLOBA (L.) Taub. (syn. C. psoralioides DC.). Guar, Cluster bean. 2n=14. Probably domesticated in Africa (Anderson, 1960). However Hymowitz (1973) described how seeds of C. senegalensis* arrived in Africa with Arab-Indian horse trade. Subsequently it came into domestication in India. Cultivated in India, Pakistan and elsewhere for fodder, food and as a source of gum. No wild forms in the Indo-Pakistan subcontinent.

DOLICHOS UNIFLORUS Lam. (syn. D. biflorus auct. non Linn.). Horse gram. 2n=20, 22, (24). Tropics of Old World, especially in India and Himalayas where it is also cultivated.

INDIGOFERA PILOSA Poir. 2n=16, 32. Used in Sri Lanka as a green manure.

MELILOTUS INDICUS All. Indian clover, Yellow annual sweet clover, Sour clover. 2n=16. Punjab, India to the Mediterranean area and Turkestan. Cultivated in N. India as a fodder crop and in USA as cover crop.

MUCUNA CAPITATA*.

MUCUNA PACHYLOBIA (Piper & Tracy) Rock (syn. Stizolobium pachylobium Piper & Tracy). Fleshy pod bean. 2n= . India. Cultivated as vegetable.

MUCUNA UTILIS Wall. ex Wight. Velvet bean. 2n = . India. Cultivated as vegetable, cattle food and green manure.

SESBANIA ACULEATA (Pers.) Poir. Dhanchia. 2n =(12), 24, 32. Cultivated in Bengal for its fibre and especially as green manure.

SESBANIA AEGYPTIACA*.

SESBANIA SPECIOSA Taub. ex Engl. 2n=12. India (?). Cultivated there as green manure in rice fields.

VIGNA ACONITIFOLIA (Jacq.) Maréchal (syn. Phaseolus aconitifolius Jacq., Vigna lobata (L.) Verdc., Phaseolus trilobus Wall.). Mat bean, Moth bean. 2n=22. India, Bangladesh and Burma. Cultivated in these countries and also on Sri Lanka and in China. In USA it is cultivated as a fodder crop.

VIGNA MUNGO (L.) Hepper (syn. Phaseolus mungo L.). Black gram, Urd, Urid. 2n=22, (24). India. Unknown wild. Closely related to V. radiata*. V. radiata var. sublobata (Roxb.) Verdc. (syn. Phaseolus sublobatus Roxb.) (2n=22) is most likely the wild parent. In Pantnagar, strains of this variety are intersterile (Singh & Ahuja, 1977).

VIGNA UNGUICULATA (L.) Walp. (syn. V. sinensis (L.) Savi, Dolichos sinensis L.). Cowpea, Black eye, Southern pea. 2n=22, 24. Primary centre of diversity: W. Africa. Secondary centre: India. Probably originally domesticated in W. and C. Africa (p. 138).

From Africa, cowpea was taken to India and later it spread from both those regions over the world.. Ssp. mensensis Verdc. grows wild in the African forest zone and ssp. dekindtiana Verdc. wild in the African savanna zone. Most cultivars belong to ssp. unguiculata and the yard-long bean and asparagus bean cultivars to ssp. sesquipedalis (L.) Van Eseltine are rare in Africa. These last two subspecies evolved from ssp. unguiculata (Summerfield et al., 1974).

In N. Nigeria, a form developed for the fibre obtained from the peduncles. Other uses are food, green manure, forage and cover crop.

Liliaceae

IPHIGENIA STELLATA Blatter. 2n= . W. India. A source of colchicine.

Linaceae

LINUM USITATISSIMUM L. Flax. 2n=30, (32). Its possible origin is given on p. 99. In India and adjacent areas, flax of ssp. indo-abyssinicum Vav. & Ell. is found. It is identical to flax of Ethiopia including Eritrea and it may have originated there. It hybridizes with ssp. mediterraneum* resulting in a hybrid ssp. hindustanicum Vav. & Ell.

Malvaceae

ABELMOSCHUS ESCULENTUS (L.) Moench (syn. Hibiscus esculentus L.). Okra, Lady's finger, Gombo. 2n=72-132. Probably a cultigen developed from a wild species A. tuberculatus Pal & Singh (2n=) in trop. Asia. It could be the ancestral or wild form of A. esculentus (van Borssum Waalkes, 1966; Bates, 1968). It is a N. Indian species differing from A. esculentus only in having strigose pubescence on the stems and shorter capsules beset with bristly tuberculate hairs. Van Borssum Waalkes suggested that A. tuberculatus be included in A. esculentus.

ABELMOSCHUS MANIHOT (L.) Medikus. (syn. Hibiscus manihot L.). 2n=60, 66. India, Pakistan, through S. China to New Guinea and N. Australia. Cultivated for its immature fruits.

Ssp. manihot is the cultigen that must have been selected by man from wild hairy and prickly types (ssp. tetraphyllus (Roxb. ex Hornem.) Borss., syn. Hibiscus tetraphyllus Roxb. ex Hornem.).

ABELMOSCHUS MOSCHATUS Medikus. (syn. Hibiscus moschatus L.). Musk mallow. 2n=72. India, S. China, Indochina to Indonesia and SW. Pacific islands to New Guinea and N. Australia. Centre of origin possibly E. India (Mansfeld, 1959). Cultivated for its seeds, which are used as perfume, for its immature edible fruits, its fibre and often as an ornamental.

ABUTILON INDICUM*.

GOSSYPIUM ARBOREUM L. Tree cotton. 2n=26, genome formula A_2A_2. Primary centre: Indian subcontinent. Unknow wild. Spread E. and SE. to Burma, Indochina and the Malaysian Archipelago. Centre of domestication probably Gujarat, which is the westernmost state of India (Hutchinson, 1971). Close to this area, a fragment of textile and a string dated 2500-1700 BC. have been found at Mohenjo-Daro, Pakistan. Race indicum of Indian subcontinent is more closely related to cottons belonging to G. herbaceum* than are other races of G. arboreum. It includes both perennial and annual forms. It is very likely that the perennial forms are primitive and that the annuals were selected later.

In N. India and Pakistan, race bengalense was cultivated. Perennial forms are occasionally found in remote places in Rajputana and in the Ganges Valley. It spread S., SE. and W. The African race soudanense* was probably the cotton cultivated by the people of Meroë (an ancient Nubian civilization), who were the first in Africa to spin and weave cotton. Chowdhury & Buth (1970) suggested, that this race might be indigenous to Africa rather than introduced from India as a textile crop.

GOSSYPIUM STOCKSII Masters. 2n=26, genome formula E_1E_1. Sind, India and SE. Arabia. It is drought-resistant.

HIBISCUS RADIATUS Cav. 2n=72, genome formula AABB. India to Burma. Introduced into Africa and elsewhere where it is cultivated. Mainly used as ornamental; cultivated in Java as vegetable and drug plant. It is a source of resistance to root-knot nematode for H. sabdariffa . It is an allotetraploid of H. cannabinus* and another diploid species. If it is indigenous to India, the amphiploidization must have taken place there after the introduction of H. cannabinus as a fibre crop. However the only known diploid B-carrier is the African H. surattensis* (Menzel & Martin, 1971). If the origin of H. furcatus Roxb. non Willd. (2n=144), genome formula BBGGWWZZ from India and Sri Lanka is studied, the origin of H. radiatus may also be solved.

SIDA RHOMBIFOLIA L. Queensland hemp, Broomjue sida, Cuba jute. 2n=14, 28. Tropics. Cultivated in India and later in Queensland as a fibre crop (var. retusa L.). It is an extremely variable species.

Moraceae

ARTOCARPUS HETEROPHYLLUS Lam. (A. integra (Thunb.) Merr., A. integrifolia L.f.). Jack fruit, Jak. 2n=56. Unknown wild. It has a very ancient cultivation in India. There and in Sri Lanka it is popular; it is also cultivated elsewhere in the tropics (Purseglove, 1968).

FICUS ELASTICA Roxb. Indian rubber tree, Karet tree. 2n=26, (39). India and Malaya. Cultivated in India, Java and elsewhere. It is also cultivated as an ornamental house-plant (Purseglove, 1968).

FICUS RELIGIOSA L. Pipal tree, Peepal tree, Bot tree. 2n=26. This strangling fig is sacred to Hindus and Buddhists. It is propagated by cuttings and layering. A scion planted at cuttings and layering. A scion planted at Anuradhapura in Sri Lanka in 288 BC. (Purseglove, 1968) died in 1971.

FICUS ROXBURGHII Wall. 2n= . Cultivated for its figs.

Moringaceae

MORINGA OLEIFERA Lam. Horse-radish tree, Drumstick tree. 2n=28. India. Cultivated throughout the tropics as a vegetable, in hedges and for its fruits, whose oil is used for lamps and cosmetics.

Musaceae

MUSA cultivars of the AB group. Ney poovan (and other names). 2n=22. Cultivated on a small scale now. See p. 52 for discussion.

MUSA cultivars of the AAB group. 2n=33. Mostly India. Only the clone Maia maoli has probably arisen in Philippines.

MUSA BALBISIANA Colla. Pisang bau, Klue Tani. 2n=22, genome formula BB. India, Burma, Sri Lanka and E. New Guinea. Cultivated for its leaves as a packing material or as a fibre plant (de Langhe, 1969). It is not very variable. It is one of the parents of the AAB, ABB and ABBB groups (p. 59) of cultivated bananas.

Myrtaceae

EUGENIA JAMBOLANA*.

RHODOMYRTUS TORMENTOSA*.

Oleaceae

JASMINUM GRANDIFLORUS L. Catalonian jasmine, Italian jasmine. 2n=26. Himalayas. Cultivated for its fragrant flowers and used in perfumery.

JASMINUM SAMBAC (L.). Ait. Arabian jasmine. 2n=26, 39. India and Sri Lanka. Cultivated in tropics. Flowers are used for scenting tea and as source of an essential oil.

Palmae

ARENGA PINNATA (Wurmb.) Merr. Sugar palm. 2n= . Primary centre: possibly Malaysian Archipelago (p. 61). Secondary centre: India. Cultivated in many trop. Asian countries.

BORASSUS FLABELLIFER*.

COCOS NUCIFERA L. Coconut palm. 2n=32. SE. Asia, Indonesia and W. Pacific islands. Possible secondary centre: India.

Pedaliaceae

SESAMUM INDICUM L. Sesame, Beni seed. 2n=26. Primary centre: Africa (p. 144). Secondary centre: India. Thence it is believed to have spread E. through China, Indochina into Japan, and W. through Afghanistan, Asia Minor and Iran to the Mediterranean area including N. Africa.

Perioplocaceae

CRYPTOSTEGIA GRANDIFLORA*.

Piperaceae

PIPER LONGUM L. Indian long pepper, Jaborandi pepper. 2n=24, 48, 52, 96. The foot of Himalayas. Cultivated in India and Sri Lanka for its spike, which is used as a spice. It resembles P. retrofractum Vahl*.

PIPER NIGRUM L. Black pepper. 2n=36, 48, 52, 60, 104, 128. The slopes of mountains in the Ghats, Malabar, SW. India at an altitude between 150 and 2 400 m. Spread to SE. Asia and Philippines. Now cultivated in other trop. countries (Gentry, 1955; de Waard & Zeven, 1969).

Plantaginaceae

PLANTAGO OVATA Forsk. (syn. P. decumbens Forsk.). 2n=8. Mediterranean area, C. Asia and India. Cultivated in India (esp. Gujarat) for its seeds used in medicine.

Polygonaceae

RUMEX VESICARIUS L. 2n=18, (20). Greece, N. Africa, India and Malaysia. Cultivated in India as a medicinal plant.

Resedaceae

RESEDA ODORATA L. Mignonette. 2n=12 (14). For origin see p. 118. Var. neilgherrensis (Muell. -Arg.) Abdallah & de Wit is found on Nilagiri Mt and in Bombay area and Decca Peninsula (Abdallah & de Wit, 1978).

Rosaceae

RUBUS ALBESCENS Roxb. Mysore raspberry. 2n= . Mountains of India, Sri Lanka, Malaya and Indonesia. Occasionally cultivated, especially in Puerto Rico.

Rubiaceae

COFFEA BENGALENSE Heyne ex Willd. 2n=22. Bengal, Burma and Sumatra. Occasionally cultivated in India (Purseglove, 1968).

MORINDA ANGUSTIFOLIA Roxb. 2n= . Trop. Himalayas, Assam and adjacent areas. Cultivated for bark and wood, as source of yellow dye.

MORINDA CITRIFOLIA L. (syn. M. bracteata Roxb.). Indian mulberry. 2n= . S. India and Malaysia up to Pacific isles. Cultivated in India as a dye crop.

RUBIA CORDIFOLIA L. Indian madder. 2n=22. Trop. and temp. Asia. Cultivated in India as a dye plant.

Rutaceae

CITRUS LATIPES (Swing) Tan. 2n= . Hills of NE. India. The fruits are not edible. It can be crossed with other Citrus species, including the cultigens.

CLAUSENA DENTATA (Willd.) Roem. (syn. C. willdenowii Wight & Arn.). 2n=18, 36. India. This small tree is known for its edible berries.

FERONIA LIMONIA (L.) Swing. (syn. Limonia acidissima L.). Indian wood apple. Elephant apple. 2n=18. India and Sri Lanka. Now cultivated in several trop. countries for its fruits

MURRAYA KOENIGII (L.) Spreng. Curry-leaf tree. 2n=18. India. Cultivated for its leaves.

Sapindaceae

SAPINDUS TRIFOLIATUS L. Soap-berry tree, Soapnut tree, Arceta. 2n= . India, Pakistan and Sri Lanka. Cultivated for its fruits, which yield soap.

Sapotaceae

MADHUCA INDICA Gmelin (syn. M. latifolia (Roxb.) Macbr. Moa tree. 2n= . N. and C. India. Cultivated for its flowers, which are rich in nectar.

MADHUCA LONGIFOLIA (Koenig) Macb. (syn. M. indica J. F. Gmel.). Mahua, Mowra butter tree. 2n= . India. Cultivated there.

MANILKARA HEXANDRA (Roxb.) Dubard. 2n= . S. Asia. Cultivated in India.

Solanaceae

ATROPA BELLADONNA L. Belladonna. 2n=(50), 72. From Spain, the Balkans, Asia Minor to India. Medicinal plant. In India, var. acuminata (syn. A. acuminata Royle, 2n=72) is found. It is cultivated there.

CAPSICUM ANNUUM L. Bell pepper, cayenne pepper. 2n=24. Mexico (p. 196). Secondary centre: Asia.

DATURA METEL L. Hindu datura. 2n=24. India. Medicinal plant introduced into many parts of (sub)tropics. Often cultivated as ornamental.

SOLANUM MELONGENA L. Egg-plant, Aubergine, Bringal, Melongene. 2n=24, (36, 48). Very probably India. A wild-looking form with many small fruits, sometimes called var. insanum, is found on the Bengal Plain of India. Perhaps it is a de-domesticated run-wild type. Martin & Rhodes (1979) found associations of some characteristics of cultivars. This could point to reproductive isolation of this self-fertilizer or to human selection pressure. Primary centres in India, secondary in China (p. 46). S. melongena is closely related to S. incanum*.

Strychnaceae

STRYCHNOS NUX-VOMICA L. Strychnine tree. 2n= 24, 44. India, Sri Lanka and Indonesia. Cultivated for its nux vomica used in medicine.

Theaceae

CAMELLIA SINENSIS (L.) O. Kuntze (syn. C. thea Link., Thea sinensis L.). The origin of tea is discussed on p. 39. Secondary centres: India, Assam and Sri Lanka.

Tiliaceae

CORCHORUS CAPSULARIS L. Jute, White jute, 2n=14. Unknown wild. Primary centre: India and Pakistan. It has been cultivated there for a long time. Spread now throughout the tropics.

GREWIA ASIATICA L. Phalsa. 2n=36. Salt Range, Puna, India (Mansfeld, 1959). Cultivated in India, Sri Lanka and elsewhere for its fruits.

Umbelliferae

ANETHUM GRAVEOLENS L. (syn. Peucedanum graveolens (L.) Hiern.). Dill. 2n=22. Eurasia. Cultivated in Greece, the district of Rome and Palestine (p. 118). Indian types have longer fruits. This species includes A. sowa*.

CARUM COPTICUM (L.) Benth. & Hook. (syn. Trachyspermum ammi (L.) Sprague). Ammi, Lorage. 2n=(16), 18. India. It yields an essential oil.

Urticaceae

GIRARDINIA HETEROPHYLLA Dcne. (syn. Urtica heterophylla Roxb.). Nilgeri nettle. 2n=20. From NW. Himalaya to Malaysia. In the Nilgeri area, India var. palmata is cultivated.

MAOUTIA PUYA Weddell (syn. Boehmeria puya Hassk., Urtica puya Wall.). 2n= . Perennial herb of trop. Himalaya, Khasia and Burma. Occasionally cultivated for its fibres.

Verbenaceae

NYCTANTHES ARBOR-TRISTIS L. Tree of sadness. 2n=44. C. India. Planted near temples. It is a source of a saffron-yellow dye. The oil is used in perfumery. Cultivated as ornamental.

Zingiberaceae

AMOMUM AROMATICUM Roxb. Bengal cardamon, Nepal cardamon. 2n= . India and Pakistan. Cultivated there.

AMOMUM XANTHIOIDES Wall. 2n= . Burma. Cultivated in India.

CURCUMA AMADA Roxb. 2n=42. India and Pakistan. Cultivated in India for Mango ginger.

CURCUMA ANGUSTIFOLIA Roxb. East Indian arrowroot. 2n=42, (64). Himalayan area. Cultivated for its edible starchy rhizomes.

CURCUMA CAESIA Roxb. Kalihaldi. 2n= . Bengal. Occasionally cultivated for its edible rhizomes.

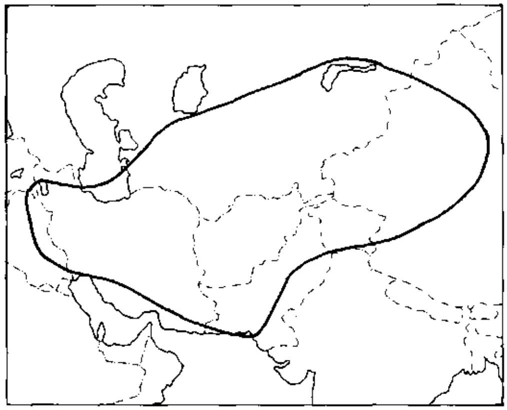
CURCUMA DOMESTICA Val. (syn. C. longa Koenig non L.). Turmeric, Curcuma. 2n=(32), 62, (63, 64). A completely sterile triploid, which probably arose with the wild C. aromatica Salisb. (Wild turmeric, Yellow zedoary; 2n=42) as one parent. C. aromatica grows in India. At first, turmeric may have been used as a sacred plant; later it was cultivated for its rhizomes, which are used for flavouring, and for colouring food and cloth. It spread in early times to China, SE. Asia and later to other parts of the tropics. There it may have run wild (Purseglove, 1972).

CURCUMA ZEDOARIA Rosc. Zedoary. 2n=63, 64. E. India. Cultivated in SE. Asia, Sri Lanka and Madagascar. Rhizomes are a source of a condiment. Young flowers are used for flavouring food.

ELETTARIA CARDAMONUM (L.) Maton. Cardemon. 2n=48, (52). S. India and Sri Lanka. Cultivated in India and Malaysian Archipelago. Seeds of cardamon are used to flavour coffee and in cooking; the oil is used for perfumery. The cultivated types can be divided into three varieties and two groups: group major Thwaites includes the Sri Lanka variety; group minuscula Burkill (syn. var. minor Watt) includes the Malaban variety and Mysore variety. Wild types have also been described as belonging to major. Plants of this group are marked by anthocyanin pigmentation.

ZINGIBER OFFICINALE Rosc. Ginger. 2n=22. Unknown wild. Probably domesticated in India. It was known in China and Trop. Asia at an early date. Cultivated now throughout the tropics.

5 Central Asian Region



The Central Asian Region was called Southwestern Asian Centre by Vavilov. Zohary (1970) preferred to join it with Region 6, the Near Eastern Centre, as did Zhukovskij (1968), who separated both areas by number only. But in 1970, both centres were on the map, separated by a line, and Region 5 was extended northwards (Zhukovskij, 1970).

This centre served as a transfer zone between Regions 1 and 4. Furthermore, the Himalayas have provided many species as parental stock for crops. Agriculture must have reached this centre from Region 6 about 5 000 BC.

Major crops of this centre include fruit-trees, Allium cepa, A. sativum, Daucus carota, Lathyrus sativus, Spinacea oleracea and Vicia faba. Cucumis melo has there a secondary centre of diversity.

Alliaceae

ALLIUM CEPA L. Onion. 2n=16. Cultivated since 1 000 BC. Probably C. Asia and esp. NW. India, Afghanistan, Uzbekistan and W. Tien Shan, where related species A. pskemense O. Fedtsch. (2n=16) and A. vavilovi Popov & Vved. (2n=16) grew wild (Vavilov, 1949/50). Secondary centre is Region 7. Another related wild species is A. oschaninii O. Fedtsch. (syn. A. cepa var. sylvestre Regel) from Pamirs, Alai and Tien Shan. This species is used as food. Wendelbo (1971) and McCollum (1974) suggested this species to be the wild A. cepa or the wild ancestor of A. cepa.

The top onion, tree onion or Egyptian onion (A. proliferum*, syn. A. cepa viviparum (Metzger) Alefeld) is a hybrid of A. cepa and A. fistulosum* (Fiskesjö, 1975). Such hybrids have also been described as A. aobanum Araki, 2n=16 and A. wakegii (see A. chinense*). A. cornutum G.C. Clementi ex Vis., 2n= near Budva, SW. Yugoslavia is probably a bulbilliferous form derived from extinct cultivation (Tutin et al., 1976). Var. ophioscorodon (Link) Döll has a stem coiled in one or two wide loops before anthesis.

ALLIUM PROLIFERUM. 2n=16. Tree onion, Egyptian onion. Formerly described as A. cepa* var. proliferum and as A. fistolosum*, but a true natural hybrid of both these species (Fiskesjö, 1975; Vosa, 1976). Propagated by bulbs. Viviparous.

ALLIUM SATIVUM L. Garlic. 2n=16, genome formula SS. Some consider A. longicuspis Regel (2n=16) as the wild parent of garlic. This species occurs in C. Asia. Var. pekinense (Prokh.) Makino came into cultivation in China (p. 53). Secondary centres developed in Regions 6 and 7 (Kazakova, 1971). Garlic was already known in Egypt before 3 000 BC. Sterile, propagated with bulbils.

Anacardiaceae

PISTACEA VERA L. Pistacio. 2n=30. Mountain slopes, sometimes forms sparse forests. Cultivated in this centre and elsewhere for its seeds. In Turkmenia, there are relic populations, which indicate the once wide distribution of this species (Kabulov, 1969). Dioeceous. In orchards of P. atlantica (2n=28) grown for rootstocks in USA, hybrids with P. vera form and develop female and male branches. They could perhaps be used to breed monoeceous trees.

Chenopodiaceae

BETA VULGARIS L. Beet. 2n=18, (27, 36). Primary centre is discussed on p. 104. Secondary centre developed in Region 5.

SPINACEA OLERACEA L. Spinach. 2n=12. Iran to Manchuria. Primary centre in Afghanistan and Tajikistan. Related to S. tetrandra* and S. turkestanica*. An anemophilous species of which the very young seedlings are eaten as a vegetable.

SPINACEA TETRANDRA Stev. 2n=12. A wild relative of S. oleracea* occurring in the stony steppes of Caucasia including Armenia, and Kurdistan. A weedy anemophilous species.

SPINACEA TURKESTANICA Iljin. 2n=12. A wild relative of S. oleracea* occurring in the loess foothills of the Kara Kum, the southern foothills of Uzbekistan and Turkmenia, and along the Syr Darya. A weedy anemophilous species.

Compositae

ARTEMISIA CINA Berg. Levant wormseed plant. 2n=18. The Orient and Russian Turkestan. Cultivated in Russia and W. of USA.

ARTEMISIA DRACUNCULUS L. Tarragon, Estragon. 2n=18, 36, 54, 72, 90. USSR and from W. Asia to Himalaya. Perennial widely cultivated as a condiment. 'Russian' tarragon (2n=90), a decaploid, is fertile, whereas the 'French' tarragon (2n=36), a tetraploid, is sterile and propagated vegetatively. The types with (2n=45, 54, 72) may be hybrids (Rousi, 1969).
A. dracunculoides Pursh (2n=18) from N. America has often been included in this species.

CARTHAMUS TINCTORIUS L. Safflower. 2n=24, genome formula BB. Primary centre in Region 6 (p. 88). Secondary centre near Kabul, Afghanistan. The great variation of the safflower population there, that led Vavilov to believe that area to be a centre of origin, is very likely caused by the meeting of the Middle Eastern and West Pakistan safflower types there (Knowles, 1969).

INULA HELENIUM L. (syn. Helenium grandiflorum Gilib.). Elecampane, Elfdock, Horseheal, Yellow starwort. 2n=20. Probably C. Asia. Also wild westwards to C. and S. Europe. It used to be cultivated and had various uses.

TARAXACUM KOKSAGHYZ Rodin (syn. T. bicorne Dahlst.). Kok-saghyz. 2n=16. Turkestan. Cultivated in USSR as rubber crop.

Cucurbitaceae

CUCUMIS MELO L. Melon, Musk melon, Canteloupe 2n=24. Probably Africa (p. 124). Secondary centre in Region 5, in which are found ssp. melo Pang., convar. chandalak (Pang.) Greb., convar. ameri (Pang.) Greb., convar. zard (Pang.) Greb., ssp. flexuosus (L.) Greb. (snake melon) (2n=24), var. tarra Pang. and ssp. agrestis (Naud.) Greb. (2n=24), var. agrestis Pang. The last is a weedy field melon.

Datiscaceae

DATISCA CANNABINA L. 2n=22. C. Asia. A herb. Cultivated as a source of yellow dye.

Ebenaceae

DIOSPYROS LOTUS L. Caucasian persimmon. 2n=30. Subtrop. China (p. 36) in Talysk and W. Georgia (USSR) and adjacent Iran. Both these areas form primary centres.

Elaeagnaceae

ELAEAGNUS ANGUSTIFOLIA L. (var. E. argenta Moench). Silverberry, Russian olive. 2n=12, 28. From S. Europe to C. Asia, China and Himalayas. Primary centre in C. Asia. Cultivated there and in Iran for its edible nuts.
E. orientalis L. has been included as var. orientalis (L.) O. Kuntze. in this species.

Gramineae

AEGILOPS CAUDATA*

AEGILOPS CYLINDRICA*

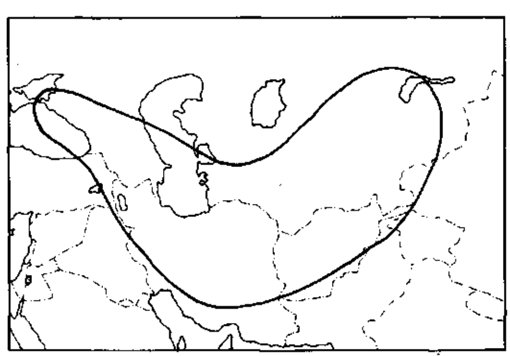
AEGILOPS JUVENALIS*

AEGILOPS KOTSCHYI*

AEGILOPS LORENTII*

AEGILOPS OVATA*

AEGILOPS SQUARROSA auct. non. L. (syn. Ae. tauschii Cosson, Triticum tauschii (Coss.) Schmalh.). 2n=14, genome formula DD. E. Turkey, Iraq, Crimea and Caucasia (Zohary et al., 1969) in the west, and Pakistan and Kashmir in the east. Primary centre to the south of the Caspian Sea. This wild species is the D



Aegilops squarrosa

genome parent of T. aestivum*. Ssp. eusquarrosa Eig (syn. Ae. tauschii ssp. tauschii) usually has short anthers and is generally strictly autogamous, whereas ecotypes with long anthers are facultatively allogamous and resemble ssp. strangulata (Eig) Tzvel. (Hammer & Knüpffer, 1979).

AEGILOPS TRIARISTATA*

AEGILOPS TRIUNCIALIS*

SECALE CEREALE L. Weedy and cultivated rye. 2n=14. The origin of this species is discussed on p. 91. Secondary centre in E. Iran and Afghanistan, where S. afghanicum (Vav.) Roshev. (syn. S. cereale ssp. afghanicum (Vav.) Khush) originated. The main stream of cultivated rye spreading over Europe and Asia comes from the secondary centre (Khush, 1963). Khush based his conclusion on the pigmented ears of all cultivated rye varieties and those of the weedy rye types in Afghanistan. They occur in grain fields with a habit and growth rhythm similar to wheat (Stutz, 1972).

Var. eligulatum Vav., liguleless rye was found by Vavilov in the secondary centre.

SECALE TURKESTANICUM*

TRITICUM AESTIVUM (L.) Thell. ssp. compactum (Host.) MK. (syn. T. compactum Host.). Club wheat. 2n=42, genome formula AABBDD. Ssp. compactum developed in the mountains of the Hindu Kush.

TRITICUM TURGIDUM ssp. turgidum conv. polonicum (L.) MK. 2n=28, genome formula AABB. The type 'T. ispahanicum Heslot' was found in Isfahan (Iran) where it is adapted to irrigated cultivation. It is marked by its narrow and elongated glumes.

Hippocastanaceae

AESCULUS HIPPOCASTANUM*

Juglandaceae

JUGLANS REGIA L. Walnut. Persian walnut, English walnut. 2n=32, 36. Secondary centre: Moldavia, SE. Europe and SW. Europe (p. 155). Many varieties have been described.

Labiatae

LALLEMANTIA ROYLEANA (Wall. & Benth.) Benth. 2n=14. From Iran to Himalayas. Cultivated in E. India as an oil crop.

Leguminosae

CICER ARIETINUM L. Chick-peas, Gram. 2n=14, 16, (24, 32, 33). Secondary centre in Afghanistan, whence the 'Kabuli' types of India derive. They were introduced there about 1700

Juglans regia

(van der Maesen, 1972).

CICER MICROPHYLLUM Royle (syn. C. songaricum Steph., C. jaquemontii Jaub. & Spach.). 2n=14. Tibet, Afghanistan and W. Himalayas. Cultivated in W. Himalayas for its seeds.

FLEMINGIA VESTITA Benth. ex Baker (syn. Moghenia vestita (Benth. ex Baker) O. Kuntze. Sohphlong. 2n=22. W. Himalayas, N. India. Cultivated for its edible tubers, especially in Assam.

LATHYRUS SATIVUS L. Grass pea, Chickling pea. 2n=14. Probably W. Asia. A centre of diversity in the Mediterranean Region. Cultivated in Europe since ancient times and in Region 7 (p. 114). Unkown wild.

MEDICAGO SATIVA L. Lucerne, Blue alfalfa. 2n=16, genome formula SS, 32, genome formula SSSS. Transcaucasia (p. 97). The centre of diversity of blue lucerne is in NW. Iran and adjacent regions to Tibet.

VICIA FABA L. (syn. Faba vulgaris Moench.). Field bean, Broad bean, Horse bean, Tick bean, Windsor bean, Faba bean. 2n=12, 14. Probably SW. Asia (Ladizinsky, 1975c) or Mediterranean region (Zohary, 1977). Wild ancestor uncertain. It may derive from the weed V. angustifolia L. (2n=14). Formerly it was believed to derive from V. narbonensis, but Ladizinsky (1975c) and Abdalla & Günzel (1979) showed that this species was not related to the field bean. Ladizinsky (1975c) also showed that V. galilaea Plit. & Zoh. (2n=14) and V. hyaeniscyamus Mount. (2n=14) were not related either. Related species are V. bithynica (L.) L. and V. johannis Tamanschian. The field bean is divided into three varieties according to the size of the seed: var. minuta (Alef.) Mansf. (syn. var. minor (Pieterm.) Harz.,), pigeon bean or tick bean, var. equina Pers., horse bean, and var. faba (syn. var. major Harz.), broad bean.

From its centre of domestication, the field bean spread to Europe, China and the Mediterranean. In the Mediterranean region, a secondary centre of diversity arose (p. 116). The pigeon and horse beans are used as animal feed, and the broad bean as a vegetable.

Schultze-Motel (1972) has listed all data on archaeological remains of the field bean. Almost all these remnants belong to var. minuta. He did not find a sharp distinction between long-seeded and roundish types, so the development of the field bean from two original forms is not very likely. Only once was var. faba, the broad bean found, in Iraq. It dated from about 1 000 AD., which may point to late development of the large seed.

Liliaceae

FRITILLARIA IMPERIALIS L. Crown imperial. 2n=24. Iran and Turkestan. The bulbs were a source of starch and used in medicine. It is an ornamental.

Linaceae

LINUM USITATISSIMUM L. Flax, Linseed. 2n=30, (32). Origin of flax is discussed on p. 99. Primary centre of origin probably in Region 5 (Vavilov, 1957). This conclusion is based on the great diversity of flax in India and adjacent northerly area. Spread from Region 5 into Region 4(p. 76).

In the mountains of C. Asia, the 'curly oil flax' developed. It is characterized by the large number (140-150) of seed capsules per plant.

Malvaceae

GOSSYPIUM BARBADENSE L. Sea Islands cotton. 2n=52, genome formula $(AADD)_2$. Peru. Spread to reach Africa and Asia in historical times. Secondary centre in Turkmenia, Tajikistan and S. Uzbekistan, USSR.

GOSSYPIUM HERBACEUM L. Short staple American cotton. 2n=26, genome formula A_1A_1. S. Africa (p. 139). Introduced into Ethiopia, S. Arabia and Baluchistan, where race acerifolium (p. 99) developed (Hutchinson, 1962).

Meliaceae

MELIA AZEDARACH L. China berry, Bakayan, Pride of India, Persian lilac, Bead tree. 2n=28. SW. Asia up to W. China. Cultivated in tropics as an ornamental and shade tree. Seeds produce oil. They are also used as beads.

Moraceae

MORUS NIGRA L. Black mulberry. 2n=(89-106), 308. C. Asia. Cultivated at higher altitude in the tropics (Purseglove, 1968), and also throughout S. Eurasia for its fruits. The Black Persian mulberry is probably a variety (Purseglove, 1968).

URTICA CANNABINA L. 2n= . C. and N. Asia. Cultivated for fibre.

Oleaceae

JASMINUM OFFICINALE L. Common white jasmine. 2n=26. From Iran to Kashmir and China. Cultivated especially in S. France for its flowers, which contain essential oil used in perfumery.

Polygonaceae

RHEUM RHAPONTICUM L. Rhubarb. 2n=44. SE. USSR. Cultivated as vegetable. Probably one of the parents of R. hybridum*. Related to R. palmatum*.

Rosaceae

AMYGDALUS BROWICZII Freitag. 2n= . Afghanistan. Related to A. communis* and A. korshinskyi Hand.-Mazz, 2n= .

AMYGDALUS BUCHARICA Korsh. (syn. Prunus bucharica (Korsh.) Fedtsch.). Bukhara almond. 2n=16. W. Tien Shan, Pamirs and Alai, and in Afghanistan. It may form a source of sweet pits, of high oil content and of a good kernel to shell ratio.

AMYGDALUS COMMUNIS L. (syn. Prunus amygdalus Batsch.). Almond. 2n=16. W. Kopet-Dagh (Turkmenia), Afghanistan and W. Tien Shan (p. 100). Primary centres: W. Kopet-Dagh (Turkmenia) and W. Tien Shan. Extensively cultivated in S. Europe and California. In this centre and in Region 6 (p. 100) other Amygdalus species are found. In Georgia (USSR) A. georgica Desf. (2n=16) is found. In Kopet-Dagh and Badkhyz A. turcomanica Lincz. occurs. In Armenia A. nairica Fed. & Takhi. and A. urartu* with A. fenzliana are native. In this area and in Nakhichevan A. fenzliana* (syn. Prunus fenzliana Fritsch) (2n=16) grows. This species is very cold resistant and crosses freely with cultivated species. Further A. scoparia Spach. (syn. Prunus scoparia (Spach.) Schneid.) (2n=16) is found in Kopet-Dagh and Iran.

AMYGDALUS PERSICA L. Peach. 2n=16. Primary centre: China (p. 42). Secondary centre in Iran and C. Asia.

AMYGDALUS PETUNNIKOWII Litvin. (syn. Prunus petunnikowii (Litvin.) Rehd.). Turkestan almond. 2n=16. W. Tien Shan, in Kazakhstan, Tadshikistan and Uzbekistan and partly in Kirgizistan, USSR. It is an ornamental. It has a high oil content. It is drought resistant. It easily crosses with A. communis*.

AMYGDALUS SPINOSISSIMA Bge. (syn. Prunus spinosissima (Bge.) Franch.). Thorny peach brush. 2n=16. C. Asia from Kopet-Dagh (Turkmenia) through Pamir-Alai to W. Tien Shan, in Iran, Afghanistan and Kurdestan. It is late flowering and has a high oil content.

AMYGDALUS TANGUTICA Korsh. (syn. Prunus dehiscens Koehne). Tangut plum. 2n= . W. China. Cultivated in some parts of China for the kernels.

AMYGDALUS ULMIFOLIA (Franch.) M. Pop. (syn. Prunus triloba Lindl.). 2n=16. C. Asia.

AMYGDALUS VAVILOVII M. Pop. (syn. Prunus vavilovii M. Pop.). Vavilov almond. 2n=16. Kopet Dagh (Iran and Turkmenia), W. Tien Shan, the Pamirs and Alai. At one time it was believed that this species was a hybrid between A. spinosissima* and A. communis*.

ARMENIACA DASYCARPA (Erhr.) Borkh. (syn. A. atropurpurea Lois., Prunus dasycarpa Ehrh.). Purple apricot, Black apricot. 2n= . Unknown wild. Cultivated in C. Asia, Transcaucasia and Iran. The fruits are very sour and may be used in marmalades. It might be used as a source of late flowering, and of cold resistance of the flower buds.

ARMENIACA VULGARIS L. Apricot. 2n=16. Primary centre in NE. China (p. 42). Secondary centre for the cultivated apricot E. Tien Shan. For the wild apricot, this primary gene centre was formerly continuous with the main part in China (p. 42).

CRATAEGUS AZAROLUS L. (syn. C. aronia Bosc.). Azarolier. 2n= . S. Europe, Africa (p. 118) and the Orient. In Uzbekistan, a large-fruited type, var. turcomanica Popoff, is found. It is poor in vigour.

FRAGARIA BUCHARICA Losinsk. Bukhara strawberry. 2n= . Region 5.

MALUS KIRGHIZORUM Al. & Fed. 2n= . W. Tien Shan in the underbush of wild walnut (Juglans regia L.). Primary centres are in the basins of the Pskem, Ugam, Kok-Su and other rivers. It is a polymorphous species. It is likely that it introgressed into the cultivated apple (Malus pumila*).

MALUS PUMILA*

MALUS SIEVERSII (Ledeb.) M. Roem. 2n= . W. Tien Shan and in Ala Tau of N. Xingiang Uygur (Sinkiang Province) in the underbush of the wild walnut (Juglans regia L.). Var. hissarica (Kudr.) Ponomarenko is also described as P. hissarica Kudr.

MALUS SYLVESTRIS (L.) Miller. 2n=34. Much of Europe, in Transcaucasia and probably into W. Turkestan. In the Caucasus, this species is not always distinct from M. pumila*. It is very winter-hardy. Used as a root-stock. Where it grows together with M. pumila, hybrids occur and so M. sylvestris must have been involved in the distant origin of the cultivated apple. One subspecies, ssp. praecox (Malus praecox (Pall.) Borkh.), is early-maturing. Primary centre in C. Asia. Occasionally cultivated in N. Africa (Uphof, 1968).

Malus kirghizorum

Malus sieversii

PRUNUS subgen CERASUS Pers. In Region 5, there occur wild cherries with small fruits (sect. Microcerasus Webb.).

PRUNUS CERASIFERA Ehrh. Cherry plum. Myrobalan. 2n=16, genome formula CC, (24, 32, 48). Primary centre is in Caucasia (p. 101). Secondary centre: the W. Tien Shan. It is characterized by high yield, early flowering, early ripening, wide adaptability and high acid content.

PRUNUS FERGANICA Lincz. Ferghana plum. 2n= . Ferghana ridge in Tien Shan and in the Pamirs and Alai (USSR). It is a true-breeding hybrid of a spontaneous cross Amygdalus communis and Prunus cerasifera*.

PYRUS BUCHARICA Litv. 2n= . W. Tien Shan and the mountains of Tajikistan. It is thought to be a hybrid of P. regelii* and P. korshinskyi* (Vavilov, 1930a).

PYRUS KORSHINSKYI Nak. & Kik. 2n= . Pamirs, Alai and W. Tien Shan. It is considered as one parent of P. bucharica*.

PYRUS REGELII Rehd. 2n= . W. Tien Shan, Pamirs, Alai and Bukhara Uplands. It is very resistant to drought.

PYRUS SOGDIANA S. Kudr. 2n= . Shakhrisyabz region of Uzbekistan.

PYRUS VAVILOVII M. Pop. 2n= . E. Ferghana. It is considered a hybrid of P. communis* x P. korshinskyi* (Vavilov, 1930a).

ROSA MOSCHATA J. Hermann. 2n=14, (28). Himalayas and Iran. Cultivated as ornamentals. It is a parent of R. x bifera*.

Salicaceae

SALIX ALBA L. (syn. S. Aurea Salisb.). White willow. 2n=76. Europe (p. 161), Asia and N. Africa. Cultivated in the Kashmir for lopping as fodder (Heybroek, 1963).

Tamaricaceae

TAMARIX GALLICA L. Tamarisk. 2n=24. W. Himalayas and NW. India. Cultivated for shelter and as an ornamental.

Ulmaceae

ULMUS VILLOSA Brandis ex Gramble. 2n= . Himalayas. Cultivated in sacred places or for ornamental purposes. It is lopped for fodder (Heybroek, 1963).

ULMUS WALLICHIANA Planch. 2n= . Large-leaved elm. Himalayas. Cultivated in Kashmir and lopped for fodder (Heybroek, 1963).

Umbelliferae

CUMINUM CYMINUM*

DAUCUS CAROTA L. Carrot. 2n=18. Wild types occur in Europe, SW. and C. Asia and N. Africa. These wild types have been grouped into two aggregates: (1) ssp. agg. gingidium including former sspp. gummifer Hooker f., commutatus (Paol.) Thell., hispanicus (Goüan) Thell., hispidus (Arcangeli) Heywood, gadecaei (Rouy & Camus) Heywood, drepanensis (Arcangeli) Heywood, and rupestris (Guss.) Heywood.
(2) ssp. agg. carota with the former sspp. carota, maritimus (Lam.) Batt., major (Vis.) Arcangeli and maximus (Desf.) Ball.

There are some intermediate types (Small, 1978b).

Carrot was domesticated in Afghanistan (primary centre of diversity) and from there it spread over Europe, the Mediterranean area and Asia. During spread, it introgressed with local wild types.

The domesticated types are divided into two groups:
(1) the 'Eastern (or Asian) carrots' (var. atrorubus Alef.), with mainly purple and yellow roots.
(2) the 'Western carrots' (var. sativus Hoffm.) with mainly orange roots (Small, 1978b). The purple types have a short storage time.

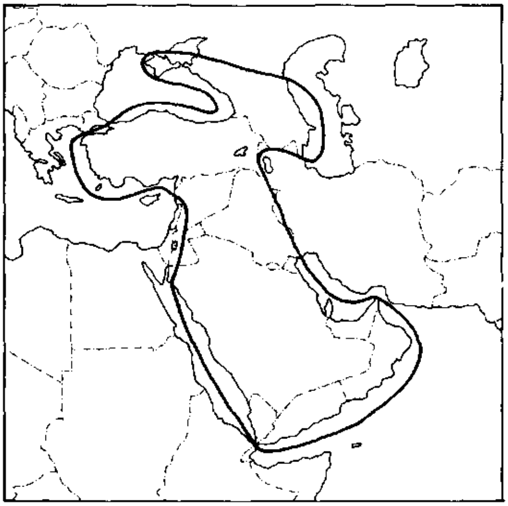
In Turkey and Japan, hybrids between the two groups occur, in Turkey because the two groups grow near together and hybridize naturally. Turkey is therefore a secondary centre of diversity (p. 101). In Japan, breeders developed varieties from artificial crosses of these two groups.
During its spread, the yellow and white carrots probably originated by mutation (but see p. 162). The white mutants (albus) were used for fodder and did not participate in the development of the European carrot (Banga, 1957).

After reaching Iran, it probably spread thence to China (Banga, 1962).

Vitadaceae

VITIS VINIFERA L. Common grape. 2n=38. Deep valleys of Tien Shan and adjacent areas. Primary centre for the cultivated grape lies in that Region (see further p. 102).

6 Near Eastern Region



The Near Eastern Region was described by Vavilov. It included a part of Region 5.

Darlington (1956) called the area the SW. Asian region. Zhukovskij (1968) recognised two regions 5 and 6, and in 1970 he separated these on his map. Zohary (1969) preferred to combine these regions into one. Within the Region lies the Fertile Crescent. Here agriculture probably evolved around 9000 BC. (Çambal & Braidwood, 1970). Harlan (1971) called the area of the Fertile Crescent, A1 Near East centre. Agriculture spread from there to Europe, the Mediterranean Region, Afghanistan, India and possibly Africa.

Major crops include several fruit-tree species of Brassica oleracea, Hordeum vulgare, Lens esculenta, Medicago spp., Secale spp., Triticum spp., Vicia faba and Vitis vinifera.

In Georgia (USSR), a secondary centre of diversity developed for Glycine max, Lupinus albus, Phaseolus vulgaris, Setaria italica and Zea mays. Maize entered USSR by way of Georgia.

In Turkey, Harlan (1951) described microcentres for Amygdalus spp., Cucumis melo, C. sativus, Cucurbita moschata, C. pepo, Lens esculentum, Lupinus spp., Malus spp., Medicago sativa, other annual Medicago spp., Onobrychis viceaefolia, Phaseolus vulgaris, Pistacea spp., Prunus spp., Pyrus spp., Trifolium spp., Vicia faba, Vitis vinifera and Zea mays.

Alliaceae

ALLIUM AMPELOPRASUM L. Levant garlic, Perennial sweet leek. 2n=16, (24), 32, genome formula AAA'A", (40), 48, genome formula AAA'A'-A"A", AABBBB. Europe, Asia Minor, Caucasia to Iran and N. Africa. A type resembling ssp. iranicum P.W. is cultivated near Tehran (Tahbaz, 1971). In Israel the diploid is rare, but the triploid is a vegetatively propagated triploid weed (Kollmann, 1972). Var. babingtonii (Borrer) Syme (syn. A. babingtonii Borrer) of W. Ireland and SW. England and var. bulbiferum Syme (syn. var. bulbilliferum Lloyd) of the Channel Islands and W. France are possible relics of former cultivation (Tutin et al., 1976).

ALLIUM ASCALONICUM L. Shallot. 2n=16. N. Africa, E. Mediterranean area. Closely related to A. deserti-syriaci Feinbrun (2n=   ) from Syria and Iraq (de Wilde-Duyfjes, 1976). Also described as a variant of A. cepa* (Vosa, 1976; and others).

ALLIUM KURRAT Schweinfl. Salad leek, kurrat. 2n=32. Probably Arabia and Sinai (Uphof, 1968). The geographic destribution is not known. Cultivated in the Nile area, Arabia and Palestine for its leaves (Uphof, 1968) It might be derived from A. ampeloprasum* (Kuckuck & Kobabe, 1962). Because of its close relationship to A. ampeloprasum*, it is often included in that species as var. kurrat Schweinf. ex Krause or in A. porrum* (de Wilde-Duyfjes, 1976).

ALLIUM PORRUM L. Leek. 2n=32. Asia Minor. Probably gene centre for cultivated forms (Kuckuck, 1962). Leek is a cultivated form derived from A. ampeloprasum*. If so, it is included as var. porrum (L.) Cav. in the latter species.

ALLIUM SATIVUM L. Garlic. 2n=16, genome formula SS. Wild type in C. Asia (p. 81). Secondary centre in Region 6 (Kazakova, 1971).

Boraginaceae

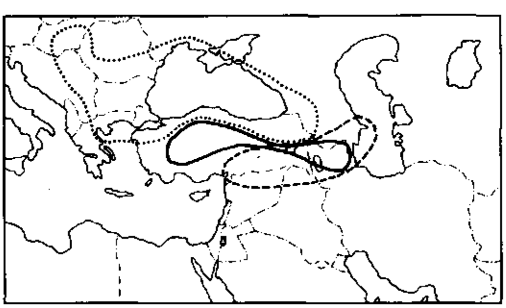
SYMPHYTUM ASPERUM Lepechin (syn. S. asperrimum Donn.). Prickly comfrey. 2n=40. Caucasia to Armenia and N. Iran. Cultivated as forage crop. It is probably one of the parents of S. x uplandicum Nyman, (2n=36), a forage crop. The other is S. officinale L., common comfrey (2n=26, c. 36, 40, c. 40, 48), which is native to Europe, W. Siberia and Asia Minor.

Chenopodiaceae

BETA COROLLIFLORA Zosimovich ex Buttler. 2n=36, genome formula CCCC and aneuploids of 36. Turkey, Georgia (USSR) and Azerbaijan (USSR and Iran). Self-incompatible and frost-resistant.

BETA INTERMEDIA Bunge. 2n=36, genome formula possibly LLCC. Plants which are probably hybrids of B. lomatogona* and B. trigyna* have been described as B. intermedia. They occur where the two species grow together. It is a source of resistance to yellow mosaic disease.

BETA LOMATOGONA Fisch. & Mey. 2n=18, genome formula LL, (22), 36. Asia Minor and E. Transcaucasia. It is a weed characterized by 'monogerm fruits'. Where the distribution of this species and of B. trigyna overlap, tetraploid B. lomatogona is found. The hybrids are probably identical to plants described as B. intermedia*.



Beta lomatogona and B. intermedia (—), B. macrorrhiza (---) and B. trigyna (···)(Ulbrich, 1934).

BETA MACRORRHIZA Stev. 2n=18. (Sub)alpine zones of mountains in Iran, Turkish Armenia (Lake Van) and the Caucasus. A winter-hardy species containing sugar (8-12%) and white pulp.

BETA TRIGYNA Wald. & Kit. 2n=54, genome formula LLCCCC. Around the Black Sea with outliers to the Caspian Sea, Iran, Ukraine and Hungary.

CHENOPODIUM CAPITATUM (L.) Asch. 2n=16, 18. The Orient. Cultivated (Mansfeld, 1959).

Compositae

CARTHAMUS TINCTORIUS L. *Safflower*. 2n=24, genome formula BB. Vavilov (1951) and Kupzow (1932) proposed three areas of origin for the cultivated safflower: in India, based on variation and ancient culture; in Afghanistan, based on variation and proximity of wild species; and in Ethiopia, because of the presence of wild safflower species. However Hanelt (1961), and Ashri & Knowles (1960) placed the centre of origin in the Near East because of the similarity of cultivated safflower to two closely related wild species: C. flavescens Spreng. (syn. C. persicus Willd. (2n=24, genome formula BB), found in Turkey, Syria and Lebanon; and C. palaestinus Eig. (2n=24, genome formula BB), found in deserts of W. Iraq and Israel (Khidir & Knowles, 1970). In that area, introgression may still occur between wild and cultivated safflower.

The great variation in the Afghanistan safflower population must be caused by the meeting of the Middle Eastern and the Pakistani types (Knowles, 1969) (p. 82). The wild safflower of Ethiopia cannot be the progenitor of safflower in the Near East because it has 32 pairs of chromosomes, whereas the cultivated species has 12 pairs (Knowles, 1969). Safflower is or has been cultivated in many areas of the Old World and in North America. Many improved USA varieties derive mainly from Sudanese material. They are now cultivated in Egypt, Spain and some other countries too, where they may cross with local varieties and so produce new genotypes or they may replace the local varieties so that gene material is lost. Cultivated mainly for its flowers, which were a source of pigment. It is now cultivated for its seeds which yield an edible oil, whose high polyunsaturation due to its high content of linoleic acid makes it very suitable for consumption.

Imrie & Knowles (1970) suggested that C. palaestinus is a wild species. The weedy species C. flavescens and C. oxyantha M. B. (2n=24, genome formula BB) and the cultivated species C. tinctorius derive from that species.

CHRYSANTHEMUM COCCINEUM Willd. (syn. C. roseum Adam). 2n=18. Wild in N. Iran, Caucasia and

Armenia. Cultivated as a garden plant. The flowers contain the insecticide pyrethrin, but their toxity is less than C. cinerariaefolium*.

TANACETUM PARTHENIUM*

Cornaceae

CORNUS MAS L. (syn. C. mascula Hort.). Cornelian cherry. 2n=18, 54. Caucasia and Asia Minor as an underbush of deciduous forests. Cultivated for its edible fruits and as an ornamental shrub. The fruits are also used to produce vin de Cornouille, an alcoholic beverage.

Corylaceae

CORYLUS AVELLANA L. European hazel. 2n=22, 28. Europe and Caucasus. Primary centre in the Caucasus. Cultivated widely for its nuts: hazel nut or cobnut.

In this same centre there is a wealth of other Corylus species; C. maxima*, C. pontica C. Koch (2n=28), C. colchica Alb., C. iberica Wittm. & Kemular, C. imoretica Kemular, C. cervorum Petr. and C. colurna*. Trazels are hybrids of C. avellana and tree hazels (C. colurna*). They have a high kernel quality, are winter-hardy and vigorous.

CORYLUS COLURNA L. Turkish hazel. 2n=28. Occasionally cultivated in Turkey for its nuts. It is also used as a rootstock and as a source of resistance of diseases of C. avellana*. Hybrids of that species are called 'trazels'.

CORYLUS MAXIMA Miller. Filbert, White filbert, Red filbert. 2n=22, 28. Caucasia, W. Asia and SE. Europe. Cultivated for its nuts.

Cruciferae

BRASSICA OLERACEA L. Wild and cultivated cabbages. 2n=18, genome formula CC. In Asia Minor, varieties belonging to convar. oleracea*, convar. capitata* and convar. acephala* are common.

CAMELINA SATIVA (L.) Crantz. False flax. 2n=40. In SE. Europe and SW. Asia, the wild parental form occurs, probably C. microcarpa Andrz. (2n=40). It became a weed in cereal crops and flax. Later is was cultivated for its oily seeds, the cultigen being called C. sativa. An intermediate form is C. pilosa (DC) Zinger. Another weed of flax fields is C. alyssum (Miller) Thell. (2n=40). All these species have also been grouped in one species, C. sativa, being divided into subspecies microcarpa (Andrz.) Hegi, sativa, pilosa (DC.) Hegi and alyssum (Miller) Hegi. It has almost disappeared from cultivation.

CRAMBE ABYSSINICA Hochst. ex. R.E. Vries. 2n=90. Distribution in the wild is obscure. Three introductions from Turkey into USA have been used to develop an oil-producing crop.

CRAMBE CORDIFOLIA Steven (syn. C. tatarica Jacq.). Tatar sea-kale. 2n= . Highlands of Asia Minor, India and Ethiopia. The perennial herb is cultivated for the young leaves.

IRATIS TINCTORIA L. (syn. I. canescens DC., I. littoralis Steven, I. taurica Bieb.). 2n=28. Most of Europe. Cultivated as source of dye, and therefore probably introduced.

Cucurbitaceae

CUCUMIS MELO L. Melon. Musk melon, Canteloupe. 2n=24. Africa (p. 124). Secondary centre arose in Region 4, in which convar. cassaba (Pang.) Greb. (cassaba melon, winter melon) from Asia Minor, convar. cantalupa (Pang.) Greb. (cantaloupe melons), convar. adana (Pang.) Greb., (kilik melons) convar. flexuosus (L.) Greb. (tarra melons, adjur melons, snake melons, serpent melons) are found.

CUCUMIS SATIVUS L. Cucumber, Gherkin. 2n=14. India (p. 72). Secondary centre (bethalpha type) arose in this region.

Dipsacaceae

CEPHALARIA SYRIACA (L.) Roemer & Schultes. Pelemir. 2n=10. This pestweed of wheat fields is occasionally cultivated on the C. Anatolian peneplane as an oil crop.

DIPSACUS SATIVUS (L.) Scholler. Teasel. 2n=16, 18. Cultivated in Europe and elsewhere. It has probably derived from D. ferox Loissel (2n=16, 18), which grows in Corsica, Sardinia and some sites in C. Italy or from D. fullosum L. (syn. D. sylvestris Hudson, 2n=16, 18), which grows in S., W. and C. Europe to NE. Ukraine.

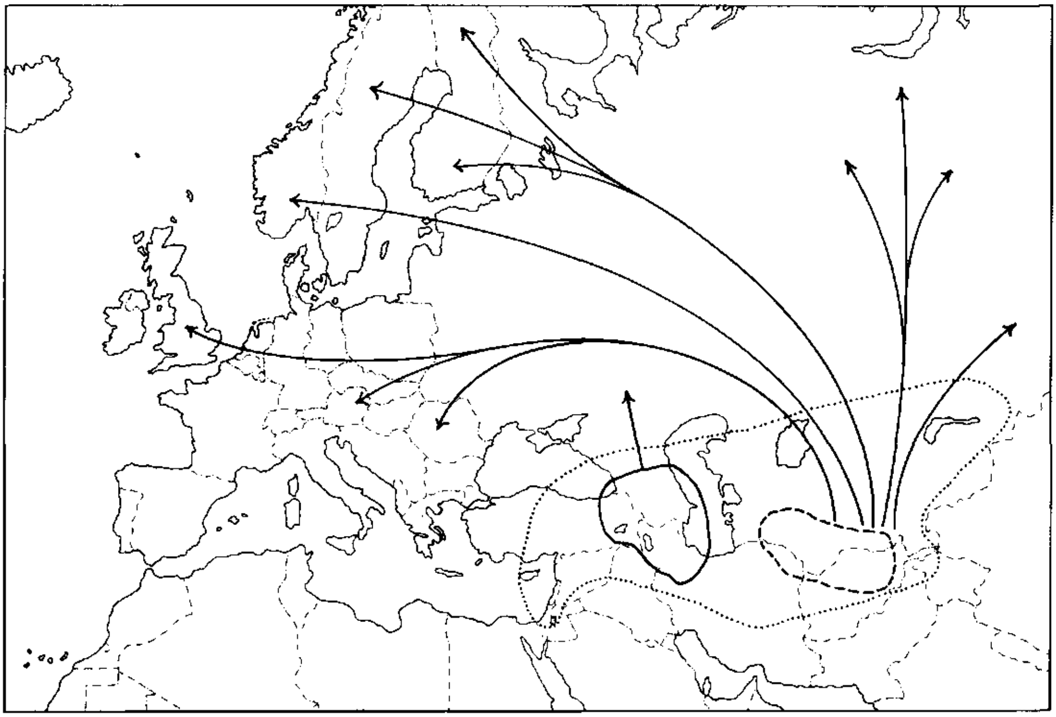
Fagaceae

CASTANEA SATIVA Mill. (syn. C. vesca Gaertn.). Sweet chestnut, Spanish chestnut. 2n=22, 24. From Italy northwards to Hungary and eastwards to Asia Minor and W. Georgia (USSR). Cultivated for its nuts and timber. Outside that range, it is naturalized.

Gramineae

AEGILOPS CAUDATA L. (syn. Triticum dichasians (Zhuk.) Bowden, T. caudatum (L.) Godr. & Gren.). 2n=14, genome formula CC. Greece, Turkey, Iraq and Afghanistan. Its cytoplasm has a male-sterilizing action om the T. aestivum* nucleus.

AEGILOPS COLUMNARIS Zhuk. 2n=28, genome formula $C^uC^uM^cM^c$. Turkey, Iraq, Iran and Caucasia. It is a weed of cultivation and looks quite like Ae. triaristata* (Bor, 1970). The C^u genome will be renamed U.



Primary centre (—), secondary centre (---) and distribution of wild and weedy Secale cereale types and ways of their introduction and that of rye into Europe and N. Asia (...) (Khush, 1962).

2n=14, genome formula R^cR^c. Primary centre of annual and perennial rye species and forms: NE. Turkey - NW. Iran. Khush (1963) suggested that a secondary centre (p. 83) is in Afghanistan and that the cultivated rye of Europe and N. and C. Asia derives from that centre. Only a few come from the primary centre. In the primary centre, S. vavilovii* and S. montaneum* hybridize with each other and introgress, resulting in a mixture of genetic variants described as 'S. segetale', 'S. afghanicum', 'S. daralgesii', 'S. cereale', 'S. turkestanicum' and 'S. dighoricum' (Stutz, 1972). Stutz (1972) suggested that from this highly variable population the annual S. cereale types invaded cultivated fields to become weeds.

S. cereale includes cultivated rye and a number of weedy rye types occurring in grain fields and along ditchbanks and roadsides, throughout the Middle East (Stutz, 1972). These weedy types are:

S. afghanicum*

S. dighoricum (Vav.) Roshev. (syn. S. cereale L. ssp. dighoricum (Vav.) Khush). It is a weed in grain fields of N. Ossetia (USSR).

S. segetale (Zhuk.) Roshev. (syn. S. cereale L. ssp. segetale (Zhuk.) Khush.). This is a polymorphic weed in grain fields throughout E. Europe and the Middle East (Stutz, 1972).

S. ancestrale Zhuk. (syn. S. cereale L. ssp. ancestrale (Zhuk.) Khush). It is a robust tall (up to 2.4 m) weed with small invested seeds and fragile rachis restricted to sandy ditchbanks and fence rows near Aydin, SW. Turkey. It is reproductively isolated from domesticated rye (Stutz, 1976).

S. turkestanicum Bensin. A self-compatible cultigen of C. Asia (p. 83) and Transcaucasia.

The weedy types have derived mainly from S. vavilovii* by introgression with S. montanum* and its derivative species S. anatolicum*. In some places less favourable for wheat and barley, rye may have been developed to become fully domesticated. It is generally proposed that S. ancestrale and S. segetale are the parental types of S. cereale; however Stutz (1972) suggested that S. ancestrale derives from S. cereale. There is no introgression into S. ancestrale of other Secale genetic material, in spite of contact with other species, because a high incidence of geno-typically controlled chromosomal breaks in outcrossed hybrids leads to sterility (Stutz, 1971).

Hybridization between wheat (p. 93) and rye may have increased in the variability of wheat. Rye is a source of resistance to diseases used in wheat breeding and is a parent of octaploid and hexaploid triticales.

The closest wild relative of cultivated rye is S. ancestrale and this taxon probably gave rise to the weedy S. segetale complex. Wild rye is characterized by spikelets that all disarticulate at maturity, while in the weed complex the lower one quarter or more of the spikelets are not deciduous at maturity. Cultivated rye is known from the Neolithic of Austria, but it became widespread as a cereal in Europe only since the Bronze age.

SECALE MONTANUM Guss. Mountain rye. 2n=14, genome formula R^mR^m. From the C. Atlas Mountains of Morocco and the Sierra Nevada Mountains of Spain, eastwards in isolated pockets in the mountains of Sicily, Italy, Yugoslavia, Greece, Lebanon, Turkey, Iran and Iraq (Stutz, 1972). It is a highly polymorphic cross-fertilizing perennial. Some of the isolates have been described as distinct species or varieties:

S. ciliatoglume (Boiss.) Grossh. (syn. S. montanum var. ciliatoglume Boiss.). A weedy population with pubescent culms in orchards and vineyards near Mardin, SE. Turkey.

S. dalmaticum Vis., population growing within the walls of the old St. Johannis Fortress above Kotor, S. Jugoslavia.

S. daralgesii Thum., a weedy form with nonfragile rachis along roadsides and ditchbanks of Armenia.

S. kuprijanovii Grossh., a broad-leaved form of mountain meadows of the N. Caucasus Mountains.

S. montanum has the same chromosomal arrangement as S. anatolicum*, S. silvestre* and S. africanum*. Its chromosomal arrangement differs from that of S. vavilovii and S. cereale and from its closely related forms in reciprocal translocations involving 6 of the 14 chromosomes.

It derives from S. silvestre* (Singh & Röbbelen, 1975) and is the parental species of S. anatolicum (Stutz, 1972), S. africanum, S. vavilovii and S. cereale.

SECALE SILVESTRE Host. (syn. S. fragile Marsch.). 2n=14. C. Hungary eastward throughout the sandy steppe of S. Russia up to W. Siberia and the Pamirs and Alai (Bor, 1970; Stutz, 1972). A low-growing annual psammophyte with fragile rachis. It has the same chromosome arrangement as S. montanum*. This species is believed to be phylogenetically the oldest species and is probably the ancestor of S. montanum* (Rimpau & Flavell, 1974; Singh & Röbbelen, 1975) from which S. cereale* derives.

SECALE VAVILOVII Grossh. 2n=14. Common to the lower slopes of Mount Ararat and along the banks of the Araks River. It is a wild low-growing, annual self-compatible psammophyte with fragile rachis. It has the same chromosome arrangement as S. cereale (see S. montanum*). Bor (1970), strongly suspected this species of being the same as S. afghanicum*. Khush (1960) suggested that it derived from S. montanum, but Stutz (1972) made it clear that is is the ancestor of S. cereale*.

TRITICUM AESTIVUM (L.) Thell. Wheat. 2n=42, genome formula AABBDD. Primary centre: Transcaucasia and adjacent areas. There, natural cross-fertilization is still taking place within the species and between subspecies, other Triticum species and related species of Aegilops and Secale. This species is a natural amphiploid of emmer and Aegilops squarrosa*. This amphiploidization must have taken place after the development of emmer from its wild ancestor T. turgidum ssp. dicoccoides* in the area south of the Caspian Sea (Nakai, 1979).

This hybridization has led to hexaploid types with a very brittle ear. This is a 'wild' character and so one could say that there are wild hexaploid wheats. However these segregants cannot really be called wild.

The main division of T. aestivum is into ssp. spelta (L.) Thell. (syn. T. spelta L.), spelt; ssp. vavilovi (Tum.) Sears (syn. T. vavilovii (Tum.) Jakubz.); ssp. macha (Dek. & Men.) MK. (syn. T. macha Dek. & Men.). Makha wheat, ssp. vulgare (Vill.) MK. (syn. T. vulgare Vill.), common wheat, bread wheat; ssp. compactum Host.) MK. (syn. T. compactum Host.), club wheat; and ssp. sphaerococcum (Perc.) MK. (syn. T. sphaerococcum Perc.), Indian dwarf wheat. The origin of some subspecies has not yet been assertained. They have originated in another centre.

Spelt wheats have been found in Iran, in C. Europe (p. 154) and Africa (p. 135). The spread of bread wheat during Neolithic times has been described (Zeven, 1979; 1980).

Ssp. vavilovi wheat is indigenous to Armenia. It is characterized by its branching spikelet.

Makha wheat is indigenous to W. Georgia (USSR). It is often mixed with T. turgidum ssp. paleocolchicum*.

The spread of bread wheat during Neolithic times has been described (Zeven, 1979; 1980). Bread wheat is now widespread. Primary centre in Transcaucasia and adjacent regions. Secondary centres in Hindu Kush and adjacent regions (p. 83), in China and Japan (p. 39) and probably in African Sahara (p. 135).

Club wheat developed in Afghanistan and adjacent regions (p. 83) and probably in Switzerland/Austria (p. 154). A secondary centre of diversity is Armenia.

Indian dwarf wheat originated in NW. India and adjacent regions (p. 75). Its presence has been reported in N. Africa.

Dorofejev (1971) suggested that ssp. macha is the oldest hexaploid. From it, ssp. vulgare developed. Ssp. spelta and ssp. vavilovii are secondary spelts. They may have derived from ssp. vulgare.

There has been much research to identify the donor species of the B genome. However in vain, because it probably does not exist (see T. turgidum*).

TRITICUM AESTIVUM (L.) Thell. ssp. compactum (Host) MK. (syn. T. compactum Host.). Club wheat. 2n=42, genome formula AABBDD. This subspecies developed in the Hindu Kush (p. 83).

Secondary centre Armenia.

TRITICUM MONOCOCCUM L. Wild and cultivated einkorn. 2n=14, genome formula AA. The wild ssp. boeoticum (Boiss.) Mac Key (syn. T. boeoticum Boiss.) includes the types aegilopoides (T. aegilopoides (Link) Bal. and thaoudar (T. thaoudar Reut.), as well as 'T. spontaneum Flaksb.' and 'T. urartu Tuman.'. It is spread over Greece, Turkey, Syria, N. Iraq and Transcaucasia. Aegilopoides is characterized by one grain and one awn per spikelet, whereas thaoudar has two grains and two awns. There are two distribution centres: in the Fertile Crescent and in Turkey. In peripheral areas, it is segetal. In the Fertile Crescent thaoudar is found. Aegilopoides type occurs in the colder part of Balkans and W. Anatolia. In Anatolia, intermediate types and mixtures are found. In Armenia the type urartu has been described. It has two awns and a winter habit.

In the Fertile Crescent, the wild einkorn was domesticated to become ssp. monococcum, which has a tough rachis.

Its earliest appearance is from Ali Kosh dating from c. 6500 BC., thus later than the first appearance to T. turgidum ssp. dicoccum.

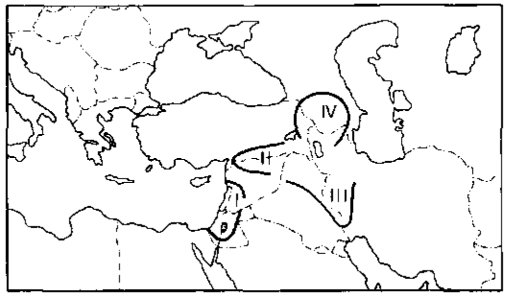
Einkorn was spread over Europe, N. Africa, Asia Minor, Caucasia, Iraq and Iran. Cultivated in some areas as a fodder crop. It forms a component of the Zanduri wheat, which is a mixture of einkorn. T. timopheevi ssp. timopheevi* and T. zhukovskyi*. This population is cultivated in Georgia (USSR). This species forms a useful source of disease resistance.

There is still a natural gene flow between diploid and tetraploid species (Vardi & Zohary, 1967).

TRITICUM TIMOPHEEVI Zhuk. 2n=28, genome formula AABB (or AAB'B', AAGG). This species consists of two subspecies ssp. araraticum (Jakubz.) Mac Key (syn. T. araraticum Jakubz.) and ssp. timopheevi. Ssp. araraticum grows wild in Transcaucasia. N. Iraq, W. Iran and E. Turkey. It was first described as T. dicoccoides ssp. armeniacum Jakubz. and as T. armeniacum Mak. Some types closely resemble T. dicoccoides . However the subspecies only crosses easily with ssp. timopheevi.

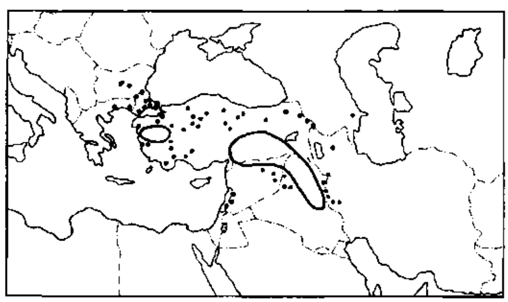
Ssp. timopheevi is part of the Zanduri wheat cultivated in Georgia (USSR). It is an ancient cultivated wheat. Its rather brittle rachis causes difficulties in threshing. It is difficult to cross with other Triticum species; It is a source of disease resistance, (Timopheevi) durum and aestivum plants often are male-sterile.

Maan (1973) concluded from his nucleo-cytoplasmic and cytogenic studies that T. timopheevi ssp. timopheevi and ssp. araraticum and T. dicoccoides var. nudiglumis ex Turkey-Iran -Iraq area have the same type of cytoplasm and the genome formula AAGG. The cytoplasm of Ae. speltoides* is closer to the above cytoplasm than to T. turgidum*-cultivated wheats.



Wild tetraploid Triticum species: Triticum turgidum ssp. dicoccoides (I,II,III,), ssp. dicoccoides var. nudiglunis (III) and T. timopheevi ssp. araraticum (IV) (Johnson, 1972).

TRITICUM TURGIDUM (L.) Thell. Wild emmer wheats. 2n=28, genome formula AABB. The distribution of the wild ssp. dicoccoides can be divided into two regions. The N. region is S. Turkey - Iran - Iraq, where var. nudiglumis is found; the S. region is Israel, S. Syria and Jordan. The cytoplasm of var. nudiglumis is similar to that of T. timopheevi*, whereas that of ssp. dicoccoides of the southern region is the same as the cultivated T. turgidum* (Maan, 1973). Ssp. dicoccoides (Körn.) Thell. (syn. T. dicoccoides Körn.). derived from a natural amphidiploidization of an unknown diploid species and T. monococcum ssp. boeoticum . This amphidiploidization must probably have occurred in Syria and Palestine, probably at several places. There has been much research to identify the unknown diploid parent. However in vain.



Triticum boeoticum (Harlan & Zohary, 1969).

The research has failed because the B genome of this species and of its donor have evolved of the first tetraploid Triticum species - some 100 000 years ago. Evolution followed different paths, which branched to give rise to several species with related but different B genomes.

From ssp. dicoccoides, several cultivated subspecies have been derived. These are dicoccum*, palaeocolchicum*, turgidum* and carthlicum*. The ssp. turgidum includes conv. turgidum, conv. durum, conv. turanicum and conv. polonicum. Ssp. dicoccoides is a source of disease resistance; it also carries a restorer gene of (timopheevi) cytoplasmic malesterility.

TRITICUM TURGIDUM (L.) Thell. Cultivated emmer wheats. 2n=28, genome formula AABB. The cultivated tetraploid wheat can be subdivided as follows (MacKey, 1966):
ssp. dicoccum (Schrank) Thell. (syn. T. dicoccum Schubl.)., emmer,
ssp. palaeocolchicum (Men.) Mac Key (syn. T. palaeocolchicum Men.,
T. georgicum Dek.), Georgian emmer, Kolchic emmer,
ssp. turgidum including conv. turgidum, Poulard wheat, English wheat, conv. durum (Desf.) Mac Key (syn. T. durum Desf.), durum wheat, hard wheat, conv. turanicum (Jakubz.) Mac Key (T. turanicum Jakubz., T. orientale Perc.), Khurasan wheat, conv. polonicum (L.) Mac Key (syn. T. polonicum L.) Polish wheat,
ssp. carthlicum (Nevski) Mac Key (syn. T. carthlicum Nevski, T. persicum Vav. ex Zhuk.), Persian wheat. They have originated by cultivation from ssp. didoccoides* and perhaps by intergeneric and interspecific hybridization.

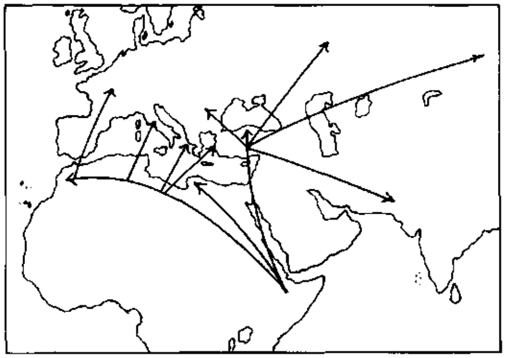
Primary centre in Near Eastern Region. Secondary centres in Ethiopia (p. 135) and in the Mediterranean Region (p. 112).

Emmer is the oldest cultivated wheat. Its cultivation is declining. Until recently, it was cultivated in Ethiopia (p. 135), Iran, E. Turkey, Transcaucasia, Volga Basin, Yugoslavia, Czechoslovakia and India. It may have been domesticated c.8000 BC. in the Fertile Crescent. The first appearance of domesticated emmer dates from c.7000 BC. at Aceramic Neolithic Beidha, Ali Kosh, Jericho and Ramad. Already in 4000-3000 BC., it had reached the Atlantic coast from Scandinavia to Spain and the Nile Delta. Helbaek (1960) was surprised by the uniformity of emmer. However plants are called dicoccum when they correspond to a certain morphological description. It is unknown whether the idiotypes of the various dicoccum populations also correspond to each other for characteristics other than morphological ones.

The disease-resistant khapli (khapli is the vernacular name of emmer) of India and Yaroslav emmer from USSR belong to ssp. dicocum.

Durum wheat is cultivated over a large area: Mediterranean coastal region, Ethiopia where a secondary centre exists (p. 135) and in areas north of the Black Sea. Another centre of diversity is in India (Jain et al., 1976). It is rarely observed in wheats of Iran and Afghanistan. It is also cultivated in the Americas and elsewhere. Distribution in the Old World is shown by Ciferri (1939). It is the second most important wheat in the world.

Turanicum wheat originally involved as an oasis ecotype. Its cultivation is restricted to irrigated fields (Mac Key, 1966). Mac Key suggested a wide occurrence in Asia, but Kuckuck (1970) and Bor (1970) limited it to Iran and Iraq. Kuckuck (1970) suggested that it is a hybrid of durum x polonicum.



Spread of durum wheat in the Old World (Ciferri, 1939).

Polonicum wheat, distinguished by long glumes and kernels was cultivated in S. Europe, Turkey, Iraq, Iran, Afghanistan and NW. India. According to Kihara et al. (1956), in includes T. ispahanicum Heslot.

Carthlicum wheat is characterized by the presence of the Q (vulgare) gene. It is not known whether this gene arose independently in this wheat or came from vulgare wheat. Carthlicum wheat was cultivated in Iraq, Iran and Caucasia. It is a source of disease resistance.

Georgian emmer, Kolchic emmer (ssp. palaeocolchicum) was formerly cultivated in a mixture with T. aestivum ssp. macha* in W. Georgia (USSR).

English wheat (conv. turgidum) was at one time cultivated in Europe and elsewhere. From time to time, it was reintroduced into cultivation because its branching habit (Osiris wheat, Wonder wheat) convinced farmers that its yield must be high.

TRITICUM ZHUKOVSKYI Men. & Er. Zanduri. 2n=42, genome formula AAAABB or $A^zA^zA^tA^tB^tB^t$. It was cultivated in W. Georgia, USSR. Zanduri was composed of einkorn, T. timopheevi ssp. timopheevi* and T. zhukovskyi. The latter is a hexaploid but its genome formula differs from those of the common hexaploid subspecies. It is a natural amphiploid of ssp. timopheevi and einkorn. Its cytoplasm has the same malesterilizing action on the durum and aestivum nuclei as ssp. timopheevi. It carries genes for resistance to stem rust and mildew.

ZEA MAYS L. Maize. 2n=20. Secondary centre in the Near East (Brandolini, 1970). Domesticated in C. America (p. 190). Flint maize - indurata Sturt. is common in the Near East.

Iridaceae

CROCUS SATIVUS*

Labiatae

LALLEMANTIA IBERICA Fisch. & Mey. Lallemantia. 2n=16. Asia Minor and some regions of USSR.

Cultivated in Iran and S. USSR for its oil seeds.

Leguminosae

ALOPHOTROPIS FORMOSUM (Boiss.) Lamprecht (syn. Pisum formosum (Stev.) Boiss., Vavilovia formosa (Stev.) Fed.). Wild perennial pea. 2n= 14. Montane and submontane zones of Asia Minor, Transcaucasia, Armenia and Iran.

CICER ARIETINUM L. Chick-pea, Gram, Garbanzos. 2n=14, 16, (24, 32, 33). Unknown wild. Secondary centres of diversity probably developed in Regions 4 (p. 76), 5 (p. 83) and 7 (p. 113). Cultivated in S. Europe and N. Africa from the Atlantic eastwards, the Nile Delta and Ethiopia, and northwards and eastwards to NW. Burma, W. China, Kazakhstan (USSR). Some of the Cicer species indigenous to Anatolia may have played a role in its ancestry, particularly C. pinnatifidum Jaub. & Spach., 2n=16, (from Anatolia, Soviet Armenia, Syria, N. Iraq and Cyprus), C. echinospermum P.H. Davis, 2n= , (from E. Anatolia) and C. bijugum K.H. Rech., 2n=16 (from SE. Anatolia, N. Syria, and N. Iraq) (van der Maesen, 1972).

Ladizinsky (1975a) found a wild annual species in Turkey: C. reticulatum Lad., 2n= , which is cross-compatible with chick-pea, producing a fertile F_1. This species resembles chick-pea and could be the wild parent of the cultigen. So Moreno & Cubero (1978) proposed to include it as ssp. reticulatum (Lad.) Moreno & Cubero in C. arietinum.

Race orientale Pop. is characterized by very small seeds (1000-seed weight 100-120 g). It is common in Ethiopia, Sudan, Egypt, India, the Pamirs, Tajikistan and Iran. Those from Ethiopia are black-seeded.

Race asiaticum Pop. has somewhat bigger, but still small, seeds (1000-seed weight 140-200 g). It occurs in C. Asia, Afghanistan, W. China, Iran and E. Turkey.

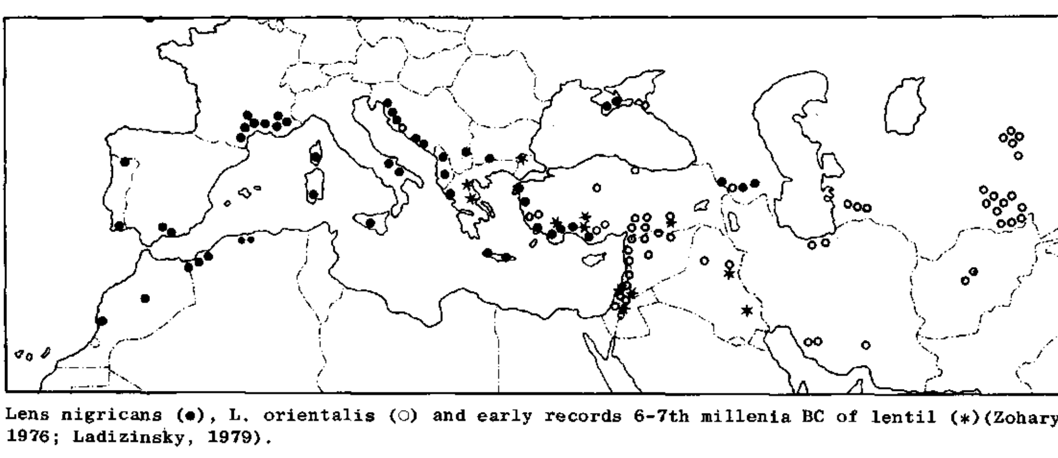
Race eurasiaticum Pop. has moderately large seeds (1000-seed weight 200-300 g). It is cultivated in the Near East, Armenia, Azerbaijan, Ukraine up to C. USSR, and near large cities in the eastern part of the area of cultivation. The seeds are white.

Race mediterraneum Pop. has the largest seeds (1000-seed weight over 350 g). It is found in Spain, Italy, Morocco, Algeria, Tunisia and W. Turkey. The seeds are white. However Moreno & Cubero (1978) grouped the cultivars into two races: the small-seeded in race microsperma, and the large-seeded in race macrosperma. The latter is selected from the first.

GALEGA ORIENTALIS Lam. 2n=16. Caucasia. Cultivated as a fodder and as an ornamental.

LENS ESCULENTA Moench (syn. L. culinaris Medik., Ervum lens L.). Lentil. 2n=14. Zohary (1972) suggested that L. orientalis (Boiss.) Hand.-Mazz., 2n= , is the wild ancestor of lentil; it grows wild in Region 6. L. orientalis is a dwarf lentil, as was confirmed by Williams et al. (1974). Ladizinsky (1979) too found a close affinity between the two species and L. nigricans (M.B.) Godr., 2n= . So Williams et al. (1974) concluded that lentil and its wild ancestor belonged to one species L. esculenta, both types being ssp. culinaris (Medik.) Williams, Sanchez & Jackson for lentil, and ssp. orientalis (Boiss.) Williams, Sanchez & Jackson for wild lentil.

Lentil had been divided by seed size into varieties: var. macrosperma, a large-seeded form from the Mediterranean Region, var. syrica Barul., a medium-seeded form from the inner mountainous region of Asia Minor, and var. afghanica Barul., a small-seeded form of the highlands of Afghanistan. Another division is ssp. macrosperma (Baumg.) Barul. and ssp. microsperma (Baumg.) Barul. However Williams et al. (1974) concluded that such division is meaningless as macrosperma and microsperma form the extremes of a cline for seed size. Microsperma is found in all prehistoric exca-



Lens nigricans (•), L. orientalis (○) and early records 6-7th millenia BC of lentil (*)(Zohary, 1976; Ladizinsky, 1979).

vations (van Zeist & Bottema, 1971).

Agro-ecological groups meet in Turkey, where there are microcentres of diversity (Harlan, 1951).

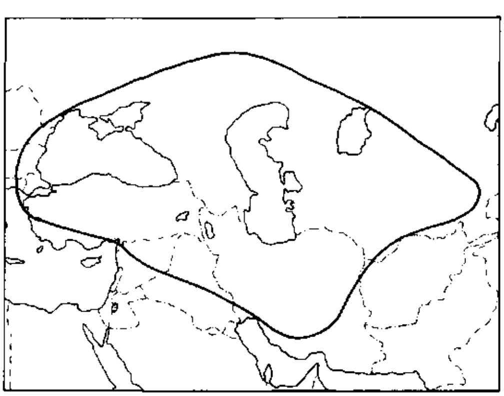
MEDICAGO CANCELLATA Bieb. 2n=48. SE. European USSR and N. Caucasia. Useful as gene source for adaptation of M. sativa* to poor soils.

MEDICAGO DZHAWAKHETICA Bordz. 2n=16, genome formula DD, 32. The (sub)alpine zones of the Alkhalak uplands, Georgia, USSR and a part of Asia Minor. A wild perennial species. Var. timofeevi Troitz., (2n=32) is endemic to Transcaucasia. It crosses fairly easy with M. sativa (Lesins and Lesins, 1966). Some include this species as var. dzhawakhetica Bordz. in M. papillosa Boiss. (2n=16).

MEDICAGO GLUTINOSA Bieb. 2n=32. Causasus. Useful as gene source for M. sativa*.

MEDICAGO ROMANICA Prod. 2n=16. Caucasia. A wild variable perennial species.

MEDICAGO SATIVA L. Lucerne, Alfalfa. 2n=16, genome formula SS; 32, genome formula SSSS; (48). The species probably evolved around the Caspian Sea, whence it spread as a wild plant. It was the first species to be cultivated as a forage crop, probably in association with the increasing use of horses and the development of light horse-drawn chariots in the first part of the 2nd Millenium BC. It was probably intentionally sown and the more vigorous tetraploid crowded out the diploid. During the



Medicago sativa (Fischer, 1938).

Persian-Greek War in the 5th Century BC., lucerne (from Provencal, meaning shining) and its older name alfalfa (from Arabic and ultimately Old Iranian aspo-asti, horse fodder) was introduced into Greece, whence it spread to S. Italy and Europe, and later to other parts of the world (Lesins & Lesins, 1979).

MEDICAGO SAXATILIS Bieb. 2n=16. Yaila Range of Mountains in Crimea. Useful as gene source for M. sativa*.

ONOBRYCHIS ALTISSIMA Grossh. 2n=14. Transcaucasia.

ONOBRYCHIS VICIIFOLIA Scop. Esparcette. 2n=28. Cultivation of this fodder crop started in S. France (p. 157). In Transcaucasia, var. transcaucasia (syn. O. transcaucasia Grossh.) is endemic.

PISUM SATIVUM L. (syn. P. arvense L.s.l.). Pea. 2n=14. This species may be divided into six subspecies: ssp. abyssinicum (p. 137), ssp. jomardi (p. 115), ssp. syriacum Berger, ssp. elatius (Stev.) Alef., ssp. arvense Poir., and ssp. hortense Asch. et Graeb. (Gentry, 1971).

Ssp. syriacum (syn. P. humile Boiss. et Noë, P. sativum var. humile, P. syriacum Berger) is found in N. Iraq, Jordan, Syria, N., NW. and W. Iran, Israel, Turkey and Cyprus. Some forms are robust (30-70 cm tall), others slender and small (20-40 cm) (Ben-Ze'ev & Zohary, 1973). This is Zohary's (1973) 'steppe' type. It is the primary wild progenitor.

Ssp. elatius (syn. P. elatius Stev.) is found in Syria, N. Israel, Lebanon, S. coast of Turkey, Aegean belt of Turkey and Greece, Cyprus, Adriatic coast of Yugoslavia, S. Italy, Sicily, Sardinia and scattered localities in Morocco, Algeria, Tunisia, S. Spain, S. France, N. Italy and the Black Sea coast of Turkey, Crimea and Caucasia (Ben Ze'ev & Zohary, 1973). This is Zohary's (1973) tall 'maquis' type.

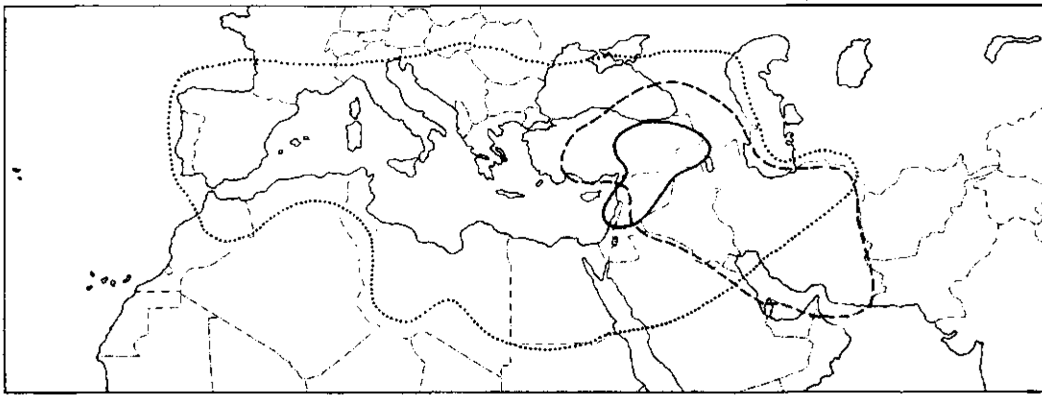
In the E. Mediterranean countries (esp. S. Turkey), intermediate types are found.

Ben Ze'ev & Zohary (1973) suggested that ecotypes of Turkey and Syria may have formed the parental material of the domesticated types ssp. arvense (P. arvense L.), field pea, and ssp. hortense (ssp. sativum, P. sativum L.), garden pea.

It may also derive from ssp. elatius, or from hybrids of ssp. elatius x ssp. arvense. Secondary centre in the Mediterranean Region (p. 115). It may have been domesticated in SW. Asia. The crop reached the Greeks by way of the Black Sea, who passed it on to Latin and Germanic tribes. It spread to India and China through the Himalayas and Tibet, and to Ethiopia and E. Africa (Purseglove, 1968).

TRIFOLIUM AMBIGUUM M.B. Caucasian clover. 2n=2x=16, (32; allo-6x=48). Caucasia, Crimea and Turkey. This valuable fodder plant forms an essential part of pastures and meadows. In Australia, an allohexaploid cultivar derives from an introduction from USSR. It withstands periods of 6 weeks submerged in water.

TRIGONELLA FOENUM-GRAECUM L. Fenugreek. 2n=16, (4x=32). Probably SW. Asia. Cultivated in S. Europe, N. Africa and India as a fodder. The seeds are also eaten in India and used in medicine.



Pisum humile (—), P. elatius (···) and Alophotropis formosum (---)(Govorov, 1937).

VICIA ERVILEA (L.) Willd. Bitter vetch, Ervil. 2n=14. Primary centre in the Mediterranean Region (p. 116). In Asia Minor, a characteristic group developed.

It is now cultivated as a fodder but in prehistoric times it was cultivated for food. It was already cultivated in Turkey in 5750 BC. and probably in Greece about 5500 BC. (van Zeist & Bottema, 1971).

VICIA NARBONENSIS L. Narbonne vetch. 2n=14. Primary gene centre probably E. Georgia. Secondary gene centre in the Mediterranean Region. This species is a weed in wheat and barley fields of Transcaucasia and other areas in SE. Asia. It is not cultivated there.

VICIA PANNONICA Crantz. Hungarian vetch. 2n=12. Primary gene centre in Georgia (USSR), on the plateau of Akhalkalak, where it grows wild and is cultivated. Secondary gene centre in Hungary.

VICIA SATIVA L. Common vetch. 2n=10, 12, 14. The V. sativa aggregate is complex because of variation in form, in chromosome number and in karyotype, and of irregular cytogenetic affinities between the types with different karyotypes (Ladizinsky & Temkin, 1978). The 3 cytotypes are found among the wild, weedy and domesticated types (Zohary & Plitmann, 1979). In the wild types, they are partially isolated by ecological barriers, partial hybrid sterility and predominance of self-fertilization. Human disturbance of the land has removed these barriers and increased variation, including that of the karyotypes.

Zohary & Plitmann (1979) divided the aggregate up as follows:

1. ssp. sativa, 2n=12, 7 karyotypes found. From Atlantic fringe of Europe through Mediterranean to W. India, weedy, escapes and cultivars (seed and hay), run wild in New World
2. ssp. macrocarpa (Moris) Arcang., 2n=12, 2 karyotypes. W. Mediterranean, cultivars (seed)
3a. ssp. nigra (L.) Ehrh. var. nigra (syn. V. sativa L. var. angustifolia L.), 2n=12, more than 25 karyotypes. Mediterranean Basin and Europe, run wild in the New World, cultivated for hay.
3b. ssp. nigra (L.) Ehrh. var. segetalis (Thuill.) Ser. in DC (syn. V. segetalis Thuill.), mostly 2n=12, more than 80 karyotypes. Mediterranean Basin deep into C. Europe, very weedy, recently cultivated for hay.
4. ssp. cordata (Wulfen ex Hoppe) Aschers. & Graebn. (syn. V. cordata Wulfen ex Hoppe), 2n=10, more than 30 karyotypes. Mediterranean Region, very weedy, some domesticated types (hay)
5. ssp. incisa (M.B.) Arcang. (syn. V. incisa M.B.), 2n=14, karyotypic variation unknown. Near East
6. ssp. amphicarpa (Dorth.) Aschers. & Graebn. (syn. V. amphicarpa Dorth.), 2n=14, karyotypic variation unknown. Mediterranean Area and Near East. This type is unique for its subterranean pods and is according to Ladizinsky (1978) an advanced form
7. ssp. pilosa (M.B.) Plitm. & D.Zoh. (syn. V. pilosa M.B.), 2n=14, karyotypic variation unknown. Crimea and Caucasia.

By further hybridization of cytotypes and karyotypes, and by natural and human selection, the variation of this species may still increase considerably.

VICIA VILLOSA Roth. Sand vetch, Hairy vetch, Winter vetch. 2n=14. W. and C. Europe, Mediterranean Region, N. Iraq, N. Iran and SW. of USSR. Primary centre probably W. Asia and Ante-Asia. Spread to the Mediterranean area and Europe as a cereal weed.

Liliaceae

HYACINTHUS ORIENTALIS L. Common hyacinth. 2n=16, (24, 32). Syria, Asia Minor, Greece and Dalmatia. Cultivated in the Netherlands as an ornamental and in S. France as a source of an essential oil used in perfumery.

Linum usitatissimum, various length and branching types

Linaceae

LINUM USITATISSIMUM L. Flax, Linseed. 2n=30, (32). Primary centre probably in Central Asian Region (Vavilov, 1957), since flax varies widely in India and adjacent northerly areas. However as the progenitor of flax, L. bienne Mill. (Pale flax, 2n=30) is not found in this area it cannot have been domesticated there (Helbaek, 1956). Helbaek suggested that flax was domesticated about the same time as emmer and barley in the mountains of the Near East. Thence it spread to other parts of the Old World. So it must have been domesticated before c.6200 BC.(van Zeist & Bakker-Heeres, 1975).

L. bienne can be divided into two main geographic races. The first is the continental winter annual of the semi-arid foothills of Iraqi Kurdistan and Iran. It might be the parent of the prostrate multi-stemmed type cultivated since ancient times along the N.coast of Turkey, the Caspian coast of Azerbaijan and some parts of Colchis bordering the Black Sea. According to Helbaek (1956), this type is the ancestor of the small-seeded flax cultivated by the prehistoric C. European pile-dwellers. The latter is the parent of 'Winterlein', a winter annual cultivated in mountainous S. Germany.

The second is the Atlantic-Mediterranean coastland race, a perennial, also described as L. angustifolium Huds. (2n=30). It has the highest seed oil content and the highest seed weight of all wild species (Seetharam, 1972).

During domestication and furter development, types for fibre (flax) and oil (linseed) developed.

Malvaceae

ALTHAEA OFFICINALIS*

ALTHAEA ROSAE*

GOSSYPIUM AREYSIANUM Deflers. 2n=26, genome formula E_3E_3. S. Arabia. It is drought-resistant and early maturing.

GOSSYPIUM HERBACEUM L. Short-staple cotton. 2n=26, genome formula A_1A_1. S. Africa (p. 139). Introduced to Ethiopia, S. Arabia and Baluchistan, where race acerifolium* developed. In Iran, a characteristic group of annual forms has arisen, named race persicum. It spread to W. India, where it was the first annual cotton cultivated. Varieties of G. herbaceum are now often cultivated. In C. Asia, race kuljianum developed. It matures in three months from sowing, giving a small crop.

GOSSYPIUM INCANUM (Schwartz) Hillcoat. 2n=26, genome formula E4E4. S. Yemen. It is drought-resistant.

GOSSYPIUM STOCKSII*

Moraceae

FICUS CARICA L. Common fig. 2n=26. Probably S. Asia. Primary gene centre in SE. Asia. Spread to Asia Minor, Mediterranean countries and W. Europe (Storey & Condit, 1969). Long cultivated. In 4000 BC., figs were already cultivated in Egypt. In Transcaucasia, Crimea, C. Asia, Baluchistan and the Mediterranean countries, it ran wild a long time ago.

Aweke (1979) suggests that Ethiopia or at least Africa might be the area of origin of the fig and that F. palmata* is its ancestor. Var. transcaspica from the Kopet Dagh of Turkmenia is a source of frost resistance.

FICUS SYCOMORUS L. Sycomore fig. 2n=26. Its distribution is given on p. 116. Galil et al. (1976) suggested that the sycomore was domesticated in the Middle East where man was forced to propagate the tree vegetatively because of the lack of the specific pollinator.

Nelumbonaceae

NELUMBO NUCIFERA Gaertn. Indian lotus. 2n=16. Centre of diversity probably lies in N. Iran, the Kura Estuary in Transcaucasia and Volga Delta. Cultivated in China, Japan and elsewhere for its rhizomes and fruits. Formerly it was also grown in the E. Mediterranean Region

(Hjelmquist, 1972).

Papaveraceae

PAPAVER SOMNIFERUM*

Polygonaceae

FAGOPYRUM ESCULENTUM Moench. (syn. F. vulgare T. Nees, F. sagittatum Gilib., Polygonum fagopyrum L.). Buckwheat, Silverhull. 2n=16, 32. C. Asia. Introduced into several countries as a grain crop. It is often found as a ruderal. It is insect-pollinated.

Punicaceae

PUNICA GRANATUM L. Pomegranate. 2n=16, 18, 19. Wild in the Near East and C. Asia. An ancient fruit-tree, which was even cultivated in the Hanging Gardens of Babylon. Cultivated now in many countries. The only related species is P. protopunica Ralf. found wild on Socotra in the Indian Ocean.

Resedaceae

RESEDA PHYTEUMA*

Rosaceae

AMYGDALUS BESSERIANA*

AMYGDALUS COMMUNIS L. (syn. Prunus amygdalus Batsch.). Almond. 2n=16. Primary gene centres in C. Asia (p. 84) and in the Near Eastern Region.

AMYGDALUS FENZLIANA (Fritsch) Lipsky (syn. A. divaricata Fenzl., A. urartu S. Tam., Prunus fenzliana Fritsch.). Fenzel almond. 2n=16. S. Transcaucasia and Anatolia. An ornamental. It easily crosses with A. communis* and it might be a source of cold and drought resistance for that species.

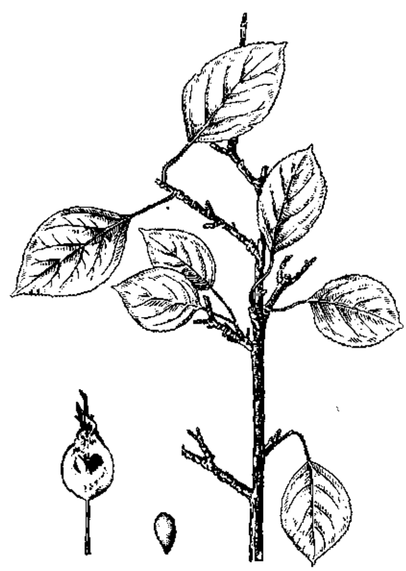
AMYGDALUS PERSICA L. Peach. 2n=16. Primary centre in China (p. 42). Secondary centre in Caucasia and Crimea.

ARMENIACA VULGARIS L. Apricot. 2n=16. Primary centres in NE. China (p. 42) and in Daghestan on the slopes of the Khunzakh Plateau at an altitude of 1200-1800 m. The latter centre probably formerly linked with the main one (p. 42). The tree has a shrubby habit. Cultivated over the entire Near East.

CYDONIA OBLONGA Mill. Quince. 2n=34. Talysh Mountain Range (S. Daghestan), the Ior Valleys and Azalan (Georgia), in the Terter Valley (Soviet Azerbaijan) and in the canyons of Aidero and Yuz-Begi, Kopet Dagh (USSR). Primary centre lies there. Long cultivated.

MALUS ORIENTALIS Uglits. 2n= . This is the only wild Malus species in the especially sparse oak forest of Caucasia. It is polymorphous. Through introgression, characteristics such as tallness, late ripening, good transportability of fruits, high sugar content and, unfortunately, low hardiness entered the cultivated apple (Malus pumila Mill.), as can still be recognized in Caucasian, Crimean and even Italian cultivars.

MALUS PRUNIFOLIA (Willd.) Borkh. (syn. Pyrus prunifolia Willd.). Chinese apple. 2n=34, 51, 68. Primary centre in N. China. Cultivated in E. Asia for its fruits. In the USSR, this species is represented in wild forms in E. Siberia. It is highly resistant to frost and drought, much used by I.V. Michurin to breed hybrid varieties such as Kandil Kitaika (Kitaika = Chinese), Bellefleur Kitaika, Saffran Peppin, Saffran Kitaika.



Malus prunifolia

MALUS PUMILA*

MALUS TURKMENORUM Juz. & M. Pop. 2n= . Turkmenia, in the gorges of the Kopet Dagh. Primary gene centre also there. The cultivated form is known in Russian as 'Baba-arabka' (old arab woman). This name refers to the dying-down of the main stem at an age of about 20 years and its replacement by soboles permanently rejuvenating the tree.

MESPILUS GERMANICA L. Medlar. 2n=34. Caucasia, N. Iran and Asia Minor. Cultivated elsewhere and run wild there. It crosses with Crataegus oxyacantha* and Sorbus aucuparia*.

PRUNUS AVIUM L. (syn. Cerasus avium Moench.). Sweet cherry, Mazzard. 2n=16, (24, 32). Primary centre in Asia Minor and Transcaucasia. Wild trees also in other parts of Europe, W. Asia and N. Africa. The wild trees of Ukrainia could be grouped into four classes: 1. dark-coloured fruit: a. bitter and b. sweet and 2. light-coloured fruit: c. bitter and d. sweet. The sweetfruited types had elongate stones and longer fruit-stalks and petioles than the bitter-fruited types (M'yakushko & M'yakushko, 1970). It is likely that man selected the sweet-fruited types.

Rjadnova (1967) suggested that domestication occurred in various places. This resulted in several ecotypes differing, for instance, in resistance to unfavourable conditions and quality of fruit. Constant selection resulted in large-fruited hardy types.

P. avium is one of the parents of P. cerasus*. Hybrids with P. cerasus (P. x gondounii (Poiteau & Turpin) Rehder are known in W. Europe as 'Duke' cherries. These hybrids and P. cerasus are sources of resistance to bacterial canker caused by Pseudomonas syringae Van Hall.

PRUNUS CERASIFERA Ehrh. (syn. P. divaricata Led.). Cherry plum, Myrobalan. 2n=16, genome formula CC, (24, 32, 48). Wild in Caucasia, Iran, Asia Minor, Altai and C. Asia. Primary centre C. and S. Caucasian coast of the Black Sea, whence it spread eastwards and westwards. Secondary centre in W. Tien-Shan (p. 85). It is highly polymorphic.

This species is one of the parents of P. domestica*. It is also planted as a rootstock and in hedges. Var. pissardii (Carrière) L.H. Bailey has dark red leaves and flowers tinged with reddish pink. It is an ornamental.

PRUNUS CERASUS L. (syn. Cerasus vulgaris Mill.). Sour cherry, Pie cherry. 2n=32. Unknown wild, although trees that have run wild grow mainly in Caucasia and Asia Minor, but also in the European USSR, W. Balkan countries and Germany. Probably an allotetraploid of P. fruticosa* x P. avium*. Sour cherry can be divided into the true Sour cherries and 'Duke' cherries. The first can be subdivided into Morellos (austera L.) and Amarelles (caproniana L.) (Zylka, 1971a).

A special population 'Vladimir cherry' originated in Region 9 (p. 160).

PRUNUS DOMESTICA L. Garden plum, Domestic plum. 2n=48, genome formula CCSSSS or $CdCdSSS_1S_1$ or $CdCdD_1D_1D_2D_2$. Caucasia. This species is thought to be a natural hexaploid of P. cerasifera* and P. spinosa*. This alloploidization apparently took place in Caucasia, where both species occur and natural hybrids with 2n=24 and 48 are still found. However it may have happened elsewhere. For instance Werneck (1958) considered the garden plum to have arisen in Upper Austria (p. 160).

Rybin (1936) resynthesized the garden plum. Artificial hexaploids resembled the natural ones.

PRUNUS SPINOSA L. Blackthorn, Sloe. 2n=32, genome formula SSSS of SSS_1S_1 or SSC_sC_s. Wild throughout the entire territory of this centre and in Europe and N. Africa. Volga Basin types carry genes for high hardiness. It is one of the parents of P. domestica*. Some natural hybrids with P. domestica are described as P. fruticans Weihe (2n=40).

PYRUS. The Near East is the main geographic centre of origin of Pyrus species. Of about 60 Pyrus species in the world, about 25 have been described for Caucasia. Some of them also occur in Iran or in Asia Minor.

PYRUS CAUCASICA Fed. 2n= . The entire forest zone of Caucasia except the Talysh Mountain Range (Soviet Azerbaijan). A polymorphic species. In open areas, it spreads quickly and vigourously.

PYRUS SYRIACA Boiss. 2n= . Armenia. It is cold-resistant and probably played a part in the origin of the cultivated pear (Evreinov, 1944). Cultivated locally.

PYRUS TAKHTADZHIANA Fed. 2n= . Habit of a cultivated tree. Cultivated in ancient times but later ran wild.

ROSA CENTIFOLIA L. (syn. R. gallica L. var. centifolia Reg.). Provence rose. 2n=28. E. Caucasia. Cultivated for its flowers. The petals are used in the perfume industry.

SORBUS DOMESTICA L. Service tree. 2n=34. Its distribution is given on p. 161. Large-fruited forms are found in forests of Crimea.

Rubiaceae

COFFEA ARABICA L. Arabica coffee. 2n=22, 44, (66). The primary centre in SW. Ethiopia. Secondary centre in Yemen. This area is the source of Arabica coffee now cultivated in Latin America, Kenya, India, Java and elsewhere (Meyer, 1965).

Rutaceae

CITRUS MEDICA L. Citron. 2n=18. Probably SW. Asia. although India has often been mentioned as centre of origin. Unknown wild. It has now spread through the (sub)tropics.

The Etrog citron (var. ethrog Engl.) is used by Jews at the Feast of Tabernacles, and the fingered citron (var. sarcodactylis Noot.) Swing) by the Chinese as a medicine and an ornamental.

Umbelliferae

CUMINUM CYMINUM*

DAUCUS CAROTA L. Carrot. 2n=18. For origin see p. 86. By hybridization between the 'Eastern' and 'Western' carrots in Turkey, a secondary centre of diversity has developed there.

MALABAILA SECACUL (Mill.) Boiss. Sekakul. 2n= . Asia Minor and Syria. Cultivated for its roots, used as a aphrodisiac.

PIMPINELLA ANISUM L. (syn. Anisum vulgare Gaertn., Anisum officinarum Moench). Anise plant. 2n=18, 20. Probably the Orient. Cultivated for aromatic fruits.

Valerianaceae

VALERIANA PHU L. 2n= . N. Anatolia. Cultivated for its rhizome, which yields the drug valerian.

Vitidaceae

VITIS LABRUSCA L. Fox grape. 2n=38. N. America (p. 206). Introduced into W. Georgia (USSR) as a cultivated grape.

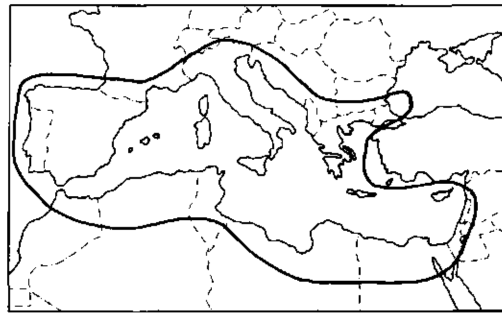
VITIS VINIFERA L. Common grape, European grape. 2n=38, (40, 57, 76). Primary centres: the Central Asian (p. 86), the Near Eastern and the Mediterranean Regions (p. 119). The wild vine, ssp. sylvestris Gmel., is found in regions bordering the Mediterranean Sea, except Libya and Egypt, up to Turkestan and Kashmir. Primary centre: probably Armenia (USSR) and N. Iran. The western wild types have been called ssp. silvestris, and the eastern types ssp. caucasia Vav. The wild type is dioecious and the domesticated type (ssp. sativa DC, ssp. vinifera) is hermaphrodite derived from the male wild plants.

The vine may have been domesticated in SE. Europe where types with large bunches, and seedless grapes have developed. Natural hybrids are still forming in several areas, e.g. the mountains of S. Tajikistan (USSR), where many new forms are observed. From crosses between the wild grape and cultivated types in Europe, old and new cultivars developed.

The common grape has been crossed with the North American V. labrusca*. The fruits are used to prepare wine, currants and raisins.

V. amurensis* is a possible source of hardiness.

7 *Mediterranean Region*



The Mediterranean Region was described by Vavilov. Darlington (1956) suggested the name Mediterranean Region of Origin.

Its situation near the Cradle of Agriculture in the Near East led to an early introduction of plant cultivation. Early farming sites have been found at Nea Nikomedeia in Greece dating c.5470 BC. (van Zeist & Bottema, 1971) and at Fayum in Egypt dating from the 5th Millenium, reaching the coast of the Atlantic perhaps c. 3rd Millenium. A very old site at Kom Ombo in the Nile Valley of Upper Egypt dated from 15 000-10 500 BC. It is a non-farming site occupied the whole year round (Churcher & Smith, 1972).

Many crops have been domesticated in the region including Avena sp., Beta vulgaris, Brassica napus, B. oleracea, Lathyrus sp., Linum usitatissimum, Lolium sp., Lupinus sp., Olea europaea, Raphanus sativus, Trifolium sp. and Vitis vinifera.

Alliaceae

ALLIUM CEPA L; Spanish onion. 2n=16. See p. 81. Secondary centre in the Mediterranean Region.

ALLIUM SATIVUM L. Garlic. 2n=16, genome formula SS. C. Asia (p. 81). Secondary centre in the Mediterranean Region (Kazakova, 1971).

Amaranthaceae

AMARANTHUS LIVIDUS L. 2n=34. Spread through Europe, Asia and to the tropics of the Old and New World. Var. ascendens Thell. (syn. A. viridis L., 2n=34) is native to S. Europe and E. Mediterranean Region. Cultivated there in the Middle Ages. Var. lividus is unknown wild. It might be a cultigen of this species. It was cultivated in the 16th and 17th Centuries as a vegetable and medicinal crop and in the 18th Century as pig food.

Var. oleraceus Thell. (syn. A. oleraceus L., 2n=) is probably a cultigen of var. ascendens. Cultivated in Europe and elsewhere as a vegetable (Mansfeld, 1959).

Amaryllidaceae

NARCISSUS JONQUILLA L. Jonquille. 2n=14. Europe, Ante-Asia to Iran and Algeria. Commonly cultivated as an ornamental and in S. France for its essential oil.

NARCISSUS POETICUS L. Poet's narcissus. 2n=14, 21. Portugal, Spain, France and Italy. Cultivated as an ornamental and in S. France for its essential oil.

Anacardiaceae

RHUS CORIARIA L. Sicilian sumach. 2n= . Mediterranean area. A shrub cultivated in Sicily and S. Italy for the leaves, which are a source of tanning material.

Apocynaceae

NERIUM OLEANDER L. Oleander. 2n=16, 22. A shrub of Mediterranean area. Cultivated as an ornamental.

Asclepiadiaceae

CYNANCHUM VINCETOXICUM*

Balanitaceae

BALANITES AEGYPTIACA Del. Betu, Desert date. 2n=16, 18. This shrub grows wild in Arabia, Palestine, N. Trop. Africa and Angola. Cultivated in Egypt for its edible leaves and flowers (Cufodontis, 1957; Terra, 1967).

Boraginaceae

ALKANNA TINCTORIA (L.) Tausch. Alkanna. 2n=14. S. and E. Europe and Turkey. A herb cultivated as a source of a red pigment.

BORAGO OFFICINALIS L. Borage. 2n=16. Mediterranean Region. A herb cultivated as an ornamental, as a pot-herb and for bees.

Capparidaceae

CAPPARIS SPINOSA L. Caper bush. 2n=24, 38. The cultivated forms with large flower-head, var. spinosa, and small flower-head, var. parviflora J. Grey probably derived from the wild var. aegyptia (Lam.) Boiss. This variety grows wild in S. and SE. Mediterranean area to the Sudan and Eritro-Arabia. Var. spinosa developed in the N. Mediterranean Region, whence it spread to other areas, where it is cultivated as a condiment. Var. parviflora is also cultivated and might be a mutant of var. spinosa. Hybrids with C. ovata Desf. are found.

Caryophyllaceae

DIANTHUS CARYOPHYLLUS L. Carnation, Clove, Pink, Picotee. 2n=30. Mediterranean Region. A perennial herb cultivated as an ornamental and also as a source of an essential oil.

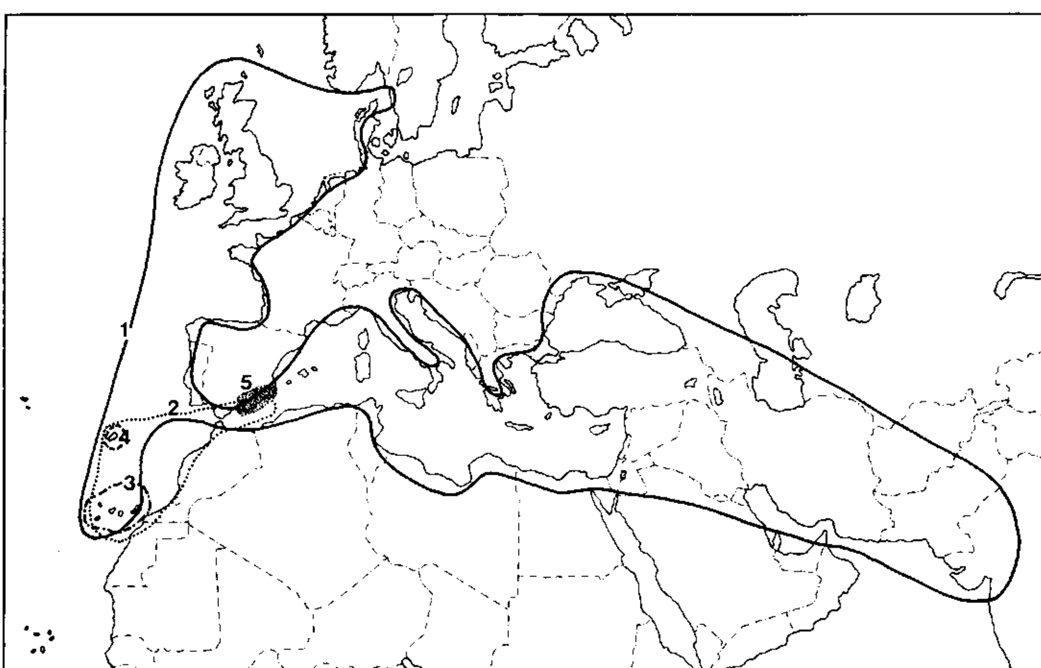
GYPSOPHILA PANICULATA L. Baby's breath. 2n=34. S. and C. Europe and Caucasia. Cultivated formerly for its roots, which contain saponin. Now it is an ornamental.

Chenopodiaceae

BETA PATELLARIS Moq. 2n=18, (36). Mediterranean and Atlantic coasts of NW. Africa, Canary Islands, Cape Verde Islands and Madeira. A source of resistance to nematodes and Cercospora and tolerance to yellow mosaic for B. vulgaris*.

BETA PROCUMBENS Chr. 2n=18. Canary Islands and Cape Verde Islands. A source of nematode resistance for B. vulgaris*.

BETA VULGARIS L. Beet. 2n=18, genome formula VV. The parental form is the wild sea-beet (ssp. maritima (L.) Thell., syn. B. maritima L.). Primary centre probably in the E. part of the Mediterranean Region. Spread in a westerly direction along the Mediterranean, Atlantic coast of Europe and to Cape Verde Islands and Canary Islands. In the Mediterranean Region, leaves and roots of the wild plant may have been collected, perhaps leading to development of Swiss chard and Spinach beet (var. cicla, var. vulgaris), whose leaves and stalks are eaten, and to garden beet, table beet and red beet (var. cruenta, var. esculenta). Development may have been influenced by hybridization with wild types like ssp. macrocarpa (syn. B. macrocarpa Guss.) in N. Africa. In California, such hybridization still continues (McFarlane,



Beta vulgaris (1), B. patellaris (2), B. procumbens and B. webbiana (3), B. patula (4) and B. atriplicifolia (5)(Ulbrich, 1934).

1975). The fodder beet (var. rapa) probably developed in the Netherlands (p. 149), after introduction of types from Spain, and the sugar -beet in Silesia (Poland) (p. 149). The wild B. macrocarpa Guss. from the coasts of the Mediterranean Region and Canary Islands, B. patula Ait. from Madeira and B. atriplicifolia Rouy from S. Spain easily hybridize with B. vulgaris, with which they may be included as subspecies.

In NW. Europe, hybrid plants of cultivated sugar-beet and ssp. maritima are occasionally observed. They derive from material propagated in France and Italy. Such hybrids bolt in the first year, producing seed. The seed drops and may result in a weed (F_2 plants) for several years. It is possible that, on a very small scale, wild genes derived from these hybrids introgress into the cultivated population.

The wild plants may form sources of resistance to disease such as Cercospora, yellow mosaic and increase the variation for selection of new high-yielding types.

BETA WEBBIANA Moq. 2n=18. Canary Islands. A source of nematode resistance for B. vulgaris*.

CHENOPODIUM AMBROSIOIDES L. American wormweed, Indian wormweed. 2n=16, 32, 36, 64. Probably S. Europe. Widespread in the tropics and introduced into N. America. The cultivated type, var. anthelminticus L. is a source of medicinal and essential oils.

HALOGETON SATIVUS (L.) Moq. 2n= . NW. Africa. Cultivated in the Mediterranean Region for the base-rich ash it yields when burned.

Compositae

ANACYCLUS OFFICINARUM Hayne. Bertram. 2n=18. Probably the Mediterranean Region. Formerly cultivated in C. Europe.

ANACYCLUS PYRETHRUM (L.) Link. Pellitoria of Spain. 2n=18. N. Africa, Arabia and Syria. Formerly cultivated in Europe as a medicinal plant and now in Algeria for an essential oil.

ARTEMISIA JUDAICA L. 2n= . Cultivated in the Mediterranean Region.

CALENDULA OFFICINALIS L. Marigold. 2n=(28), 32. Centre of origin probably in the Mediterranean Region. Cultivated as an ornamental, but formerly as a medicinal plant.

CICHORIUM ENDIVIA L. Endive, Escarolle. 2n=18. S. Europe to India. Cultivated as a vegetable.

CNICUS BENEDICTUS L. (syn. Centaurea benedicta L., Garberia benedicta Adans.). Blessed thistle. 2n=22. Mediterranean Region to Transcaucasia, Syria and Iran. Formerly cultivated in Germany.

CYNARA CARDUNCULUS L. (Wild) cardoon. 2n=34. W. and C. Mediterranean area. Cultivated for its leaf stalks. Probably together with C. syriaca*, one of the parents of C. scolymus* (Zohary & Basnizky, 1975).

CYNARA SCOLYMUS L. Artichoke, Globe artichoke. 2n=34. Mediterranean area. Cultivated for soft fleshy edible receptacles of young flower heads and thick bases of the scales around the flower heads as well as for a source of a bitter compound. Several varieties are known. If it derives from C. syriaca* with introgression of C. cardunculus*, it originated in W. Mediterranean area; if it derives from C. cardunculus with introgression of C. syriaca, it originated in E. Mediterranean area (Zohary & Basnizky, 1975).

CYNARA SIBTHROPIANA Boiss. & Heldr. 2n= . Mainly on Aegean Islands, Crete and Cyprus. Related to C. cardunculus* and C. scolymus* (Zohary & Basnizky, 1975).

CYNARA SYRIACA Boiss. Wild Syrian artichoke. 2n= . Levant and S. Turkey. Probably one of the ancestors of C. scolymus*.

LACTUCA VIROSA L. Bitter lettuce, Lettuce opium. 2n=18. Primary centre round the Mediterranean (Lindqvist, 1960). Cultivated on a small scale in some parts of Europe for its latex, which has narcotic properties.

SCOLYMUS HISPANICUS L. Golden thistle, Spanish oyster plant. 2n=20. Mediterranean area. A root vegetable. Its cultivation is declining.

SCORZONERA HISPANICA L. Scorzonera, Black salsify. 2n=14. C. Europe, Mediterranean area, Caucasia and S. Siberia. A vegetable especially of S. Europe. Perhaps it was first cultivated in Spain (Mansfeld, 1959).

SILYBUM MARIANUM (L.) Gaertn. Holy thistle, Milk thistle, Lady's milk. 2n=34. S. Europe. Cultivated as a medicinal plant and as an ornamental.

TANACETUM CINERARIIFOLIUM (Trev.) Schultz Bip. (syn. Chrysanthemum cinerariifolium (Trev.) Brocc. Pyrethrum. 2n=18. Dalmatian coast including Yugoslavia and Albania. Introduced into many countries. Kenya is the main producer of the insecticide pyrethrin.

TANACETUM PARTHENIUM (L.) Schultz Bip. (syn. Chrysanthemum parthenium (L.) Bernh., Leucanthemum parthenium (L.) Gren. & Godron, Pyrethrum parthenium (L.) Sm). Feverfew, Wild camomile. 2n=18. Mediterranean area, Balkan, Asia Minor and Caucasia. Cultivated as medicinal plant and as an ornamental.

TRAGOPOGON PORRIFOLIUS L. Salsify, Oyster plant, Purple goats beard. 2n=12. Mediterranean Region. This vegetable was first cultivated for its roots long ago. It may have been eties have been described (Mansfeld, 1959): var. oleiformis Pers. (R. chinensis Mill.) is the oil-seed radish cultivated in India, Japan, China (p. 35) and on a small scale in Rumania and Spain; var. mougri Helm* (syn. R. caudatus L.); var. sativus, the radish, small radish; var. niger Kerner, radish, Spanish radish. Recently fodder radish has been bred. It is a reputed selection from oil-seed radish in France. More research is needed to ascertain the origin of radish and the various botanic varieties and cultivars. Through natural (and artificial) hybridization with Brassica spp., genes may introgress into R. sativus.

SINAPIS ALBA L. (syn.Brassica alba (L.)Boiss.). White mustard. 2n=24, Mediterranean area. The wild plant is low-growing and much-branched, with siliquae containing browny black seeds (melanosperma) (Hemingway, 1976). Weedy or naturalized plants may be found from Spain through Asia Minor to E. India. Young seedlings are used as salad. Seeds are the source of white mustard.

Cucurbitaceae

BRYONIA CRETICA*

CITRULLUS COLOCYNTHIS (L.) Schrad. Colocynth. 2n=22, (34). Arid regions of N. Africa and Trop. Asia. Cultivated in India and the Mediterranean area for its purgative fruits.

ECBALLIUM ELATERIUM (L.) A. Rich. Squirting cucumber. 2n=(18), 24. Mediterranean area, Azores, Asia Minor and Crimea. Cultivated in England as a medicinal plant.

Cyperaceae

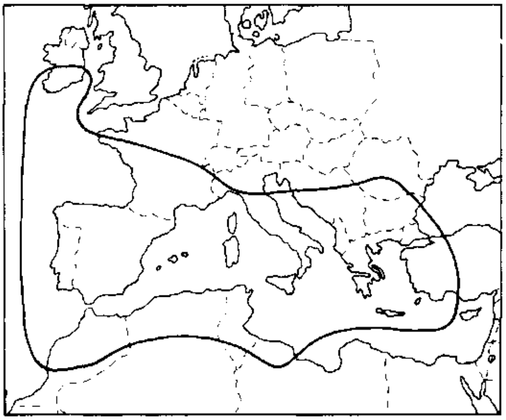
CYPERUS ALOPECUROIDES Rottb. Mat sedge. 2n= . Trop. Old World. Cultivated in Egypt for mat-making (Mansfeld, 1959).

CYPERUS ESCULENTUS L. Chufa, Earth almond, Tiger nut, Rush nut, Zulu nut, Yellow nutgrass. 2n=(18), 108. White Nile region and in the tropics. Introduced to S. Europe by the Arabs. Cultivated in Spain, Italy and elsewhere for its flavoured tubers. The wild form is var. aureus (Ten.) Richt. and the cultivated form is var. esculentus.

CYPERUS PAPYRUS L. Papyrus plant. 2n=c.102. Africa. Formerly cultivated in Egypt, Palestine and the Mediterranean Area. Now rarely cultivated. It could probably remedy and prevent eutrophication of tropical lakes by nutrient extraction. 'More active' extractor genotypes could perhaps be obtained by breeding.

Ericaceae

ARBUTUS UNEDO L. Strawberry tree, Arbutus. 2n=26. Mediterranean Region. Occasionally cultivated for its edible fruits.



Arbutus unedo (Hutchinson, 1969).

Euphorbiaceae

CHROZOPHORA TINCTORIA (L.) Juss. Giradol. Mediterranean Region, France, Yugoslavia, Crimea to W. Asia, NW. India, Arabia. Formerly cultivated in S. France as a source of red and blue dye. The red dye was used for colouring Dutch cheeses.

EUPHORBIA LATHYRUS L. 2n=20. S., W. and C. Europe. A ruderal and weedy plant occasionally cultivated as a medicinal. Probably only native to E. and C. Mediterranean Region.

Fagaceae

QUERCUS SUBER L. Cork oak. 2n=24. W. Mediterranean Area. A very variable species. Cultivated in S. France, Portugal, Spain, Sardinia, Corsica, Istria, Dalmatia and Algeria.

Geraniaceae

ERODIUM CICUTARIUM (L.) L'Herit. ex Ait. Storksbill, Red-stem filaree, Alfilaree. 2n=(20, 30-40, 36), 40, (48, 54). S., W. and C. Europe, Mediterranean area, Temp. Asia. Cultivated as fodder for sheep in N. and S. America.

ERODIUM MOSCHATUM (L.) L'Herit. ex Ait. Musk storksbill, White-stem filaree. 2n=20. Mediterranean Region. Formerly cultivated as a medicinal crop.

Gramineae

AEGILOPS BICORNIS (Forsk.) Jaub. & Sp. (syn. Triticum bicorne Forsk.). 2n=14, genome formula S^bS^b. Xeric sandy soils of S. Israel, Lower Egypt and Cyrenaica (Libya). It is sometimes believed to be the B donor of tetraploid and hexaploid Triticum spp. (p. 93).

AEGILOPS COMOSA Sibth. & Sm. (syn. Triticum comosum (Sibth. & Sm.) Richter). 2n=14, genome formula MM. Mediterranean Greece, the Aegean Islands and W. Turkey. Used as a source of resistance to yellow rust (Puccinia striiformis West.).

AEGILOPS CYLINDRICA*

AEGILOPS KOTSCHYI*

AEGILOPS LORENTII*

AEGILOPS OVATA*

AEGILOPS TRIARISTATA*

AEGILOPS TRIUNCIALIS*

AEGILOPS UNIARISTATA Vis. (syn. Triticum uniaristatum (Vis.) Richter). 2n=14, genome formula M^uM^u. The Mediterranean Greece, around the Sea of Marmara and the Adriatic coast of Yugoslavia.

AEGILOPS VARIABILIS Eig. (syn. Ae. peregrina (Hack.) Maire & Weill., Triticum peregrinum Hack & Fraser). 2n=28, genome formula $C^uC^uS^vS^v$. N. Africa, Egypt, Palestine, Greek Islands, Turkey and Iraq. Probably identical with Ae. kotschyi*.

AEGILOPS VENTRICOSA Tausch. (syn. Triticum ventricosum Ces., Pass. & Gib.). 2n=28, genome formula M^vM^vDD. W. Mediterranean Area. It is a source of resistance to the wheat disease eyespot caused by Cercosporella herpotricoides Fron. Natural hybrids with Triticum turgidum group durum have been found and described as Triticum rodeti Trabut. Amphiploids with tetraploid Triticum species have been named Aegilotricum.

AGROPYRON JUNCEUM (Jusl.) Beauv. Sea wheatgrass, Bent grass. 2n=28, 42, (84). Coasts of Europe, N. Africa and Asia Minor. Occasionally cultivated to stabilize dunes.

AGROSTIS TENUIS*

ARUNDO DONAX L. Giant reed. 2n=(c.60), 110. Mediterranean area to Caucasia and Syria. A grass cultivated since ancient times in S. Europe. Also cultivated elsewhere now.

AVENA CANARIENSIS Baum, Rajhathy & Sampson. 20=14, genome formula AcAc. Uplands of Fuerteventura, Canary Islands. It is the donor of the A genome of the evolutionary complex of maroccana*, A. murphyi* and A. sterilis* (Craig et al., 1974; Leggett, 1980).

AVENA CLAUDA Dur. 2n=14. The whole Mediterranean Basin from Morocco, eastwards. It usually grows together with A. sativa type sterilis* and A. strigosa type barbata* (Ladizinsky & Zohary, 1971). This wild species includes type eriantha (syn. A. eriantha Dur., A. pilosa MB; genome formula CpCp) and type clauda (A. clauda Dur.).

AVENA DAMASCENA Rajhathy & Baum. 2n=14, genome formula AdAd. An area 60 km north of Damascus, Syria. It has a high degree of genome homology with A. prostrata*. Both species are considered relics of a once common population, but are now separated by some 2500 km (Rajhathy & Baum, 1972). Cahana & Ladizinsky (1978) consider A. damascena to derive from A. prostrata*. It resembles A. strigosa*.

AVENA LONGIGLUMIS Dur. 2n=14, genome formula AlAl. The coastal fringe of Mediterranean countries and Morocco, Portugal and Spain. Mediterranean and Negev desert ecogeographic races have been recognized (Ladizinsky & Zohary, 1971). It derives from A. prostrata* (Cahana & Ladizinsky, 1978).

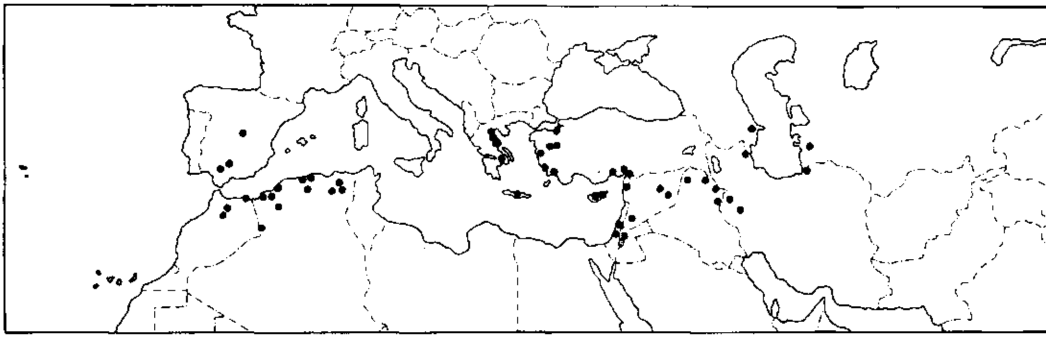
AVENA MAROCCANA Gandog (syn. A. magna Murphy & Terrell). 2n=28, genome formula AACC. Morocco. Probably not an ancestor of A. sativa* (Leggett, 1980). An annual belonging to the A. maroccana (magna)-A. murphyi*-A. sterilis complex. It is often confused with A. sterilis.

AVENA MURPHYI Ladizinsky. 2n=28, genome formula AACC. Between Tarifa and Vejer de la Frontera, S. Spain. Probably not an ancestor of A. sativa* (Leggett, 1980). It belongs to the A. maroccana* (magna)-A. murphyi-A. sterilis* complex.

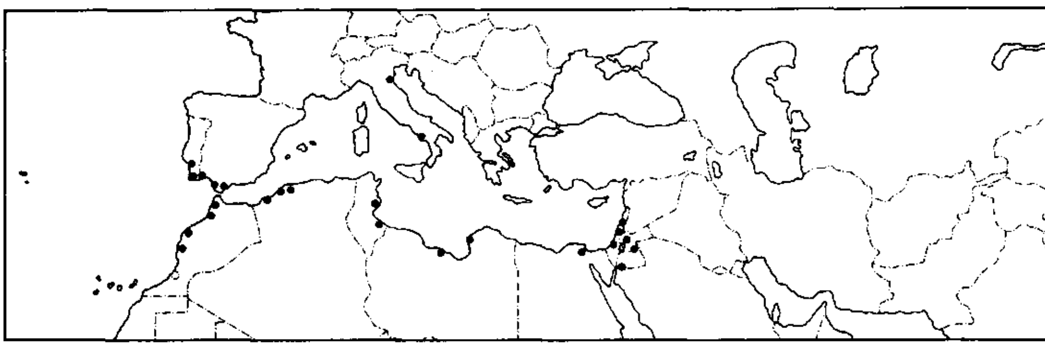
AVENA PROSTRATA Ladizinsky. 2n=14, genome formula ApAp. SE. Spain. Parental genome donor of A. longiglumis* and A. damascena* (Cahana & Ladizinsky, 1978). It is not the ancestor of the A. maroccana*-A. murphyi* complex (Leggett, 1980).

AVENA SATIVA L. Oat. 2n=42, genome formula AACCDD. Two species of hexaploid oats are commonly recognized: A. sativa, characterized by florets that separate by fracturing of the rachilla, leaving a section of rachilla attached to each floret after threshing; and A. byzanthina C. Koch in which the basal floret leaves an abscission scar on threshing. It is widely held that these two complexes were independently domesticated (Bell, 1965) but a monophyletic origin of oats is equally likely (Coffman, 1946), as becomes obvious if A. sterilis is accepted as the wild progenitor of domesticated oats. Florets of A. sterilis occur among remains of cultivated wheat and barley in agricultural settlements from Europe to China. In the northern extremes of wheat cultivation the better adapted weed was eventually adopted as a cultivated cereal. The cytoplasm comes from a diploid species with A genome (Steer & Thomas, 1976). The winter crop Dormoats is an oat with a deep dormancy deriving from A. septentrionalis* (A. fatua) x A. sativa.

AVENA STERILIS L. (syn. A. athenathera Presl,



Avena clauda (Ladizinsky & Zohary, 1971).



Avena longiglumis (Ladizinsky & Zohary, 1971).

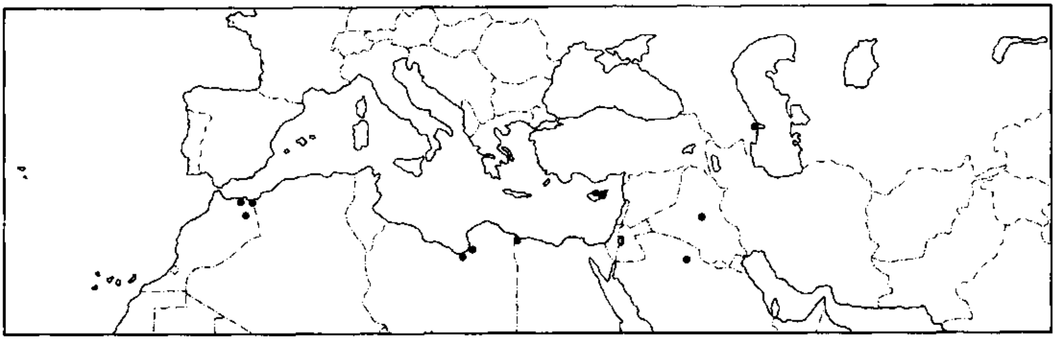
A. trichophylla C. Koch), Wild oats. 2n=42. Near East, Mediterranean Region of Europe and North Africa. Wild oats is characterized by dispersal units that disarticulate through abscission callus below the basal floret of each spikelet. Florets separate later by fracturing of rachilla segments.

It is often assumed that the mimetic weed oats (A. fatua L., A. hybrida Petterm., A. occidentalis Dur. as recognized by Baum, 1977) are progenitors of domesticated oats. This is unlikely. These weeds are characterized by florets that disarticulate individually by formation of abscission callus. Lack of a mechanism for seed dispersal in domesticated oats is genetically dominant over fatua-type seed dispersal. A more likely explanation is that the fatua-type dispersal evolved after oats became domesticated.

AVENA STRIGOSA Schreb. Black oat, Bristle oat. 2n=14, genome formula AsAs, 2n=28, genome formula AsAsBB, AABB or AsAsAsAs. The As and B genomes are partially homologous and may derive from a common parent (Ladizinsky & Zohary, 1971; Ladizinsky, 1973). The As genome might be the prototype of the A genome of the polyploid species (Rajhathy et al., 1971). Ladizinsky & Zohary (1971) included in this species the wild A. hirtula Lag. (2n=14), A. wiestii Schreb. (2n=14), A. barbata Pott. (2n=28) and A. vaviloviana Malz.* (2n=28), and the cultivated A. strigosa Schreb. (2n=14) and A. abyssinica Hochst.* (2n=28). Leggett (1980) gives the following genome formulas: A. hirtula-wiestii oat group AsAs and A. barbata AABB.

All over the Mediterranean area, wild and weedy diploid and tetraploid forms are found, hybridizing freely. "A. hirtula" is common in Spain, Morocco, Algeria, Italy, Greece, Turkey and Israel. "A. wiestii" grows in the drier steppe of the northern fringes of the Sahara and the Arabian Desert. The cultivated strigosa of W. and N. Europe derives from the weedy forms common in cereal fields and edges of cultivation in the Iberian peninsula. The As and B genome are partially homologous and may derive from a common parent (Ladizinsky & Zohary, 1971). The As genome might be the prototype of the A genome of the polyploid species (Rajhathy et al., 1971).
Diploid and tetraploid cytotypes introgress by means of triploids.

AVENA VENTRICOSA Balansa. 2n=14, genome formula CvCv. This wild species includes ssp. bruhnsiana (Gruner) Malzew (syn. A. bruhnsiana



Avena ventricosa (Ladizinsky & Zohary, 1971).

Gruner) and ssp. ventricosa (Balansa) Malzew (syn. A. ventricosa Balansa s. str., genome formula AvAv).
Ssp. bruhnsiana is found in the Apsheron Peninsula of Soviet Azerbaijan and ssp. ventricosa in Algeria and Cyprus. The karyotype of ssp. ventricosa is c_v^1 and of ssp. bruhnsiana c_v^3 and c_v^2 (Rajhathy, 1971).
A. ventricosa is also found in Cyrenaica (Libya) and Iraq (Ladizinsky & Zohary, 1971).

CHRYSOPOGON GRYLLUS (Torner) Trin. (syn. Andropogon gryllus Torner). 2n=20, 40. Mediterranean area to India. Cultivated in the Po plain, Italy for its essential oil.

HORDEUM VULGARE L. 2n=14. For origin of barley see p. 91. The Mediterranean Region is the centre of origin of ssp. mediterraneum Vav. & Bacht.

LOLIUM MULTIFLORUM Lam. ssp. italicum (A.Br.) Volkart ex Schinz & Kell. Italian ryegrass. 2n=14. The irrigated lands of Lombardy in N. Italy. Probably cultivated there in the 13th or 14th Century (Beddows, 1953). Spread to N. Europe.

Sorghum halepense.

LOLIUM PERENNE*

PHALARIS CANARIENSIS L. Canary grass. 2n=12. W. Mediterranean area: Canary Islands, Spain, Portugal. Cultivated for birdseed.

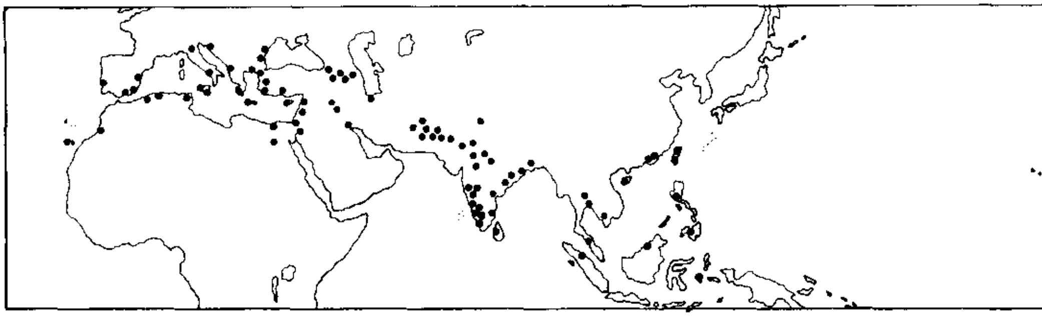
PHALARIS TUBEROSA L. (syn. Ph. aquatica L.). Toowoomba grass, Harding grass. 2n=28. Mediterranean area. Cultivated in warm countries.

SORGHUM BICOLOR (L.) Moench. Broomcorn. 2n=20. Sorghum originated in Africa (see p. 133). The broomcorns developed in the Mediterranean area from material that came from India/Iran or Africa through the Middle East.

SORGHUM HALEPENSE (L.) Pers. (syn. S. miliaceum (Roxb.) Snowden, S. controversum (Steud.) Snowden). Johnson grass. 2n=40. Mediterranean area to Pakistan and S. India. This rhizomatous perennial was introduced as a fodder to all warmer parts of the world. The leaves and stems contain HCN but make excellent hay. In the Americas, S. halepense has widely introgressed with grain sorghums (Celarier, 1958). Derivatives of such introgression are known as S. almum Parodi (Columbus grass) in Argentina (Saez, 1949) (p. 171).

Some new perennial diploid types were selected from the cross S. halepense x S. bicolor. These types combine high yield and palatibility with some frost tolerance and disease resistance. Their origin is similar to S. almum*.

STIPA TENACISSIMA L. Halfa, Alfa, Esparto. 2n=32, 40. Mediterranean area. In Spain, some cultivation is done with cv. Albardin, which has a larger fibre than wild ones. The variety

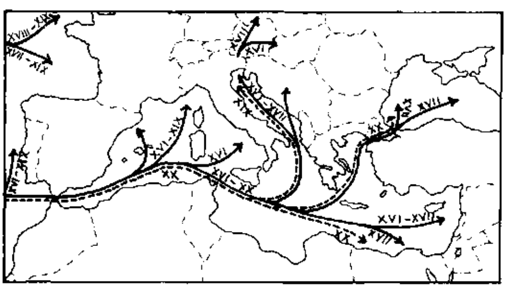


Sorghum halepense (de Wet & Huckabay, 1967).

seems to have developed there. In N. Africa and Spain, wild halfa yields a fibre for paper-making.

TRITICUM TURGIDUM spp. turgidum conv. durum (Desf.) Mac Key. 2n=28, genome formula AABB. It originated during cultivation of emmer (p. 95). Secondary centre in the Mediterranean area.

ZEA MAYS L. 2n=20. Maize was domesticated in C. America (p. 198). Secondary centres in Mediterranean area and in the Nile Basin (Brandolini, 1970).



Spread of maize in the West European and the Mediterranean region, *indurata* (—), *indentata* (---), century of introduction (roman number) (Brandolini, 1970).

Grossulariaceae

RIBES MULTIFLORUM Kitt. 2n=16. Mediterranean area. It is one of the parental species of present-day red currant cultivars (p. 155).

Hippocastanaceae

AESCULUS HIPPOCASTANUM L. Horse-chestnut. 2n=40. C. Balkan Peninsula, E. Bulgaria, W. Iran and the Himalayas. Cultivated as an ornamental or shade tree, and for its timber. A. carnea Hayne (2n=40, 80) is a hybrid with the N. American A. pavia L., Red buckeye (2n=40).

Iridaceae

CROCUS SATIVUS L. Saffron crocus 2n=(14, 16), 24, (40). Mediterranean area and Ante-Asia. Cultivated since ancient times for its styles, which are a source of saffron. Formerly cultivated for this purpose in Europe and N. America, and now in S. Europe, Asia Minor, Iran, N. India and China.

The origin of present-day cultivars is not known.

IRIS GERMANICA L. German iris, Flag iris. 2n=24, (34, 36), 44, 48, (60). Mediterranean area. A perennial herb widely cultivated as an ornamental and for its rootstocks, which are used in perfumery.

Labiatae

HYSSOPUS OFFICINALIS L. 2n=12. Mediterranean area, Asia Minor and Iran. Cultivated for its essential oil, as a medicinal plant and as an ornamental.

LAVANDULA LATIFOLIA Medik. Broad-leaved lavender. 2n=54. Cultivated in S. France and occasionally in C. Europe for its Oil of Spike. The cultivated plants are often hybrids with L. officinalis*.

LAVANDULA OFFICINALIS Chaix. (syn. L. angustifolia Mill., L. spica L.). Lavender. 2n=(36), 54. Primary centre. An old cultivated plant for perfumery. First used as an insect repellant. Many cultivated varieties are hybrids with wild plants and L. latifolia*.

MELISSA OFFICINALIS L. Common balm. 2n=32, 64. E. Mediterranean area to Caucasia, SW. Siberia, S. Iran, Turkestan and Syria. Cultivated formerly in Europe and elsewhere for diverse purposes. The commonest cultivated type var. officinalis is perhaps derived from var. hirsuta Pers. (syn. M. hirsuta (Pers.) Hornem.), a variety from the Balkans.

MENTHA AQUATICA L. (syn. M. citrata Ehrh.). Bergamot mint. 2n=(36, 60), 96, genome formula $R^aR^aSSJJA^{aq}A^{aq}$, c.96. S. Europe, Asia and N. Africa. It is a source of an essential oil. Its A^{aq} genome is partial homologous with the

A genome of M. arvensis var. piperascens* (Ikeda & Ono, 1969). It is one of the parents of M. x piperita*. M. aquatica is cultivated as M. citrata in the USA for its lavender-like oil used in perfumery (Todd & Murray, 1968). Patented hybrids with M. crispa L. (syn. M. spicata* var. crispata Schrad.) are also cultivated in the USA (M.J. Murray, pers. comm., 1971).

MENTHA LONGIFOLIA (L.) Huds. (syn. M. spicata L. var. longifolia L., M. sylvestris L.). Horse-mint. 2n=18, 24, (27, 36, 48). S. and C. Europe, N. Africa, Ethiopia, Arabia, Ante-Asia and C. Asia. Formerly it was much cultivated. Now only var. crispa Benth. is cultivated. It is related to M. rotundifolia* and M. spicata*.

MENTHA PULEGIUM L. Penny royal, Pudding grass. 2n=(10), 20, (30), 40, (40-42). Mediterranean area and Europe to Iran. Formerly cultivated in Europe and elsewhere.

ORIGANUM MAJORANA L. (syn. Majorana hortensis Moench.). Marjoram. 2n=30. Wild on Cyprus, in SW. Turkey, Palestine and E. Egypt. Subspontaneous in the Mediterranean area. Cultivated all over the world. Hybrids with O. vulgare* have been described as O. x applii (Domin) Bores, 2n= and O. x majoricum Cambessedes, 2n= . O. x applii occurs in gardens in W. and C. Europe. O. x majoricum grows wild on the Balearic Islands, Spain and Portugal (Ietswaart, 1980). Cultivated as medicinal plant.

ROSMARINUS OFFICINALIS L. Rosemary. 2n=24. Mediterranean area. Cultivated as ornamental and for its aromatic oils.

SALVIA OFFICINALIS L. Sage, Dalmatian sage. 2n=14, (16). Mediterranean area. A culinary herb now cultivated in many gardens in temperate and tropic countries.

SALVIA SCLAREA L. Clary sage, Clary wort. 2n=22. Mediterranean area to Iran and Transcaucasia. Formerly cultivated in the Mediterranean Region and S. Europe for various purposes, e.g. flavouring wine and beer.

SALVIA VIRIDIS L. Bluebeard. 2n=16. Mediterranean area to Iran. Cultivated locally for its oil to flavour wine and beer.

SATUREJA HORTENSIS L. (incl. S. laxiflora C. Koch and S. pachyphylla C. Koch). Summer savory. 2n=45-48. Mediterranean area, C. Europe and Siberia. Cultivated for oil of savory and as a pot-herb.

SATUREJA MONTANA L. (syn. S. obovata Lag., S. illyrica Host). Winter savory. 2n=12, 30. Mediterranean area to Ukraine. Cultivated in S. Europe and Germany.

TEUCRIUM CHAMAEDRYS L. (syn. T. officinale Lam.). Common germander. 2n=32, 60, 64. Mediterranean area, France, C. Germany to S. Ural, Iran, N. Syria and Morocco. Formerly cultivated as a medicinal crop.

TEUCRIUM MARUM L. 2n= . W. Mediterranean area and S. France. Cultivated in S. Europe and formerly in Germany.

THYMUS VULGARIS L. Thyme. 2n=30. Mediterranean Region. Now cultivated in temperate and tropical countries.

Lauraceae

LAURUS NOBILIS L. Laurel, True bay, Sweet bay. 2n=42, 48. Mediterranean Region. Primary centre also there. Cultivated there and elsewhere for its leaves, which are used as a condiment.

Leguminosae

ASTRAGALUS BOETICUS L. Milk vetch, Loco. 2n=16, 30. S. Europe and Mediterranean area. Cultivated as a substitute for coffee.

CERATONIA SILIQUA L. Carob, Locust tree, St. John's bread. 2n=24. Mediterranean area, Syria and adjacent countries. Primary centre in this Region. Cultivated especially on Cyprus as a fodder crop. The fruits are eaten and the seeds are used to prepare carob coffee. More uses are given by Uphof (1968).

CERCIS SILIQUASTRUM L. Judas tree. 2n=14. A tree of the Mediterranean Region to Crimea and Iran. Cultivated for its leaves (vegetable).

CICER ARIETINUM L. Garbanzos, Chick-pea. 2n=14, 16, (24, 32, 33). Probably W. Asia (p. 96). Secondary gene centre in the Mediterranean area. Especially large-seeded types, race mediterraneum Pop., are cultivated.

CYTISUS CANARIENSIS (L.). O. Kuntze. Genista. 2n=46. Canary Islands. Cultivated elsewhere. Used in Mexico as hallucinogen.

CYTISUS PALLIDUS Poir. 2n= . Canary Islands. Cultivated as a forage crop.

CYTISUS PROLIFER Kit. (syn. C. pullilans Kit.). Tree lucerne, Tree alfalfa, Tagasaste, Escabon. 2n=48. Canary Islands or, according to Uphof (1968), Hungary. Cultivated there as a forage plant. Introduced into New Zealand.

GLYCYRRHIZA GLABRA*

HEDYSARUM CORONARIUM L. Spanish esparcet. 2n=16. Mediterranean area. Cultivated as a fodder crop.

LATHYRUS ANNUUS L. 2n=14. Mediterranean area and Portugal. Sometimes cultivated as a fodder.

LATHYRUS CICERA L. Vetchling, Flat-pod pea-vine, Jurosse, Garousse. 2n=14. Mediterranean area, Canary Islands, Iraq, Iran and Transcaucasia. Cultivated in S. Europe as a fodder crop and as a green manure.

LATHYRUS CLYMENUM L. (syn. L. purpureus Desf., L. alatus Sibth. & Sm.). Cicerchia porporina. 2n=14. Mediterranean area and Madeira. Cultivated in S. Europe.

LATHYRUS HIRSUTUS L. Rough pea, Caley pea, Singletary pea. 2n=14. Mediterranean area. Cultivated especially in USA as a pasture hay, winter cover and for soil improvement.

LATHYRUS OCHRUS DC. 2n=14. Mediterranean area. Occasionally cultivated in Greece as a fodder.

LATHYRUS ODORATUS L. Sweet pea. 2n=14. Mediterranean area. Seeds of wild plants were sent from Sicily to NW. Europe in 1667 by a monk, Francesco Cupani. It is commonly cultivated as an ornamental. Its flowers are also used as a source of an essential oil.

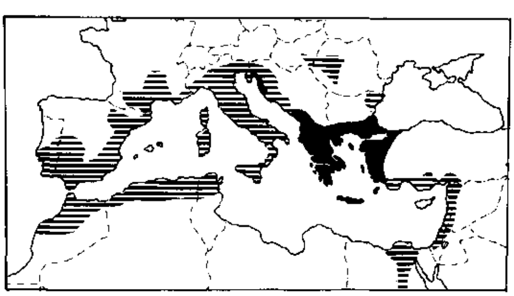
LATHYRUS SATIVUS L. Grass pea, Chickling pea. 2n=14. Probably domesticated in W. Asia (p. 83). Primary centre in the Mediterranean area.

LATHYRUS TINGITANUS L. Tangier pea. 2n=14. Mediterranean Region. It has a micro-centre in Morocco. Cultivated as a winter annual, also in USA.

LOTUS EDULIS L. Asparagus pea, Winged pea. 2n=14. Mediterranean area to Asia Minor and Syria. Occasionally cultivated for its young pods.

LUPINUS ALBUS L. (syn. L. sativum Gaertn.). White lupin, Mediterranean white lupin. 2n=50. Wild in Balkan, Crete and W. Turkey. Probably domesticated in the Balkans (Gladstone, 1977). All cultivars have white seeds, the production of pigment being suppressed by two independent pairs of inhibitor genes. These genes must already have been selected for by farmers some 4000 years ago (Kazimierski, 1960).

L. albus is closely related to L. termis*. According to Kazimierski (1960) both derive from L. graecum (see L. termis*). This latter species would derive from L. jugoslavicus Kazim. & Now. (2n=50) which is found in Yugoslavia. Gladstone (1970) considered L. termis, L. graecus and L. jugoslavicus as synonyms of L. albus.



Distribution of Lupinus albus in the Mediterranean as a wild and cultivated plant. Hatched: cultivated (var. albus only); black: cultivated (var. albus) and native (var. graecus)(Gladstone, 1976).

LUPINUS ANGUSTIFOLIUS L. (syn. L. varius L., L. linifolius Roth, L. reticulatus Desv.). Narrow-leaved lupin, Blue lupin. 2n=40. Primary centre in the Mediterranean area. The present European cultivars probably derive from wild types of Palestine. Cultivated also in S. Africa and Australia as a forage. Widely cultivated as an ornamental too.

LUPINUS COSENTINI Guss. (syn. L. varius L., spp. varius Franco & P. Silva). Western Australian blue lupin, Sand-plain lupin, Geraldton lupin. 2n=32. Coastal Morocco and other sites in W. Mediterranean area. Introduced into W. Australia about the middle of the 19th Century and naturalized. Since 1910, it has been cultivated for summer sheep food and soil improvement. Described as L. pilosus L., L. varius L. and L. digitatus Forsk.

LUPINUS LUTEUS L. (European) yellow lupin. 2n=(46, 48, 50), 52. Mediterranean area, where its primary centre lies. The present European cultivars derive probably from wild Palestinean plants. Cultivated as a fodder crop, green manure and ornamental. Closely related to L. hispanicus Boiss. & Reut. and L. rothmaleri Klink (2n=50, 52).

LUPINUS PILOSUS L. (syn. L. varius L. ssp. orientalis Franco & P. Silva). Greater blue lupin, Hairy lupin. 2n=42, (50). NE. Mediterranean Region. It may occasionally be cultivated. It is characterized by its big seeds, the biggest of all Lupinus-species. The cultivated type has 2n=50.

LUPINUS TERMIS Forsk. (syn. L. graecus Boiss., L. albus ssp. albus). Egyptian lupin. 2n= . Palestine and Egypt. Cultivated in Egypt since ancient times and in Nigeria. The seeds contain alkaloids, which have to be removed before consumption. Closely related to L. albus*. L. termis and L. graecus may be varieties of L. albus*.

MEDICAGO ARBOREA L. Cytisus. 2n=32, 48. Canary Islands, Balaeric Islands, S. Europe to Asia Minor. The 4x type is common while the 6x type is found on Esparta, Balearic Islands only. A shrub formerly used for fodder and for making baskets (Lesins & Lesins, 1979).

MEDICAGO POLYMORPHA L. (syn. M. hispida Gaertn. and M. denticulata Willd.). Bur clover. 2n= 14. Mediterranean area. Spread world wide. Cultivated as a green manure, for pasture and as a hay crop in Australia, S. America and S. USA.

MEDICAGO SATIVA L. Lucerne, (Blue) alfalfa. 2n=16, genome formula SS, 32 genome formula SSSS, 64. Transcaucasia (p. 97). Secondary centre in N. Africa, especially Algeria.

MELILOTUS INFESTUS Guss. 2n=16. A plant of W. Mediterranean area, being a source of resistance to the sweet clover weevil of M. albus* and M. officinalis*.

MELILOTUS MACROCARPA Coss. & Dur. 2n=16. N. Africa. Cultivated in Algeria for its large fruits used as spice.

MELILOTUS SULCATUS Desf. 2n=16, (32). S. Portugal and the Mediterranean area. Plants belonging to ssp. brachystachus Maire are coumarin deficient and resistant to drought, and most pests including the sweet clover weevil. Ssp. segetalis (Brot.) Maire has also been described as M. segetalis Ser. (2n=16).

ORNITHOPUS COMPRESSUS L. 2n=14. Spain, Portugal and Mediterranean area. Its northernmost point of occurrence is Brittany in France. It has a high leaf and seed production. It might be useful as a breeding source for O. sativus*.

ORNITHOPUS SATIVUS Brot. Serradella. 2n=14. Wild plants in NW. Portugal, N. Spain and SW. France. From here its cultivation spread over W. and N. Europe, since the beginning of the 19th Century. A green manure and fodder. Ssp. sativus (syn. O. roseus Dufour) is native to SW. France, N. Iberian Peninsula and the Azores. Cultivated elsewhere.

A related species is O. isthmocarpus Coss. (syn. O. sativus ssp. isthmocarpus (Cosson) Dostal) (2n=14). A Mediterranean-Atlantic species, where it grows together with O. sativus, hybrids, described as O. macrorrhynchus (Willk.) Klinkowski & Schwz. (syn. O. sativus var. macrorrhynchus Willk.) are found.

PISUM SATIVUM L. ssp. hortense Asch. & Graeb. Garden pea. 2n=14. Ssp. hortense is domesticated in SW. Asia (p. 97). Secondary centre in the Mediterranean area.

PISUM SATIVUM ssp. jomardi (Schrank) Alef. (syn. ecotype arvense s.str., P. elatius (M. B.) Stev., P. jomardi Schrank, P. transcaucasicum Stankov). 2n=14. Cultivated in Egypt. Closely related to ssp. abyssinicum (p. 137) (Fouzdar & Tandon, 1976).

PSORALEA BITUMINOSA L. Asphalt clover. 2n=20. Mediterranean area and Canary Islands. Cultivated for fodder.

SPARTIUM JUNCEUM L. Spanish broom, Weaver's broom. 2n=48, 52, 52-56. Mediterranean area and Europe. Cultivated in France near Aspiran (Hérault).

TRIFOLIUM ALEXANDRINUM L. Alexandrian clover, Egyptian clover, Berseem. 2n=16. E. Mediterranean area. Cultivated in the Near East and India. It is the oldest clover cultivated and is closely associated with agriculture in Egypt. Secondary centre in Egypt. T. alexandrinum derives from T. berytheum Boiss. (syn. T. alexandrinum var. berytheum) and T. salmoneum Mout., 2n= . T. alexandrinum is self-compatible while its progenitors are self-incompatible. Self-compatibility may be a characteristic of domestication.

TRIFOLIUM FRAGIFERUM L. (syn. T. neglectum Fisch & Mey). Strawberry clover. 2n=16. Europe, Canary Islands, Madeira, N. Africa and W. Asia. Cultivated as fodder.

TRIFOLIUM INCARNATUM L. Crimson clover. 2n=14. C. and S. Europe, Balkans and N. Africa. The cultivated type (var. sativum Duc., ssp. incarnatum) probably derives from the wild var. molinerii (Balbis ex Hornem.) Syme. The latter is found in Spain. Long cultivated in Catalonia (Spain) and S. France. Spread to E. and N. Europe and later to N. America.

TRIFOLIUM ISRAELITICUM D. Zoh. & Katzn. (syn. T. subterraneum L. var. telavivensis Eig). 2n =14. N. Israel. It is not a parent of T. subterraneum as has been suggested. It only has 14 chromosomes while T. subterraneum has 16. Formerly it was considered as the "Israeli race" of this species.

TRIFOLIUM REPENS L. var. giganteum. Lodi clover, Ladino clover. 2n=32. Probably, Lodi, N. Italy. Cultivated first in N. Italy and the Netherlands (p. 157). An excellent fodder crop.

TRIFOLIUM SUBTERRANEUM L. Subterranean clover, Sub clover. 2n=16. Mediterranean area, SE. and W. Europe, Caucasian Region and N. Iran. It is possible that the westward migration followed the course of clearing and cropping by man (Katznelson & Morley, 1965a, 1965b). Secondary centre in Australia (p. 66). Naturalized in Australia, S. Africa, and N. and S. America.

T. subterraneum can be divided into three subspecies: 1. ssp. subterraneum (syn. T. blesense Dodart) which is the commonest taxon sympatric with the species; 2. ssp. yanninicum Katzn. & Morley, which occurs in Istria, Dalmatia, Albania, Serbia and N. Greece; 3. ssp. brachycalycinum Katzn. & Morley (syn. var. oxaloides Eig) which occurs from W. Thrace to Caspian Sea. These subspecies are almost completely intersterile (Katznelson & Morley, 1965a). The existence of two closely related but more primitive species (T. batmanicum

Katzn. (syn. T. anatolicum Katzn.) (2n=16) in Diyarbakir Province, and T. chlorotrichum Boiss. & Balansa (2n=) in Phrygia) in Turkey and the absence of these and other close relatives elsewhere indicates the origin of T. subterraneum in Turkey. However, the greatest variation is found in Greece (Katznelson & Morley, 1965a).

Bailey & Francis (1971) found that the isoflavone pattern of T. batmanicum closely resembles that of spp. brachycalycinum. They concluded that T. batmanicum might be the ancestor species of T. subterraneum and ssp. brachycalycinum is probably the earliest form of subterranean clover. They postulated that ssp. subterraneum evolved later and colonized a wider range of environments.
The isoflavone pattern of T. batmanicum is very similar to that of T. globosum L. (syn. T. radiosum Wahlenb., T. nidificum Griseb.) (2n=16), However, that species belongs to another subsection.

TRIFOLIUM VAVILOVII Eig. 2n=16. Israel.

VICIA ARTICULATA Hornem. One-flowered vetch. 2n= . Mediterranean area, Asia Minor, Madeira and Canary Islands. Cultivated.

VICIA BENGHALENSIS L. (syn. V. atropurpurea Desf.). Purple vetch. 2n=12, 14. Mediterranean area. Naturalized in the USA. Cultivated as a clover crop and green manure, and as a winter and spring forage.

VICIA CALCARATA Desf. Demehi. 2n=12, 14. Sahara Oasis, where it is cultivated for its seeds. Also Iran & cultivated in Tripolitania (Libya).

VICIA ERVILEA (L.) Willd. Bitter vetch, Ervil. 2n=14. Primary centre in the Mediterranean area. Cultivated in Spain. A characteristic group developed in Asia Minor (p. 98). Used as forage and for grain.

VICIA FABA L. (syn. Faba vulgaris Moench). Field bean, Broad bean, Horse bean, Pigeon bean, Tick bean, Windsor bean. 2n=12 (14). SW. Asia (p. 83) or Near East or Mediterranean area (Zohary, 1977). Wild ancestor uncertain. See p. 83 for discussion of origin.

Schultz-Motel (1972) found no evidence for a supposed division of the small-seeded type into two geographical races: a long-seeded type in the W. Mediterranean area and a round-seeded type in the eastern part. So there is no reason to suppose that the broad bean originated in two separate areas. Whether V. pliniana (Trabut) Moratova found in Algeria and Morocco, is a type of V. faba or a related species is not known.

VICIA NARBONENSIS L. Narbonne vetch. 2n=14. SW. Asia (p. 98). Secondary gene centre in Mediterranean area where it is cultivated.

Liliaceae

ALOE BARBADENSIS Mill. (syn. A. vera L.). Curaçao aloe, Barbados aloe. 2n=(10), 14. Mediterranean area, S. Arabia, E. Africa, NW. India and S. China. The wild var. barbadensis of the Mediterranean area has run wild in C. America, W. Indies to Bolivia. It probably arrived there through Spain. Cultivated in W. Indies.

LILIUM CANDIDUM L. Madonna lily, Bourbon lily. 2n=14. Mediterranean area and SW. Asia. Cultivated especially in S. France for its flowers. These are a source of an essential oil. It is the oldest lily of European gardens.

URGINEA MARITIMA (L.) Baker. (syn. U. scilla Steinh.). Sea onion. 2n=20, (30), 40, 60. Mediterranean coast; most common in E. Algeria. Wild and cultivated plants are used for their pharmaceutical properties and in rat poison.

Linaceae

LINUM USITATISSIMUM L. Flax, Linseed. 2n=30, (32). For origin see p. 99. In the Mediterranean area, the oil-flax (spp. mediterraneum Vav. & Ell.) is cultivated. In Italy, hybrid forms (spp. transitorium Vav. & Ell.) of ssp. eurasiaticum and ssp. mediterraneum are found. Large-seeded types are cultivated in N. Africa. Those from Algeria are a source of Fusarium resistance.

Malvaceae

ALTHAEA OFFICINALIS L. Marsh mallow. 2n=42, (c.42, 40-44). Europe, E. Mediterranean area and W. Asia. Cultivated for its roots, which are a source of medicine.

ALTHAEA ROSEA (L.) Cav. Garden hollyhock, Hollyhock. 2n=(26), 42, (56). Asia Minor, Balkans and Crete. Ran wild in Italy, S. France and S. Tyrol. Cultivated in Europe since the 16th Century, especially var. nigra hort., which has blackish purple petals used to colour wine and as medicine. Cultivated now in many types as an ornamental.

Moraceae

FICUS SYCOMORUS L. Sycomore fig. 2n=26. Its area of distribution can be divided into two parts: 1. the main part is the E. Coast of Africa from S. Africa to Sudan, where trees produce viable seed and grow wild; 2. the northern area is the Middle East and N. Africa where trees do not produce viable seed and have to vegetatively propagate. The tree was perhaps domesticated in the Middle East (p. 99). The southern boundary of the domesticated sycomores runs through Sudan (Galil et al., 1976).

Myrtaceae

EUCALYPTUS CAMALDULENSIS Dehn. Longbeak eucalyptus. 2n=22. Primary centre in Australia (p. 66). Secondary centres in the Mediterranean Region and S. America (p. 177). It was believed that the trees of this species cultivated in Israel came from S. Australia, but the leaves of the Israeli trees contain three polyphenols which have not been found in the species anywhere in Australia.

EUCALYPTUS GLOBULUS Labell. Fever tree, Blue gum. 2n=20, 22, 28. SE. Tasmania. Cultivated. Secondary centre in the Mediterranean Region.

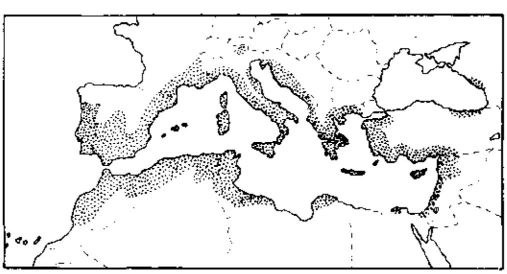
MYRTUS COMMUNIS L. Myrtle. 2n=22. Mediterranean area and SW. Europe. Cultivated since ancient times for its fruits and for its medicinal properties.

Oleaceae

FRAXINUS ORNUS L. Flowering ash, Manna ash. 2n=46. A tree of C. and E. Mediterranean area. Cultivated on the N. coast of Sicily.

OLEA CHRYSOPHYLLA Lam. Golden-leaved olive tree. 2n= . Wild over a large part of the Old World, including the Mediterranean area. It is possibly the wild ancestor of O. europaea*. If so, it is a synonym of O. europaea var. sylvestris Brotero.

OLEA EUROPAEA L. Olive tree. 2n=46. Mediterranean area. Primary centre in the Mediterranean Region. Its domestication started there in ancient times. Var. sylvestris Brotero includes the wild forms and the possible naturalized cultivated types. Var. europaea is the cultivated form. The main differences of var. sylvestris are spiny lower branches and small leaves and drupes. Some cultivars are developed for table olives, others for oil. See also O. chrysophylla*.



Olea europaea (Polunin & Huxley, 1972).

Palmae

CHAMAEROPS HUMULIS L. Dwarf palm. 2n=36. Wild in the W. Mediterranean area. Cultivated in some parts of Morocco. Often planted as an ornamental. A source of fibre (crin végétable).

Papaveraceae

PAPAVER SOMNIFERUM L. Opium poppy. 2n=2x=22, 4x=44. The cultigen ssp. somniferum derives from the wild ssp. setigerum (DC) Corb. (syn. P. setigerum DC), 2n=2x=22, 4x=44, which occurs in the Mediterranean Region from the Canary Isles eastwards. In Greece and Cyprus, tetraploid types are found, which are more ruderal than the diploid and hence spread easier (Hammer & Fritsch, 1977). Schültze-Motel (1979) stated that the poppy was domesticated in the W. Mediterranean area. The cultigen is grown for the dried latex obtained from unripe capsules, which is used in medicine and as a narcotic, for its ripe seeds, which are eaten or pressed for poppy oil, and as an ornamental. It often escapes from cultivation. There are several taxonomic classifications to divide the cultigen into various subspecies on the basis of phenotypic variation.

Pinaceae

PINUS PINEA L. Stone pine, Pinie. 2n= . S. Europe. A tree often cultivated for its edible seeds.

Pistaciaceae

PISTACIA LENTISCUS L. Lentisk pistache. 2n=24. Mediterranean area. A small tree cultivated for its chewing gum.

PISTACIA TEREBINTHUS L. Terebinth pistache. 2n= . Mediterranean area. On the Aegean islands, a type with big fruits and large leaves was cultivated.

Plantaginaceae

PLANTAGO INDICA L. 2n=12. C., S. and E. Europe and W. Asia. Cultivated in S. France as a medicinal herb (Mansfeld, 1959).

PLANTAGO PSYLLIUM L. Psyllium. 2n=12. Mediterranean area.

Ranunculaceae

AQUILEGIA VULGARIS L. Columbine. 2n=14. S. and C. Europe (p. 158), N. Africa and temp. Asia. Cultivated widely as an ornamental, formerly also for medicinal purposes.

NIGELLA SATIVA L. Black cumin. 2n=12. C. (p. 158) and S. Europe, N. Africa and W. Asia. Cultivated for its seed in the Mediterranean area and in the Orient. Cultivated formerly in C. Europe.

Resedaceae

RESEDA LUTEOLA L. Weld. 2n=24, (26, 28). C. Europe (p. 158), Mediterranean area, Iran and Afghanistan. Formerly cultivated as a source of deep yellow dye.

RESEDA ODORATA L. Mignonette. 2n=12, (14). N. Africa. It may derive from R. phyteuma* with introgression of R. arabica Boiss., 2n=24 and R. orientalis (Muell.-Arg.) Boiss., 2n= . R. arabica is found in Africa north of the Sahara, Egypt, Palestine, Syria and upto the Persian Gulf, while R. orientalis occurs in S. Turkey, Cyprus, Lebanon, Syria and Palestine. Between 1733 and 1737 material was sent to Paris and from there its cultivation as a perfumery plant started and spread (Abdallah & de Wit, 1978). Var. neilgherrensis is grown in India (p. 78).

RESEDA PHYTEUMA L. 2n=12. N. and S. of the W. and C. Mediterranean area. Said to be eaten as a vegetable in Greece. It may be the main ancestor of R. orientalis* (Abdallah & de Wit, 1978).

Rhamnaceae

RHAMNUS CATHARTICUS*

RHAMNUS FRANGULA*

RHAMNUS PRINOIDES L'Hér. 2n=14. Ethiopia. Cultivated for leaves and branches which are used to flavour beverages, and for medicine (Jansen, 1981).

ZIZIPHUS LOTUS (L.) Lam. 2n=24. Mediterranean area. A tree cultivated in Italy, S. Spain and Egypt. It is probably the lotophagus of the ancient peoples of Libya.

Rosaceae

AMYGDALUS PERSICA L. Peach. 2n=16. Primary centre in China (p. 42). Secondary centre in Italy and Spain.

CRATAEGUS AZAROLUS L. (syn. C. aronica Bosc.). Azerolier. 2n= . S. Europe, N. Africa and the Orient (p. 85). This shrub or small tree is often cultivated for its edible fruits. Var. aronica L. is found wild on Crete.

Rutaceae

CITRUS AURANTIUM L. spp. bergamia (Risso & Poit.) Wight & Arn. Bergamot. 2n=18. Calabria (Italy. Primary centre probably in SE. Asia (p. 63). Cultivated for bergamot oil in Calabria.

CITRUS LIMON (L.) Burm. Lemon. 2n=18, (36). Primary centre probably in SE. Asia (p. 63). Secondary centre in the Mediterranean Region, especially in Sicily.

CITRUS SINENSIS (L.) Osbeck (syn. C. aurantium L. var. sinensis L.). Sweet orange. 2n=18, (27, 36). Primary centre probably in S. China or Cochinchina (p. 63). Secondary centres in Israel (e.g. the varieties Shamuti, Beladi, Khalili) and in Spain (e.g. the variety Valencia, blood orange).

RUTA CHALEPENSIS L. Fringed rue. 2n=36. Mediterranean area. Cultivated there and elsewhere as a medicinal plant.

RUTA GRAVEOLENS L. Common rue, Rue. 2n=72, 81. Wild in the Mediterranean area. Introduced into many tropical countries. The leaves are used as a condiment and medicinally.

Scrophulariaceae

DIGITALIS PURPUREA*

Solanaceae

ATROPA BELLADONNA L. Belladonna. 2n=72. From Spain, the Balkans, Asia Minor to India (p. 79). Cultivated in Europe, India and USA as a medicinal plant. A. martiana F.Q. is considered a hybrid of A. belladonna and A. baetica Willk. (2n=72), which is found in Spain.

HYOSCYAMUS NIGER L. Black henbane. 2n=34. Mediterranean area. A medicinal plant cultivated in some countries for its alkaloids.

Ulmaceae

CELTIS AUSTRALIS L. (syn. C. excelsa Salisb.). Hackberry. 2n=40. Mediterranean area. Tree cultivated there as an ornamental and in Asia Minor for its edible fruits (Mansfeld, 1959).

ULMUS spp. Semi-cultivated by the Romans as a support for grapevines and so distributed. The leaves are used as fodder in dry summers.

Umbelliferae

AMMADAUCUS LEUCOTRICHUS (Coss. & Bur.). 2n=16. N. Africa. Cultivated there.

AMMI MAJUS L. (syn. Apium ammi Crantz). Bishop's weed. 2n=22. Mediterranean area to Iran and to Switzerland and Belgium. Cultivated since the Middle Ages for its aromatic seeds and for medicinal purposes.

ANETHUM GRAVEOLENS L. (syn. A. sowa Kurz.). Satapashpi, Sowa, Suwa. 2n=22. Eurasia. Cultivated in India. It has longer fruits than the Indian type (p. 79).

APIUM GRAVEOLENS L. Celery. 2n=22. Cultivation started in the Mediterranean area. The wild parent A. graveolens var. silvestre Presl. (syn. var. graveolens) is cosmopolitan. Not much is known about the development of the three botanical varieties of A. graveolens: var. silvestre f. secalinum Alef. (syn. var. secalinum Alef.), Leafy celery, Smallage or Soup celery; var. rapaceum (Mill.) DC., Celeriac, Turnip-rooted celery or German celery; var. dulce (Mill.) Pers., Blanching celery, Pascal celery or Stalk celery.

CORIANDRUM SATIVUM L. Coriander. 2n=22. Mediterranean area and W. Asia. Cultivated for its aromatic fruits.

CRITHMUM MARITIMUM L. Samphire, Sea samphire, Sea fennel, Piercestone. 2n=20, (22). Canary Islands, Madeire, coasts of Portugal to S. England and those of the Mediterranean area and Crimea. Cultivated in the USA as a kitchen herb.

CUMINUM CYMINUM L. Cumin. 2n=14. Mediterranean area to Turkistan. Cultivated in SE. Europe, N. Africa, India and China.

DAUCUS CAROTA L. Yellow carrot. 2n=18. Wild species from Afghanistan (p. 86) to the Mediterranean area. Although yellow carrots may have arisen in other areas where purple carrots were cultivated, it is thought that the true yellow carrots developed in the Mediterranean Region from crosses with the wild D. carota ssp. agg. carota (syn. ssp. maximus (Desf.) Ball).

FOENICULUM VULGARE Mill. (syn. F. officinale Gaertn.). Fennel. 2n=22. Mediterranean area. Cultivated there for a long time and introduced into many other temperate countries.

Var. piperitum (Ucr.) Cout. (syn. F. piperitum Acr., 2n=22) is Bitter fennel. Var. dulce (Mill.) Thell. (syn. F. dulce Mill., 2n=22) is the Florence fennel, Sweet fennel or Roman fennel. Cultivated for its blanched petioles in S. France and the Mediterranean area. Var. azoricum (Mill.)Thell. (syn. F.azoricum Mill.), Carosella or Italian fennel, originated in Italy. It has very broad leaf-stalk bases.

MEUM ANTHAMANTICUM Jacq. Signel. 2n=22. A herb of C. and S. Europe, once cultivated in N. England for its roots.

PETROSELINUM CRISPUM (Mill.) Nym. ex A.W. Hill (syn. Carum petroselinum Benth.). Parsley. 2n=22. S. Europe. Widely cultivated there and elsewhere. Mansfeld (1959) has classified the wild and cultivated types.

SIUM SISARUM L. Skirret, Chervin. 2n=20, 22. E. Asia and Mediterranean area. Occasionally cultivated for its edible tuberous roots (var. sisarum).

SMYRNIUM OLUSATRUM L. Alisander, Alexanders, Maceron. 2n=22. Mediterranean area, S. and W. Europe and Caucasia. Formerly much cultivated but now replaced by celery.

Urticaceae

SOLEIROLIA SOLEIROLII (Req.) Dandy. 2n= . Islands of W. Mediterranean area. Cultivated.

Valerianaceae

FEDIA CORNUCOPIAE Gaertn. African valerian, Valeriane d'Alger. 2n=32. Mediterranean area. Cultivated as a pot-herb and during famine.

VALERIANA ERIOCARPA Desv. Italian corn salad. 2n= . Mediterranean area. Cultivated for salad.

Verbenaceae

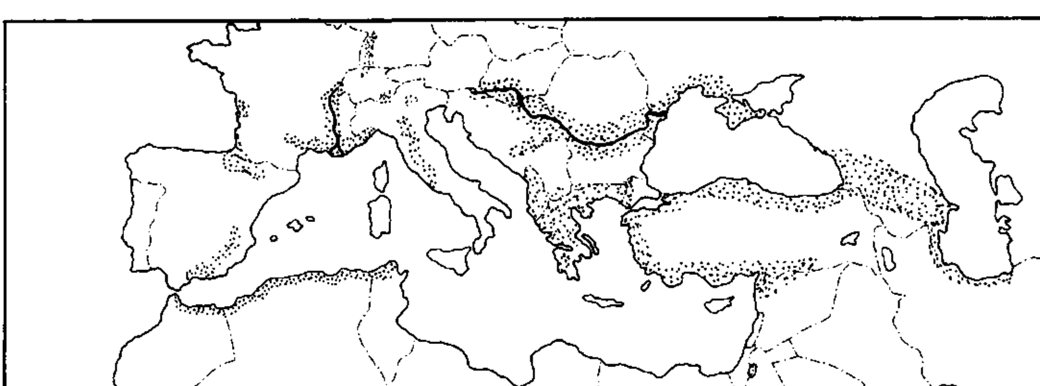
VITEX AGNUS-CASTUS L. Chaste tree. 2n=24, 32. Mediterranean area. Cultivated in the Old and New Worlds for various purposes.

Violaceae

VIOLA ODORATA L. (syn. V. officinalis Cr.). Sweet violet, Sweet scented violet, Common violet. 2n=20. Europe and SW. Asia. Var. parma is cultivated in N. Italy and S. France as a source of an essential oil for perfumery.

Vitadaceae

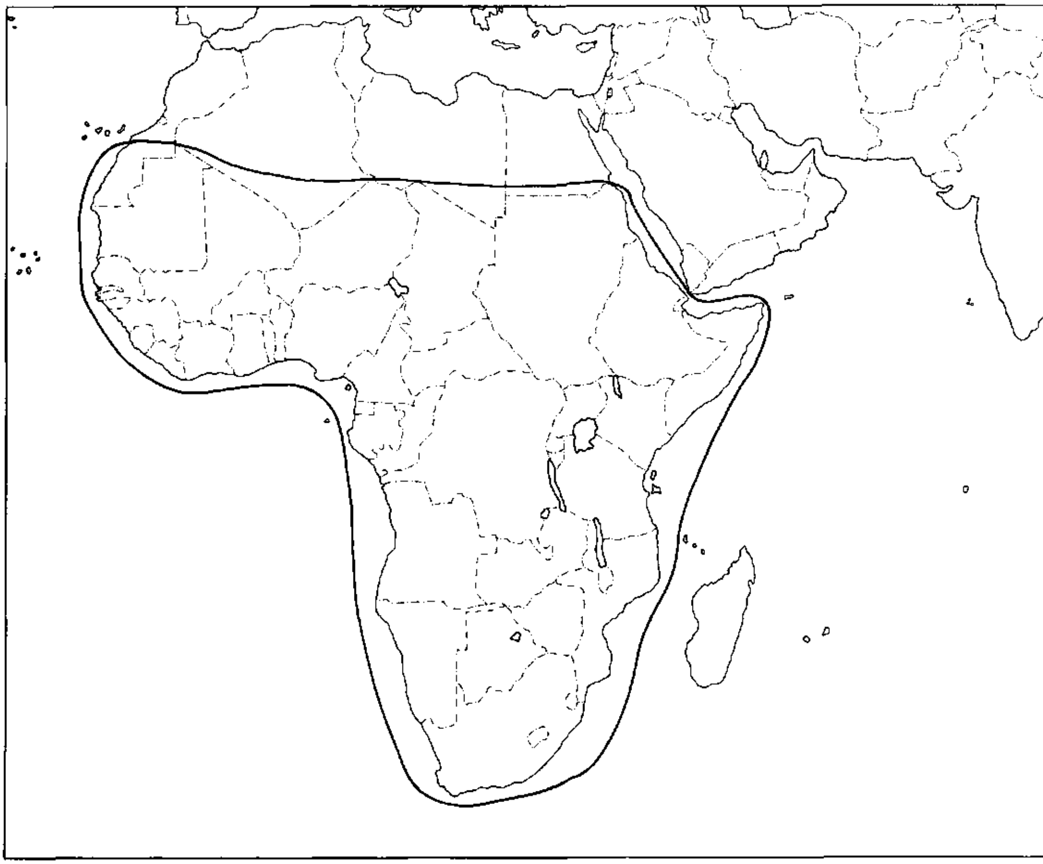
VITIS VINIFERA L. Common grape, European grape.



Wild grape (Vitis vinifera. var. silvestris) (Zohary & Spiegel-Roy, 1975).

2n=38, (40, 57, 76). The Mediterranean Region is one of the three primary centres of diversity. On p. 102 the *domestication of the grape* is discussed and other data are presented. The grape reached Greece and Italy c. 1000 BC. and spread northwards to enter France c. 55 AD. There by introgression, it absorbed genes for adaptation to cooler and more humid climates (Rives, 1975). There are several secondary centres, e.g. the varieties for currants in Greece, and the varieties for wine in Italy, Spain and Algeria.

8 African Region



The African Region includes all of Africa south of the Sahara. Portères (1950) recognized four major centres of plant domestication in Africa: a Mediterranean cradle, which forms part of the Mediterannean Region (Chap. 7); an Ethiopian cradle, which corresponds with the Abyssinian Centre of Vavilov (1928) and the Ethiopian Centre of Darlington (1956); an East African cradle; and a West African cradle. Portères divided his West African cradle into Senegambian, Central Niger, Benin and Adamawa subcradles. An independent origin of agriculture in the West African savanna was also proposed by Anderson (1960) and Murdock (1960), but several research workers have presented evidence against this hypothesis (Wrigley, 1960; Clark, 1962; Harris, 1967). Agriculture in Africa north of the Sahara is typically Near Eastern in origin. South of the Sahara, agriculture is based primarily on native African crops. A notable exception is the Highlands of Ethiopia, where wheat and barley have been grown since at least the beginning of the Christian Era.

The antiquity of native agriculture in Africa is not known. Archaeological remains of finger millet (Eleusine coracana) from Ethiopia suggests that this cereal has been cultivated in Africa for at least five millennia. This archaeological race of finger millet has lost the ability to disperse seed naturally, so cereal cultivation in Africa must be substantially older than 5000 years (Hilu et al., 1979). Remains of pearl millet (Pennisetum americanum) dating back to the fifth millennium BC. were uncovered from lake edge settlements in Mauritania (Munson, 1976). A sequence from gathering wild grasses to growing cereals such as pearl millet and possibly sorghum (Sorghum bicolor) is obvious in these settlements. However, these crops probably reached Mauritania fully domesticated. Wild races of pearl millet occurs in C. Sahel and Highlands of C. Sahara, and wild sorghum is native to the savanna regions, where these two cereals were probably domesticated (Brunken et al., 1977; de Wet, 1978).

The pollen record shows that the Sahara was substantially wetter some 8000 years ago than now. People with cattle, goats and sheep camped along the edges of numerous shallow lakes in C. Sahara, and harvested wild cereals and other plant foods in areas that are now desert (Clark, 1976). The Sahara became progressively drier over several subsequent millennia, and it was probably these nomadic herdsmen who domesticated the native cereals of West Africa as they migrated south into what is now savanna (Harlan et al., 1976).

Acanthaceae

ADHATODA SCHIMPERIANA (Hochst.) Nees. 2n= E. Africa. In Ethiopia cultivated as a hedgeplant (Jansen, 1981).

JUSTICIA INSULARIS T. And. 2n= . Africa. Cultivated in W. Africa for its edible leaves.

Agavaceae

AGAVE FOURCROYDES Lem. Henequen agave. 2n= c. 140. Yucatan (p. 185). Secondary centre possibly in Africa. Cultivated for fibre.

DRACAENA ARBOREA Link. (syn. D. mannii Baker). Asparagus tree, Soap tree; D. fragrans (L.) Carol; and D. smithii ex Hook.f., Cocked hat, Cockade bush. 2n= . These four species are native to Africa. Cultivated as living fences and live sticks.

SANSEVERINIA GUINEENSIS (L.) Willd. Bowstring hemp. 2n= . Africa. A fibre crop cultivated on a small scale in Mexico.

SANSEVERINIA LONGIFLORA Sims. Florida bowstring hemp. 2n= . Africa. Cultivated in Trinidad, S. Florida and S. Carolina.

SANSEVERINIA THYRSIFLORA Thunb. 2n= . S. Africa. Cultivated for its fibres in the tropics.

SANSEVERINIA TRIFASCIATA Prain. African bowstring hemp. 2n= . Trop. W. Africa. Cultivated (often as S. guineensis*) in the tropics. Var. laurentii (De Wildem.) N.E. Brown is cultivated as an ornamental in Zaïre.

Aizoaceae

MESEMBRYANTHEMUM ANGULATUM Thunb. Marigold. 2n=18. S. Africa. An annual cultivated in Zaïre and the Mediterranean area as a spinach.

MESEMBRYANTHEMUM CRYSTALINUM L. (syn. Cryophytum crystallinum (L.) N.E. Brown). Ice plant, Crystalline. 2n=18. S. Africa. Cultivated as salad vegetable or as a soil stabilizer.

MESEMBRYANTHEMUM EDULE L. (syn. Carpobrotus edulis (L.) L. Bolus). Hottentot fig. 2n=18. S. Africa. A dune stabilizer, leaves used as forage and as a source of water.

Amaranthaceae

CELOSIA TRIGYNA L. 2n=18. Trop. Africa, Madagascar and Arabia. Cultivated as a vegetable in Africa.

Annonaceae

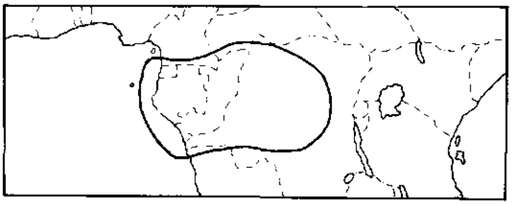
XYLOPIA AETHIOPICA (Dun.) A. Rich. African pepper, Guinea pepper, Ethiopian pepper, Spice tree. 2n= . Trop. Africa. (Semi-)cultivated in W. Africa.

Apocynaceae

CARISSA GRANDIFLORA A.DC. Natal plum. 2n=22. S. Africa. Cultivated for its fruits and as an ornamental.

FUNTUMIA ELASTICA (Preuss) Stapf. Lagos silk rubber. 2n=22. W. Africa. Large plantations of this tree were established in W. Africa, after the discovery that it was a source of rubber. However, these plantations cannot compete with Hevea rubber.

TABERNANTHE IBOGA Baillon. Iboga. 2n=22. Gabon, Congo and the NW. Zaïre. Cultivated in Gabon. The roots contain several indole alkaloids. The most important is ibogaine which is a



Tabernanthe iboga (Pope, 1969).

stimulant and in large doses a hallucinogen. Roots of wild plants are collected which has resulted in the almost extinction of this plant in several districts in Gabon.

VINCA ROSEA L. Madagascar periwinkle, Cape periwinkle. 2n=16, (32). Probably Madagascar. A herb cultivated as a medicinal plant.

Bignoniaceae

KIGELIA AFRICANA (Lam.) Benth. 2n=40. Sausage tree. Trop. W. Africa. Cultivated for medicine and witchcraft.

Bombacaceae

CEIBA PENTANDRA Gaertn. Kapok tree, Silk cotton tree. 2n=72, 80, 88. Some authors believe in an American/African origin of the kapok tree (p. 187). If America is the sole centre of origin, then the African centre is secondary. The African kapok tree is divided in the Caribbean forest type and the Caribbean savanna type. The latter type, which has a broadly spreading crown, is planted in market places. It is possible that this type arose from cuttings of plagiotropic branches (Zeven, 1969).

Burseraceae

CANARIUM EDULE Hook.f. (syn. Pachylobus edulis G. Don, Dacryodes edulis (G. Don.) Lam). Bush butter tree, Native pear. 2n= . Trop. Africa. Occasionally cultivated for its edible fruits.

COMMIPHORA OPOBALSAMUM Engl. Mecca myrrh tree, Harobol myrrh. 2n= . Arabia and Somalia. Formerly (11th-17th Century) cultivated in Egypt and Palestine (Mansfeld, 1959).

Cannaceae

CANNA SPECIOSA Rosc. 2n= . W. Africa. Cultivated in Sierra Leone. It is the source of African Turmeric. The tubers resemble those of Curcuma longa*.

Celastraceae

CATHA EDULIS Forsk. Khat, Miraa. 2n= . Ethiopia and Somalia, south to Natal and Transvaal in South Africa, and in Yemen and Saudi Arabia where it probably was introduced. Cultivated in Ethiopia and Arabia for its leaves that contain a mild narcotic. The fresh leaves and twigs are used as a stimulant particularly in Arabia, Somalia, Ethiopia and Tanzania. Leaves are either chewed, or a refreshing tea is brewed from them. In Ethiopia, the leaf has been used as a protection against pestilence, and especially in Arabia against bubonic plague. In Yemen, khat is an important item at birth, circumcision, and at marriages and funerals. In Harrar, twigs of khat are placed on graves for seven days.

Cleomaceae

GYNANDROPSIS GYNANDRA (L.) Briq. (syn. G. pentaphylla DC.). Cat's whiskers. 2n=30, 32, 34. (Sub)trop. Africa and India. Cultivated in Africa, in the West Indies and in Malaya. Used as vegetable and as ornamental.

Compositae

CRASSOCEPHALUM BIAFRAE S. Moore. 2n= . W. Africa. Cultivated as a vegetable. Several types are known (Terra, 1967).

CRASSOCEPHALUM CREPIDIOIDES (Benth.) S. Moore. 2n=40. Vegetable of Nigeria.

GUIZOTIA ABYSSINICA (L.f.) Cass. Niger seed. 2n=30. Centre of diversity Ethiopia (Baagoe, 1974) and spread southwards to Malawi and to India, where it has run wild. Used for oilseed.

GYNURA CERNUA Benth. 2n=20. W. Africa. A herb cultivated for its leaves.

LACTUCA TARAXACIFOLIA (Willd.) Schum. (syn. Sonchus taraxacifolius Willd.). Wild lettuce, Langue de vaches. 2n= . Trop. Africa especially in Sierra Leone, Ghana, S. Nigeria and Nile region. Cultivated in W. Africa as a vegetable and as fodder.

LAUNAEA TARAXACIFOLIA (Willd.) Amin ex C. Jeffrey. Wild lettuce. 2n= . Vegetable of Nigeria.

SENECIO BIAFRAE Oliv. 2n= . Africa. Occasionally cultivated in W. Africa.

SENECIO GABONICUS Oliv. 2n= . Trop. W. Africa. Occasionally cultivated.

STRUCHIUM SPARGANOPHORA (L.) O. Ktze. Water bitterleaf. 2n= . Vegetable of Nigeria.

Crassulaceae

BRYOPHYLLUM PINNATUM (Lam.) Oken. Never-die, Resurrection plant. 2n= . Africa. Cultivated there as a medicinal crop and elsewhere as an ornamental.

Cruciferae

BRASSICA CARINATA A.Br. Abyssinian mustard. 2n=34, genome formula BBCC. Unknown wild. Cultivated in Ethiopia as a vegetable and as an oil crop. A natural amphidiploid of ♀ B. nigra* and ♂ B. oleracea* (Uchimiya & Wildman, 1978).

BRASSICA JUNCEA (L.) Czern. & Coss. (syn. Sinapsis juncea L.). Sarepta mustard, Brown mustard, Leaf mustard, Indian mustard. 2n=36, genome formula AABB. Africa. However, Hemingway (1976) suggested a centre of domestication in C. Asia-Himalayas with secondary centres of diversity in India, China and Caucasia. Spread to E. Europe and China. Now distributed from Europe to E. Asia. Often as a weed. It is cultivated for its oily seeds and as a condiment.

This species originated from the natural amphidiploid of ♀ B. campestris* and ♂ B. nigra* (Uchimiya & Wildman, 1978). Through artificial amphiploidization of hybrids of the parental species it has been possible to introduce characteristics of both parents into Sarepta mustard.

ERUCA PINNATIFIDA (Desf.) Pomel. 2n= . Sahara. Occasionally cultivated in oases as fodder.

LEPIDIUM SATIVUM L. Garden cress, Common cress. 2n=16, 32. Wild type var. silvestre Thell. From Sudan area to the Himalayas. Cultivated in ancient times in Europe as a vegetable. It may have reached Europe from the Levant as a flax weed. In Africa, there are red, white and black varieties and seeds are used for medicinal purposes, oil production and as a vegetable.

Cucurbitaceae

CITRULLUS LANATUS (Thunb.) Mansf. (syn. C. vulgaris Schrad.). Water-melon. 2n=22. Tropical and subtropical Africa. The wild race is commonly eaten by animals. An edible wild race, the tsama occurs in the Kalahari Desert, where it is often the principal source of water for animals and the bushmen. Food is often cooked directly in the tsama. Cultivated since ancient times in Mediterranean area and India. Now cultivated in many countries of the Old and New Worlds so that secondary centres of diversity have arisen. Var. citroides (Bailey) Mansf. is found in Sudan. Cultivated in USA (Citron, Preserving melon) and USSR.

The citron - a fodder melon - is adapted to very dry areas. It has both weedy and cultivated races.

The wild form, var. colocynthoides (syn. C. colocynthoides Pang.) is characterized by its white or yellow flesh with bitter flavour or not and the cultivated form var. edulis (syn. C. edulis Pang.) has red or yellow flesh with sweet flavour (Shimotsuma, 1965).

COCCINIA ABYSSINICA (W. & A.) Cogn. Anchoté. 2n= . Ethiopia. Sporadic cultivation in SW. of Ethiopia for its tubers but its fruits are not eaten. The tubers and fruits of the wild plants are inedible.

CUCUMEROPSIS EDULIS (Hook.f.). Cogn. 2n= . W. Africa. Cultivated in gardens and on roofs.

CUCUMEROPSIS MANNII Naud. 2n= . W. and C. Africa. Cultivated there.

CUCUMIS ACULEALUS Cogn. 2n=40. Wild perennial from Ethiopia.

CUCUMIS AFRICANUS L.f. 2n=24. Wild in S. Africa. Resistant to cucumis green mottle mosaic virus and powdery mildew (Visser & de Nijs, 1980).

CUCUMIS ANGURIA L. 2n=24. Gherkin. The wild type is var. longipes A. Meeuse (syn. C. longipes Hook.) occurring in Ethiopia and S. Africa. Introduced to the Caribbean, where the cultigen West Indian gherkin (var. auguria) developed (Meeuse, 1958). Esquinas-Alcazar (1978) found similar electrophoretic patterns for enzymes of both varieties, but Puchalski et al. (1979) did not. Some accessions of both varieties resistant to cucumis squash mottle mosaic virus and powdery mildew (Visser & de Nijs, 1980).

CUCUMIS DIPSACEUS Spach. Teasel gourd. 2n=24. Africa. An ornamental.

CUCUMIS FICIFOLIUS A.Rich. 2n=24, (48). A perennial from Ethiopia southwards.

CUCUMIS FIGAREI Naudin. 2n=72. Wild in Nigeria.

CUCUMIS HEPTADACTYLUS Naudin. 2n=48. Africa. Perennial (Dane et al., 1980).

CUCUMIS MELO L. Musk-melon, Melon, Canteloupe. 2n=24. As most Cucumis species come from Africa, the species probably originates from trop. Africa, whence it spread to other regions, producing secondary gene centres in Iran (p. 89), China (p. 36), Iran and S. USSR (p. 82) (Leppik, 1966).

CUCUMIS METULIFERUS Naudin. African horned cucumber. 2n=24. Cultivated as an ornamental and in some parts of Africa for its fruits. This self-compatible species is a source of resistance to southern root-knot nematode, aphids and squash mosaic virus for C. sativa*.

CUCUMIS MYRIOCARPUS Naudin. 2n=24. S. Africa. Wild. Closely related to C. africanus* and C. leptodermis Schweik., 2n=24 (A.P.M. de Nijs, pers. comm. 1980). Resistance to powdery mildew (Visser & de Nijs, 1980).

CUCUMIS ZEYHERI Sond. 2n=(24), 48. A perennial from S. Africa (Dane et al., 1980).

LAGENARIA SICERARIA (Molina) Standl. (syn. L. vulgaris Ser.). Bottle gourd, White-flowered

Lagenaria siceraria

gourd, Calabash gourd. 2n=22. Widespread in Africa, now pantropic. Although an extensive variation occurs in Africa both subspecies asiatica Kob.(found in Asia) and afrikana Kob. (found in Africa) also occur in Papua New Guinea, where the penis gourd developed (Heiser, 1973a, 1973b).

It now occurs subspontaneously and is cultivated in trop. Africa, Asia and America. It has been shown that gourds float for a long time and seeds remain viable. This may explain very early spread to other continents by sea currents. Remains of plant material tentatively identified as belonging to Lagenaria have been found in the Spirit Cave, Thailand and have been dated 10000-6000 BC. (Gorman, 1970). Remains of the bottle gourd were found in Mexico dated 7000-5500 BC. (Whitaker & Cutler, 1971) in Peru 4000-3000 BC., in the Egyptian tombs dated 3500-3000 BC. (Purseglove, 1968) and in China 500 AD. (Li, 1969). Material found in Mexico and dated 700-1300 AD. appears to be more closely related to the modern races punctatum and latifolium than it is to other races (Whitaker & Cutler, 1971).

It must be the oldest crop cultivated in the tropics (Purseglove, 1968). Related species are: L. abyssinica (Hook.f.) C. Jeffrey (syn. Adenopus abyssinicus Hook.f., A. reticulatus Gilg) (2n=), L. guineënsis (G. Don.) C. Jeffrey (syn. Bryonia guineënsis G. Don., Adenopus longiflorus Benth., A. guineënsis (G. Don.) Exell, A. pynaerti De Wild.) (2n=) and L. rufa (Gilg) C. Jeffrey (syn. Adenopus rufus (Gilg) (2n=) (Jeffrey, 1962).

TELFAIRIA OCCIDENTALIS Hook.f. Fluted pumpkin. 2n= . Trop. Africa. Cultivated there for its seeds.

Cupressaceae

JUNIPERUS PROCERA Hochst. 2n= . E. Africa. Mainly a timber tree; also used for soil conservation and for medicinal purposes.

Dioscoreaceae

DIOSCOREA ABYSSINICA Hochst. 2n=40. Ethiopia, savanna of Africa. Cultivated to a limited extent as a food crop, especially in Uganda (Burkill, 1939; Coursey, 1967).

DIOSCOREA BULBIFERA L. (syn. D. latifolia Benth.). Potato yam, Aerial yam, Bulbil-bearing yam. 2n=36, 40, 54, 60, 80, 100. Wild and cultivated in trop. Asia (p. 52) and Africa. It could have been domesticated in both regions.

DIOSCOREA CAYENENSIS Lam. Yellow yam, Yellow Guinea yam, Twelve-month yam, Cut-and come yam. 2n=36, 54, 60, 80, 140 and aneuploids. W. Africa. Also cultivated in W. Indies.

DIOSCOREA COLOCASIIFOLIA Pax. False water yam. 2n= . W. Africa. Cultivated in E. Ghana, Cameroons and Mayumbe area of Zaïre.

DIOSCOREA DUMETORUM (Kunth) Pax. Bitter yam, Cluster yam. 2n=36, 40, 45, 54. Cultivated throughout Africa between 15°N and 15°S. Closely related to the Asian D. hispida*.

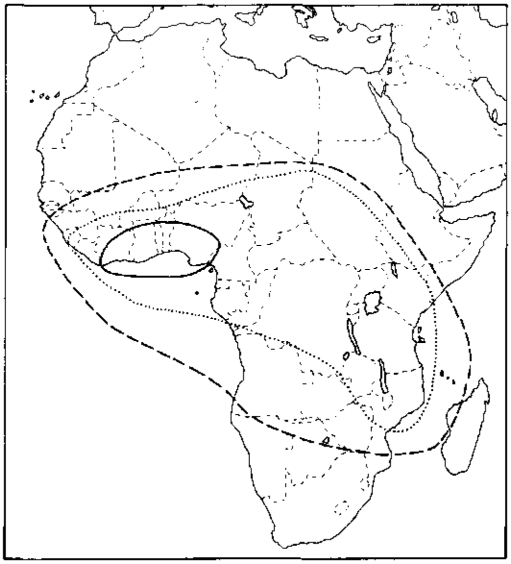
DIOSCOREA ELEPHANTIDES (L'Hér.) Engl. Elephant's foot. 2n= . S. Africa, in the rocky, semi-deserts. Collected and eaten by Hottentots. In Europe and N. America, it is cultivated as a curiosity (Coursey, 1967). The tuber can grow to 350 kg.

DIOSCOREA HIRTIFLORA Benth. 2n=40. Savanna of Africa. Cultivated in N. Nigeria.

DIOSCOREA LIEBRECHTSIANA De Wild. 2n= . Africa. Cultivated.

DIOSCOREA OVINALA Baker. Ovinala. 2n= . Madagascar. Cultivated there. Almost replaced by D. alata* and Manihot utilissima* (Coursey, 1967).

DIOSCOREA PRAEHENSILIS Benth. Bush yam, Forest yam. 2n=40, 80. W. Africa. Cultivated there. Probably ancestor of D. rotundata*.



Dioscorea cayenensis and D. rotundata (—), D. dumetorum (···) and D. bulbifera (---)(Harris, 1972).

DIOSCOREA ROTUNDATA Poir. White yam, White Guinea yam, Guinea yam, Ibo yam. 2n=40, 60. W. Africa. The most important yam cultivated there. Probably derived from D. praehensilis*. Widely variable. Closey related to D. cayenensis* and often included it.

DIOSCOREA SANSIBARIENSIS Pax. (syn. D. macroura Harms, D. welwitschii Renole). Africa. Cultivated there.

DIOSCOREA SEMPERFLORENS Illine. 2n= . Cultivated in Congo.

DIOSCOREA SOSO Jun. & Perr. 2n= . Formerly cultivated in Madagascar, but now replaced by Manihot utilissima*.

DIOSCOREA ZARA Baudon. 2n= . Cultivated to some extent in C. Africa. This name is applied to what is possibly a form of either D. sagittifolia Pax. or D. lecardii De Wild.

Ehretiaceae

CORDIA AFRICANA Lam. Sudan teak. 2n= . Trop. Africa, trop. Arabia. Occasionally cultivated in Ethiopia, the leaves being used for medicinal purposes and the wood for building and furniture (Jansen, 1981).

Euphorbiaceae

BRIDELIA MICRANTHA (Hochst.) Baillon. 2n= . Trop. Africa. Cultivated as food plant of the African silk caterpillar.

EUPHORBIA DREGEANA E. Mey. 2n= . Namaqualand, S. Africa. Somethimes cultivated for rubber (Uphof, 1968).

EUPHORBIA KAMERUNICA Pax. Solo. 2n= . W. Africa. A tall xerophytic tree. Cultivated for the latex used for tattooing and to poison arrows (Uphof, 1968).

MANIHOT ESCULENTA Crantz. Cassava. 2n=36. S. and C. America (p. 170). Secondary centre in Africa.

PLUKENETIA CONOPHORA Muell. Arg. (syn. Tetracarpidum conophorum Hutch. & Dalz.). 2n= . A woody vine of trop. Africa. Cultivated as a source of oil.

RICINODENDRON HEUDELOTII (Baill.) Pierre ex Pax. 2n=22. W. Africa up to Angola and Usambara Highlands (Tanzania). Fruits and seeds are used as a source of oil. Also cultivated in Cameroons.

RICINUS COMMUNIS L. Castor bean, Castor-oil plant. 2n=20, (21). Trop. E. Africa and India. Now cultivated in most tropical countries where it runs wild in clearings, roadsides and dumpheaps. It probably originated as camp-follower, evolving into an oil plant, a drug and an ornamental (Anderson, 1952). The only species of this genus.

Flacourtiaceae

ONCOBA ECHINATA Oliver (syn. Caloncoba echinata (Oliver) Gilg.). 2n= . Trop. W. Africa. Cultivated in C. and S. America for medicinal seed oil.

Geraniaceae

PELARGONIUM X ASPERUM Ehrh. ex Willd. (syn. P. radula L'Hér. var. roseum Willd., Pelargonium roseum Willd.). Rose geranium. 2n=77, 81. S. Africa. Cultivated for its geranium oil. The plant is male-sterile. Autetraploids (2n=4x=154) are fertile. Crossed with autotetraploid P. denticulatum and backcrossed with 4x P. x asperum resulted in plants with 40-55% more oil than P. roseum (Tamai & Tokumasu, 1968). P. x asperum is probably a hybrid of P. radens x P. denticulatum* (Clifford, 1958) or P. graveolens* x P. radens (Moore, 1955). P. radens Moore. (2n=) is a plant of S. Africa.

If the first parentage is correct, the new oil-rich hybrids are a cross of a 4x hybrid (p. radens x P. denticulatum) with 4x P. denticulatum and of backcrossing with the 4x original hybrid.

This species, P. quercifolium Ait. (2n=auto 4x=44; Oak-leaved geranium) and P. crispum* have identical zymograms for esterase, peroxidase and acid phosphatase (Tokumasu et al., 1977), which points to a close relationship.

PELARGONIUM CRISPUM (L.) L'Hér. ex Ait. (syn.

P. rigidum Willd.). 2n=2x=22. S. Africa. Cultivated for its lemon-scented oil. It varies considerably in the wild and there are several forms.

PELARGONIUM DENTICULATUM Jacq. 2n=90. S. Africa. Was cultivated as a fragrant pelargonium in Japan where it was replaced in 1954 by P. roseum*. It has a pine scent.

PELARGONIUM GRAVEOLENS L'Hér. (syn. P. terebinthinaceum (Cav.) Small). Rose geranium. 2n=90. S. Africa. A pelargonium with rose-scented leaves. Cultivated for it oil. There are many cultivars. P. capitatum Willd., is a derivative of P. graveolens (Moore, 1955). Cultivated in Algeria and Isle of Réunion.

PELARGONIUM KAROOENSE Kunth. 2n= . S. Africa. Cultivated for its geranol.

PELARGONIUM ODORATISSIMUM (L.) Ait. 2n=16. Trop. Africa. Extensively cultivated for its apple-scented geranium oil.

PELARGONIUM TOMENTOSUM Jacq. 2n= . S. Africa. Cultivated for its peppermint-scented oil. It crosses readily with P. graveolens*.

Gramineae

ACROCERAS AMPLECTANS Stapf. (syn. Panicum zizanoides Hbk. var. angustatum Stapf). 2n= . W. Africa. Cultivated in Gambia as a vegetable (Terra, 1967).

ACROCERAS MACRUM Stapf. Nilegrass. 2n=36. S. and E. Africa. Cultivated as a pasture grass.

ANDROPOGON GAYANUS Kunth. Gamba. 2n=20, 40. N. Nigeria. It has been divided into var. gayanus (syn. var. genuinus Hack.), var. squamulatus (Hochst.) Stapf., var. bisquamulatus (Hochst.) Hack., and var. tridentatus (Hochst.) Hack. The second and third varieties have been used for selection. The tetraploid plants found in var. tridentatus are perhaps hybrids of A. gayanus (2n=20) in the far north of Nigeria and A.tectorum (2n=20)in the S. part of N. Nigeria.

ARUNDINARIA ALPINA K. Schum. Alpine bamboo. 2n= . Kenya, Tanzania, Uganda, Sudan, Ethiopia, Rwanda and Burundi in mountain forests at an altitude of about 2400-3000 m. Its stems are used in paper industry and as building material.

AVENA ABYSSINICA Hochst. Ethiopian oats, Abyssinian oats. 2n=28, genome formula AABB. Obligate weed in wheat and barley fields above 2000 m on the Ethiopian Plateau. It resembles domesticated cereals in that it has lost the ability of natural seed dispersal. Ethiopian oats are unintentionally harvested and sown with the crop it accompanies, as a mimictic weed. A spontaneous race (A. vaviloviana (Malz.) Mordv.) also occurs in Ethiopia. Natural seed dispersal mechanisms in A. abyssinica are controlled by two independent loci that are homozygous recessive in the non-brittle, obligately weedy race. Ethiopian oats is derived from the Mediterranean tetraploid (AABB) A. barbata Pott. ex Link. (Ladizinsky, 1975b; Ladizinsky & Zohary, 1971).

AVENA STRIGOSA Schreb. abyssinica type. Abyssinian oat. 2n=28, genome formula AsAsBB. This type has also been described as A. abyssinica Hochst. This is the non-brittle form while the semi-brittle form (vaviloviana type, A. vaviloviana Malz.) is also found in Ethiopia. The abyssinian type is harvested and threshed together with barley. Both types probably derive from introduced barbata type of A. strigosa* (Ladizinsky & Zohary, 1971).

BRACHIARIA BRIZANTHA (Hochst.) Stapf. Palisade grass. 2n=(x=9), 36, 54. Trop. and S. Africa, cultivated esp. in Sri Lanka and Brazil.

BRACHIARIA DECUMBENS Stapf. Signal grass. 2n=4x=36. Trop. Africa. Cultivated throughout the tropics for fodder. An obligate aposporous apomict.

BRACHIARIA DEFLEXA (Schumach.) C.E. Hubbard. Animal fonio. 2n=20. Guinea coast to Yemen, and south to S. Africa and Botswana. Var. sativa Portères is cultivated as a cereal on the Fouta Djalon Highlands of Guinea in W. Africa. Often invades cultivated fields as a weed, and is frequently harvested as a wild cereal. In Angola, an aggressive colonizer race is a tolerated wild cereal in maize fields (de Wet, 1977). This species grades morphologically into B. ramosa (L.) Stapf, a species that is cultivated as a cereal in S. India.

BRACHIARIA MUTICA (Forsk.) Stapf (syn. B. purpurascens (Raddi) Henri). Para grass, Mauritius grass, Watergrass. 2n=36. Throughout tropics and subtropics. Grown as a fodder.

BRACHIARIA RUZIZIENSIS Germain & C. Evrard. Congo signal grass, Ruzi grass. 2n=18. E. Africa. In Australia Kennedy ruzi grass is cultivated. It is self-incompatible.

CENCHRUS BIFLORUS Roxb. (syn. C. barbatus Schum., C. catharticus Del.) Cramcram. 2n=30, 34, 36. Aggressive colonizer of disturbed habitats in African savanna, extending to India. Widely harvested in W. Africa as a cereal, and important fodder in the arid savanna.

CENCHRUS CILIARIS L. Buffel grass, African foxtail, Rhodesian foxtail. 2n=mainly 36. Cultivated in Australia. Obligate and facultative apomixis and sexual propagation (Bray, 1972). Related to C. setigerus Vehl, Birdwood grass, 2n=34, 36, 37.

CHLORIS GAYANA Kunth. Rhodes grass. 2n=20, 30,

40. E. Africa from Ethiopia to South Africa. Excellent natural forage. Cultivated widely as a fodder in the tropics and subtropics.

CHLORIS ROXBURGHIANA Schult. 2n=20. Kenya.

CYNODON DACTYLON (L.) Persoon. Kweek grass, Bermuda grass. 2n=18, 36. Africa and Eurasia; introduced to the New World. Several varieties are recognized (Harlan et al., 1970). Selections from var. dactylon are widely planted as lawn-grasses. Coastal Bermuda grass (Burton, 1947), a widely planted fodder in SE. USA reproduced vegetatively from a hybrid between var. dactylon (2n=36) and var. elegans (2n=36). Var. coursii (2n=36) is an important natural fodder in Madagascar, as is var. elegans in S. Africa. Var. aridus (2n=18) is drought-tolerant, and extends from the S. Karroo (S. Africa), across the Near East to India. See p. 73.

CYNODON INCOMPLETUS Nees. var. hirsutus (Stent) De Wet & Harlan (syn. C. bradleyi Stent). 2n=18. S. Africa. Widely cultivated lawn-grass.

CYNODON X MAGENISII Hurcombe. Magenis, Sunturf. This triploid represents a natural hybrid between C. dactylon var. dactylon (2n=36) and C. transvaalensis (2n=18). Widely planted lawn-grass from a single hybrid clone near Johannesburg in South Africa.

CYNODON NLEMFUENSIS Vanderyst. Giant star grass. 2n=18, 36. Ethiopia, Uganda and south to Angola and Zimbabwe. An excellent natural fodder. Cultivated in trop. Africa. A cultivar grown in SW. Nigeria was derived from a cross between this species (2n=36) and C. dactylon* var. coursii (2n=36).

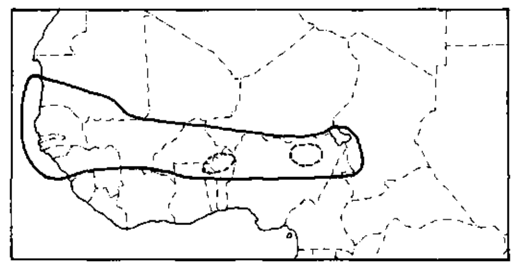
CYNODON PLECTOSTACHYUS (Schumach.) Pilger. Star grass. 2n=18. Ethiopia to Zaïre and Zambia. An excellent natural fodder, but cultivated in Kenya. Often confused with C. nlemfuensis*, but readily distinguished by its minute glumes.

CYNODON TRANSVAALENSIS Burtt-Davy. Transvaal Bermuda, African Bermuda grass (US). 2n=18. South Africa. An excellent fine hardy lawn-grass.

DIGITARIA ABYSSINICA (Hochst.) Stapf. Abyssinian finger grass. 2n= . Trop. Africa. Used in S. Africa to control erosion; useful fodder.

DIGITARIA DECUMBENS Stent. Digit grass, Pangola (finger) grass. 2n=27. S. Africa. An excellent natural fodder. An introduction from S. Africa is grown as a fodder in the Americas as Pangola grass.

DIGITARIA EXILIS (Kippist) Stapf. Fonio, Acha, Fundi. 2n=18, 36. W. Africa. Cultivated as a cereal in the W. African savanna (Portères, 1955). Its closest wild relative is D. longiflora (Retz.) Persoon, which is widely distributed in the tropics. Portères (1976) recognizes five races of fonio. However, these races have no geographic unity and grade morphologically into one another. The most primitive is var. gracilis with two racemes and spikelets that are mostly grouped into threes along the rachis. In these traits, var. gracilis resembles D. longiflora except that the spikelets are glabrous. The lower part of each raceme is devoid of spikelets in var. stricta. The other three varieties have usually more than two racemes per inflorescence. Var. densa is characterized by crowded spikelets. Var. rustica and var. mixta include robust plants that are late to mature.



Digitaria exilis (—) and D. iburua (---)(Portères, 1950).

DIGITARIA IBURUA Stapf. Iburu, Black fonio, Hungry rice. 2n=36. W. Africa. Cultivated as a cereal by the Hausa of Nigeria between Jos and Zaria, and sporadically around Zinder in Niger, Azagive in the Ivory Coast, Kande and Atalote in Togo, and between Birni and Natitingou in Benin. It is often grown in between rows of sorghum or pearl millet, and frequently as a mixture with D. exilis*. The closest wild relative of black fonio is D. barbinodis Henr., an aggressive natural colonizer in W. African savanna.

DIGITARIA PENTZII Stent. Taiwan pangola grass. 2n=(18, 27), 36, (45), 54. S. Africa. Related and perhaps identical with D. decumbens*. Source of resistance to virus diseases.

DIGITARIA TRICOSTULATA (Hack.) Henr. 2n= Africa. Related to D. iburua*.

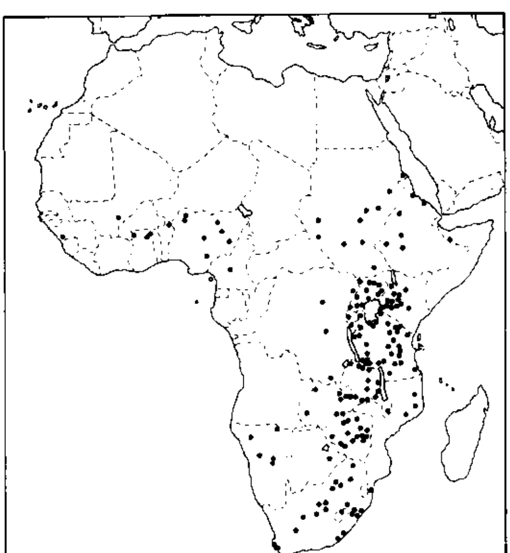
DIGITARIA VALIDA Stent. Giant pangola grass. 2n=24, 30, 36. S. Africa. A source of disease resistant for D. decumbens*. Introduced in Florida and Surinam.

ECHINOCHLOA COLONA (L.) Link. 2n=54. Widely distributed in the tropics and subtropics. Formerly cultivated in Egypt and Tanzania. Now cultivated as inferior cereal in India. An important wild cereal and good fodder across the dry African savanna and as fodder in N. America.

EHRHARTA CALYCINA Smith. Perennial veldtgrass. 2n=24, 30, 48. S. Africa. Used as a soil stabilizer in W. of USA. Cv. California veldtgrass has an open panicle and sheds its caryopses. The new cv. Mission veldtgrass has a compact panicle and is non-shedding.

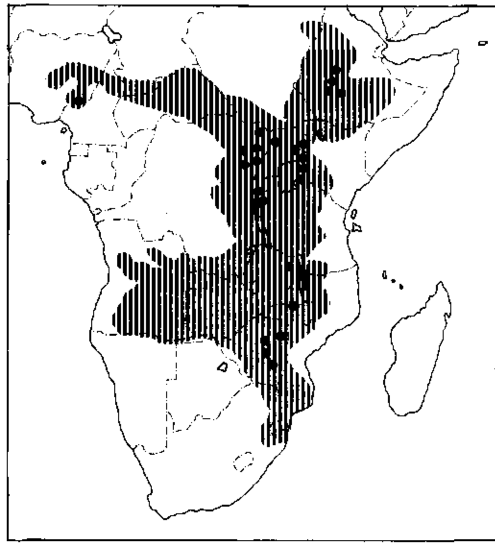
ELEUSINE CORACANA (L.) Gaertn. ssp. africana (Kenn.-O'Bryan) Hilu & de Wet (syn. E. africana Kennedy-O'Bryan). Wild finger millet. 2n=36. Guinea coast of W. Africa to Ethiopia and south to the Cape Province (S. Africa). Differs from E. indica* in being tetraploid, not diploid, and in having more obviously sculptured grains (Phillips, 1972).

ELEUSINE CORACANA (L.) ssp. coracana. (syn. E. coracana (L.) Gaertn). Finger millet. 2n=36. Widely cultivated as a cereal along the highlands of E. Africa from Uganda and Ethiopia to South Africa. Mehra (1963) recognizes an African highland race with open inflorescence. Hilu & de Wet (1976) show that the African highland race is widely cultivated on the E. African highlands and was derived under cultivation from ssp. africana. This race gave rise to an African lowland race that was introduced to India, where it evolved into a morphologically distinct cereal complex. The oldest known domesticated finger millet occurs in the archaeological record of Ethiopia



Eleusine africana (Phillips, 1972).

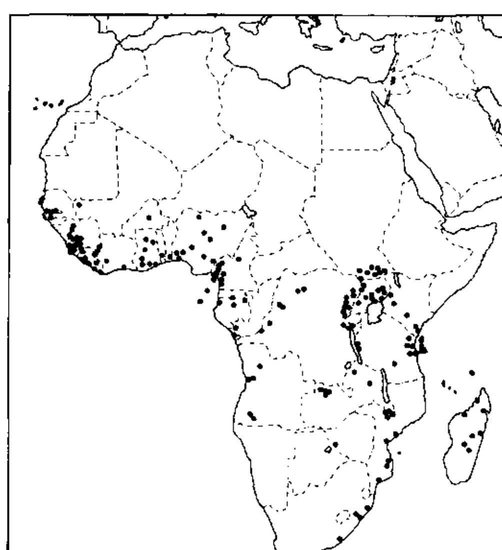
dating back some 5000 years (Hilu et al., 1979). It never spread into the W. African savanna, probably because of competition with other millets such as the fonios (Digitaria sp.). However it became widely cultivated as far



Eleusine coracana in Africa (grey) African highland race, (●) African lowland race.

south as the Transvaal of South Africa by the beginning of the Bantu Iron Age.

ELEUSINE INDICA (L.) Gaertn. Goosegrass. 2n=18. Eurasia and Africa. Introduced to the New World, where it is an aggressive weed. Jameson (1970) proposed that the Indian races of finger millet were derived from E. indica while E. coracana* ssp. africana is the progenitor of domesticated African finger millets. Cytogenetic evidence refutes this hypothesis. Ssp.



Eleusine indica (Phillips, 1972).

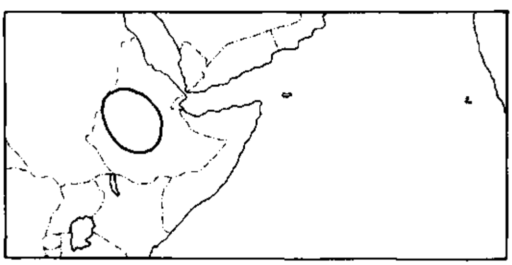
africana (2n=36) crosses readily with both African and Indian finger millets to produce fertile hybrids (Chennaveeraiah & Hiremath, 1974).

ENTEROPOGON MACROSTACHYUS Schum. Bush rye. 2n= 20. E. Africa.

ERAGROSTIS CURVULA (Schrad.) Nees. Weeping lovegrass, Boer lovegrass. 2n=20, 30, 40, 50, 60, 70, 80, 30-70, x=10. S. Africa. There is no relation between region of provenance and 2n. Most plants belong to type robusta. The reproduction is sexual, obligate and facultative apomixis. Used as sand stabilizer.

ERAGROSTIS SUPERBA Peyr. Tickgrass. 2n=40. E. Africa. Cultivated there.

ERAGROSTIS TEF (Zucc.) Trotter. (syn. E. abyssinica (Jacq.) Link.). Teff, Teffgrass. 2n= 40. The large and widely distributed genus Eragrostis includes this one domesticated cereal species. Teff is an endemic cereal crop of the Ethiopian highlands (Tadessa, 1975). Widely grown in S. Africa as a fodder for livestock; introduced in USA. The wild progenitor of teff is not certain. Its closest wild relative E. pilosa (L.) Beauv. is widely distributed across warm temperate parts of the world, and is harvested as a wild cereal in E. Africa (Rozhevicz, 1928).



Eragrostis tef (Portères, 1950).

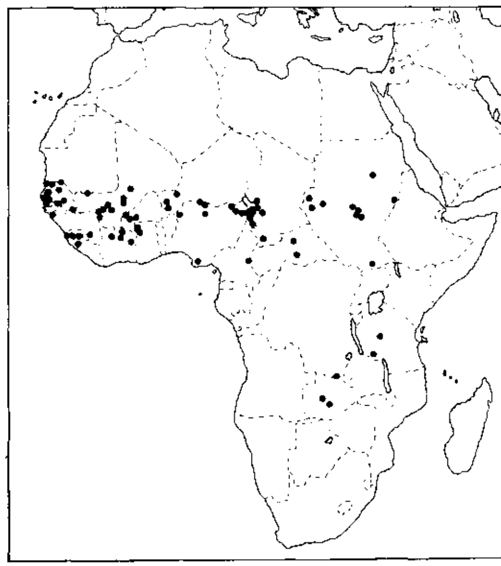
HEMARTHRIA ALTISSIMA (Poir.) Stapf & C.E. Hubb. Limpograss. 2n=18, 36, (54). SE. Africa. Domesticated in Florida, USA as a perennial, vegetatively propagated forage grass.

HYPARRHENIA RUFA (Nees) Stapf. (syn. Andropogon rufus Kunth). Jaragua grass. 2n=20, 30, 36, 40. Trop. Africa. Cultivated in N. and S. America.

MELINIS MINUTIFLORA Beauv. Molasses grass, (Brazilian) stink grass, Honey grass. 2n=4x =36. Africa. Cultivated as a fodder plant. Naturalized in Brazil.

OREOBAMBOS BUCHWALDII K. Schum. 2n= . The mountains of trop. Africa.

ORYZA BARTHII A. Chev. (syn. O. breviligulata A. Chev., O. stapfii Roshev., O. perennis Moench. ssp. barthii (A. Chev.) A. Chev.). 2n= 24. From the Guinea coast of W. Africa across the savanna to Zambia. Growing in water, often as a weed in rice fields (Clayton, 1972). It probably represents derivatives of hybrids between O. longistaminata* and O. glaberrima*.

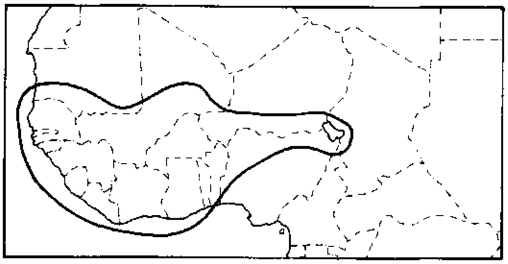


Oryza barthii (Harlan, 1973).

ORYZA BRACHYANTHA A. Chev. & Roehr. (syn. O. guineensis A. Chev.). 2n=24. From the Guinea coast of W. Africa across N. Zaire to the S. Sudan. This species usually occurs in shallow pools that dry out after the rainy season. In permanent pools it behaves as a perennial.

ORYZA EICHINGERI A. Peter (syn. O. latifolia Hook.f. var. collina (Trimen) Hook.f.) 2n=48. This slender species grows in damp places as a forest undergrowth and is distributed from the Ivory Coast to Uganda and Tanzania, and also occurs in Sri Lanka. The name O. eichingeri was also used for types now included in O. punctata*, and O. schweinfurthiana non Prod. (Gopalakrishnan & Sampath, 1966).

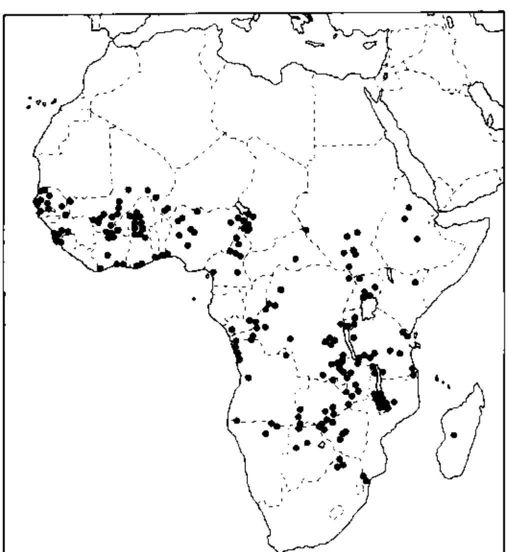
ORYZA GLABERRIMA Steud. African rice. 2n=24, genome formula A^gA^g. An indigenous cultivated rice grown in flood plains of savanna. From Senegal to Lake Chad. It is generally accepted that this species evolved under cultivation from O. longistaminata*, which is widely collected as a wild cereal in the African savanna. Nayar (1973) postulated that African rice originated as a derivative of introduced Asiatic rice, O. sativa which according to him reached



Oryza glaberrima (Portères, 1950).

Egypt during the fourth century BC. There is, however, no botanical or genetic evidence to support this hypothesis. Variation is discussed by Portères (1956).

ORYZA LONGISTAMINATA A. Chev. & Roehr. African wild rice. 2n=24. Throughout trop. Africa including N. Transvaal of South Africa. This perennial occurs in shallow pools and along the banks of rivers. It resembles O. sativa* (Asiatic rice) in having long ligules on the lower leaves.



Oryza longistaminata (Harlan, 1973).

ORYZA PUNCTATA Kotschy & Steud. (syn. O. schweinfurthiana Prod.). 2n=24. Swampy streamsides from the Guinea coast to the Sudan, south to Angola. Also in Madagascar and S. Asia.

OXYTENANTHERA ABYSSINICA Munro (syn. Bambusa abyssinica Rich.). Woody bamboograss. 2n=c.60. Senegal to Ethiopia. Cultivated for its stems which are used for boats and rafts, as well as for paper-making.

PANICUM BULBOSUM HBK (syn. P. maximum var. gongylodes Doell). Texas grass. 2n=6x=54, 70, 8x=72. Distributed in Texas, Mexico, C. and S. America. Forage grass.

PANICUM COLORATUM L. Small buffalo grass. 2n=18, 36, 44, (54). S. Africa. A good fodder. Closely allied to P. maximum*. Var. makarikariense Goossens, makarakeri grass, 2n=44 is a native of Zimbabwe. It is more drought tolerant than var. coloratum and cultivated in S. Africa as a forage grass.

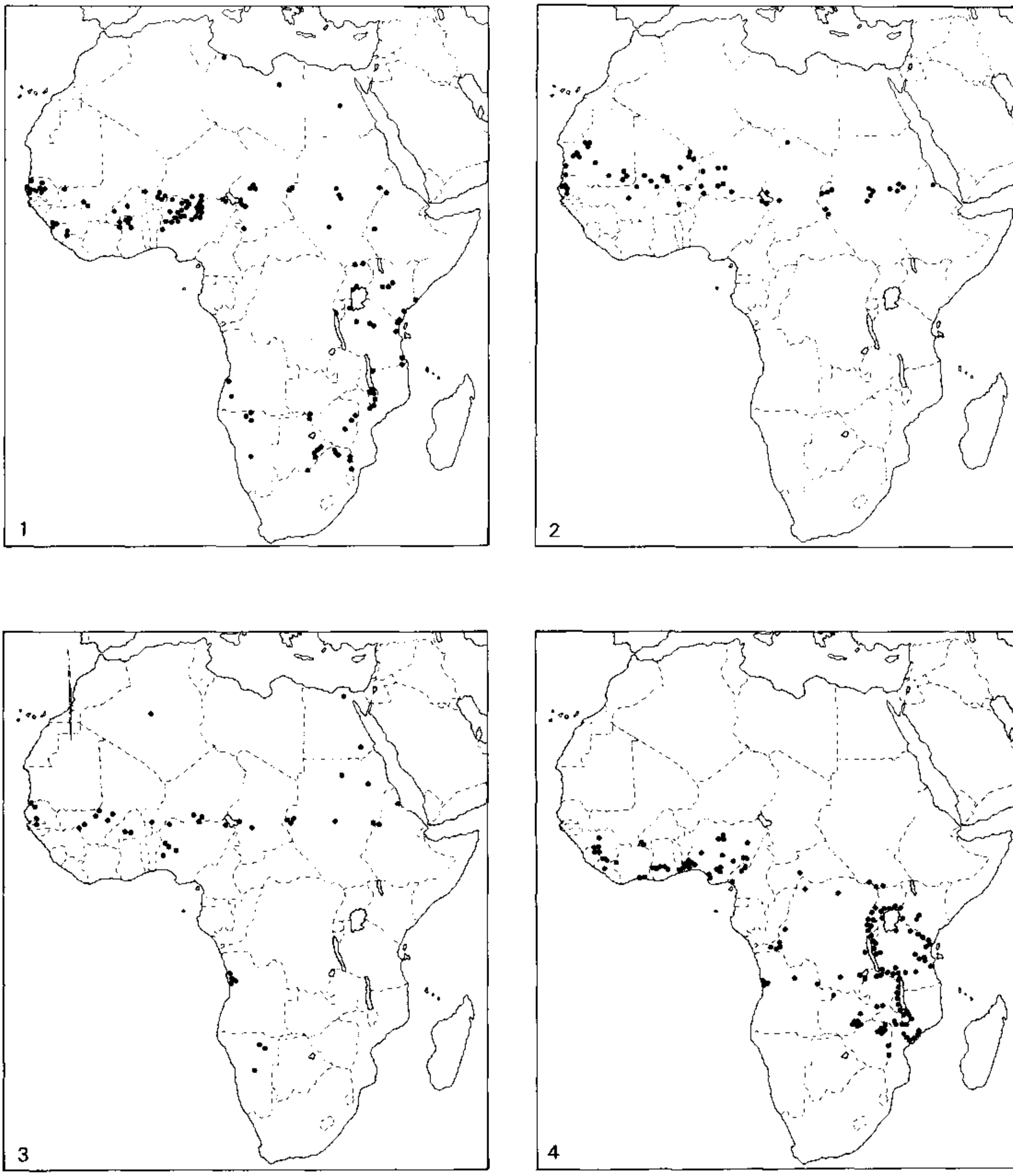
PANICUM LAETUM Kunth (syn. albidulum Steud.). Haze. 2n= . An important wild cereal and good fodder forming large stands in the Sahel from Senegal to Eritrea. A potential cereal for arid regions.

PANICUM MAXIMUM Jacq. Guinea grass, Panic. 2n=18, (32)- 36, (48). Trop. and S. Africa, Madagascar, Mascarene Islands and Yemen. Cultivated as a pasture grass in many warm countries.

PENNISETUM AMERICANUM (L.) Leeke ssp. americanum. (syn. P. typhoides (Brum.) Stapf & Hubb., P. spicatum (L.) Koern.). Pearl millet. 2n=14. African savanna, also India and the Near East. This subspecies is recognized to include all cultivated taxa of pearl millet grown primarily as cereals (Brunken, 1977). The cultivated types commonly recognized (Stapf & Hubbard, 1934) are divided among four races. Race typhoides is characterized by obovate grains and includes the primitive pearl millets from which other races were derived. Grown across the African savanna and in India. Race nigritarum has grains with angular cross-section and is an important cereal from Sudan to Senegal. Race globosum has spherical grains and is grown from Upper Volta to Sudan. Race leonis is characterized by acute oblanceolate grains. It is primarily a pearl millet of Sierra Leone, but is sporadically grown also in S. Mauritania. Its wild ancestor is ssp. monodii*; a weedy type is ssp. stenostachyum*.

PENNISETUM AMERICANUM (L.) Leeke ssp. monodii (Maire) Brunken (syn. P. violaceum Lam.). 2n=14. Wild pearl millet. W. Africa, Sahel from Dakar to C. Sudan, and the mountains of the C. Sahara. It is an aggressive colonizer of man disturbed habitats, and is the wild progenitor of pearl millet (P. americanum ssp. americanum*). Distribution suggests that pearl millet was domesticated along the C. Saharan highlands at the onset of the present dry phase in N. Africa, probably between 4000 and 5000 years ago.

PENNISETUM AMERICANUM (L.) Leeke ssp. stenostachyum (Klotzsch ex A.Br. & Bouche) Brunken (syn. P. stenostachyum Klotzsch). Shibra, Weed pearl millet. 2n=14. The pearl millet gene pool includes wild (ssp. monodii*) and cultivated



Pennisetum sect. Pennisetum americanum in Africa. 1 subspecies americanum, 2 subspecies monodii, 3 subspecies stenostachyum, 4 P. purpureum (Brunken, 1977).

(ssp. americanum*) kinds, as well as numerous spontaneous, weedy plants that mimic the crop in vegetative and floral morphology. Until maturation, these weeds are often difficult to distinguish from the race of pearl millet they accompany as a weed. However, their inflorescences disarticulates at maturity, and ssp. stenostachyum is spontaneous in man-disturbed habitats. Shibras originate from hybrids between cultivated races of pearl millet and subspecies monodii.

PENNISETUM CLANDESTINUM Hochst. ex Chiov. Kikuyu grass. 2n=36. Trop. E. Africa. An excellent natural fodder, and widely cultivated in the tropics and subtropics, as a soil stabilizer, lawn grass and fodder. Hermaphroditic and male-sterile.

PENNISETUM PURPUREUM Schumach. Napier grass. 2n=14. Trop. Africa. This species does particularly well in areas with an annual rainfall exceeding 1000 mm per year. It is an aggressive natural colonizer of wet disturbed sites. Napier grass was introduced during the 20th Century to many parts of the world as a fodder, and has become naturalized in most of the world's wet tropics. Bana grass in Kenya is a hybrid with P. americanum*.

PENNISETUM SETACEUM (Forsk.) Chiov. Fountain grass. 2n=27. African savanna. Cultivated as a fodder and in S. Africa also as an ornamental.

PENNISETUM UNISETUM (Nees) Benth. Natal grass, Drakenberg silky grass. 2n= . African Highlands. Cultivated in S. Africa as a forage grass.

PENNISETUM VULPINUM Stapf & Hubbard. 2n= . Africa. Cultivated in Sudan.

SACCHARUM SPONTANEUM L. Wild cane. 2n=104-128. From India (p. 75) plants with 2n=54 spread to Africa. In Uganda and adjacent Tanzania it is actually cultivated. In Africa originally used as a source of salt by burning, later it became used as hedges, for erosion control and for household. Grassl (1964) suggested that the high number of chromosomes may derive from hybridization of the original S. spontaneum and an African related species e.g. Sorghum bicolor*.

SECALE AFRICANUM Stapf. 2n=14. E. Karoo Plateau, S. Africa. Whether this species is a Pleistocene immigrant to S. Africa or a derivative of a relatively recent introduction of seeds of S. montanum from Spain or Italy as a contaminant of wheat and barley is not known (Khush, 1960). It has the same chromosome arrangement as S. montanum* and must have derived from this species (Stutz, 1972). Owing to its separation from the Secale-area, it adopted self-fertilization as a means of perpetuation. It has a fragile rachis and a perennial habit.

SETARIA PORPHYRANTHA Stapf. 2n= . Purple pigeon grass. Zimbabwe. Perennial grass cultivated in Australia.

SETARIA SPHACELATA (Schum.) Stapf & Hubbard. Setaria, Golden timothy grass. 2n=18, 36, 54. Africa. Cultivated there, Australia and elsewhere. Some cultivars have a high oxalic acid content which may result in the death of cattle. In Australia, it is often called S. anceps Stapf ex Massey, which species is closely related. Self-incompatible.

SORGHUM BICOLOR (L.) Moench ssp. bicolor (syn. vulgare Pers.). Sorghum. 2n=20. This subspecies is recognized to include the 28 cultivated taxa of Snowden (1936). It is widely cultivated in Africa, was introduced to India at least 3000 years ago, and has become an important crop in the New World during the last century. It is not known when sorghum was first brought into cultivation. Murdock (1959) proposes that it is a W. African crop. Doggett (1965) proposes that domestication took place somewhere in the NE. quadrant of Africa. Distribution indicated that sorghum must have been domesticated in the savanna zone south of the Sahara, and that the crop must have been cultivated for at least 3000 years (Harlan & Stemler, 1976). However, known identifiable archaeological remains of cultivated sorghum in Africa date back only to the early centuries of the Christian Era (de Wet, 1978). Cultivated kinds of grain sorghums are divided among races bicolor, kafir, durra, guinea, caudatum and several intermediated races (Harlan & de Wet, 1972).

Race bicolor (subser. Bicoloria Snowden) is characterized by open inflorescences and long clasping glumes that usually enclose the elliptic grain at maturity. Bicolor sorghums resemble spontaneous weedy sorghums, but they lack the ability of natural seed dispersal. Members of race bicolor, particularly those far removed from their African centre of origin, probably represent relics of ancient cultivated kinds. Others may have originated as selections from derivatives of hybrids between modern cultivated races and wild members of S. bicolor. Bicolor sorghums are low yielding as cereals. They are rarely an important crop, but are grown across the range of sorghum cultivation in Africa and Asia. Some selections are grown strictly for their sweet stems, while in Africa other kinds are grown for their bitter grains that are used to flavor sorghum beer. The race is morphologically heterogeneous. It includes S. dochna and S. bicolor of the Bicoloria, S. exsertum of Guineensia, and S. splendidum and S. nervosum of the subseries Nervosum Snowden.

Race kafir (subseries Caffra Snowden, excl. S. caudatum). It is characterized by more or less compact inflorescences that are often cylindrical in outline. Sessile spikelets are typically elliptic with the ripe glumes tightly clasping the usually much longer grain. The name is derived from 'kafir' the Arabic for unbeliever, referring to the Bantu who grow this race. Kafir sorghums are important staples

Cultivated for its tubers.

PLECTRANTHUS ESCULENTUS N.E.Br. (syn. Coleus dazo A. Chev., C. esculentus (N.E.Br.) Tayl., C. langouasiensis A. Chev.). Dazo, Kaffir potato. 2n=24. Africa. Cultivated there for edible tuber.

SOLENOSTEMON OCYMOIDES Schum. & Thonn. 2n= . Trop. Africa. Cultivated as a vegetable.

Leguminosae

ACACIA KARROO Hayne. (syn. A. horrida Willd.). Mimosa thorn, Allthorn acacia, Sweet thorn. 2n=52, 104. S. Africa. This tree is planted as an ornamental, in hedges and as sandbinder.

ACACIA NILOTICA (L.) Willd. ex Del. (syn. A. arabica (Lam.) Willd.). Babul acacia. 2n=52, 104. Trop. Africa extending to India. Cultivated there for its bark tannin. It also yields babul gum (Purseglove, 1968).

ACACIA SENEGAL (L.) Willd. (Sudan) gum arabic. 2n=26. Dry trop. Africa extending to the Red Sea and NW. India. The gum is mainly obtained from wild and semi-cultivated trees in the Sudan (Purseglove, 1968).

ALYSICARPUS GLUMACEUS (Vahl.) DC. 2n=20. Uganda, Kenya, Tanzania and Mozambique. Cultivated there as fodder.

ALYSICARPUS RUGOSUS (Willd.) DC. (syn. A. violaceus (Forsk.) Schindler). 2n=16. Dry trop. Africa. Used as a cover crop and fodder. Sometimes incl. in A. vaginalis*.

ALYSICARPUS VAGINALIS DC. Alyce clover, One-leaved clover. 2n=16, 20. Trop. Africa. Cultivated now in all tropics for soil improvement, as a cover crop and as a fodder crop. Var. nummularifolius (A. nummularifolius DC.) developed in the West Indies. It has a low spreading habit with buds located in the root crown. This makes it an ideal pasture plant (Whyte et al., 1953).

ARACHIS HYPOGAEA L. Groundnut, Peanut. 2n=40. S. America (p. 172). Introduced into Africa where it is cultivated widely. Bunting (1955, 1958) has described numerous varieties for trop. Africa, which points to a secondary centre in this region.

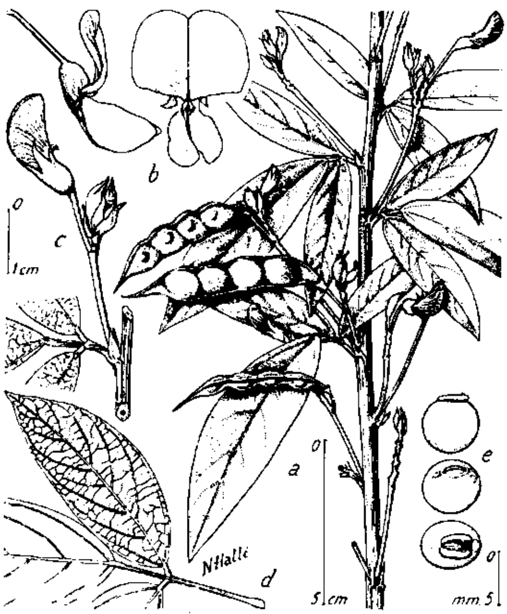
ASPALATHUS CONTAMINATUS (Thunb.) Druce. Rooibos tea-bush. 2n= . S. Africa. There are two forms: the prostrate one is found on the Cape Peninsula and the erect cultivated form (A. cedarbergensis Bolus) is observed in the Cedarbergs in the Clanwilliam and Citrusdal regions. The latter is the cultivated type (Cheney & Scholts, 1963).

ASTRAGALUS VENOSUS (A. Rich.) Hochst. 2n=16. E. Africa. Cultivated as horse fodder.

BAPHIA NITIDA Lodd. Camwood. 2n=44. W. Africa. Formerly cultivated as a source of red dye, now only as an ornamental.

BAUHINIA ESCULENTA Burch. Gemsbuck bean, Tamany berry. 2n= . Arid savanna of S. Africa, often abundant. Seeds are excellent to eat after roasting or boiling as porridge. Young tubers make a good vegetable, and may be boiled or baked. Although not cultivated, seeds and tubers are often for sale in native markets of Botswana. A potential cultivated plant.

CAJANUS CAJAN (L.) Millsp. Pigeon pea. 2n=22, 44, 66. Native to India (De, 1974; van der Maesen, 1980), where wild plants and related species occur. Its early introduction into Africa, its wide variation and run wild plants there confused earlier authors who indicated this area as its native region. A secondary centre of diversity developed in this region.



Cajanus cajan

CALPURNIA AUREA (Ait.) Bentham. 2n= . Angola, S. Africa, highlands of trop. E. Africa, Ethiopia and S. India. Hedgeplant in Ethiopia. Shadetree in coffee plantations. Ornamental in S. Europe and elsewhere (Jansen, 1981).

CANAVALIA REGALIS Dunn. 2n=22. Probably an old African domesticate known only in cultivation. It is probably derived from C. virosa (Roxb.) Wight & Arn. (2n=22), which occurs in Africa south of the Sahara and also in India (Sauer, 1964).

CASSIA ANGUSTIFOLIA Vahl. Indian senna, Tinnevelly senna. 2n=(26), 28. Somali and Arabia. Cultivated in India for senna (laxative) (Purseglove, 1968).

CASSIA SENNA L. (syn. C. acutifolia Del). Alexandrian senna. 2n= . Egypt, Sudan region and Sahara. Leaves and pods are taken from wild and cultivated plants (Purseglove, 1968).

CLITORIA TERNATA L. Butterfly pea, Kordofan pea. 2n=16. Probably from Madagascar (Lowry & Chew, 1974). It is widespread in the tropics and cultivated as a fodder and soil cover crop. In Malaysia, actinomorphic flowers with bluer anthocyanins than normal are used to colour rice cakes. That type is not cultivated, but is conserved if noticed (Lowry & Chew, 1974).

CROTALARIA CANNABINA Schweinf. 2n= . Sudan. A fibre crop.

CROTALARIA GOREENSIS Guill. & Pur. Gambia pea. 2n=16, (32). Trop. Africa. Cultivated in Queensland as green manure.

CROTALARIA INTERMEDIA Kotschy. Slenderleaf crotalaria. 2n=16. Trop. Africa. Cultivated in N. America and elsewhere especially for soil improvement, and also for grazing, hay and silage.

CROTALARIA SPECTABILIS Roth. (syn. C. sericea Retz., C. retzii A. Hitchc.). 2n=16. Trop. Africa. A green manure cultivated in (sub)-tropical countries. Wild in India and elsewhere.

CROTALARIA USARAMOENSIS E.G. Baker f. (syn. C. zanzibarica Benth.). 2n=(14), 16, (20). E. trop. Africa. A cover crop and green manure.

CYAMOPSIS SENEGALENSIS Guill. & Perr. 2n=14. Semi-arid savanna zone south of the Sahara from Senegal to Saudi Arabia. An annual herb. Probably the parental species of C. tetragonoloba* (Hymowitz, 1973). Valuable fodder in Senegal.

CYAMOPSIS TETRAGONOLOBA (l.) Taub. (syn. C. psoralioides DC.). Cluster bean, Guar. 2n=14. Purseglove (1968) suggested that its origin lies in India, but Anderson (1960) stated an African domestication of this crop (see further p. 76). Cultivated in S. India.

DESMODIUM SALICIFOLIUM (Poir. ex Lam.) DC. 2n =20, 22. Trop. Africa. Used as green manure.

DIPOGON LIGNOSUS (L.) Verdc. (syn. Dolichos lignosus L., D. benthamii Meisn., D. gibbosum Thunb., Verdcourtia lignosus (L.) Wilczek). 2n=22. C. Africa. Cultivated in Africa, S. America and Australia where it has run wild (Verdcourt, 1970).

DOLICHOS AXILLARIS E. Mey. (syn. Macrostyloma axillare (E. Mey.) Verdc.). Cultivated in E. Africa.

ERYTHRINA SENEGALENSIS DC. Coral flower. 2n= 42. W. Africa. Used as a hedge plant, as an ornamental and for medicinal purposes.

INDIGOFERA ARRECTA Hochst. Natal indigo. 2n= 16. E. Africa. Formerly cultivated for dye, and now as a green manure.

INDIGOFERA ENDECAPHYLLA Jacq. Wineleaf indigo, Creeping indigo. 2n=32, 36. Africa and Asia. Cultivated as fodder crop, usually in pastures, but poisons calves and horses.

INDIGOFERA TINCTORIA L. (syn. I. indica Lam., I. sumatrana Gaertn.). True indigo plant. 2n= 16. Probably W. Africa (Mansfeld, 1959). Cultivated as a dye plant. Also used as a green manure.

LABLAB PURPUREUS (L.) Sweet (syn. Dolichos lablab L., D. purpureus L., Lablab niger Medik.). Hyacinth bean, Bonavit bean, Lablab bean, Seins bean, Indian bean, Lubia bean, Egyptian bean. 2n=22, 24. Wild type (ssp. uncinatus Verdc., syn. Lablab uncinatus A. Rich.) in trop. Africa from W. Africa to Sudan and Ethiopia and to S. Africa. The commonly cultivated forms belong in general to ssp. purpureus unless they have linear kidney bean-like pods. Var. purpureus of this subspecies is a distinct due to all parts of the plant being purple. From Kenya, the cultivated ssp. bengalensis (Jacq.) Verdc. (syn. Dolichos bengalensis Jacq.) is reported (Verdcourt, 1970).

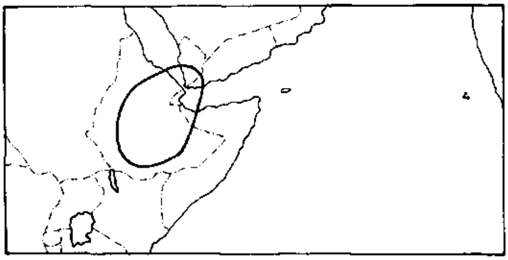
LOTONONIS BAINESII Baker. Miles lotononis. 2n=36. N. Transvaal and Zimbabwe. A perennial cultivated in Queensland.

MACROSTYLOMA GEOCARPUM (Harms) Maréchal & Baudet (syn. Kerstingiella geocarpa Harms, Voandzeia poissonii Chev.). Geocarpa bean, Geocarpa groundnut, Ground bean, Harms seeds, Kersting's groundnut. 2n=20, 22. W. Africa. Wild plants are classified as var. tisserantii (Pellegrin) Hepper (syn. Kerstingiella tisserantii Pellegrin), 2n=20, and domesticated types as var. geocarpa, 2n=22.

NEONOTONIA WIGHTII (Arnott) Lackey (syn. Glycine wightii (Arnott) Verdc.). 2n=22, 44. Africa. A perennial relative of soya (Glycine max*). Cultivars in Australia originate from Malawi, 2n=44.

PHYSOSTIGMA VENENOSUM Balf. Calabar bean, Ordeal bean. 2n= . W. Africa. Cultivated for its beans which are used as poison for ordeals.

PISUM SATIVUM ssp. abyssinicum (A. Braun) Alef (syn. P. abyssinicum Braun). 2n=14. Ethiopia and Yemen. Rarely found wild. Closely related to ssp. jomardi (p. 115).



Pisum savitum spp. abyssinicum (Govorov, 1937).

PSOPHOCARPUS GRANDIFLORUS Wilczek. 2n= . Ethiopia to Uganda and Zaïre in uplands at alt. c. 1750 m. Cultivated in Ethiopia (Westphal, 1974; Verdcourt & Halliday, 1978). Closely related to P. tetragonolobus*.

PSOPHOCARPUS PALUSTRIS Desv. 2n=16, 18, 20. From Senegal to Sudan. The Ethiopian cultivar Wondo Surprise (Westphal, 1974) belongs to P. grandiflorus* (Verdcourt & Halliday, 1978). Closely related to P. tetragonolobus*.

PSOPHOCARPUS SCANDENS (Endl.) Verd. 2n=18. E. Africa. Cultivated in Indonesia, Sri Lanka, India, Burma, Brazil and Jamaica for its fruits. Closely related to P. tetragonolobus*; it is not its direct parent (Pickersgill, 1980).

PSOPHOCARPUS TETRAGONOLOBUS (L.) DC. Goa bean, Asparagus bean, Winged bean, Manilla bean. 2n= 18, (20). The origin of this species is much discussed and Hymowitz & Boyd (1977) concluded on 'meagre evidence' (as they call it) Papua New Guinea. However like Burkill (1935), Smartt (1980) advocated E. Africa. Smartt based his conclusion on the absence of related species in Asia and their presence in Africa. Among the last, there is the closest related wild P. grandiflora* found in E. Africa from Ethiopia through Uganda to Zaïre in upland areas at c. 1750 m above sea level. Wild material could have been taken to Asia and domesticated there (Smartt, 1980). All parts of this protein-rich vegetable are edible. It can also be used as a restorative intercrop and as a cover crop and the stalks can be used as fodder. It is drought-sensitive (Hymowitz & Boyd, 1977).

SPHENOSTYLIS SCHWEINFURTHII Harms. Yam bean. 2n= . Trop. Africa. A woody plant. Cultivated for seeds and tubers.

SPHENOSTYLIS STENOCARPA (Hochst. ex A. Rich.) Harms. African yam bean, Yam bean. 2n=18. W. and E. Africa. Cultivated in Central African Republic, Zaïre, Ethiopia and along the Rift Valley of E. Africa for its edible tubers and seeds. Probably domesticated independently at several places across its native range (Okigbo, 1973).

STYLOSANTHES FRUTICOSA (Retz.) Alston (syn. S. mucronata Willd.). Wild lucerne. 2n= . Trop. Africa and SE. Asia. Cultivated as a fodder crop in Brazil and Australia. Also naturalized there.

STYLOSANTHES HUMILIS H.B. & K. Townsville lucerne, Townsville stylo. 2n=20. S. Africa. Cultivated in N. Australia in pastures.

TAMARINDUS INDICA L. Tamarind. 2n=24. The savannas of trop. Africa. Introduced to India long ago and recently to other parts of the tropics. The tree and its parts have many uses (Purseglove, 1968).

TEPHROSIA DENSIFLORA Hook.f. 2n= . W. Africa. Cultivated and used to stupefy fish. Closely related to T. vogelii*.

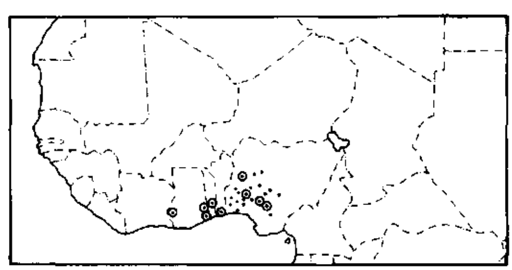
TEPHROSIA VOGELII Hook.f. Vogel tephrosia. 2n= 22. Trop. Africa. Cultivated for its rotenoids which are used as insecticides and piscicides. Also cultivated as a green manure and a cover crop.

TERAMNUS LABIALIS (Linn.f.) Spreng. 2n=20. Asia and Africa. Cultivated in E. Africa and Australia.

TERAMNUS REPENS (Taub.) Bak.f. 2n= . E. and S. Africa, and India. Cultivated in E. Africa and Australia.

TRIFOLIUM SEMIPILOSUM Fres. Kenya white clover, E. African white clover. 2n=16. Kenya. Domesticated in Australia as a forage crop.

VIGNA UNGUICULATA (L.) Walp. (syn. V. sinensis (L.) Savi). Cowpea, Black eye, Southern pea. 2n=22, 24. Primary centre W. and C. Africa. Probably domesticated in W. Africa. Introduced into the Indian subcontinent where ssp. sesquipedalis (L.) Verdc. (syn. V. sesquipedalis (L.) Fruw., Dolichos sesquipedalis L.), Asparagus pea, Yardlong pea (2n=22, 24), and ssp. cylindrica (L.) Van Eseltine (syn. V. cylindrica Skeels., V. catjang (Burm.f.) Walp.), catjang (2n=22), developed. Ssp. sesquipedalis has a long flabby pod, and is cultivated as a snap bean while ssp. cylindrica is developed as a forage crop. It has small seeds (Faris, 1965) (p. 76).



Vigna unguiculata (Harlan, 1973)

VIGNA VEXILLATA (L.) A. Rich. (syn. V. capensis auctt. non (L.) Walp., V. senegalensis A. Chev.). Wild mung. 2n=22. Grows wild in trop. Asia, Africa and Australia. Its tubers are collected in the wild. Cultivated in E. Africa.

VIGNA SUBTERRANEA (L.) Verdc. (syn. Voandzeia subterranea (L.) DC.). Bambara groundnut, Congo coober. 2n=22. Wild in W. Africa. Distributed throughout Africa and later to the Americas and Asia. Hepper (1963) described the wild type as var. spontanea (Harms) Hepper and the cultivated ones as var. subterranea Hepper.

Liliaceae

TUBAGHIA VIOLACEA Harv. Wild garlic, Wild knoflook. 2n=12. S. Africa. The Zulu of Natal often plant this species around their huts to keep snakes away, supposing that the odour repels all vermin. The leaves are cooked as a spinach and the bulb is used as a emetic love medicine (Watt & Breyer-Brandwijk, 1962).

Linaceae

LINUM USITATISSIMUM L. Flax 2n=30, (32). For possible origin see p. 99. Ssp. indo-abyssinicum Vav. & Ell. is cultivated in Ethiopia and Eritrea. Identical types are cultivated in India and may formerly have been introduced there from Africa.

Lythraceae

LAWSONIA ALBA Lam. (syn. L. inermis L.). Henna, Camphire. 2n=24. A shrub from trop. Asia and Africa with several uses.

Malvaceae

ABELMOSCHUS ESCULENTUS (L.) Moench. (syn. Hibiscus esculentus L.). Okra, Lady's finger, Gombo. 2n=72-132. See for origin p. 77. Siemonsma (1980) classified the gombo cultivars in W. Africa into the true type which is cultivated throughout the world, and the Guinean gombo. The first has 2n=c. 130 and the second 2n=c. 194. He suggested that the Guinean type, also called West African gombo, is an amphiploid of A. esculentus (true type) and A. manihot*, 2n=c. 66.

GOSSYPIUM ANOMALUM Wawr. & Peyr. 2n=26, genome formula B_1B_1. Along S. fringe of the Sahara, in SW. Africa and Angola. It can be crossed with G. herbaceum* and G. arboreum*.

GOSSYPIUM ARBOREUM L. Tree cotton. 2n=26, genome formula A_2A_2. Race soudanense. NE. and W. Africa. Hutchinson (1962) suggested that it was introduced from India, but Chowdhury and Buth (1970, 1971) thought that it is native to Africa. They found material dated about 3000 BC. at an early Neolithic site. It was probably used as stock feed, because cotton hairs intermediate between lint hairs and the hairs of wild species were found in goat dung. The form was probably cultivated by the people of Meroë, an ancient Nubian kingdom, dated about 500 BC.

GOSSYPIUM BARBADENSE L. Egyptian cotton. 2n=52 genome formula $(AADD)_2$. Peru (p.176). Spread to Africa. A perennial type from S. Nigeria made a 'Green Revolution' of cotton growing in the Nile Delta possible after 1820. This lead to introduction of other cottons. Only Sea Islands was successful. Vigourous and fertile hybrids of these two types occurred from which Egyptian was developed. It combines the annual habit and some of the quality of Sea Islands and some of the vigour and cropping characteristic of the perennial. It can be grown twice a year.

GOSSYPIUM HERBACEUM L. Short-staple cotton. 2n=26, genome formula A_1A_1. Wild G. herbaceum var. africanum (Watt) Hutch. & Chose is a perennial shrub found in the bushveldt across a belt from Mozambique to Angola and SW. Africa.

Hutchinson (1971) suggested a likely centre of domestication in S. Arabia and Baluchistan. As wild G. herbaceum plants were found on the coast of Sind near Karachi, domestication may have taken place within the area of the Harappan culture at Mohenjo-Daro (Pakistan) about 2400 BC. However fragments of textile and a string found at that site and dated 2500-1700 BC. have been identified as G. arboreum*. Hutchinson (1962) suggested that cotton must have been brought from the area of present Zimbabwe by early traders to the north. The earliest domesticants were probably selected between there and Ethiopia or Arabia. From that variety, the primitive cultivated race acerifolium was selected, which was formerly found in Ethiopia, S. Arabia and Baluchistan.

Chowdhury & Buth (1970, 1971) found cotton seed and hairs in Egyptian Nubia with an age of about 2500 BC. They suggested that the cotton was used as sheep fodder, since no textile was found. The ancient Nubian cotton resembles G. herbaceum var. africanum and G. arboreum race soudanensis*.

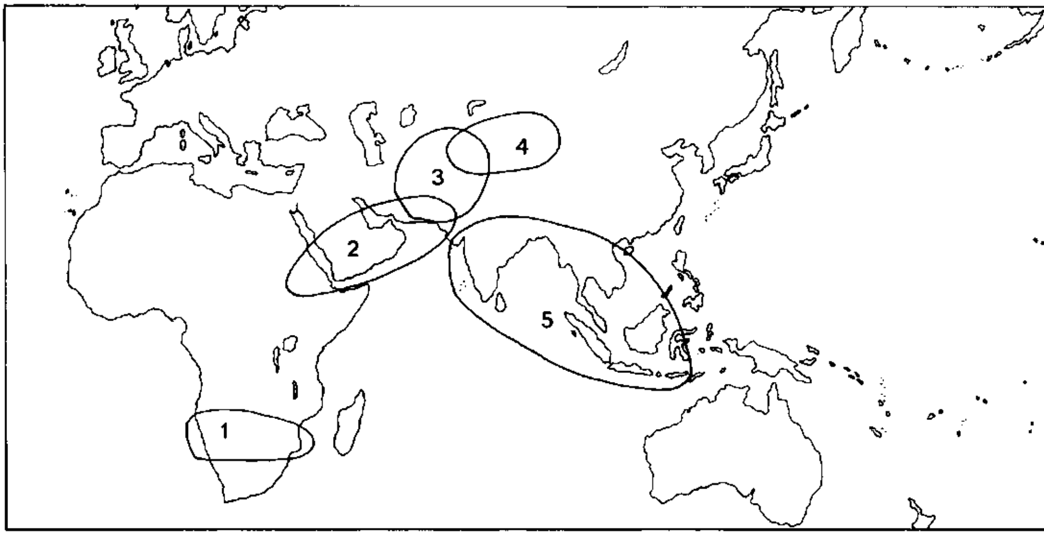
Race persicum*, race kuljianum* and G. arboreum race indicum* derived from race acerifolium.

Either G. herbaceum reached S. America from America or G. arboreum reached Peru from Asia by way of the Pacific islands to form the amphiploid G. hirsutum* and G. barbadense*.

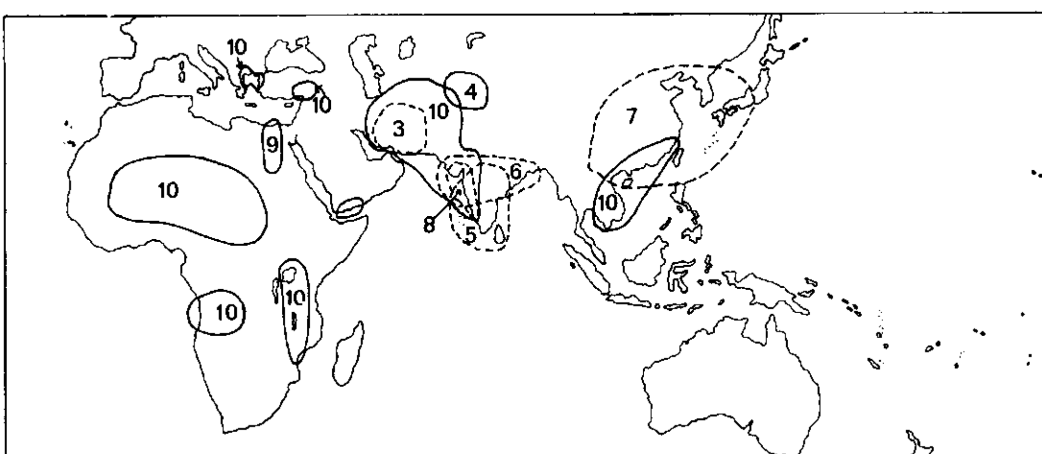
Many varieties belonging to G. hirsutum and G. barbadense are grown in Africa. G. hirsutum varieties (Upland and Cambodia) are cultivated in W. and C. Africa (race punctanum) in Congo and E. Africa, while G. barbadense (Egyptian) is found in the Nile Valley and Delta.

Var. africanum has a very simple protein-banding pattern (Cherry et al., 1970).

GOSSYPIUM LONGIOCALYX Hutch. & Lee. 2n=26, ge-



Distribution of the Old World cottons in the 13th Century: Gossypium herbaceum var. africanum (1), G. herbaceum var. acerifolium (2), G. herbaceum var. persicum (3), G. herbaceum var. kuljianum (4) and G. arboreum var. indicum (5)(Hutchinson, 1962)



Distribution of annual cottons in the Old World in 1960: Gossypium herbaceum var. persicum (3), G. herbaceum var. kuljianum (4), G. arboreum var. indicum (5), G. arboreum var. bengalense (6), G. arboreum var. sinense (7), G. herbareum var. wightianum (8), G. barbarense Egyptians (9), G. hirsutum uplands and Cambodias (10)(Hutchinson, 1962)

nome formula E_5E_5. Uganda and Tanzania. It has an entire leaf like the American G. klotzschianum*.

GOSSYPIUM SOMALENSE (Guerke) Hutch. 2n=26, genome formula E_2E_2. Sudan, Somali and Kenya. A variable species.

GOSSYPIUM TRIPHYLLUM (Harv. ex Harv. & Sond.) Hochr. 2n=26, genome forumula B_2B_2. Desert of SW. Africa and S. Angola. It can be crossed with G. herbaceum* and G. arboreum*.

HIBISCUS ACETOSELLA Welw. ex Hiern. Azedas, Red-leaved hibiscus, Bronze hibiscus. 2n=72. Genome formula AABB. Tanzania, Zaïre, Zimbabwe and Angola. Cultivated in SW. Africa as a vegetable. Introduced as H. eetveldeanus De Wild. & Dur. into Indonesia. Cultivated in the (sub)tropics as an ornamental.

The A genome is almost homologous to the A genome of H. asper*. The B genome is from H. surattensis* (Wilson & Menzel, 1964; Menzel & Martin, 1970), which grows in W. trop. Africa. The closely related H. radiatus* comes from Asia.

H. noldeae Baker f. is a spiny, inedible (primitive?) wild or weedy form of H. acetosella (Wilson & Menzel, 1964).

HIBISCUS ASPER Hook.f. 2n=36, genome formula AA, 72. Wild in W. and C. trop. Africa. Wild plants are collected for bast fibre. Occasionally cultivated for this purpose. Its A genome is close to the A genome of H. cannabinus*. It is one of the parents of H. sabdariffa* and H. acetosella* (Menzel & Martin, 1970). The A genome is also found in the African H. meeusei Exell (2n=72), genome formula AAXX (Menzel & Martin, 1971).

HIBISCUS CANNABINUS L. Kenaf. 2n=36, genome formula AA. Probably (sub)trop. Africa. Also wild in Asia but these plants might derive from naturalized plants. Its A genome is related to that of H. asper*. Kenaf is the A-genome donor of H. radiatus*.

HIBISCUS SABDARIFFA L. Rosella, Jamaica sorrel, Guinea sorrel, Florida cranberry, rozelle, sorrel, red sorrel, Indian sorrel, sour-sour, Queensland jelly plant, jelly okra, lemon bush. 2n=(36), 72, genome formula AAYY. Africa. Angola is apparently its primary centre of dispersal. Probably first domesticated as a dooryard or weedy plant for its seeds. Later it became a vegetable and finally a fibre crop (var. altissima Webster). It is a ruderal species of Angola, SW. Africa, Zaïre and Tanzania. Its A genome is derived from H. asper* (Menzel & Martin, 1970). Its Y genome donor is not yet known. Wilson and Menzel (1964) noted the relationship of roselle and H. mechowii Garcke. Var. sabdariffa is used on Jamaica to produce a sorrel drink.

HIBISCUS SCHIZOPETALUS Hook.f. 2n=45. E. Africa. Used there and elsewhere for hedges and as an ornamental. Its uneven chromosome number suggests a hybrid origin, H. rosa-sinensis L., 2n=36, 46, 72, 92, c.144, 168 being one parent. Van Borssum Waalkes (1966) concluded that, as H. schizopetalus was first collected in E. Africa, H. rosa-sinensis might have an African origin. However, Negroid people in general do not cultivate ornamentals and therefore a domestication of H. rosa-sinensis in Africa is unlikely. More probable is that H. schizopetalus arose in E. Africa after introduction of H. rosa-sinensis, probably from Asia. Judging from the variable number of this last species it might have a hybrid origin too.

H. x archeri W. Watson is an artificial hybrid of H. rosa-sinensis and H. schizopetalus.

HIBISCUS SURATTENSIS L. 2n=36, genome formula BB, (72). Africa. It also occurs in India, SE. Asia, Indonesia and Philippines. The B donor of H. acetosella* and H. radiatus*.

Marantaceae

THAUMATOCOCCUS DANIELLII Benth. 2n= . W. African rainforest from Sierra Leone to Zaïre. It produces proteins which are a non-sugar sweetener.

Melastomataceae

SAKERSIA LAURENTIA Cogn. 2n= . Zaïre. Cultivated there for its leaves (Terra, 1967).

Menispermaceae

CISSAMPELOS OWARIENSIS Beauv. Velvet leaf. 2n= . W. Africa. Cultivated near coast as a medicinal (Dalziel, 1937).

JATEORHIZA PALMATA (Lam.) Miers (syn. J. columba (Roxb.) Miers, J. miersii Oliv.). 2n= . Trop. Africa. Cultivated as a medicinal.

Moraceae

CHLOROPHORA EXCELSA (Welw.) Benth. Iroko. 2n= . Africa. Cultivated there for its timber.

FICUS OVATA Vahl. 2n=26. Africa. Planted in S. Ethiopia as a sacred tree.

FICUS PALMATA Forsk. 2n=26. Ethiopia, Sudan, Egypt, Arabia, Yemen. According to Aweke (1979), this species could be the ancestor of F. carica (p. 99).

FICUS TILIAEFOLIA Bak. Voara. 2n= . Madagascar. Cultivated there for its fibre.

Moringaceae

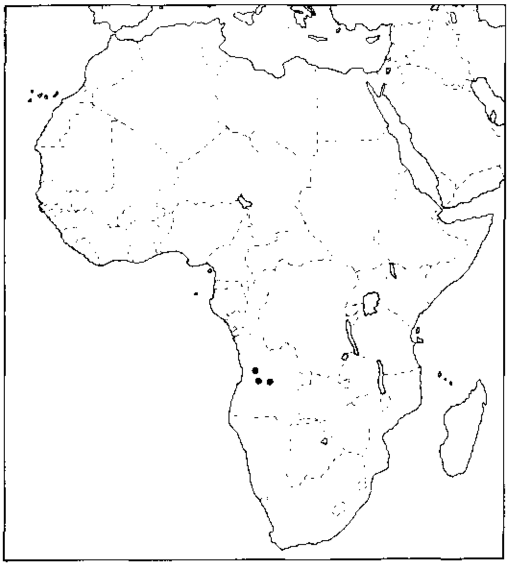
MORINGA PEREGRINA (Forsk.) Fiori. 2n= . Egypt and Somalia. Cultivated in the (sub)tropics for the seeds which are the source of bennu oil. This species is closely related to M. oleifera*.

Musaceae

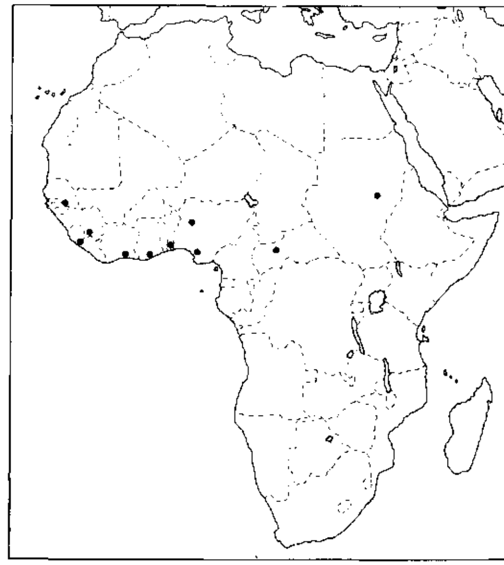
ENSETE VENTRICOSUM (Welw.) Cheesm. (syn. E. edule (Horan) Cheesm.). Ensete, Inset, Abyssinian banana. 2n=18. Ethiopia, the mountains of Kordofan (Sudan) and the lower part of the montane forest belt of Mount Ruwenzori (border of Uganda and Zaïre). Cultivated for the flour obtained from the pseudostem and also for its fibres. It is propagated by offshoots and by seeds from cultivated types or occasionally from wild plants. The cultivated plants are grown at higher altitudes than the wild plant. Several cultivated types are recognized. It is suggested that there are about forty types of ensete. The back of the leaf of the Koba type is red to purple. This variety has been described as var. montbeliardi D. Bois (Smeds, 1955).

It is suggested that ensete is one of the oldest cultivated plants of Ethiopia.

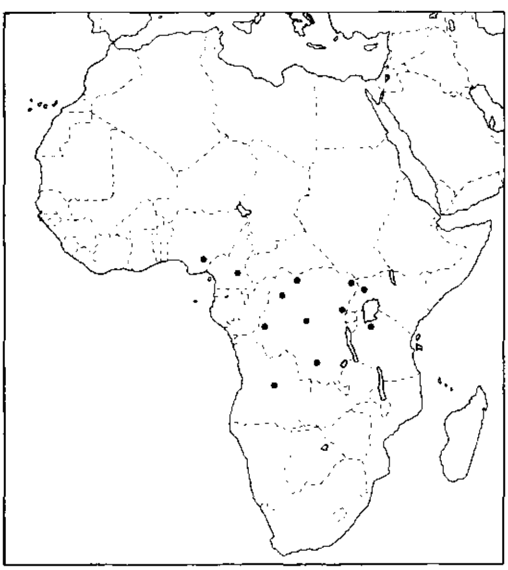
MUSA cultivars of the AAA group. Banana. 2n=33. Primary centre in the Malayan region (p. 59). Secondary centre in the uplands of E. Africa. There it has long been cultivated. The



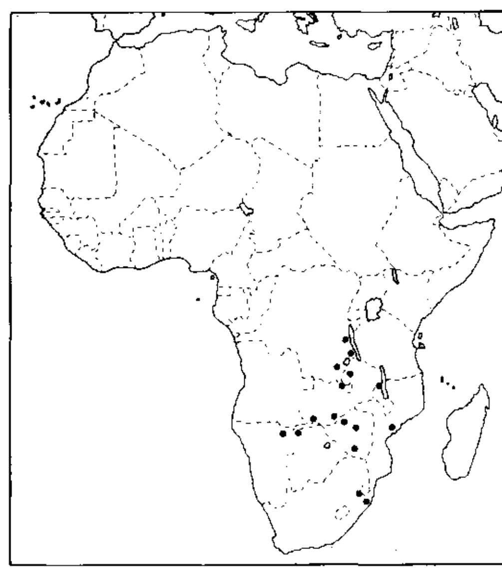
Hibiscus acetosella (Menzel & Wilson, 1969).



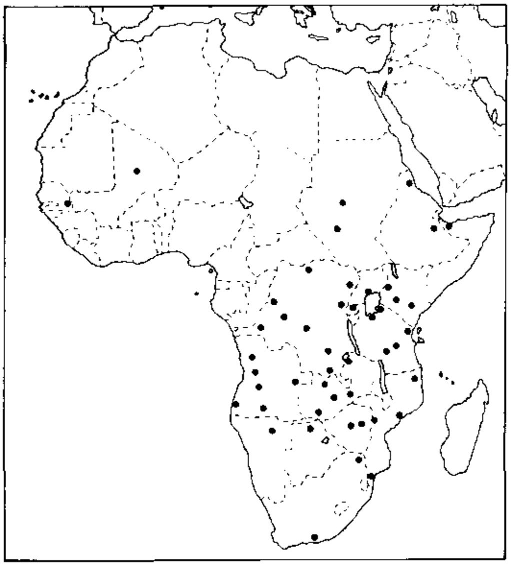
Hibiscus asper (Menzel & Wilson, 1969).



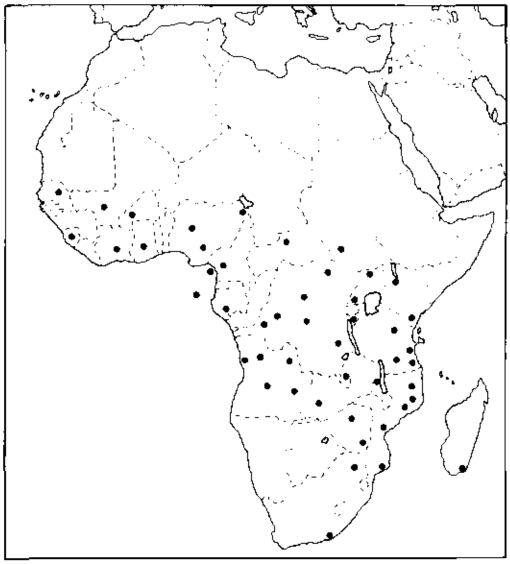
Hibiscus noldeae (Menzel & Wilson, 1969).



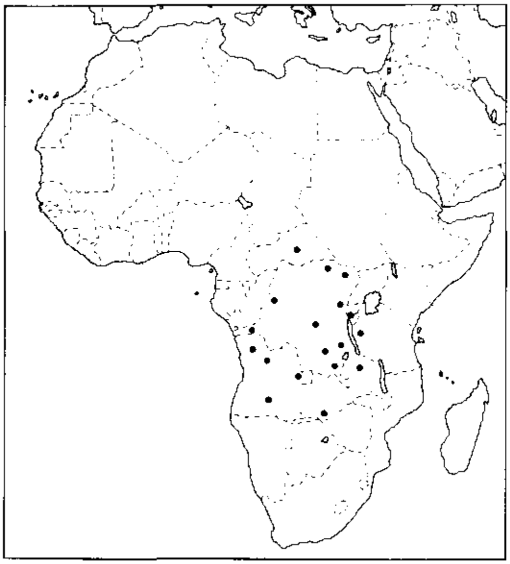
Hibiscus meeusei (Menzel & Wilson, 1969).



Hibiscus cannabinus (Menzel & Wilson, 1969).



Hibiscus surattensis (Menzel & Wilson, 1969).



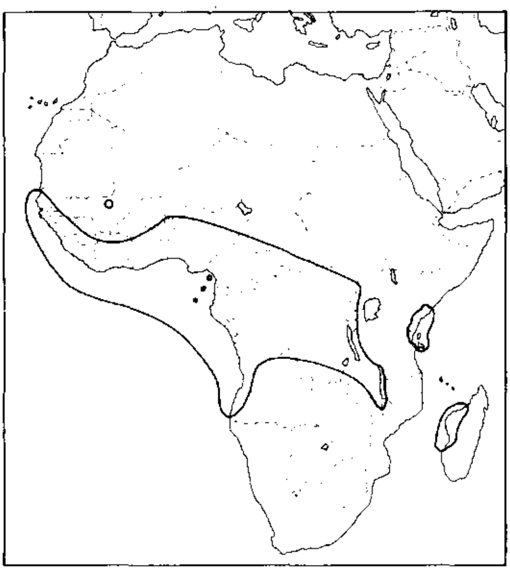
Hibiscus mechowii (Menzel & Wilson, 1969).

AAB plantain also occurs in Ghana and probably elsewhere in W. Africa.

Palmae

BORASSUS FLABELLIFER L. Lontar, Palmyra palm. 2n=36. India and Malay Archipelago. Cultivated there. Unknown wild. Probably a cultigen of the African B. aethiopum Mart. (2n=).

ELAEIS GUINEENSIS Jacq. Oil palm. 2n=32. The coastal belt from Sierra Leone to Angola. Primary centre in Africa. Large areas are covered by semi-wild palms. The oil palm was domesticated only in a few areas before the establishment of 'European' plantations and 'development' farmer's plots (Zeven, 1967, 1972). Large plantations are found in Africa, SE. Asia and in C. America.

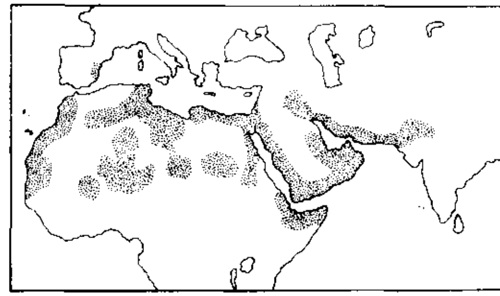


Elaeis guineensis (Zeven, 1967).

PHOENIX ATLANTICA Chev. False date palm. 2n= 36. Africa. It closely resembles Ph. dactylifera*. Near Marrakesh in Morocco var. marocana Chev. is cultivated. It has fairly tasty fleshy fruits while those of this species are, in general, of poor quality (Meunier, 1962).

PHOENIX CANARIENSIS hort. (syn. Ph. jubae Christ.) 2n=36. The Canary Islands. Spread as an ornamental to N.Africa and S.France. Closely related to Ph. dactylifera* and easily hybridizes with this and other Phoenix species.

PHOENIX DACTYLIFERA L. Date palm. 2n=28. Primary gene centre: probably N. Africa. One of the oldest cultivated plants and cultivated for a long time from the Atlantic to NW. India.



Phoenix dactylifera (Oudejans, 1969).

Phoenix species easily hybridize. This may have resulted in an increased variation. Perhaps all mentioned Phoenix* species should be included in one species.

PHOENIX HUMILIS Chev. 2n= . Cameroons. There palms are wild and semi-wild. In the latter case, they are protected, but not planted. They are in a pre-domestication stage.

PHOENIX RECLINATA Jacq. False date palm. 2n= 36. W. Africa. Some reports refer to this palm as being cultivated as a wine palm. However these may refer to Ph. humilis* (Portères, 1955b).

PHOENIX SYLVESTRIS Roxb. Wild date palm. 2n= 36. Pakistan, India and S. Iran. Cultivated there as a source of sugar and wine. Closely related to Ph. dactylifera* and may have been derived from it, or they may have a common progenitor.

RAPHIA HOOKERI Mann & Wendl. Wine palm. 2n= . The 100-250 km wide coastal belt of W. Africa (Russell, 1965). Highly valued for its wine and fibre, and therefore cultivated and cared for. In SE. Nigeria, pedlars sold germinated fruits from the Imo River banks to farmers up to 100 km away.

Pandanaceae

PANDANUS UTILIS Bory. 2n= . Africa. Introduced elsewhere as an ornamental, while leaves are used for various purposes. Cultivated in Mauritius for making sugar bags.

Pedaliaceae

CERATOTHECA SESAMOIDES Endl. Bungu. 2n=32. W. Africa. Cultivated in some northern areas. It yields leaves for soups and seeds for oil.

SESAMUM ALATUM Thonn. Tacoutta. 2n=26. Trop. Africa or India. Occasionally cultivated for its seeds in W. Sudan zone.

SESAMUM INDICUM L. (syn. S. orientalis L.). Oriental sesame, Beni seed. 2n=26, (52, 58).

Unknown wild. Secondary centre in India (p. 78) and in China/Japan (p. 42). An ancient crop, much cultivated, at present, in India, China, Japan, Burma, NW. Africa, Americas and Europe. As all wild Sesamum species but one (S. prostratum Retz. (2n=32), wild in E. India) occur in Africa it is thought that its progenitor(s) are African. Spontaneous tetraploids have been observed.

Nayar & Mehra (1970) considered S. indicum var. malabaricum (2n=26) as a possible 'companion weed' of sesame. It may have originated from hybrids between sesame and some sympatric wild Sesamum species.

SESAMUM RADIATUM Schum. & Thonn. 2n=64. Trop. Africa. Cultivated in C. and W. Africa for its oil seeds.

Perioplocaceae

CRYPTOSTEGIA GRANDIFLORA Br. 2n=24. Trop. Africa or India (p. 78). Occasionally cultivated for its Palay rubber and often as an ornamental.

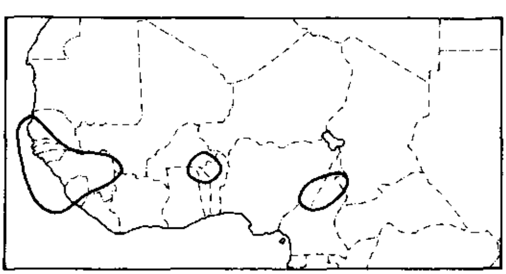
Piperaceae

PIPER CLUSII DC. 2n= . W. Africa. Cultivated as a spice.

PIPER GUINEENSE Schum. & Thonn. Guinea pepper, Ashanti pepper. 2n= . W. Africa. Cultivated there as a spice.

Polygalaceae

POLYGALA BUTYRACEA Heck. Cheyi, Numbuni. 2n= . W. Africa. This plant probably does not exist in the wild. It is probably a relic of an ancient tropical W. African culture. However, more evidence is needed. Cultivated in W. Africa for its fibre and edible seed.



Polygala butyracea (Portères, 1950).

Polygonaceae

RUMEX ABYSSINICUS Jacq. Spanish rhubarb dock. 2n= . Ethiopia. Cultivated in the Congo basin for its brick-red pigment.

Portulacaceae

TALINUM CUNEIFOLIUM (Vahl) Willd. 2n= . Africa and Arabia. Cultivated in E. Africa as a vegetable.

TALINUM PANICULATUM (Jacq.) Gaertn. 2n=24. Vegetable of Nigeria.

TALINUM PORTULACIFOLIUM (Forsk.) Aschers. 2n= . Trop. Africa and Asia. Cultivated in Africa as a vegetable.

TALINUM TRIANGULARE Willd. 2n=48, 72. Probably C. or S. America or trop. Africa. Cultivated in Brazil (p. 178), West Indies and W. Africa as a vegetable. The cultivation in forest regions may indicate an African origin, but as species of this genus are native to Africa and to the New World further investigation is necessary.

Rosaceae

HAGENIA ABYSSINICA J.F. Gmel. (syn. Brayera anthelmintica Kunth). 2n= . Ethiopia. Cultivated there for its flowers used as medicine against tapeworm.

Rubiaceae

COFFEA ARABICA L. Arabica coffee. 2n=22, 44, (66, 88). Primary centre: SW. Ethiopia (Meyer, 1969). Secondary centre: Yemen (p. 101). Traditionally the arabica coffee has only been known in cultivation. Cultivated now over large areas.

Arabica coffee is the only known Coffea species being allopolyploid and self-compatible. Its parental species are not known, but closest relatives occur in C. and W. Africa (Meyer, 1969). Kammacher & Capot (1972) suggested that one of the genomes has a similar structure to the genome of C. canephora*.

Various botanical and agricultural varieties are known and so are many mutants. An example is the mutant discovered on Réunion, formerly Bourbon, which became the highly productive Bourbon coffee (Meyer, 1965). Icatu is a hybrid of C. arabica and C. canephora*.

COFFEA CANEPHORA Pierre ex Froehner (syn. C. robusta Linden). Robusta coffee. 2n=22, 44. W. to C. (sub)trop. Africa, from Guinea and Liberia to Sudan and Uganda. It has the highest cafein content of the Coffea species (Charnier & Berthaud, 1975). Self-incompatible. Icatu is a hybrid of C. arabica* and C. canephora. The greatest diversity has been described for Zaïre.

Before the arrival of the Europeans in Africa, it was already cultivated there. Cultivated now especially in Indonesia and, because it is used to prepare 'instant' coffee, its cultivation increased in other tropical Asian and African countries.

It is a cross-fertilizer and hence very polymorphic. This has resulted in several synonyms.

'Congusta' coffee is probably a hybrid of C. canephora and C. congensis* although the latter is considered to be a form of C. canephora. Some botanical and agricultural varieties are described.

COFFEA CONGENSIS Froehner. 2n=22, (44). Congo Basin. It resembles C. arabica*. Possibly a form of C. canephora*. 'Congusta' coffee is a hybrid product of C. congensis and C. canephora. Form 'de la Nana' is a heterogeneous population most closely resembling this species (Berthaud & Guillaumet, 1978).

COFFEA EUGENIOIDES S. Moore. 2n=22. Wild in the Lake Kivu area of Zaîre, W. Uganda and W. Tanzania. Cultivated there. It resembles a slender form of C. arabica*.

COFFEA LIBERICA Hiern. Liberica coffee. 2n=22, 44. Guinea to Angola. Cultivated to some extent in Liberia, Surinam and a few other countries. It is a cross-fertilizer and hence very polymorphic. It has been crossed with C. arabica to produce hybrids which are cultivated.

This species includes the Excelsa coffee (C. excelsa Chev., syn. C. liberica var. dewevrei De Wild. & Dew., C. arnoldiana De Wild.).

There is a possibility that in the ancestry of this species some introgression with C. canephora* has occurred (Chinnappa, 1970).

VANGUERIA MADAGASCARIENSIS J.F. Gmel. (syn. V. edulis Vahl.). 2n= . Trop. Africa and Madagascar. Cultivated for its edible fruits.

Rutaceae

ADENANDRA FRAGRANS (Sims.) Roem. & Schult. 2n= . S. Africa. Cultivated there for its leaves which are used to decoct tea.

BAROSMA BETULINA (Berg) Bartl. & Wendl.f. Buchu. 2n= . SW. and S. Africa. Cultivated on a small scale in the Clanwilliam district. Leaves of wild and cultivated crops are used for their medicinal properties (Gentry, 1961).

CITROPSIS GILLETIANA Swing. & Kell. and other Citropsis species. Trop. Africa. Closely related to Citrus. They can be used as citrus rootstocks.

Sapindaceae

BLIGHIA SAPIDA Koenig. Akee. 2n=32. Forests of W. Africa. Cultivated in Jamaica and W. Africa. In Jamaica, it is naturalized.

Sapotaceae

ARGANIA SPINOSA (L.) Skeels (syn. A. sideroxylon Rom. & Schult.). Argan, Arganier. 2n=20. SW. Morocco. A wild tree, communally owned and harvested for their fruits which are a source of argan oil, used like olive oil (G.. Barbeau, pers. comm., 1979). This tree is suitable for domestication.

BUTYROSPERMUM PARKII (Don.) Kotschy (syn. B. paradoxum (Gaertn.f.) Hepper ssp. parkii (Don.) Hepper, Vitellaria paradoxa Gaertn.f.). Karité, Shea butter tree. 2n=24. Semiwild in the savannas of W. Africa.

CHRYSOPHYLLUM AFRICANUM A. DC. African star apple. 2n=26. Trop. Africa. Cultivated for its fruits.

Solanaceae

SOLANUM ACULEASTRUM Dunal. 2n=24. Trop. Africa. This non-tuberous plant is used for hedges.

SOLANUM AETHIOPICUM L. 2n=24. Trop. Africa. This non-tuberous plant is cultivated for its edible leaves and fruits.

SOLANUM ANOMALUM Thonn. Children's tomato. 2n= . Trop. Africa. This non-tuberous plant is sometimes cultivated for its red berries used as condiment.

SOLANUM BURBANKII Bitter. Wonderberry, Msoba. 2n=6x=72. Probably derived from S. African msoba (Heiser, 1969). It is apparently not a hybrid of S. sarrachoides (syn. S. villosum) (2n=) and S. melanocerasum Allioni (syn. S. guineense Lam. non L.), Garden Shuckleberry (2n=72), but a contaminant.

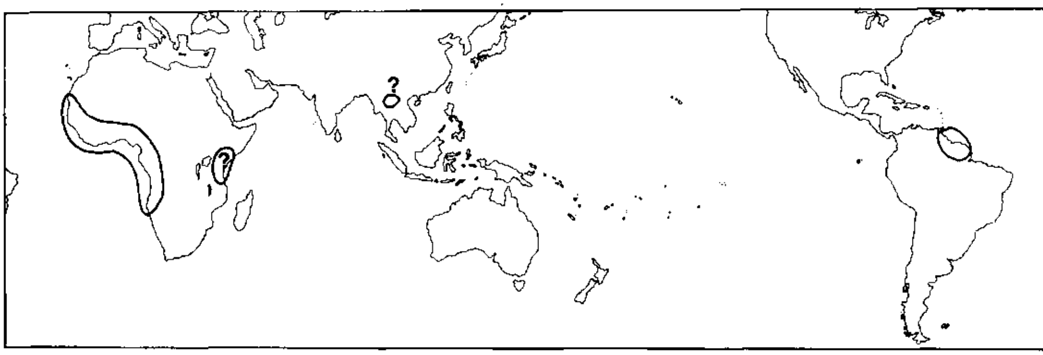
SOLANUM DUPLOSINUATUM Klotsch. 2n= . Trop. and S. Africa. Cultivated for its edible fruits and leaves.

SOLANUM GILO Raddi. 2n=24. Vegetable of Nigeria.

SOLANUM INCANUM L. 2n=24. Africa. Occasionally cultivated. Hybridisation with S. melongena* succeeded only when S. incanum was taken as mother. The two species are closely related (Baksh, 1979).

SOLANUM MACROCARPON L. African eggplant. 2n=36. Mascarene Islands. Cultivated for its leaves and fruits (Ghana, Togo, Benin and Nigeria). The cultivar type is described as var. calvum Bitter. Its triploid number of chromosomes may point to a hybrid origin.

SOLANUM NIGRUM L. Black nightshade. 2n=(x=12), 24, (36, 40, 48), 72 genome formula AAAASS, (96, 144). Native region not known. The 6x is amphidiploid of S. americanum Mill., 2n=2x=24 and S. villosum Mill., 2n=4x=48, genome formula SSXX. The S genome derives from S. sarrachoides Sandtn., 2n=24 (Edmonds & Glidewel, 1977). The hybrid S. nigrum (2n=6x) x S. sarrachoides is named S. x procurrens Leslie (2n=4x=48). It is sterile.



Aframomum melegueta (van Harten, 1970).

SOLANUM NODIFLORUM Jacq. 2n=24, 72. The Sahara and Nigeria. Cultivated for its leaves. May have run wild elsewhere.

SOLANUM OLIVARE Paill. 2n= . Cultivated in Ivory Coast, Benin and Congo.

SOLANUM ROTUNDIFOLIUM Moric. ex Dun. (syn. S. nelsoni Dun.). Hausa potato. 2n= . Believed to come from Ethiopia. Spread to W. Africa and other parts of Africa.

Sterculiaceae

COLA ACUMINATA (P. Brenan) Schott. & Endl. Abata kola. 2n=40. Nigeria to W. Gabon. Spread to Zaîre and Angola, to the West Indies and elsewhere. Cultivated esp. in W. Nigeria, but is second in importance to C. nitida*.

COLA ANOMELA K. Schum. Bamenda kola. 2n= . Cameroon, esp. in Bamenda. Cultivated there.

COLA NITIDA (Vent.) Schott & Endl. Gbanja kola. 2n=40. Sierra Leone to Benin, with its highest frequency in the forest area of Ivory Coast and Ghana. The genus Cola has its primary centre in W. Africa (van Eijnatten, 1969, 1970). Fruits were taken to the Caribbean, where this kola already grew in 1630. Introduced to other tropical countries. This is the main kola of commerce. Subspecies refer to fruit colour, but this may be caused by some genes conditioning these colours.

COLA VERTICILLATA (Thonn.) Stapf ex Chev. Owe kola. 2n= . From Ivory Coast to lower Congo. Often found as stray individuals in plantings, of C. nitida*. On the Mambilla Plateau in N. Nigeria, it is the only kola found (van Eijnatten, 1970).

Tamaricaceae

TAMARIX ARTICULATA Vahl. 2n= . The Sahara, Arabia and Iran. Great numbers are found in S. Morocco and Mauritania. Cultivated as a windbreak for orange cultivation, as a sandbinder, for fuel and as ornamental.

Tiliaceae

CORCHORUS TRILOCULARIS L. Al Moulinouquia. 2n= 14. Senegal to India. Sometimes cultivated as a vegetable, e.g. near Timbuktu (Mali) (Uphof, 1968).

Verbenaceae

LIPPIA ADOENSIS Hochst. Gambian teabush. 2n= . Zaîre. A pot-herb cultivated there. In W. Africa it is used as a tea substitute.

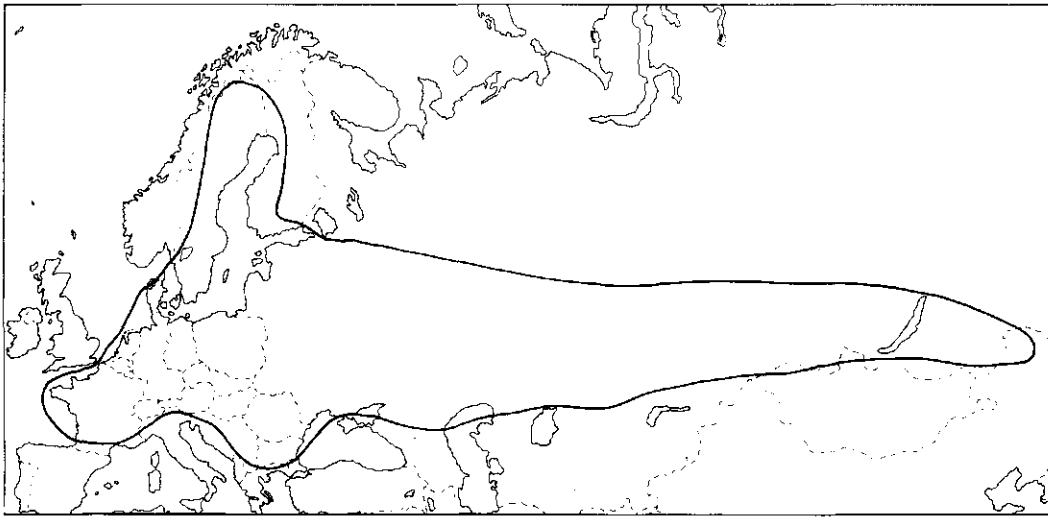
VITEX CIENKOWSKII Kotschy & Peye. 2n=32. Trop. Africa. A tree planted on compounds or semi-cultivated for its edible fruits.

Zingiberaceae

AFRAMOMUM CORRORIMA (Braun) Jansen. Korarima. 2n= . Ethiopia. Also cultivated there and elsewhere as a condiment and for medicine (Jansen, 1981).

AFRAMOMUM MELEGUETA (Rosc.) K. Schum. Melegueta pepper. 2n= . W. African coastal belt from Guinea to Angola, including Fernando Po and San Thomé (van Harten, 1970). Probably not cultivated in W. Africa. After its introduction into S. America, cultivated in Surinam and Guyana. It is the historically known 'grains of paradise', giving its name to the West African Pepper Coast, Grain Coast or Malagueta Coast.

9 European-Siberian Region



The European-Siberian Region was not indicated by Vavilov. Darlington (1956) was the first to refer to Europe as a region of origin of crop plants. Zhukovskij (1968) recognized it as a megacentre of diversity of a relatively small importance.

Agriculture reached the region from the Near Eastern Region and arrived in NW. Europe about 4000 BC.

Important crops have been developed in this region including fruit-trees, grasses, Brassica sp., Cannabis sativa, Cichorium sp., Digitaria sanguinalis, Fragaria sp., Lactuca sativa, Humulus lupulus, Medicago sp., Ribes sp., Rubus sp. and Trifolium sp.

Alliaceae

ALLIUM AMPELOPRASUM L. Levant garlic. Perennial sweet leek. 2n=16, 24, 32, genome formula AAA'A'', 40, (48, genome formula AAA'A'A''A'', AABBBB), (56). Europe, Asia Minor, Caucasia to Iran and N. Africa. Cultivated in S. France and around Nuremberg, Germany for its bulbs (Kuckuck, 1962). Some cultivation also in Kashmir (p. 70) and Iran (p. 87).

ALLIUM SCORODOPRASUM L. Giant garlic. 2n=16 + 0-2B, 24, 32, 38 + 1B, 40 + 0-4B, 48 + 0-1B. C. and S. Europe and Asia Minor. Tutin et al. (1976) describe 4 subspecies: ssp. rotundum (L.) Stearn (syn. A. rotundum L.), 2n=16 + 0-2B, 32, 38 + 1B, 40 + 1-4B, 48 + 1B, ssp. waldsteinii (G. Don) Stearn (syn. A. waldsteinii G. Don), 2n=16, 32, 40, 48, ssp. jajlae (Vved.) Stearn (syn. A. jajlae Vved.), 2n= and ssp. scorodoprasum, 2n=16, 24. The last is probably derived from ssp. rotundum and its wide and scattered distribution are probably partly due to former cultivation as a culinary plant. According to Kuckuck (1962), it is still cultivated in USSR.

Araceae

ACORUS CALAMUS L. Sweet flag, Sweet root, Calamus. 2n=18, 24, 36, (44, 45, 48, 54). N. Europe, temperate Asia and E. North America. Used as a medicinal plant, as an ornamental and for the root that is used for various purposes such as preparation of oil. Widely cultivated now, but roots of wild plants are still collected and used.

Aristolochiaceae

ARISTOLOCHIA CLEMATIS L. 2n=14. Probably E. and S. Europe. Formerly cultivated as a medicinal herb in most of Europe and now naturalized.

Asclepiadaceae

CYNANCHUM VINCETOXICUM (L.) Pers. Swallowswort. 2n=22. Europe to Himalayas and Altai, and in N. Africa. A perennial herb cultivated formerly in gardens as a medicinal plant.

Berberidaceae

BERBERIS VULGARIS L. European berberry. 2n=28. Most of Europe and Caucasia. Difficult to assess its territory because it was formerly planted for its edible berries and now as an ornamental. Wood and bark were used to produce a yellow dye. It is an intermediate host of stem rust (Puccinia graminis Pers.) and has therefore been eradicated in many parts.

Boraginaceae

LITHOSPERMUM OFFICINALE L. Gromwell. 2n=28. Spp. officinale throughout Europe, W. Asia, Caucasia and Iran. Formerly cultivated in Bohemia for preparing Bohemian or Croatian tea. Spp. erythrorhizon is cultivated in China and Japan (p. 34).

Campanulaceae

CAMPANULA RAPUNCULUS L. Rampion, Ramps. 2n=20, 102. Europe, N. Africa, SW. Asia and Siberia. Cultivated in the Middle Ages for its fleshy roots.

Cannabidaceae

CANNABIS SATIVA L. Hemp. 2n=20. The wild form is found in C. Asia. It is marked by a horseshoe-shaped scar at the base of the achene. C. sativa is one of the earliest cultivated crops. It had reached China by 2500 BC. Cultivated for its fibre and for its seeds, for food or as a source of hemp seed oil. 'C. ruderalis Janisch' is a weedy non-toxic type. The Indian type, 'C. indica' (p. 71) is cultivated as a source of narcotics. Special cultivar groups have been developed for different purposes. Exceptionally tall types are found in NE. China (p. 33).

HUMULUS LUPULUS L. Hop. 2n=2x=20 with X-Y sex chromosome system. Var. lupulus is cultivated in Europe, Asia and N. America. It has been domesticated in Europe and its present distribution probably reflects dispersion by man. Hop is grown for its cones (female inflorescences) which are used to flavour beer. A perennial mainly propagated by rhizomes.

Var. neomexicanus, var. pubescens and var. lupuloides occur in N. America (p. 199), while var. cordifolius is found in Japan and China (p. 34) (Small, 1978a).

Caryophyllaceae

SAPONARIA OFFICINALIS L. Soapwort, Soaproot. 2n=28. Europe and Asia. Occasionally cultivated in Germany (Mansfeld, 1959).

SPERGULA ARVENSIS L. (syn. Spergularia arvensis Cambess.). Corn spurrey. 2n=18. Europe. Var. sativa (Boenningh.) Mert. & Koch (syn. S. sativa Boenningh.). Cultivated as a fodder crop or as a green manure. Var. arvensis is a widespread weed, while var. maxima (Weihe) Mert. & Koch. is a weed in flax fields.

Chenopodiaceae

ATRIPLEX HORTENSIS L. Mountain spinach, Garden orach. 2n=18. Wild in temperate Europe and Asia. Formerly cultivated in Europe as a vegetable.

BETA VULGARIS L. var. rapa. Fodder beet. 2n=18. Distribution of the wild type is given on p. 104. Probably developed in the Netherlands, perhaps from types introduced from Spain. Secondary centre in Region 5 (p. 81). Spread to Germany and elsewhere. It may have played a role in the development of sugar-beet, var. saccharifera (syn. var. altissima). Sugar-beet probably developed in Silesia by hybridization of an old garden form and fodder beet. The land variety "Weisser schlesischer Zückerrübe" is the parent of all sugar-beet varieties. Fuel beets are sugar-beets suitable for alcohol production but not for sugar extraction.

CHENOPODIUM ALBUM L. Goosefoot, Fat hen, Lambsquarters. 2n=18, 36, 54. Probably cultivated in Europe in Neolithic times. Now it is a weed.

CHENOPODIUM BONUS-HENRICUS L. (syn. Ch. esculentus Salisb.). Allgood, Good King Henry. 2n=36. Native to the temperate Old World. Formerly cultivated as a pot-herb.

CHENOPODIUM FOLIOSUM Aschers. 2n=18. Europe and the Orient. Formerly cultivated as a vegetable (Uphof, 1968).

Compositae

ANTHEMIS TINCTORIA L. (syn. Cota tinctoria (L.) Gay). Dyer's chamomile, Golden chamomile. 2n=18. Europe and W. Asia. Cultivated as a dye plant.

ARCTIUM LAPPA L. (syn. Lappa arctium Gaertn.). Great burdoc, Cocklebur. 2n=32, 36. Europe and Asia. Cultivated in Europe as a medicinal plant, and also in China and Japan (p. 34).

ARTEMISIA ABROTANUM L. Southern wood. 2n=18. S. Europe and temp. Asia. Cultivated as a medicinal crop for flowers and as an ornamental.

ARTEMISIA ABSINTHIUM L. Absinthe. 2n=18. Europe, S. Siberia, Kashmir and Mediterranean area. Cultivated in S. Europe, N. Africa and USA for the production of absinthe.

ARTEMISIA LAXA Fritsch. 2n=18. C. and S. Europe. Cultivated.

ARTEMISIA MARITIMA L. 2n=18, 36, 54. Europe to Mongolia. Cultivated as a medicinal crop.

ARTEMISIA VULGARIS L. Mugwort. 2n=16, 18. Temp. N. Hemisphere. Cultivated in Indonesia and elsewhere for several uses.

CHAMAEMELUM NOBILE (L.) All. (syn. Anthemis nobilis L.). Noble chamomile. 2n=18. S. and W. Europe. Cultivated as a medicinal and as an ornamental.

CHAMOMILLA RECRUTICA (L.) Rauschert (syn. Matricaria chamomilla L.). Chamomile, German chamomile. 2n=18. Europe, Iran and Afghanistan. Cultivated in Europe as a medicinal and as a source of an essential oil used for flavouring and perfumery. A substitute of Chamaemelum nobile*.

CICHORIUM INTYBUS L. Chicory, Succory, Brussels witloof, Sugar-loaf chicory. 2n=18. Europe, Siberia, N. Africa and the Near East to Iran, Baluchistan and Lake Baikal. Wild type (var. intybus) was used as a salad and for medicinal purposes. Var. sativum Lam. & DC. is cultivated in Europe and elsewhere to produce a coffee substitute while var. foliosum Hegi, the Brussels witloof, was first developed around Brussels since c. 1830 from var. sativum, whose young leaves had already been traded as lettuce since c. 1800 and were known as barba de capucin (Moens, 1974).

HELIANTHUS ANNUUS L. Sunflower. 2n=34. Wild in N. America (p. 200). Secondary centre in USSR. Domesticated and cultivated in N. America. Largeheaded forms introduced in Europe.

LACTUCA QUERCINA L. 2n=18. Europe, esp. in Germany, France to USSR and the Balkans. A biennal. Sometimes cultivated near Clermont-Ferrand (France) for its narcotic properties (Uphof, 1968).

LACTUCA SATIVA L. Lettuce. 2n=18. Primary centre: the Middle East. Lettuce derives from L. serriola L., prickly lettuce. This species occurs in S. and C. Europe to Denmark, Caucasia, Transcaucasia, Iran, Iraq, Syria, Saudi Arabia, Siberia to Altai, and N. Africa to the Canary Islands. However, Lindqvist (1960) believed that lettuce probably derives by hybridization of other Lactuca species including L. saligna L. and that L. serriola arose from the same or subsequent hybridization. L. serriola is now a weed. L. saligna like L. serriola has its main distribution centre round the Mediterranean Sea (Lindqvist, 1960).

The first record of lettuce dates from 2500 BC.; a long-leaved form was depicted in the Egyptian tombs.

The present marked variation of lettuce is probably a product of hybridization with L. serriola, but may also have been induced by some natural mutation (Whitaker, 1969).

Var. asparagina Bailey (syn. L. angustana Vilm., L. sativa var. angustana Irish), Asparagus lettuce of Celtuce, forms a single thickened straight stem 90 cm or more long, which is eaten as salad when young.

L. saligna from Israel is a source of resistance to downy mildew, Bremia lactucae Reg.

TANACETUM VULGARE L. (syn. Chrysanthemum vulgare (L.) Bernh. non (Lam.) Gaterau, C. tanacetum Karsch. non Vis. incl. T. audibertii (Req.) DC). Common tansy. 2n=18. Almost throughout Europe. Cultivated as a pot-herb, medicinal and ornamental.

TARAXACUM HYBERNUM Steven. Krim sagiz. 2n=32, 40. Italy, Balkans, Asia Minor, Syria and Crimea. Cultivated in USSR as a rubber crop.

TARAXACUM OFFICINALE Weber. Dandelion, Lionstooth, Milk-gowan, Puffball. 2n=8, 24 (and others). Europe and W. Asia. In France and elsewhere, improved varieties are cultivated. These varieties "Pissenlit à coeur plein amélioré" and "Pissenlit vert de Montmagny" differ from wild plants (pissenlit ordinaire) as they have less bitter leaves. Young etiolated leaves of wild plants covered by molehills are collected as dandelion salad.

Crassulaceae

SEDUM REFLEXUM L. Jenny stonecrop. 2n=34, c. 56, 68, c. 112. S. Europe. Cultivated in W. and C. Europe and used to flavour soup and salad.

SEMPERVIVUM TECTORUM L. Hen-and-Chickens, Roof houseleek. 2n=(36), 72. Europe. Cultivated as a medicinal plant.

Cruciferae

ARMORACIA RUSTICANA (Lam.) Gaertner. Mey & Schreb., (syn. Cochlearia armoracia L.). Horseradish. 2n=28, 32. Finland, to Poland, the Caspian Sea and the deserts of Cuman and in Turkey. Primary centre in temperate E. Europe (Counter & Rhodes, 1969). Cultivated as condiment and hence naturalized.

BARBAREA PRAECOX R.Br. (syn. B. verna Asch.). Scurvy grass, Winter-cress, Upland cress. 2n=16. Europe. Cultivated as a vegetable.

BARBAREA VULGARIS R.Br. Yellow rocket, Common winter-cress, Upland cress. 2n=16. Temp. Europe, Asia and N. Africa. Spread throughout the world. Cultivated as a pot-herb.

BRASSICA CAMPESTRIS L. Turnip group. 2n=20, genome formula AA. The wild form ssp. sylvestris (L.) Jancken grows as a weed and ruderal in most of Europe, Asia and N. Africa. The various oily (ssp. oleifera (Metzg.) Sinsk., oil-seed turnip) and fodder (ssp. rapifera (Metzg.) Sinsk., "stubble turnip", Dutch turnip) cultivars have developed independently.

There are three main groups: the Asian (p.

35), the Mediterranean and the West European. The turnip-rape, var. oleifera (Metzg.) Sinsk., possibly developed in Belgium. Leafy types of turnip are cultivated especially in Finland.

The A genome is also found in the diploid B. chinensis* and the diploid B. japonica*. This genome is related to the Ad genome of B. adpressa Boiss., the F genome of B. fruticulosa Cyril. and the D or T genome of B. tournefortii Gouan (Mizushima, 1969).

B. campestris is one of the parents of B. juncea* and B. napus*, and also of the artificially made B. napocampestris (2n=58, genome formula $A_1A_1AAC_1C_1$).

BRASSICA NAPOBRASSICA (L.) Mill. (syn. B. napus L. var. napobrassica (L.) Rchb.). Rutabaga, Swedish turnip. 2n=38. Unknown wild. Primary gene centre in the Mediterranean area (p. 106). Secondary gene centre in Europe. Probably a derivative of B. oleracea* x B. napus*. The roots are more elongated and oval and larger than those of turnip. They are eaten as a vegetable.

BRASSICA NIGRA (L.) Koch. Black mustard. 2n=16, genome formula BB. Europe, especially in C. and S. parts. However, Hemingway (1976) suggested a centre of domestication in Asia Minor or Iran. Cultivated since ancient times. Seeds are pressed for black mustard seedoil. The B genome is related to the F genome of B. fruticulosa (Mizushima, 1969). Black mustard is one of the parents of B. juncea* and B. carinata*. An artificial amphiploid of B. tournefortii* and this species is called B. amarifolia (2n=36), genome formula TTBB or DDBB).

BRASSICA OLERACEA L. Wild kale. 2n=18, genome formula CC. Atlantic coast of Europe. Occurrence on Heligoland is probably spontaneous. It may have already been present there in medieval times. The wild kales of Atlantic Europe are closely related to the wild kales of the Mediterranean (see B. oleracea, p. 106).

BRASSICA OLERACEA L. var. gemmifera DC. Brussels sprouts. 2n=18, genome formula CC. Developed in Belgium probably from var. ramosa.

COCHLEARIA OFFICINALIS L. Spoonwort, Scorbute grass, Scurvy grass. 2n=(14), 24, genome formula $A_6A_6A_6A_6$, (28, 36). N. and W. Europe. Cultivated formerly as a medicinal plant.

CRAMBE MARITIMA L. Sea kale. 2n=60. Sea coast of Europe. Cultivated in England as a vegetable.

HESPERIS MATRONALIS L. Damask. 2n=24. C. and S. Europe. Cultivated for its seeds which are a source of oil and as an ornamental. Escapes are common.

NASTURTIUM OFFICINALIS R. Br. (syn. Rorippa nasturtium-aquaticum (L.) Hayek). Watercress. 2n=2x=32, (28, 64). W. Asia and S. Europe and Great Britain, where it is cultivated. The leafy stems are eaten as salad. It is also cooked as a vegetable. In New Zealand, it is a serious weed of rivers. The almost sterile hybrid (N. x sterile (Shaw) Oefel, 2n=3x=48) of watercress and N. microphyllum (Boenn.) Rchb., 2n=4x=64 is also cultivated for salad (Purseglove, 1968). It is vegetatively propagated. Watercress and N. x sterile have both run wild in Florida, USA.

Cucurbitaceae

BRYONIA ALBA L. White bryony. 2n=20. C. Europe, USSR, the Balkans and N. Iran. Cultivated formerly as a medicinal plant.

BRYONIA CRETICA L. Red berry bryony. 2n=20. S., SC. and W. Europe to Great Britain and N. Africa. Cultivated formerly as a medicinal crop. Spp. cretica is found in the Aegean region, spp. dioica (Jacq.) Tutin (syn. B. dioica Jacq.) has a wide distribution, while spp. acuta Desf.) Tutin (B. acuta Desf.) is found in Tunesia and Libya.

Cyperaceae

CAREX ARENARIA L. (syn. C. spadicea Gilib.). 2n=58, 60-64. Europe, especially the littoral areas. Cultivated as a soil stabilizer.

SCIRPUS LACUSTRIS L. (syn. S. validus Vahl.). Great bulbrush. 2n=(38, 40), 42. A world wide distribution. Cultivated in the Netherlands and Germany, to promote land reclamation and improve impoldered land. In Germany cultivated to clean polluted water and so it is expected that the planting will increase and better varieties of this plant will be bred. Its culms contain 80% air taken from the atmosphere. They absorb air pollutant gases, sodium, phosphorus, zinc and copper.

Gramineae

AGROPYRON CANINUM P.B. (syn. Roegneria canina (L.) Nevski). 2n=28, genome formula S'S'H'H'. Cultivated in the USSR.

AGROPYRON CRISTATUM L. Gaertn. Crested wheatgrass. 2n=14 mainly, 28, (42). Europe and Asia. Introduced into N. America. Cultivated there as a hay crop. This species includes a number of other species like A. desertorum (Fisch.) Schult., A. pectiniforme Roem. & Schult., A. michnoi Roshev. and A. sibiricum (Willd.) P.B.

AGROPYRON INTERMEDIUM (Host) Beauv. (syn. A. glaucum, Elytrigea intermedia (Host) Nevski). 2n=(28), 42, genome formula $B_2B_2E_1E_1E_2E_2$. Intermediate wheatgrass. S. and C. Europe to Iran, Pakistan and Caucasia. Self-compatible.

AGROPYRON REPENS (L.) Beauv. (syn. Elytrigia repens (L.) Desv.). Couchgrass, Twitch, Quackgrass. 2n=18, 6x=42, genome formula $S_1S_1S_2S_2XX$, (56). Temperate Eurasia. Aggressive weed with wide adaptation. Spread to all continents. Sometimes used as palatable high-quality forage grass. It easily crosses with A. spicatum*, which introgresses as the F_1 is fertile (Dewey, 1976).

AGROSTIS CANINA L. 2n=14, 28, (35, 42, 56). Europe. Cultivated in the Netherlands.

AGROSTIS GIGANTEA Roth. (syn. A. alba auct. non L.). Fiorin, Red top. 2n=42, genome formula $A_1A_1A_2A_2A_3A_3$. Europe, Asia and N. America. Cultivated as a pasture grass and as a hay crop.

AGROSTIS TENUIS Sibth. (syn. A. vulgaris With.). Rhode Island bent, Colonial bent. 2n=28, genome formula $A_1A_1A_2A_2$. Most of Europe, N. Asia Minor, Armenia, Caucasia, Siberia, N. Africa and N. America. Hybrids with A. gigantea* have been found in Germany and called A. intermedia C.A. Weber.

ALOPECURUS PRATENSIS L. Meadow foxtail. 2n=28, (42). Most of Europe, N. Asia and Caucasia. Cultivated as a meadow grass.

AMMOPHILA ARENARIA Link (syn. A. arundinacea Host.). Beachgrass. 2n=28. The coastal areas of Europe. A perennial cultivated as a sand binder.

ANTHOXANTHUM ODORATUM L. Sweet scented vernal grass, Spring grass. 2n=10, 20. Europe, Asia, W. part of N. Africa. Cultivated as a forage grass. It has a low food value. The diploid is also described as A. alpinum Löve & Löve. Autoploidy has played an important role in the genesis of the tetraploid (Hedberg, 1970). Teppner (1970) suggested the following genome formula for A. alpinum and A. odoratum:

species	ploidy	genome formula	region
A. alpinum	2x	AA	general
A. alpinum	4x	AAAA	Cantal, France
A. odoratum	2x	CC	Italy
A. odorarum	2x	DD	Italy, Yugoslavia, Greece
A. odoratum	2x	DE	Serbia
A. odoratum	4x	BBDD	Southern C. and W. Europe
A. odoratum	4x	BBFF	W. Europe

A comparison of Austrian, Swiss, Swedish and Polish populations showed that diploids from Austria and Switzerland are morphological closer to those from Poland than to those in Scandinavia (Hedberg, 1969).

ARRHENATHERUM AVENACEUM Beauv. (syn. A. eliator Beauv.). Tall meadow oatgrass. 2n=40. Europe. A valuable pasture grass.

ARRHENATHERUM TUBEROSUM Druce (syn. Avena tuberosa Gilib., Arrhenatherum avenaceum Beauv.). Onion couchgrass. 2n=18. In neolithic times possibly cultivated for its tubers.

AVENA SEPTENTRIOLANIS Malz. (syn. A. fatua spp. septentrionalis (Malz.) Malz.). 2n=42. N. and NE. European USSR to W. Siberia. There it usually grows in undisturbed habitats. Baum (1972) stated that is is probably the most closely related taxon to A. sativa* and that it resembles the hypothetical ancestor of the predomesticated oats.

BROMUS ERECTUS Huds. (syn. B. arvensis Poll.). 2n=(28, genome formula AeAeAeAe), 42, 56, (70, 84, 112). C. and S. Europe, N. Africa, Ante-Asia up to Caucasia. Cultivated especially in S. France, Switzerland, S. Germany and USSR. Some people regard this species and its synonyms as two species.

BROMUS INERMIS Leyss. Awnless brome, Smooth brome, Hungarian brome. 2n=(28, genome formula AiAiBiBi, 42, 49), 56, genome formula AiAiAi AiBiBiBiBi, (54-58). N., C., and SE. Europe, Caucasia, temperate Asia and China. Cultivation started at various places in Europe. Introduced to N. America.

BROMUS SECALINUM L. Chess, Rye brome. 2n=28. A cultivated hulled cereal of prehistory grown together with emmer (Triticum dicoccum*) and einkorn T. monococcum*). It has a very high multiplication factor (2500 caryopses per plant). It is now a weed mainly of winter cereals, but types with a spring habit are also found (Knörzer, 1965).

CYNOSURUS CRISTATUS L. Crested dogtail, Dogstail grass. 2n=14. Primary centre in C. and W. Europe, Caucasia and Asia Minor.

DACTYLIS GLOMERATA L. Cocksfoot, Orchard grass. 2n=28. Stebbins (1956) suggested that D. glomerata is a tetraploid derived from two related diploids. One of them could be D. aschersoniana Aschers. & Graebn. (2n=14). This species is distributed over C. Europe, Himalaya and W. China. Another diploid is D. smithii Link which exists in the Canary Islands. It is likely that all diploids derive from one common diploid. Hybridization of diploids and doubling of the number of chromosomes and again hybridization within the tetraploid group and with the diploids has led to the very variable D. glomerata. Cultivated as a pasture and hay grass.

DIGITARIA SANGUINALIS Scop. 2n=18, 28, 36 (-48, 54, 76). Bluthirse, Millet sanguin. S. Europe, Asia Minor, Central Asia, N. and S. America, in temperate zones. There is a great variation of the species. The cultivated type is var. esculenta (Gaudin) Caldesi. Among this variety var. frumentacea Henr. and spp. aegyptiaca (Retz) Henr. are found. Primary centre is not known. Probably first cultivated in Illyria preceeded by a long time of collection of wild plants. Cultivated formerly in a large area in Europe. Another area of cultivation is in India (p. 73). Whether the origin of cultivation independently arose here, or whether this cereal spread to India from Europe or the reverse is not known (Portères, 1955a). Spp. pectiniformis Henr. of E. Europe, the Near East and NE. Africa. Not cultivated. Spp. aegyptiaca has an 'eastern' origin but it is probably not in Egypt. From this subspecies the cultivated var. frumentacea is derived. Spp. vulgaris (Schrander) Henr. is very variable and widely distributed.

FESTUCA ARUNDINACEA Schreb. 2n=(28), 42, (70). Europe, N. Africa and Asia (Syria, Siberia, Japan) Not much cultivated, due to its coarseness although seeds have been commercially available for a long time.

According to Borrill (1972) the tetraploid and hexaploid cytotypes have affinities with F. pratensis*, while the octoploid and decaploid possess a genome pair of F. scariosa Aschs. & Graebn. (2n=14). This species is endemic in the Spanish Sierra Nevada.

F. arundinacea has been rather widely introduced as a meadow and pasture grass in northern USA.

FESTUCA OVINA L. Sheep's fescue. 2n=14, (21), 28, 42, (49), 56, 70. Europe, the Caucasus, the Himalaya and N. America. Cultivated in Europe. An important grass of Australia and S. Africa. Many 4x and 6x types have been described as Festuca species.

FESTUCA PRATENSIS Huds. (syn. F. elatior L.). Fescue grass, Meadow fescue, English bluegrass. 2n=14, FpFp, (28, 42, 70). Europe, Caucasia, Iran, the Urals and Siberia. Cultivated in Europe and N. America. Natural hybrids with Lolium perenne* are described as Festulolium loliaceum (Huds.) P. Fourn. (syn. Festuca loliacea Huds.), 2n=2x=14, LpFp, loloid 3x=FpLp Lp, festucoid 3x=FpFpLp.

According to Jauhar (1975), F. pratensis and Lolium perenne are closely related and probably evolved from a common progenitor, as there is no effective intergeneric barrier to gene flow.

FESTUCA RUBRA L. Red fescue. 2n=14, (28), 42, 56, (70 and aneuploids). Europe, temperate Asia, Africa and N. America. Much cultivated as a pasture grass. In New Zealand chewings fescue is cultivated. It is a red fescue of the non-creeping type (spp. fallax). Var. genuina is creeping red fescue.

GLYCERIA FLUITANS R. Br. Manna grass. 2n=(20), 28, 40. Was collected in a large part of E. Europe.

HOLCUS LANATUS L. Soft meadow grass, Woolly soft grass, Yorkshire fog, Velvet grass. 2n=14. Europe and temperate Asia. Cultivated for pasture and hay. A secondary centre of diversity is developing in New Zealand (p. 65).

LOLIUM MULTIFLORUM Lam. var. westerwoldicum Wittm. (syn. spp. multiflorum (Husnot) Becherer). Westerwolds ryegrass. 2n=14. Annual types derived from populations of spp. italicum were selected at Westerwolde, NE. Netherlands.

LOLIUM PERENNE L. Perennial ryegrass. 2n=14. Not know where and when it was domesticated, but probably in Europe. However, the parent plants may have come from the Mediterranean area of SW. Asia. The first true grass sown in a pure, or relatively pure state. Cultivated now in the Old and New Worlds. Tetraploids and amphiploids with Festuca pratensis* are cultivated. Natural hybrids between these two species are described as Festulolium loliaceum (Huds.) P. Fourn. Hybrids of L. perenne and L. multiflorum* have been called L. x hybridum Hausskn. These last two species are closely related.

PHALARIS ARUNDINACEA L. Red canary grass. 2n=14, 28. Most of Europe, W., N. and E. Asia. Cultivated in the Old and New Worlds.

PHLEUM PRATENSE L. Timothy, Herdsgrass. 2n= mostly 42, genome formula $NNA_1A_1A_2A_2$. Europe, N. Asia and N. Africa. An amphiploid of P. alpinum L. (Alpine timothy, 2n=28) and P. nodosum L. (syn. P. pratense var. nodosum (L.) Richter) (2n=14, genome formula NN(?)). A tetraploid type similar to this species was developed from the diploid Ph. nodosum after doubling the number of chromosomes. Ph. pratense is cultivated in Europe and N. America as a forage and hay crop.

PHRAGMITES COMMUNIS Trinius. Reedgrass. 2n=(36), 48, (54, 84, 96). A cosmopolite grass used for land reclamation and bank protection. Young sprouts are eaten, while the culms have many uses.

POA BULBOSA*

POA PALUSTRIS L. Fowl bluegrass. 2n=18, (42). Arctic zone of Europe, Asia and N. America. Various varieties have been developed in Europe.

POA PRATENSIS L. Bluegrass, Kentucky bluegrass, Birdgrass. 2n=38-147. Europe, Asia, N. Africa and northern N. America. The great variation in chromosome number owing to autoploidization has resulted in many species descriptions, but they can be considered as synonyms. Furthermore as apomixy of this species is not constant, types with different chromosome number may be selected. So it was possible to select plants similar to P. pratensis from P. trivialis*. If this proves that P. pratensis derives from P. trivialis then P. pratensis must have originated in the Old World. Various varieties have been bred in Europe and Canada (p. 202) and elsewhere.

POA TRIVIALIS L. Roughish meadow grass. 2n=14, (28). Europe and S. Siberia. Not much cultivated. It might be the parent species of P. pratensis*.

SPARTINA ANGLICA C.E. Hubbard, Cordgrass. 2n=122. Originated in W. Europe after introduction of the American S. alternifolia Lois. (2n=62) and hybridization with the European S. maritima (Curt.) Fern. (2n=60). The hybrid is named S. x townsendii H. & J. Groves (2n=62). From this hybrid the amphiploid S. anglica evolved, which has ousted out its parent S. maritima (Adema & Mennema, 1979). Cultivated for soil reclamation and stabilization.

TRISETUM FLAVESCENS (L.) Beauv. (syn. T. pratense Bers.). Yellow catgrass, Golden oatgrass. 2n=24, 28. It probably derives from T. sibiricum Rupr. (2n=14, 24). This species occurs in Kamtschatka, Siberia. From here it spread westwards.

TRITICUM AESTIVUM (L.) Thell. spp. compactus Host.). Clubwheat. 2n=42, genome formula AABBDD. The clubwheats of the Austrian alpines, except for the research of E. Mayr. are much neglected. They are probably derivatives of the wheat (T. antiquorum Heer) cultivated by the Swiss Lake Dwellers in the Neolithicum. They are nearly extinct.

TRITICUM AESTIVUM (L.) Thell. spp. spelta (L.) Thell. Spelt. 2n=42, genome formula AABBDD. Cultivated from the Belgian Ardennes to Switzerland and to Schwaben, Germany and in Spain. Formerly the spelt area in Europe must have been much larger running from Sweden to Spain and may be up to Africa (p.135). In Spain (Asturia) spelt is harvested in the same way as in Transcaucasia. It is remarkable that many German/Belgian spelts, the relic Swedish spelt (from Gotland) and one from Africa carry an Rf_{tim}-gene (Zeven, 1971).

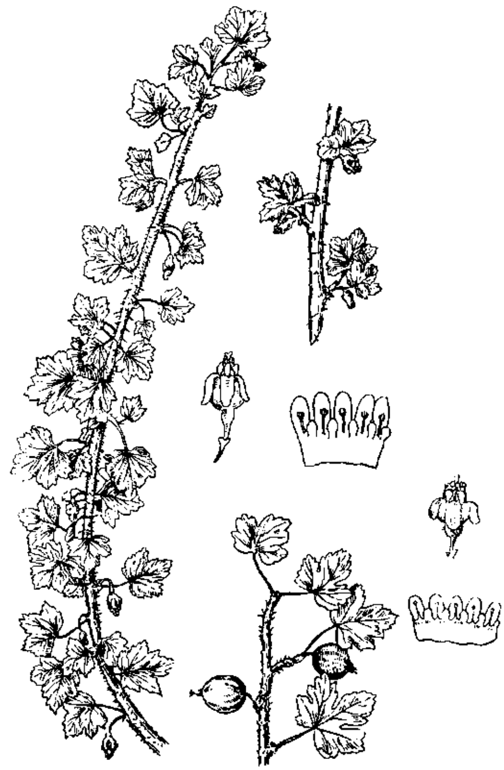
ZEA MAYS L. Maize. 2n=20. Secondary centres in S. Europe and the Mediterranean Region (p. 112) in the European corn belt and the Atlantic and Continental maize growing regions (Brandolini, 1970). Domesticated in C. America (p. 190). Flint maize - indurata Sturt. - is common in all these areas.

Siberian ecotypes are recognized by germination at 5-6°C, cold resistance of seedlings to 4-5°C, rapid growth, earliness, high assimilation rate and protogyny (Gerasenkov, 1968).

Grossulariaceae

RIBES ACICULARIS Smith. 2n= . The mountains of Siberia especially in the Altai. The most precocious Ribes-species with a high winterhardiness and mildew resistance. These characteristics are useful in Ribes-breeding.

RIBES GROSSULARIA L. (syn. R. uva-crispa L.). (European) Gooseberry. 2n=16. Eurasia and in the mountains of W. Asia and the Mediterranean countries. Cultivated in temperate zones. Re-



Ribes acicularis

lated N. American Ribes-species R. oxyacanthoides Mill. (2n=16), R. hirtellum Mix. (2n=16), R. divaricatum Dougl. (2n=16), R. cynosbati L.* (2n=16), R. pinetorum Greene (2n=) and R. niveum Lindl. (2n=16) carry resistance to mildew, while R. niveum and R. divaricatum may be used as source of mildew resistance and to improve fruit characteristics. Resistance to Nasononia ribisnigri Mosley is found in R. roezlii Regel (2n=16) and R. sanguineum Pursh (2n=16), while the latter species and R. cereum Dougl. (2n=16) are sources of resistance to Hyperomyzus lactucae L. (Keep & Briggs, 1971).

Hybrids between R. grossularia and R. sanguineum are named R. fontenayense Jancz. (2n=). Spineless types are also found of R. oxyacanthoides.

RIBES NIGRUM L. (European) Black currant. 2n=16. Eurasia and sporadically in N. America. The cultivated type was derived from the wild one. In N. Scandinavia very precocious, winterhardy types are found. The American R. americanum Mill. (2n=) and the Asiatic R. dikuscha Fish. are related to the black currant. They have breeding value.

Cultivars of var. sibiricum F. Wolf. of this species and R. ussuriense* are sources of resistance to the blackcurrant gall mite. Phy-

toptus ribis Nal.
Spontaneous hybrids with R. procumbens (2n=) occur in the USSR.

RIBES PETRAEUM Wulfen. Rock red currant. 2n=16. The Pyrena to the Carpates and N. Africa. Cultivated in the Alps. One of the parents of the present-day red currant (R. sativum*).

RIBES SATIVUM Syme (R. rubrum L., R. multiflorum Kitt. and R. petraeum Wulf.). 2n=16. The wild R. sativum grows in W. Europe. In N. America it has run wild. R. rubrum is found wild in W. and C. Europe and N. Asia. R. petraeum* grows in the mountains of Europe and Asia. R. sativum is probably the originally cultivated species. Later it hybridized with the other two, so these three species are the parents of the present-day red currant.

RIBES SPICATUM Robson. 2n=16. NE. Europe. Sometimes cultivated.

Guttiferae

HYPERICUM PERFORATUM L. Saint Johns wort. 2n=32, (36). Cultivated on a small scale in the Netherlands as a medicinal crop.

Juglandaceae

JUGLANS REGIA L. Walnut, Persian walnut, English walnut. 2n=32, 36. Primary centre of diversity in Region 5. Secondary centre in SW. Europe and Moldavia.
Almost all varieties in Germany are apomictic.

Labiatae

MENTHA CARDIACA Gerard ex Baker. Scotch mint, Scotch spearmint. 2n= . Temp. Europe. Cultivated for its volatile oil. Closely related to M. x gentilis L. (2n=54, 60, 84, 96, 108, 120). It is believed that these two species are hybrids of M. arvensis* and M. spicata*.

MENTHA x GENTILIS L. (syn. M. sativa var. gentilis (L.) Reichenb.). 2n=54, 60, 84, 96, 108, 120. A hybrid of M. arvensis* and M. spicata*. Usually sterile. Cultivated frequently.

MENTHA x PIPERITA L. Peppermint. 2n=(36, 48, 64-69), 72, (84, 108, 122, 144). Probably a natural hybrid of M. aquatica* and M. spicata*. This hybridization probably took place in England. f. piperita (blackmint, black mitcham) is cultivated in C. Europe and Great Britain. while f. pallescens Camus (white mint, white mitcham) is cultivated especially in France. In USA existing clones were replaced by the cultivar Mitcham in 1890. This is still the main clone cultivated.

MENTHA ROTUNDIFOLIA (L.) Huds. (syn. M. spicata var. rotundifolia L.). Apple mint, Woolly mint. 2n=24, genome formula RR. Europe and Canary Islands. Cultivated. Probably the parental form of M. spicata* and one of the parents of M. japonica Mak., M. arvensis* and M. aquatica* (Ikeda & Ono, 1969). This species is related to M. longifolia* and M. spicata*.

MENTHA x SMITHIANA R.A. Graham (syn. M. rubra Sm., non Miller). 2n=54, 120. Rarely cultivated (Tutin et al., 1972). It is a hybrid of M. aquatica* x M. arvensis* x M. spicata*. Usually sterile, spreading vegetatively.

MENTHA SPICATA (L.) Hudson (syn. M. viridis L.). Spearmint, Green mint, Lamb mint. 2n=36, 48, genome formula RRSS (48+2B, 64). Temp. Europe. It might derive from an autotetraploid plant of M. rotundifolia* after which one genome pair RR changed into SS. Tutin et al. (1972) suggested that this species arose in cultivation as a segmental allopolyploid of M. suaveolens (see M. x rotundifolia*) and M. longifolia*. Var. crispata Schrader (syn. M. crispa L.) has genome formula RRS^cS^c. This species is one of the parents of M. x piperita*. It might be one of the parents of M. x villosa*.
Murray et al. (1972) artificially crossed M. aquatica (2n=96) and M. spicata (2n=48). This resulted in very variable F_1 due to the heterozygosity of the pollen parent. Some hybrids resembled the natural strains of M. x piperita, others did not.

MENTHA SUAVEOLENS Ehrh. (syn. M. rotundifolia auct., non (L.) Hudson). 2n=24. Cultivated as a potherb.

MENTHA x VILLOSA Hudson (syn. M. cordifolia auct., M. gratissima Weber). 2n=36. This species is a hybrid of M. spicata* and M. suaveolens*.

NEPETA CATARIA L. (syn. Cataria vulgaris Moench.). Catnip, Catmint. 2n=(32), 34, (36). Europe. A perennial herb cultivated for medicinal purposes.

ORIGANUM VULGARE L. Wild majoram. 2n=30. An extremely variable species from the Azores, Madeira, the Canary Islands, Europe throughout the Mediterranean Region, W., C. and E. China to Taiwan. Its great variation has resulted in numerous synonyms (Ietswaart, 1980). Cultivated as a medicinal plant.

Leguminosae

ANTHYLLIS VULNERARIA L. Kidney vetch, Spring vetch, Lady's fingers, Wound-wort, Amer, Tare. 2n=12. Temp. Europe, Caucasia, Ante-Asia, N. Africa and Ethiopia. Cultivated since 1858 (Mansfeld, 1959) and is now usually mixed with pasture grasses.

ASTRAGALUS CICER L. Milk vetch. 2n=64. Europe. A perennial pasture plant well-adapted for grass mixtures (Whyte et al., 1953).

ASTRAGALUS FALCATUS Lam. Sicklepod milk vetch. 2n=16. W. Asia. A forage plant cultivated in USSR and France.

ASTRAGALUS GLYCYPHYLLUS L. Milk vetch. 2n=16. Europe and Siberia to Altai. A perennial herb cultivated as a fodder.

CORONILLA VARIA L. Crown vetch. 2n=24. C. and S. Europe extending to C. Russia. Cultivated as an ornamental, a fodder crop and a cover crop.

GALEGA OFFICINALIS L. Galega, European goat's rue. 2n=16. E., C. and S. Europe, Caucasia, Asia Minor and Iran. Cultivated as a forage crop and as an ornamental.

GLYCYRRHIZA ECHINATA L. 2n=16. SE. Europe to Hungary and Italy. Cultivated to produce liquorice.

GLYCYRRHIZA GLABRA (syn. G. glandulifera Waldst. & Kit.). Common licorice, Liquorice. 2n=16. Europe and the Mediterranean region. A perennial herb. Var. typica Regel & Herder is cultivated to produce Spanish or Italian licorice and var. glandulifera Waldst. Russian licorice.

HEDYSARUM HEDYSAROIDES (L.) Schinz. & Thell. (syn. H. alpinum Jacq.). 2n=14. S. Europe, Asia Minor, America and Caucasia. Cultivated as a fodder crop especially in the Alps.

LATHYRUS SYLVESTRIS L. Flat pea, Wood pea. 2n=14. Europe. Cultivated for forage and as an ornamental plant.

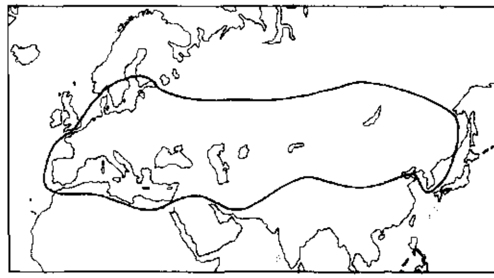
LATHYRUS TUBEROSUS L. Groundnut peavine, Earth chestnut. 2n=14. Europe and W. Asia. Cultivated for its tubers. In the 16th Century its flowers were distilled for perfumes (Uphof, 1968).

LOTUS CORNICULATUS L. Birds-foot trefoil. 2n=12, 24. Europe, moderate Asia and N. Africa to Ethiopia. Formerly and at present in USA in use in seed mixtures for a ley crop and for pastures. Landolt (1970) and Somarov & Grant (1971) suggested that the diploid is a hybrid and the tetraploid an allotetraploid of L. alpinus Schleicher (2n=12) of the Alp and the submediterranean L. pilosus Jord. (2n=12).

The erect, broad-leaved type probably from C. European origin is spread now as a contaminant of grass seed for road sides throughout W. Eur♦pe (Jones, 1973).

LOTUS ULIGINOSUS Schkuhr. Greater birds-foot trefoil. 2n=12, (24). Europe, N. Africa, Ante-Asia to Tibet. Cultivated in C. Europe and Great Britain as a fodder crop (Mansfeld, 1959).

MEDICAGO FALCATA L. Yellow lucerne. 2n=16, 32.



Medicago falcata (Fischer, 1938).

In Europe and Asia from longitude 10° to 85° E. and latitude 42° to 60° N., and mountains near the S. limits. The 4x is common while 2x is rare but occurs in the whole area. The 2x ssp. romanica (Prod.) Hayek possesses some rare characteristics and may derive from an older 2x stock (Lesins & Lesins, 1979).

MEDICAGO GLOMERATA Balbis. 2n=16, (32?). Maritime Alps. Useful as gene source of M. sativa*.

MEDICAGO LUPULINA L. Hop clover, Black medic. 2n=16, genome formula SS, 32, (64). Europe, most of Asia and N. Africa. It is naturalized in N. America. The 4x type has been found in C. Siberia. Occasionally included in seed mixtures for pastures. Cultivated since 1659 in England and 1785 in France, and now in the Old and New Worlds as a green fodder, hay crop and green manure (Lesins & Lesins, 1979).

MEDICAGO SATIVA L. Lucerne, Blue alfalfa. 2n=(16, genome formula SS), 32, (48, genome formula SSSSSS, 64). Transcaucasia (p. 97). Two populations - one from the Balkans and one from France - "met" in Thuringia, Germany. This resulted in a hybrid swarm from which winterhardy types were introduced in Minnesota, USA in 1857.

MELILOTUS ALBUS Medik. White sweet clover, Bokhara clover, Honey clover, White melilot. 2n=16. Europe and W. Asia. Cultivated in the Old World and particularly in the USA as a fodder crop and green manure.

It can be divided into two groups 1) the annual wild type and 2) the bushy type. The latter might be a mutant of group 1, or derive from a natural cross of M. albus. From both groups cultivars have been selected.

The very low variation of this species may point to only a few introductions.

MELILOTUS ALTISSIMUS Thuill. 2n=16. Europe and temp. Asia. Sometimes cultivated for horse fodder.

MELILOTUS DENTATUS (Waldst. & Kit.) Pers. 2n=16. E. and C. Europe to N. Sweden. Coumarin deficient and salt tolerant. Used to breed coumarin free cultivars of M. albus*.

MELILOTUS MACRORHIZUS Pers. 2n=16. Asia and Europe. Cultivated in China for its roots which are eaten as a vegetable. Closely related to M. altissimus*.

MELILOTUS OFFICINALIS Lam. Biennal yellow sweet clover, Field melilot, Yellow melilot. 2n=16. W. Europe to W. China. Cultivated in Europe and also in the USA. It is a biennal with sporadically some annuals.

ONOBRYCHIS VICIIFOLIA Scop. (syn. O. sativa s.l.Lam.). Esparcette, Sainfoin. 2n=18. Temp. Europe, SW. Asia to Altai and Transbaikal. Cultivation was probably started in S. France resulting in spp. sativa. There are three subspecies: arenaria (Kit & Koch.) Thellung, sand esparcette, montana (Lam. & D.C.), the mountain esparcette and sativa (Lam.) Thellung, the cultivated esparcette. The last name is confusing, because spp. arenaria (also described as var. transcaucasia, syn. O. transcaucasia Grossh.)* is cultivated too.

SAROTHAMNUS SCOPARIUS (L.) Wimm. ex Koch. Broom. 2n=(14), 46, 48. W. and C. Europe. Cultivated as a soil stabilizer.

TRIFOLIUM HYBRIDUM L. (syn. T. fistulosum Gilib.). Alslike clover. 2n=16. Temp. Europe, SW. Asia and N. Africa. Possibly first cultivated in Sweden. Introduced to other European countries and N. America. Often found in fields of red clover. Very likely not the ancestral form of T. repens*. The cultivated type spp. hybridum is probably derived from the wild type spp. elegans (Savi) Asch. & Graebn. In Anatolia spp. anatolicum (Boiss.) Hossain is found.

TRIFOLIUM PANNONICUM Jacq. Hungarian clover. 2n=c. 96, 98, c. 126, c. 130, c. 180. E., C and S. Europe. Cultivated.

TRIFOLIUM PRATENSE L. Red clover. 2n=14, genome formula AA, (28). Europe, W. and C. Asia and N. Africa. Primary centre in Region 9. It was probably first cultivated in the Netherlands, in the beginning of the 16th Century. The Classics already mentioned 2000 years ago that local ecotypes were developed in SE. Europe and Asia Minor. Spread to Germany and through Flanders to England. In the beginning of the 17th Century seed of red clover was exported from the Netherlands to the Scandinavian countries and France. From England red clover was spread to USSR and N. America. The wild type has more leaves and new shoots emerge from internodes at the butt end, while the cultivated type has less leaves and new shoots emerge from the leaf rosett. The variable wild type is described as var. pratense Bobr. and the cultivated as var. sativum (Crome) Bobr. (syn. T. sativum (Sturm) Crome.

Late red clover (var. serotinum) may have developed from contaminants or spontaneous mutants in USSR from introduced early types (var. praecox).

Autotetraploid types are widely cultivated now. Var. americanum C.O. Hartz was cultivated between 1883 and c. 1910 in C. Europe. It originated from a N. American introduction. It is often erroneously described as T. expansum Waldst. & Kit. Var. maritimum Zabel (var. villosum Wahlberg) is found wild on the S. coast of the Balkan Peninsula and var. frigidum Gaudin occurs wild in the Alps.

Red clover is closely related to the annual T. diffusum Ehrh., 2n=16, to the annual T. pallidum Waldst. & Kit., 2n=16 and the perennial T. noricum Wulf., 2n=16.

TRIFOLIUM REPENS L. White clover. 2n=32, (48, 64). Wild type (var. sylvestre). In meadows throughout Eurasia and N. Africa. Cultivation started probably in N. Italy (p. 115) and in the Netherlands. Very variable.

Brewbaker & Keim (1953) suggest that T. nigrescens Viv., Ball clover (2n=16) is one of the parents. Chen & Gibson (1970) believe that it is an autotetraploid while T. nigrescens and T. occidentale D. Coombe (2n=16) are related to it. T. uniflorum L. (2n=32) might also be a parent. This species is found in E. Mediterranean area to Sicily. It includes T. savianum Guss. of Sicily and Calabria, Italy. It is probably an autotetraploid. Navalikhina (1977) suggested that white clover is an allopolyploid of T. nigrescens, T. occidentale and T. uniflorum.

TRIFOLIUM RESUPINATUM L. (syn. T. suaveolens Willd.). Persian clover. 2n=(14), 16. The Mediterranean area to Iran, Afghanistan and India. Cultivated as a fodder crop. Var. majus Boiss. is syn. to T. suaveolens Willd.

TRIGONELLA COERULEA (L.) Ser. Sweet trefoil. 2n=16. Cultivated and also found as a weed or ruderal. It may be derived from T. procumbens (Besser) Reichenb. (syn. T. besserana Ser., T. coerulea spp. procumbens (Besser) Thell.). This species is a native to EC. and SE. Europe.

ULEX EUROPAEUS L. Common corse. 2n=96. W. Europe to Italy. Cultivated formerly for fodder, bedding and as hedges.

VICIA CRACCA L. Gerard vetch. 2n=12, 14, (21, 24), 28. W. Europe to Kamtchaska, E. China and Japan. Cultivated.

VICIA HIRSUTA (L.) S.F. Gray. Common tare, Hairy tare. 2n=14. Europe, N. Africa and W. Asia. Cultivated in W. of USSR together with barley.

VICIA PANNONICA Crantz. Hungarian vetch. 2n=12. Primary centre in SW. Asia (p. 98). Secondary centre in Hungary.

Liliaceae

ASPARAGUS OFFICINALIS L. Garden asparagus. 2n

=20. Primary centre probably in the saltsteppes of E. Europe. A. officinalis var. prostratus Richter is a tetraploid (Braak & Zeilinga, 1957).

CONVALLARIA MAJALIS L. Lily-of-the-valley. 2n =32, 36, 38. Europe, temp. Asia and Japan. A perennial herb cultivated as a medicinal crop and as an ornamental.

Linaceae

LINUM USITATISSIMUM L. Flax, Linseed. 2n=30, (32). For origin see p. 99. Helbaek (1971) supposed two ways of introduction of flax. One through Greece and the Donau valley into C. and W. Europe and the other west of the Black Sea in a northern direction into Russia. The first was probably a winter-annual which is the parent of "Winterlein" cultivated in Germany. The other was probably a summer-annual. In the first millenium B.C. the latter was introduced to C. and W. Europe. It is at present described as spp. eurasiaticum Vav. & Ell. In NW. USSR there is a centre of flax containing some of the finest fibre flax varieties.

In W. Europe and Ukraine the weed rattle flax, L. crepitans Dumort. (2n=30), now included in L. usitatissimum is probably the weedy type of flax.

Malvaceae

ALTHAEA OFFICINALIS*

Paeoniaceae

PAEONIA *OFFICINALIS* L. Peony, Piney. 2n=20. S. Europe, Asia Minor and Armenia. A perennial herb cultivated for its medicinal merits.

Plantaginaceae

PLANTAGO LACEOLATA L. Rib grass. 2n=12, (13, 12 + 2B). Cultivated on a small scale in the Netherlands and elsewhere as a medicinal crop.

Polygonaceae

RUMEX ACETOSA L. Garden sorrel. 2n=14 ♀ , 15 ♂ and other numbers. Temp. Europe and Asia. A perennial herb. Var. hortensis Dierb. (syn. R. ambiguus Gren.) is cultivated in the Old and New Worlds.

RUMEX ALPINUS L. Alpine dock, Monk's rhubarb. 2n=20. C. Europe, the Balkans and Caucasia. Cultivated formerly in C. Europe as a vegetable.

RUMEX OBTUSIFOLIUS L. Broad-leaved dock, Bitter dock. 2n=40, (60). Europe and temp. Asia. Cultivated.

RUMEX PATIENTIA L. Patience dock, Spinach dock, Herb patience. 2n=(40), 60. Probably C. Europe to W. Asia. Cultivated as a vegetable.

RUMEX SCUTATUS L. (R. alpestris Jacq.). French sorrel. 2n=20, (40). C. and S. Europe, Alpine regions, Caucasia, India. Cultivated as a vegetable (var. hortensis Lam. & DC.).

Portulacaceae

PORTULACA OLERACEA L. Purslane. 2n=2x=18, 4x= 36, 6x=54. Purslane is a cosmopolitan weed whose origin is doubtful (Danin et al., 1978). The cultivated type (ssp. sativa (Haw.) Celak., 2n=54) is a vegetable, which probably developed in Europe from the Eurasian weedy type ssp. oleracea, 2n=54. The distribution of the 2x, 4x and 6x wild and weedy subspecies indicates that one of the centres of diversity is Mexico (p.) (Danin et al., 1978).

Ranunculaceae

ACONITUM NAPELLUS L. Monkshood. 2n=24, 32. C. Europe. Cultivated as a medicinal crop and also as an ornamental.

AQUILEGIA VULGARIS*

NIGELLA SATIVA*

Resedaceae

RESEDA LUTEOLA*

Rhamnaceae

RHAMNUS CATHARTICUS L. Buckthorn. 2n=24. Europe up to Transcaucasia and W. Siberia, and in Algeria. Formerly the fruits of this tree were used as a source of yellow dye.

RHAMNUS FRANGULA L. Alder buckthorn. 2n=20, 22, 26. Europe, Asia and N. Africa. A tree formerly cultivated.

Rosaceae

AGRIMONIA ODORATA (Gouan) Mill. 2n=56. It is included in A. eupatoria L., Agrimony. Cultivated as a medicinal crop.

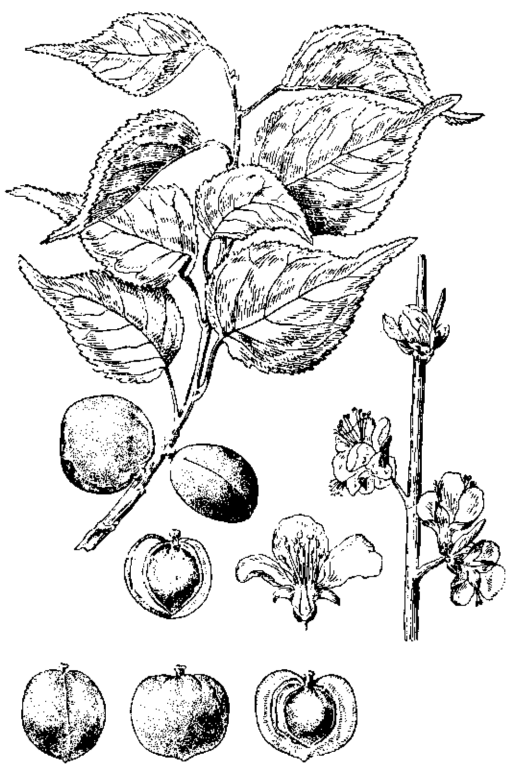
AMYGDALUS BESSERIANA Schott. (syn. A. nana L., Prunus nana (L.) Stokes, P. tenella Batsch.). Dwarf almond, Dwarf Russian almond, Steppe almond. 2n=16. Primary centre in E. Europe and Siberia. Also wild in the Balkan, Asia Minor, Causasus and China (p. 42). It is the commonest wild almond species and it is very frost resistant which makes it extremely valuable as a rootstock of A. communis.

AMYGDALUS LEDEBOURIANA Schlecht. (syn. Prunus ledebouriana Schlecht.) 2n= . A shrub from Tarbagatai and Altai.

AMYGDALUS PERSICA L. Peach. 2n=16. Primary centre in China (p. 42). Secondary centre in Moldavia, USSR.

ARMENIACA BRIGANTINA (Vizl.) Pers. (syn. Prunus brigantina Vill.). Briançon apricot. 2n= . Originated in SE. France. The seeds are the source of the perfumed oil "Huile de Marmotte" (Uphof, 1968). It might be a gene source of late flowering.

ARMENIACA SIBIRICA Pers. (syn. Prunus sibirica L., P. armeniaca var. sibirica K. Koch.). Siberian apricot. 2n=16. Intern Mongolia to the Sowjet Far East and Lake Baikal. This species has the largest distribution of all apricot species (Zylka, 1970). It is very cold resistant.

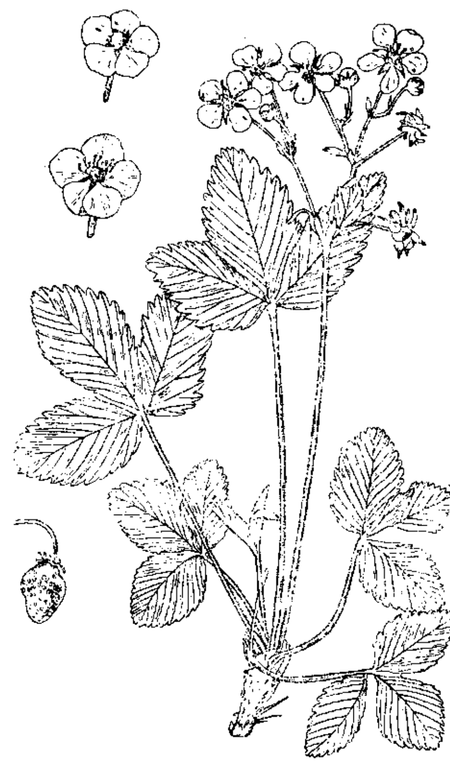


Armeniaca sibirica

FRAGARIA X ANANASSA Duch. (syn. F. grandiflora Ehrh.). Pineapple strawberry. 2n=56. Arose spontaneously in W. Europe (in a garden near Haarlem, the Netherlands) after hybridization of F. virginiana* from N. America and F. chiloensis* from S. America. F. ovalis (Rydb.) Lemm. from NW. USA is used as a source of winterhardiness.

FRAGARIA MOSCHATA Duch. Hautbois strawberry. 2n=42. Europe and European USSR. Cultivated formerly, and run wild in other countries.

FRAGARIA VESCA L. Wild strawberry, Alpine



Fragaria moschata

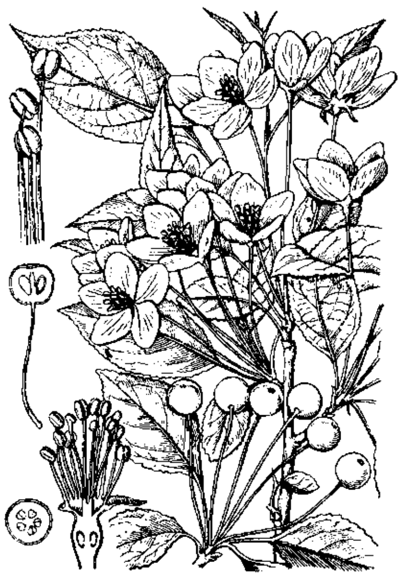
strawberry. 2n=14, genome formula AA. Europe, Asia and N. America (p. 204). Darrow (1955) stated that var. semperflorens Duch. is the parent of the cultivated strawberry. It was domesticated N. of the Italian Alps. Cultivated from seed and vegetatively.

FRAGARIA VIRIDIS Duch. Polunitsa. 2n=14. European part of Region 9. Cultivated formerly.

MALUS BACCATA (L.) Borkh. var. baccata. Siberian crab apple. 2n=34. Wild in Transbaikal and Ante-Baikal territories. Primary gene centre in Siberia. Resistant to frost.

MALUS PRUNIFOLIA (Willd.) Borkh. (syn. Pyrus prunifolia (Willd.). Chinese crab apple. 2n= 34, (51, 68). Wild and cultivated in the extreme eastern sector of Region 9. Primary centre China.

MALUS PUMILA Mill. (syn. Pyrus malus L.) Apple. 2n=34, 51, 68. The Balkans and SW. USSR (p. 85), eastwards through Transcaucasia, Iran, Turkestan, and northwards to the Altai mountains. It occurs along the ancient and mediaeval routes of commerce and migration between Europe and E. Asia. Man has greatly promoted its distribution (Wilcox, 1962). It is considered as the principal ancestor of the



Malus baccata

cultivated apple. M. sylvestris* hybridizes with this species and hence may also have played a small part as an ancestor.

European USSR is the primary centre for many old cultivars as Antonovka, Aport, Borovinka. In early 19th Century, Bolotov, described 600 Russian cultivars; about 10 000 cultivars exist in the world today. This shows the very polymorphic nature of this species which has also arisen due to introgression with other species.

PRUNUS CERASUS L. Sour cherry. 2n=32, genome formula CC. C. Asian centre (p. 101). The population Vladimirskaya vishnia with large dark-scarlet fruits that are very palatable and aromatic, originated in Region 9, extending westward and southward to the Rhine and Balkans.

PRUNUS DOMESTICA L. Garden plum, Domestic plum. 2n=48, genome formula CCSSSS or CdCdSS S_1S_1 or $CdCdD_1D_1D_2D_2$. For origin see p. 101. Werneck (1958) considered Upper Austria as a place where the garden plum has arisen. Bush seedling would have been transplanted to compounds where further domestication may have occurred. The Lake Bank Dwellers of neolithic Switzerland knew the garden plum.

PRUNUS FRUTICOSA Pall. (syn. Cerasus fruticosa Pall.). Dwarf Cherry, Bush Cherry, Ground Cherry, Mongolian Cherry, Steppe Cherry. 2n=16, 32. Extended over Europe. It occurs in great diversity beyond the Volga, in S. Ural, SW. Siberia and Bashkirskaya. One of the parents of P. cerasus*. It withstands -52°C.

PRUNUS INSITITIA L. (syn. P. domestica var. insititia (L.) C.K. Schneider, P. domestica spp. italica (Borkh.) Hegi). Bullace plum, Damson plum. 2n=48. S. and SE. Europe and adjacent parts of Asia. Occurs now throughout temp. Europe and W. Asia. Probably only known as a cultigen and naturalized. If so, it is obviously an allohexaploid. It is frost resistant.

PRUNUS MAHALEB L. Mahaleb cherry, St. Lucie cherry. 2n=16. C. and S. Europe and W. Asia. Fruits are not edible. Used as rootstock for cultivated cherries. Mainly self-incompatible.

PYRACANTHA COCCINEA M.J. Roemer. 2n=34. S. Europe and westwards to NE. Spain. Cultivated as an ornamental and for its fruits.

PYRUS COMMUNIS L. (syn. P. domestica Med.). Common pear. 2n=34, (51). Europe and W. Asia. It has been divided into spp. pyraster L. (syn. P. pyraster Burgsd., P. communis var. achras Wallr.), spp. nivalis Jacq. (syn. P. nivalis Jacq.) and spp. salvifolia (syn. P. salvifolia DC.). Spp. pyraster is the most important one, it grows in C. Europe and W. Asia. Spp. nivalis, the snow pear grows in W. Switzerland and France. It is used as a rootstock. Spp. salvifolia is found in the same areas. The cultivars are derived from these subspecies by selection and by crossing with P. serotina*, P. ussuriensis*, P. longipes, P. caucasica*, P. amygdaliformis* and P. salicifolia*. Pavlov (1969a, 1969b) reported that types of W. and S. Europe derive from crosses with P. nivalis* and P. amygdaliformis*, because they have hairiness and a high number of stomata per area like these two species.

Some cultivars in Caucasus show characteristics obviously derived from P. caucasica*. The E. European cultivars show a direct derivation from the wild P. communis.

PYRUS CORDATA Desv. 2n= . W. Europe. Cultivated in hedges and for its wood.

ROSA x ALBA L. French rose. 2n=28, 42. Cultivated in Bulgaria and S. France for the perfumery industry. Probably a hybrid of R. arvensis* x R. gallica*, and a white flowered member of the Sect. Canina.

ROSA ARVENSIS Hudson. 2n=14. S., W. and C. Europe. It is one of the parents of R. x alba*.

ROSA x BIFERA (Poiret) Pers. (syn. R. damascena auct., non Miller). Damask rose. 2n=28. Probably a hybrid of R. moschata* and R. gallica*. Cultivated in Bulgaria, S. France and Turkey. The petals are used to produce oil of roses which is used in perfumery.

ROSA CANINA L. Brier, Dog rose, Doghip. 2n=35. Europe, temperate Asia and N. Africa. It is a common rootstock of garden roses. The named selections are often less prickly than the wild ones.

ROSA GALLICA L. French rose. 2n=28. S. and C. Europe up to Belgium and C. France and W. Asia. Probably a parent of R. x bifera* and R. x alba*. The petals are used in perfumery.

ROSA RUBIGINOSA L. (syn. R. eglanteria auct.). Sweet briar. 2n=35. W. and C. Europe. Cultivated for its flowers and as rootstock.

ROSA VILLOSA L. Apple rose. 2n=28. Var. pomifera (Herrm.) Crép. Europe and SW. Asia.

RUBUS ARCTICUS L. Arctic bramble, Nectarberry. 2n=14. Europe and N. Asia. Used in breeding work with R. idaeus*. Fruits have a distinct aroma and rich in Vit. C. A hardy, high yielding, disease resistant plant.

RUBUS CHAMAEMORUS L. Cloudberry, Yellowberry, Salmonberry, Bake apple. 2n=56. Europe and N. Asia used in breeding with R. idaeus*. Easily domesticated (Larson, 1969). Seed and esp. subterranean runners are used to propagate this dioecious species.

RUBUS IDAEUS L. European red raspberry. 2n=14. Spp. vulgatus wild in Europe. It was domesticated. The present cultivars often are hybrids of this subspecies and its NE. American counterpart spp. strigosus.

The tetraploid subspecies: melanolasis Focke from NW. America and Siberia, sachalinensis Léveillé from Sakhalin and sibiricus from Kamchatka, have been grouped as R. sachalinensis Levl. Some cultivars derive from R. idaeus x R. chamaemorus*, cloudberry (2n=56). Crosses have also been made between this species and R. R. xanthocarpus Bur. & Franch from W. China, R. arcticus* L., Arctic bramble (2n=14) and P. parviflorus L., Japanese raspberry (2n=14). Other Rubus species have also been used in breeding work. Ever bearing types have been developed.

RUBUS LACINIATUS Willd. Evergreen blackberry. 2n=28. C. Europe. A cultivar was brought to N. America where hybridization took place with another European immigrant, R. procerus P.J. Muell. (2n=14, 28, 49), Himalaya berry. In 1925, a mutant was found in Oregon and named 'Thornless Evergreen'. This cultivar and its minor mutants are commonly grown in the USA.

RUBUS SAXATILIS L. Stoneberry. 2n=18. Europe and N. Asia. In Sweden a species has been found to be resistant to rust and other diseases. The fruit has only a few drupelets and lacks flavour (Larsson, 1969).

SANGUISORBA MINOR Scop. 2n=18, (54, 56). Europe and temp. Asia. Sometimes cultivated to flavour soup or for salads (Mansfeld, 1959).

SANGUISORBA OFFICINALIS L. Great burnet, Garden burnet. 2n=18, (42, 56, c. 70). Europe, Asia and N. America. Sometimes cultivated as a vegetable (Mansfeld, 1959).

SORBUS AUCUPARIA L. (syn. Mespilus aucuparia All.). Rowan tree, European mountain ash. 2n=34. The "Mährische Eberesche" (var. moravica) was found in 1810 in Czechoslovakia. It has been improved and distributed. Before its domestication var. rossica and var. rossica-major were already cultivated in USSR. It is an important source of Vitamin C (Mueller-Stoll & Michael, 1949).

SORBUS DOMESTICA L. Service tree, Mountain ash. 2n=34. S. Europe, N. Africa and W. Asia. Cultivated in Europe for its fruits which are eaten or made into wine and as an ornamental. Largefruited forms are found in forests in Crimea (p. 101).

Rubiaceae

RUBIA TINCTORUM L. Madder. 2n=44. S. Europe and Asia Minor. Cultivated in Europe as a dye plant.

Salicaceae

SALIX ACUTIFOLIA L. Caspic willow. 2n=38. A tree of USSR and Manchuria. Cultivated for twig production.

SALIX ALBA L. (syn. S. aurea Salisb.). White willow. 2n=76. In large area of Europe and Asia (p. 86) and N. Africa. Introduced into N. America. Cultivated in Europe for twig production for dike building.

SALIX CAPREA L. Goat willow, Common willow. 2n=38, (57, 76). Europe and N. Asia. Cultivated for its twigs.

SALIX FRAGILIS L. Brittle willow, Crack willow. 2n=(38), 76, (114). Europe, Asia Minor, Syria, Iran and W. and C. Siberia. Often planted for twig production. It is one of the parents of S. x rubens Schrank.

SALIX PURPUREA L. Purple willow, Purple osier willow. 2n=38. A large part of Europe, and in Asia to Japan, and in N. Africa. Cultivated for twig production for dike works and basketry.

SALIX TRIANDRA L. (syn. S. amygdalina L.). French willow, Almond-leaved willow. 2n=38, 44, (57, 88). Spread from W. Europe to E. Asia. Planted for twig production. One of the parental species of the cultivated S. x mollissima Ehrh. (2n=38).

SALIX VIMINALIS L. (syn. S. longifolia Lam.). Twiggy willow, Common osier, Basket willow, Osier willow. 2n=38. C. Europe and a large part of Asia. Much cultivated in N. and S. Europe and elsewhere for twig production. Many of the willows planted in the Netherlands for dike work belong to this species and to S. triandra*. They are often cultivated in mixed stands which leads to cross fertilization and development of hybrids.

S. dasyclados Wimmer (2n=38, 57, 76, 114) is probably a complex hybrid of S. caprea x S. cinera x S. viminalis. S. helix L. is a hybrid of S. purpurea* x S. viminalis. In Great Britain, this willow is planted as a windbreak and to shelter cattle.

Sambucaceae

SAMBUCUS EBULUS L. Dwarf elder. 2n=36. From Netherlands and Ukraine southwards. Formerly cultivated as a medicinal plant. Naturalized elsewhere.

SAMBUCUS NIGRA L. European elder. 2n=36. Europe. Cultivated. Recently there has been a new interest in this tree because of the processing of alcohol-free beverage (Strauss & Novak, 1971).

Saxiphragaceae

BERGENIA CRASSIFOLIA (L.) Fritsch. 2n=34. Siberia, Altai and N. Mongolia. A perennial herb cultivated since 1927 in USSR as a tea plant (Mansfeld, 1959).

Scrophulariaceae

DIGITALIS LANATA Ehrh. 2n=56. SE. Europe . Elsewhere in Europe it may have run wild. Cultivated as a medicinal crop.

DIGITALIS PURPUREA L. Purple fox-glove. 2n=56. S. (p. 118) and C. Europe. Cultivated as a medicinal plant and as an ornamental.

VERBASCUM THAPSIFORME Schrad. 2n=32. Spread throughout Europe. Cultivated for its medicinal properties and as an ornamental.

Solanaceae

CAPSICUM ANNUUM L. Bell pepper, Paprika, Cayenne pepper. 2n=24. Mexico (p. 196). Secondary centre in Europe.

PHYSALIS ALKEKENGI L. Strawberry tomato, Winter cherry. 2n=24. C. and S. Europe. A perennial herb cultivated for its fruits.

SCOPOLIA CARNIOLICA Jacq. Scopalia. 2n=46-48, 48. Europe. Cultivated as a medicinal crop.

SOLANUM TUBEROSUM L. Potato. 2n=48. Domesticated in S. America. In Europe spp. tuberosum developed. Its genetic basis is very small. This is probably caused by only a few introdutions, and afterwards by the selection for short-day forms and by mass killing during blight epidemics in the 1840's.

Umbelliferae

ANGELICA ARCHANGELICA L. Angelica. 2n=22. Temperate Europe, Himalaya, Siberia and Kamtschatka. Cultivated for its aromatic petioles. Spp. archangelica includes the cultivated type.

ANTHRISCUS CEREFOLIUM (Waldst. & Kit.) Sprengel. Garden chervil. 2n=18. Probably EC. and SE. Europe. Var. cerefolium has glabrous fruits. It includes the cultivated type.

BUNIUM BULBOCASTANUM L. (syn. Ligusticum bulbocastanum Crantz). 2n= . W. Europe. Formerly cultivated for its edible tubers.

CARUM CARVI L. (syn. Apium carvi Crantz). Caraway. 2n= 20, 22, (23, 25). Europe and W. Asia. Cultivated in temperate regions, N. India and Sudan (see C. roxburghianum*, C. copticum*).

CHAEROPHYLLUM BULBOSUM L. Turnip-rooted chervil. 2n=22. Europe and W. Asia. Its cultivation as a vegetable is on the decline.

DAUCUS CAROTA L. White carrot, Orange carrot. 2n=18. Afghanistan (p. 86). The origin of the white type is not clear. It probably arose as a mutant from a yellow type, most likely in France. The orange carrot probably originated in the Netherlands. This type of carrot is now cultivated widely by peoples of European stock. It has suppressed the growth of the purple carrot, which colours soups and food preparations purple (Banga, 1957, 1963). The poor storage quality of the purple types (Small, 1978b) may also have encouraged their replacement by other types. Even before the introduction of domesticated carrots, wild plants were grown in gardens as medicinal crops (W. Brandenburg, pers. comm., 1980).

LEVISTICUM OFFICINALE Koch. (syn. Angelica levisticum Ball.). Garden lovage, Bladder seed. 2n=22. Cultivated mainly for flavouring.

MYRRHIS ODORATA (L.) Scop. Garden myrrh, Sweet scented myrrh. 2n=22. Europe and Caucasia. Cultivated for flavouring and for fodder.

PASTINACA SATIVA L. Parsnip. 2n=22. Europe. Var. sativa is cultivated there and elsewhere for its sweet, fresh tap-root. The wild type has a sour root.

PEUCEDANUM CERVARIA (L.) Lapeyr. Hart's wort, Much-good, Broad-leaved spignel. 2n=22. S. and C. Europe. Cultivated formerly as a medicinal.

PEUCEDANUM OSTRUTHIUM (L.) Koch. Master wort. Pellitory of Spain, Hogfennel. 2n=22. Europe. Cultivated for its scenting root since the 16th Century, as a medicinal and as herb. Its cultivation has almost disappeared now.

Valerianaceae

VALERIANA LOCUSTA (L.) Betcke. (syn. V. olitoria Pollich). Corn salad, Lamb's lettuce. 2n= . Europe, N. Africa, Caucasia. Cultivated to be used for salads.

VALERIANA OFFICINALIS L. Valerian. 2n=2x=14, 4x=28, 8x=56. Most of Europe and temp. Asia. Subsp. officinalis (syn. V. exaltata Mikan f. ex Pohl), 2n=14, ssp. collins (Wallr.) Nyman (syn. V. collina Wallr.), 2n=28, and ssp. sambucifolius (Mikan f.) Cecak (syn. V. sambucifolius Mikan f., V. exelsa Poiret), 2n=56, are recognized, but other chromosomal numbers occur within a subspecies. These ploidy levels and occasional hybrids have led to many synonyms (Schrantz, 1961). Cultivated for its rhizome which yields the drug valerian.

VALERIANA PROCUMBENS Wallr. 2n=56. Spain, Great Britain, France and Germany. Cultivated in Germany. This species might be included in V. officinalis*.

VALERIANA SAMBUCIFOLIA Mikan f. ex Pohl. 2n=56. Wild in N., C. and E. Europe. Cultivated in Thuringia, Germany for its seeds. This species might be included in V. officinalis*.

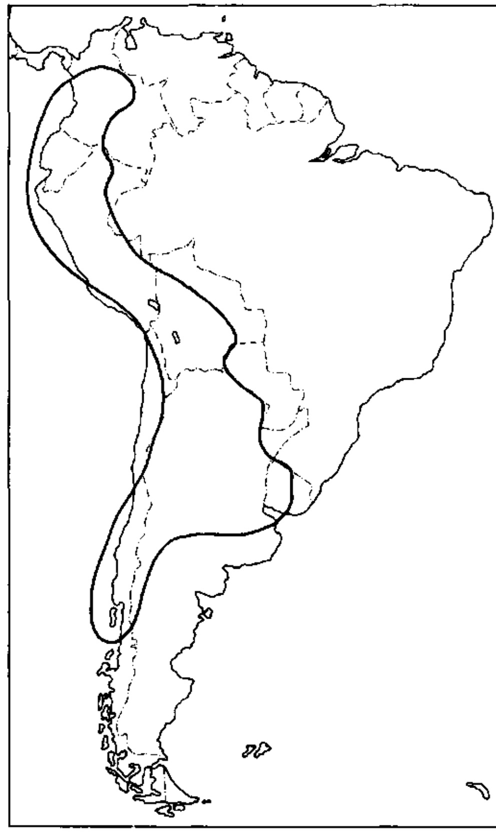
Violaceae

VIOLA TRICOLOR L. 2n=26. Europe, Siberia up to Altai and India. Spp. arvensis Gaud. (V. arvensis Murr., 2n=34) is a cosmopolitan weed. This subspecies and spp. tricolor (2n=26) are cultivated for their medicinal and ornamental purposes.

Vitidaceae

VITIS VINIFERA L. Common grape, European grape. 2n=38, (57, 76). For primary centres see p. 102). In Europe, the wild grape played a role in the development of old and modern cultivars. The wild type is declining (Schumann, 1977).

10 South American Region



The South American Region was restricted to the Andes by Vavilov (1949/50) and recognized as the Andean Centre which he divided into two areas: (1) Peru, Ecuador and Bolivia; (2) the island of Chiloe in Chile. The area between the coast of Venezuela, Guyana, Surinam and Cayenne, and S. Brazil and Paraguay was added by Darlington & Janaka Ammal (1945) as a third centre. Zhukovskij recognized a megacentre for the whole of S. America, and Harlan (1971) demonstrated the lack of well defined centres of origin for cultivated plants in this region.

The oldest known remains of cultivated plants in S. America are Phaseolus vulgaris from Guitarrero Cave in Peru, dating back some 8000 years (Kaplan et al., 1973). This, however, is not necessarily the centre of origin of agriculture in the New World. Plants were domesticated on the Andean Highlands as well as the tropical Lowlands (Reed, 1977), and a knowledge of food production may have evolved independently in these regions. Tuberous crops such as Xanthosoma were domesticated in the humid tropics while others such as Oxalis, Solanum and Ullucus are more typically crops of the High Andes. S. America provided the world with numerous fruits and vegetables, but a single cereal, Bromus mango endemic to Chiloe of Chile (Cruz, 1972). Maize (Zea mays) was introduced from C. America early in its evolution into S. America, and there evolved a major secondary centre of diversity.

Acanthaceae

JUSTICIA PECTORALIS Jacq. 2n= . West Indies and trop. America. Var. stenophylla Leonard semi-cultivated in E. Colombia to adjacent Amazonian Brazil. It is a smaller plant, has smaller and longer leaves, and has shorter inflorescences than the common type.

Agavaceae

FURCRAEA FOETIDA (L.) Haw. (syn. F. gigantea Venth.). Piteira, Piteira gigante. 2n=(18, 19, 34), 60. S. and C. America. The Mauritius hemp comes from var. willemettiana Roem. which is cultivated on Mauritius and elsewhere.

FURCRAEA MACROPHYLLA (Hook.) Baker. Fique. 2n = . Colombia. Cultivated there on a small scale. Some varieties have developed. Fique fibre also comes from other Furcraea species such as F. andina Trel. (2n=60), a wild growing species from Equador and Peru, and T. humboldtiana Trel., a wild growing species from Venezuela.

Aizoaceae

MESEMBRYANTHEMUM CHILENSE Mol. (syn. Carpobrotus chilensis (Mol.) N.E. Brown). Sea fig. 2n= . Chile. A shrub used in N. America to stabilize dunes.

Amaranthaceae

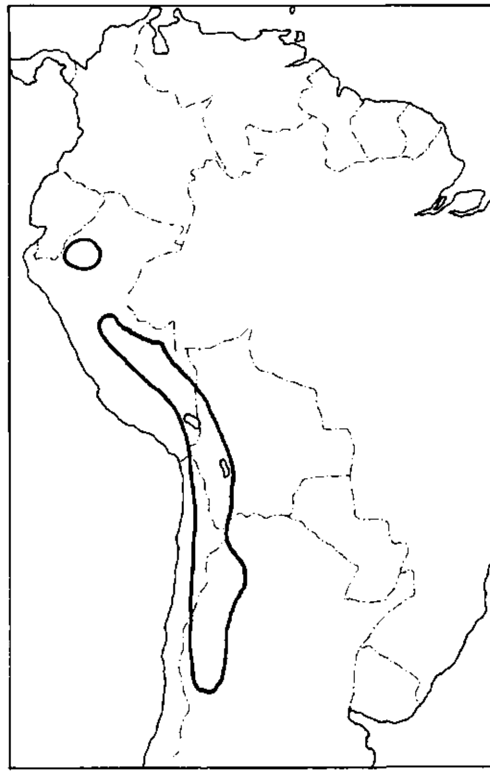
AMARANTHUS CAUDATUS L. Inca wheat, Quihuicha. 2n=32, 34. S. America, Asia and possibly in Africa. Cultivated as a grain crop. In Andean region of Peru, Bolivia and NE. Argentina and in China, India, Nepal and Afghanistan. Its leaves are also eaten. A form with red flower-spikes used as a garden ornamental ('love-lies-bleeding') should not be confused with quinoa (Chenopodium quinoa*. Quinoa is of S. American origin (Sauer, 1950)). It resembles A. edulis* and the wild S. American A. quitensis H.B.K., 2n=32.

AMARANTHUS DUBIUS Mart. ex Thell. 2n=64. Trop. America. Cultivated there as a potherb and for its grains. It also is a common weed. It resembles A. cruentus*. Perhaps it is a tetraploid from this latter species. See for hybridization with A. spinosus (p. 165).

AMARANTHUS HYBRIDUS*

AMARANTHUS MANTEGAZZIANUS Passer (syn. A. edulis Spegazzini). 2n=32. Cultivated in Argentina. The wild S. American A. quitensis H.B.K. (2n=32) closely resembles it. It is also included in A. caudata* as ssp. mantegazzianus (Passer) Hanelt.

AMARANTHUS QUITENSIS H.B.K. Sangorache. 2n= . Cultivated in Ecuador for its brilliant red inflorescences, which are a source of dye. Selection for bigger flowers (Heiser, 1964).



Amaranthus caudatus (Sauer, 1976).

AMARANTHUS SPINOSUS L. Thorny pigweed. 2n=34. S. and C. America. Widespread tropical noxious weed. Cultivated as a vegetable (Mansfeld, 1959) in Singapore. Because of the spines it is unlike any of the grain amaranths (Sauer, 1950). Where it grows together with A. dubius* sterile hybrids easily arise: A. braunii Thell. and A. caracasamus H.B.K. In general A. spinosus is the female parent. Grant (1959) supposed that A. spinosus is one of the parents of A. dubius, but Pal (1972) does not support this.

Anacardiaceae

ANACARDIUM OCCIDENTALE L. Cashew. 2n=42. Trop. America from Mexico to Peru and Brazil and also the West Indies. Cultivated now in many tropical countries which may form secondary centres of diversity. Thus Northwood (1966) showed the great variation in yield and nut size in the cashew populations in Tanzania.

SCHINUS MOLLE L. Californian pepper tree, Brazil pepper tree. 2n=28, 30. Mexico to Chile and Uruguay. Cultivated in the tropics as a medicinal plant, as a shade tree and as an ornamental.

SPONDIAS MOMBIM L. (syn. S. lutea L.). Yellow mombim, Jobo, Hog plum. 2n=32. Trop. America.

A fruit tree now cultivated in the tropics.

SPONDIAS PURPUREA L. (syn. S. mombim L.). Red mombim, Spanish plum. 2n= . Trop. America, C. America and Mexico. A small fruit tree.

SPONDIAS RADLKOFERI J. Donn. Sm. 2n= . Lower C. America and Panama. Derived from S. mombin* under selection for late fruiting.

Annonaceae

ANNONA CHERIMOLA Mill. Cherimoya. 2n=14, 16. Wild in the Andean valleys of Ecuador and Peru. There is its primary centre. A small tree. Cultivated now in the tropics. Its karyotype is similar to that of A. reticulata* and A. squamosa*. Several cultivars are known. Atemoya is a hybrid with A. squamosa*.

ROLLINIA DELICIOSA Safford. 2n= . Brazil. A tree cultivated for its fruits.

ROLLINIA LONGIFOLIA St. Hil. (syn. R. dolabripetala (Reddi) St.-Hil.) 2n= . Brazil. A tree cultivated for its fruits.

ROLLINIOPSIS DISCRETA Safford. 2n= . Brazil. A shrub cultivated for its fruits.

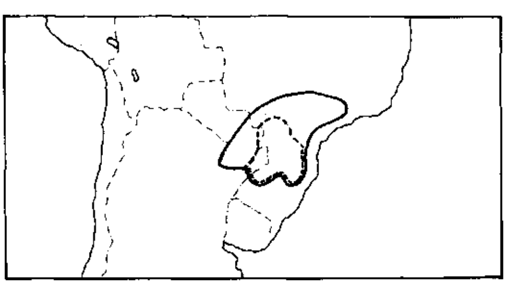
Apocynaceae

PLUMERIA ACUTIFOLIA Poir. (syn. P. acuminata Roxb., P. obtusa Lour.). 2n=36. Mexico and S. America. Cultivated in the tropics as a medicinal tree.

THEVETIA NEREIFOLIA Juss. (syn. T. peruviana Schum.). Exile tree, Yellow oleander. 2n=20, 22. Trop. America and West Indies. A shrub cultivated in the tropics as a medicinal plant.

Aquifoliaceae

ILEX PARAGUENSIS D. Don. (syn. I. paraguariensis St.-Hil.). Paraguay tea, Yerba maté. 2n= 40. S. America. Cultivated for its leaves which are used to prepare tea.



Dispersion (—) and cultivation of Ilex paraguensis (---) (Patiño, 1968).

Araceae

XANTHOSOMA ATROVIRENS C. Koch et Bouche (syn. X. peregrinum Griseb.). Yautia Amarilla, Nut Edo., 2n= . Wild in the llanos of Venezuela. Widely cultivated for its tubers in the Antilles and N. South America. It is characterized by intensely dark green upper leaf-blades, and tubers with yellow flesh. A race grown in Cuba has small tubers, and the race temba taia of Brazil is characterized by soft tubers. A race grown in Puerto Rico with somewhat hairy leaves is known as jengibrilla.

XANTHOSOMA BELOPHYLLUM (Willd.) Kunth. (syn. Caladium belophyllum Willd., X. versicolor Hort. ex Schott). Ocumo, Carouany. 2n= . Cultivated in the coastal mountains of Colombia and Venezuela, and east to Guyana. The tubers of this species is short and stocky, with white flesh. A race, d'espinagas (spinach) is grown in the mountains of Venezuela and adjacent Colombia for its edible leaves.

XANTHOSOMA BRASILIENSE Engler. Belember, Herbe a Calalou. 2n= . Wild in S. Brazil. Cultivated for its leaves that are cooked as a vegetable in Puerto Rico and other Caribbean islands.

XANTHOSOMA CARACU C. Koch et Bouche. Rolliza, Yautia blanca (Puerto Rico), Lampaza, Rejolgar (Mexico), Manola (Jamaica), Malanga (Cuba), Ocumo (Venezuela). 2n= . Widely grown, also in Africa. Tubers are almost cylindrical with white or rarely orange flesh.

XANTHOSOMA MAFAFFA Schott. (syn. X. blandum Schott, X. poeppigii Schott). Mafaffa. 2n= . Tropical forests of Colombia, Brazil, Peru and Bolivia. This species is typically a crop of the wet tropics. It is grown for its tubers in the Amazon Basin of Colombia.

XANTHOSOMA SAGITTIFOLIUM (Linn.) Schott. (syn. X. edule (Mey.) Schott., X. xanthorrhizon (Jacq.) C. Koch, Arum sagittaefolium Linn.). Yautia palma. 2n=24, 26. Mountains of Venezuela. Widely cultivated in the Antilles and S. America. Stem up to 1 m tall bearing tubers with white flesh. In Jamaica, it is sometimes known as Yautia panama, although probably introduced to the Caribbean from S. rather than C. America.

XANTHOSOMA UNDIPES (C. Koch et Bouche) C. Koch (X. jacquinii Schott.). Yautia palma, Malanga, Chau milon, Grande tayove. 2n= . This species resembles X. sagittifolium in developing and aerial stem. But, the leaves are purplish rather than green, and the tubers are white or orange inside. Yautia palma is cultivated, and occurs as a weed from C. Mexico throughout the Antilles to Equador.

XANTHOSOMA VIOLACEUM Schott. (syn. X. nigrum Vell.). Jamaica tanier (Trinidad), Oto (Panama), Pica uncucha (Peru), Ocumo (Venezuela), Yautia morada, Prieta (Puerto Rico), and Malanga (Cuba). 2n=24, 26. Widely grown in the Antilles, C. and S. America. The species is characterized by its usually violet pink to purple leaves, and tubers with white flesh but usually purplish outside.

Basellaceae

BOUSSINGAULTIA CORDIFOLIA Ten. (syn. B. baselloides H.B.K.). Madeira vine, Mignonette vine. 2n=c. 20, 36. S. and C. America. Cultivated as a leafy vegetable or for its tubers.

ULLUCUS TUBEROSUS (Lindl.) Lozano. Ulloco (Peru, Bolivia), Chiqua (Colombia), Melloco (Equador), Timbo (Venezuela), Papa lisa (Spanish). 2n=24. Cultivated for its tubers from Venezuela to Argentina. Its wild ancestor, U. aborigineus Brücher 2n= is a high Andean species of Argentina and Chile. Tubers are eaten fresh or dehydrated, and in some Andean villages ulloco ranks second as a staple only to potatoes. It is beautifully depicted on pottery of the Tiawanako culture (Leon, 1964, illustrations). Tubers are of various colours and sizes, and numerous local races are recognized.

Bixaceae

BIXA ORELLANA L. Annato. 2n=14, 16. Trop. America and the West Indies. Introduced into many other tropical countries where it may have run wild. It is a dye crop.

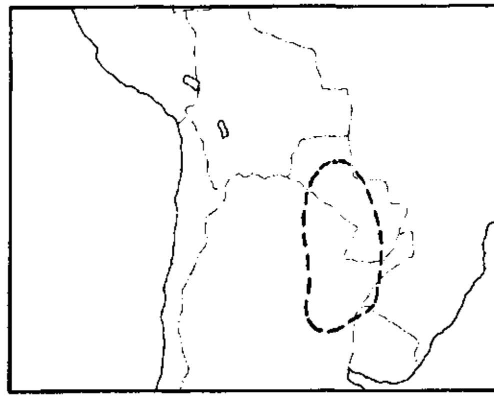
Bombacaceae

QUARARIBEA CORDATA (H. & B.) Garcia-Barriga & Hernandez (syn. Matisia cordata H. & B.) South American sapote. 2n= . NW. South America. Within this region this fruit is cultivated. No superior strains have been developed yet.

Bromeliaceae

ANANAS COMOSUS (L.) Merr. (syn. A. sativus Schult.f., Bromelia comosa L.). Pineapple. 2n=50, (75, 100). It is suggested that the Tupi-Guarani domesticated pineapple in the Paraná-Paraguay river drainage area and that from this region pineapple was spread to all (sub)-tropics. However, Brücher (1971) suggested that the domestication of pineapple might have taken place in the highlands of Guyana and alongside the rivers there. In the first area wild related species A. bracteatus (Lindl.) Schultes (2n=), A. ananassoides (Bak.) L.B. Smith (2n=) and Pseudananas sagenarius (Arudda) Camarcq. (2n=) occur. A. bracteatus var. typicus is occasionally cultivated for its fruits, while A. ananassoides var. nanus is an ornamental.

ANANAS PARGUAZENSIS Card.-Cam. & Smith. 2n= . This species occurs where the Rio Par-



Putative area of domestication of Ananas comosus (Pickersgill, 1976).

guazo discharges into the Rio Orinoco, Venezuela. Brücher (1971) suggested that primitive fibre and fruit cultivars have been selected. This selection work could have been carried out - independently of each other - in the region Guyana-Orinoco, and between Maranhao and Pernambuco.

PSEUDANANAS MACRODONTES (Harms) Morr. 2n=c. 100. Argentina and Brazil. There its primary centre is found. Cultivated on a large scale on Polynesian and Melanesian islands.

Cactaceae

CEREUS HEXAGONUS (L.) Mill. 2n= . Venezuela, West Indies, N. South America. Cultivated there for its fruits and as a hedge plant.

CEREUS PERUVIANUS (L.) Mill. 2n=24. Probably S. America (Hammer, 1976). Cultivated in the tropics as a hedge plant and ornamental.

ERIOCEREUS MARTINII (Lab.) Riccob. 2n= . Cultivated in Argentina as source of an alkaloid.

HYLOCEREUS POLYRHIZUS (Weber) Britt. & Rose. 2n= . Equador, a hedge plant.

OPUNTIA BOLDINGHII Britt. & Rose. 2n= . NW. coast of Venezuela, Trinidad and Curaçao. Cultivated in Venezuela and on Curaçao as a hedge plant and for its fruits.

OPUNTIA ELATIOR Mill. 2n= . Panama, Colombia, Venezuela. Cultivated there and in Mexico, India, Indonesia and Australia for its fruits. The wild types bear many long spines, whereas in the domesticated types fruits are naked or bear a few short thorns (Hammer, 1976).

OPUNTIA EXALTATA Berger. 2n= . Peru. Cultivated as a hedge plant, and there and elsewhere as an ornamental.

OPUNTIA VULGARIS Mill. 2n= 22, 33, 66. Brazil, Uruguay, Argentina and probably Paraguay, where it may have run wild (Hammer, 1976). Cultivated as a hedge plant in India, S. Africa and Australia. In Australia it has run wild. Formerly cultivated in India, Sri Lanka, Indonesia and E. Africa for cochenille.

PERESKIA ACULEATA Mill. Barbados cherry, Sweet Mary, West Indian gooseberry, Lemon vine. 2n=22. Trop. America. Cultivated for its fruits and as a hedge plant. Naturalized in Florida, USA.

PERESKIA BAHIENSIS Gürke. 2n= . Brazil. Cultivated in hedges.

PERESKIA BLEO (H.B.K.) DC. 2n= . Colombia, Panama, Venezuela and Brazil. Cultivated there and elsewhere.

PERESKIA GUAMACHO Weber. 2n= . Venezuela, Marguerita Island. Cultivated there and on Curaçao for hedges (Hammer, 1976).

PERESKIA SACHAROSA Griseb. 2n=22. Paraguay and Argentina. Cultivated there for hedges.

RITTEROCEREUS DEFICIENS (Otto & Dietr.) Backeb. 2n= . Venezuela and Curaçao. Hedges on Curaçao.

RITTEROCEREUS GRISEUS (Haw.) Backeb. 2n= . Venezuela. Cultivated in trop. America and Mexico for hedges and fruits.

TRICHOCEREUS BRIDGESII (Salm-Dyck) Britt. & Rose. 2n= . Bolivia. Cultivated there as hedge plant.

TRICHOCEREUS CUZCOENSIS Britt. & Rose. Peru. Cultivated there as a hedge plant.

TRICHOCEREUS PACHANOI Britton & Rose. 2n= . Andean parts of Ecuador and Peru. Apparently widely cultivated throughout the C. Andes (Schultes & Hofmann, 1973).

Cannaceae

CANNA EDULIS Ker. Achira, Queensland arrowroot. 2n=18, (27). Probably NW. South America. Spread to Mexico, C. America, West Indies and N. South America. Achira is cultivated in the West Indies, Australia, S. America, parts of Asia and Pacific Islands. Remains of achira have been found at Huaca Prieta, N. Peru (Bird, 1948). They have been dated c. 2400 BC. It could not be established whether they had been collected or cultivated.

Mukherjee & Khoshoo (1971) suggested that the triploid (2n=3x=27) is probably an intervarietal hybrid involving genetically related varieties. It is vigorous and robust and has large rhizomes.

In S. America rhizomes of other Canna species (C. coccinea Mill., C. paniculata R. & C. and C. indica L.) have been collected and eaten (Gade, 1966).

Caricaceae

CARICA CANDAMARCENSIS Hook.f. (syn. C. pubescens Lenne & Koch). Mountain papaya. 2n= . The Andes of Colombia and Ecuador. A tree cultivated there and also in E. Africa for its fruits (Mansfeld, 1959).

CARICA CHRYSOPETALA Heilb. 2n= . Ecuador. A tree cultivated for its fruits (Mansfeld, 1959). Badilla (1967) suggested that this species is a natural hybrid product of C. candamarcensis* and C. stipulata Badilla from Ecuador. He further suggested that this species, C. pentagona* and C. frutifragans Garcia & Hernandez another hybrid of the same parents (from Colombia) should be grouped in C. x heilbornii Badilla.

CARICA PENTAGONA Heilb. 2n= . Ecuador. A tree cultivated for its fruits (Mansfeld, 1959). Badilla (1967) suggested that this species is a natural hybrid product of C. candamarcencis* and C. stipulata Badilla from Ecuador.

Caryocaraceae

CARYOCAR NUCIFERUM L. 2n= . Brazil and Guyana. A tall tree cultivated in the West Indies for its edible Suari nuts.

Chenopodiaceae

CHENOPODIUM PALLIDICAULE Aellen. Cañihua. 2n=36. Andes. Cultivated on the Alti Plano of Peru and Bolivia as a marginal grain crop (Dale, 1970).

CHENOPODIUM QUINOA Willd. Quinoa, Andean grain chenopod. 2n=allo 4x=36. Andes. Cultivated in the Andes as a grain crop. This cultivation is on its decline. The weedy C. hircinum Schrad. (sensu Aellen), 2n=36 forms with quinoa a weed-cultigen complex (Wilson, 1976). Quinoa is closely related to C. nuttalliae*, which may derive from imported quinoa.

Chrysobalanaceae

CHRYSOBALANUS ICACO L. Icaco plum, Coco plum. 2n= . (Sub)trop. America. Cultivated for its fruits.

Compositae

EUPATORIUM TRIPLINERVE Vahl. (syn. E. ayapana Vent.). 2n=51. Trop. America. A perennial herb introduced in Java where it is cultivated as a medicinal plant.

MADIA SATIVA Molina. Madia, Tarweed. 2n=32. Cultivated formerly in Chile as an oil-seed crop. Attempts have been made to grow it elsewhere, but without success. The culture is almost extinct now.

POLYMNIA SONCHIFOLIA Poepp. & Endl. (syn. P. edulis Weddell.). Yacon strawberry. 2n=60. Andes. Cultivated there and elsewhere for its tubers.

SPILANTHES OLERACEA L. (syn. S. acmella Murr.). Para cress, Brazilian cress. 2n=14, 24, 52. Brazil, West Indies and also India. Cultivated as a vegetable or salad.

STEVIA REBAUDIANA Bertoni. 2n=22. N. Paraguay. Annual and biennial. The leaves contain stevioside, which is 300 times sweeter than canesugar. However it acts female sterilizing.

TAGETES MINUTA L. Marigold. 2n= . Trop. America. Spread to many other countries. Cultivated for its medicinal properties (Neher, 1968). It may reach a height of 3 m or more when cared for. Has run wild in France, Yugoslavia and Greece.

Convolvulaceae

MERREMIA MACROCARPA (L.) Roberty. 2n= . Brazil and West Indies. Cultivated for its medicinal tubers.

MERREMIA TUBEROSA (L.) Rendle (syn. Ipomoea tuberosa L.). 2n=30. Brazil, West Indies, trop. Africa and India. Origin is unknown. Cultivated as a medicinal and also as an ornamental. It may have spread from West Indies and Brazil because in these areas M. macrocarpa* grows wild and is cultivated.

Cruciferae

LEPIDIUM MEYENII Walp. Maca. 2n= . Peru and Bolivia. Cultivated in Peru for its root. A relic crop.

Cucurbitaceae

CUCURBITA MAXIMA Duch. ex Lam. Pumpkin, Winter squash. 2n=40. Cultivated all over the world. Secondary gene centre in India and adjacent areas (p. 72). Whitaker & Davis (1962) suggested a common origin for C. maxima, C. ficifolia*, C. moschata* and possibly C. pepo* and C. mixta* from C. lundelliana Bailey (2n=40).

C. lundelliana grows in S. Mexico, Guatemala and Honduras. From this parent, C. maxima developed in N. Argentina, Bolivia and S. Peru. In this area the related species C. andreana Naud. grows wild. It is probably a weedy derivative of the cultigen.

The wild C. ecuadorensis Cutler & Whitaker (2n=40) is closely related to this species and C. andreana (Cutler & Whitaker, 1969).

SICANA ODORIFERA (Vell.) Naud. Casa banana, Curaba. 2n= . Peru, Brazil to Mexico and West Indies. This vine is cultivated in trop. America.

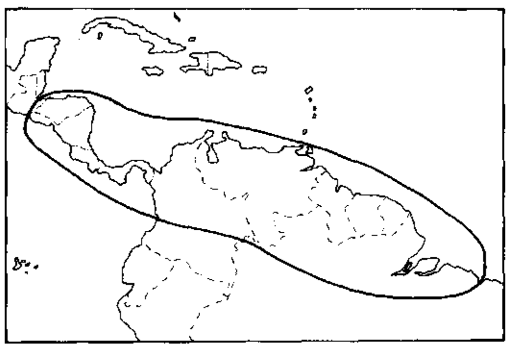
Cyperaceae

SCIRPUS CALIFORNICUS (C.A. Meyer) Steudel. (syn. S. tatara Kunth). Totora. 2n=64, 68, 70. Widely distributed in the Americas, on Easter Island and Hawaii. Material of wild plants are used for many purposes like making rafts, houses and roofs, and as food for man and animals. Sometimes cultivated in Peru (Heiser, 1978).

Dioscoreaceae

DIOSCOREA PIPERIFOLIA Humb. & Bonpl. 2n= . Brazil. Cultivated there.

DIOSCOREA TRIFIDA L.f. Cush-cush yam, Yampi. 2n=54, 72, 81. S. America and Antilles, cultivated throughout Caribbean. A race with purple tubers is grown on Puerto Rico.



Dioscorea trifida (Coursey, 1967).

Erythroxylaceae

ERYTHROXYLUM COCA Lam. Coca, Guarigos. 2n=24. Unknown wild. Probably from high Andes of Peru and Bolivia. Cultivated at high altitudes in Peru, Bolivia, Argentina, Colombia and Brazil.

Some taxonomists include E. novogratense*, E. truxillense Rusby and E. bolivianum Burck in this species.

ERYTHROXYLUM NOVOGRANATENSE (Morris) Hieron. Truxillo coca. 2n= . Andes. Cultivated at a lower altitude than E. coca*. It was distributed to the tropics.

Euphorbiaceae

HEVEA BENTHAMIANA Muell.-Arg. 2n=36. The Amazone basin, Brazil, Peru and Bolivia. A tree cultivated for its rubber.

HEVEA BRASILIENSIS (Willd.) Muell.-Arg. Brazilian hevea, Para rubber tree. 2n=36. The Amazon basin. This is the primary gene centre. Secondary gene centre in Malaya (p. 52). Cultivated now in Malaya, Indonesia, Sri Lanka and in some other countries. In Africa rubber has been cultivated as a farmer's crop and as

kas, 1969).

DESMODIUM DISCOLOR Vog. 2n=22. Brazil. A forage plant.

DESMODIUM INTORTUM (Mill.) Urb. Greenleaf. 2n=22. C. America and Brazil. Cultivated in Australia (Hutton, 1970).

DESMODIUM UNCINATUM (Jacq.) DC. Silverleaf. 2n=22. S. America. Cultivated in Australia (Hutton, 1970).

DIPTERYX ODORATA Willd. Tonka bean, Dutch tonka. 2n=32. Forests of trop. America, Venezuela, the Guyanas and lower Amazon basin. The tree is cultivated now in Venezuela, Malaya, West Indies and some other tropical countries (Cobley, 1963).

ERYTHRINA GLAUCA Willd. 2n=42. S. America. A shade tree in cacao plantations.

ERYTHRINA MICROPHERYX Poepp. Anauca. 2n= . Peru. A shade tree in cacao plantations.

GLIRICIDIA SEPIUM (Jacq.) Steud. (syn. G. maculata Benth.). 2n=20, 22. Mexico, C. America and N. South America. A shade tree, green manure and fodder crop.

INDIGOFERA ANIL L. (syn.I. suffruticosa Mill.). Indigo plant. 2n=12. S.America. Once much cultivated in the tropics for its dye (indigo) (Heiser, 1965).

INGA FEUILLEI DC. (syn. I. reticulata Spr.). 2n= . Peru. This tree is cultivated there for sweet fruit pulp (Uphof, 1968).

INGA PREUSSII Harms. 2n= . El Salvador. Used as a shade tree.

INGA PUNCTATA Willd. 2n= . S. and C. America. Used as a shade tree.

LEUCAENA LEUCOCEPHALA*

LONCHOCARPUS UTILIS Smith. 2n=44. Peru. Cultivated as a source of rotenone.

LUPINUS BOGOTENSIS Benth. 2n= . Bolivia. Cultivated there.

LUPINUS MONTANUS H.B.K. 2n= . Peru, Bolivia, Guatemala and Mexico. Cultivated in Bolivia.

LUPINUS MUTABILIS-TAURIS-CUNNINGHAMII-CRUCKSHANKSII species group. 2n=48. Andes region between Bolivia and Venezuela. This group of species, also named L. mutabilis Sweet/L. tauris Hook. is not yet well described. Formerly widely cultivated in its native centre. Still cultivated in Bolivia. Apparently farmers have not tried to select for sweet types. At present this species is used as 'bitter protection rows' around fields of Vicia faba and Pisum sativum to stop animals entering fields. Types have been developed that grow well under tropical short-day conditions, that have pods which do not open and soft-coated seeds rich in protein and of low alkaloid content (Brücher, 1970; Hackbarth & Pakendorf, 1970). The big seeds are used to prepare tarwi or ullu. Other wild, but possible valuable Lupinus -species of the American continents should be domesticated. They are often shrubby and have small seeds (Brücher, 1970).

MIMOSA INVISA*

MYROXYLON BALSAMUM (L.) Harms. Balsam of Peru. 2n=28. Var. pereira (Royle) Harms is spread in Guatemala and El Salvador. It is a source of balsam. It was cultivated in the imperial gardens of the Aztecs in Mexico (Mansfeld, 1959).

PACHYRHIZUS APIHA (Wedd.) Parodi. 2n=22. Probably a cultigen developed by the indians in Bolivia and N. Argentina.

PACHYRHIZUS TUBEROSUS (Lam.) Spreng. Yam bean, Potato bean, Jicama. 2n=22. The headwaters of the Amazon. From there it was distributed to other parts of S. America and parts of the West Indies. The young pods and tubers are eaten.

PHASEOLUS ABORIGINEUS Burk. 2n=22. Forests of NW. Argentina Andes. Probably extended through Bolivia, Peru, Ecuador up to Honduras (Burkart & Bücher, 1953). It might be the progenitor of P. vulgaris* in Peru (Heiser, 1965).

PHASEOLUS LUNATUS L. Lima bean, Sieva bean, Butter bean, Madagascar bean, Burma bean. 2n=22. C. America, and in the Andes from Peru to Argentina. Kaplan (1965) showed that the big lima bean of Peru was first domesticated in the Andean highlands and that the small lima bean of Mexico may have arisen in the Pacific coastal foothills of Mexico (p. 193). A small-seeded subspecies (ssp. microsperma, Sieva or Small Lima) originated by natural selection. It spread to the Antilles.

PHASEOLUS VULGARIS L. Common bean. 2n=22. For origin see p. 194. The earliest remains of cultivated common beans have been found in the Guitarrero Cave in Peru. It dates from about 6000 BC. The 'domesticated' characters are especially dark red brown and dark red beans (Kaplan et al., 1973).

PITHECELLOBIUM SAMAN Benth. Rain tree, Saman, Cow tamarind. 2n=26. Trop. America. It is used as a shade tree in cacao and coffee plantation.

PROSOPIS CHILENSIS (Molina) Stuntz emend. Burkart. 2n= . From Peru and Bolivia to C. Chile and NW. Argentina. An unarmed tree suitable for domestication as a shade, timber and fuel tree, and for its sweet pulpy fruits eaten by man and cattle (Burkart, 1976).

PROSOPIS JULIFLORA DC. Mesquite. 2n=28, 52, 56. Cultivated in Brazil, India and elsewhere as a shade and timber tree, and for forage. The shrubby type is an aggressive invader in Hispaniola and Pakistan (Burkart, 1976).

PROSOPIS STROMBULIFERA (Lam.) Bentham. 2n=28. W. Argentina and N. Chile. At one time cultivated in Chile for its fruits, which ease toothache. Wild fruits are gathered for this purpose. Var. ruiziana Burkart, perhaps a tetraploid (2n=4x=56) (Burkart, 1976), has fruits twice the size of var. strombulifera.

PROPOSIS TAMARUGO T. Philippi. Tamarugo tree. 2n= . Tree for desert forestation and for raising Merino sheep and Angora goat, which feed on falling leaves and legumes. The leaves absorb atmospheric moisture (Burkart, 1976).

RHYNCHOSIA MINIMA (L.) DC. 2n=22. S. America. Cultivated in Australia and elsewhere as a fodder and pasture crop.

STYLOSANTHUS GUIANENSIS SW. (syn. S. surinamensis Miq.). 2n=20. Guyana. Used as a food plant for livestock and as a soil conservator.

VICIA GRAMINEA Smith. 2n=14. Argentina and Chile. Occasionally cultivated for its seeds as a source of anti-N-lecitin (Nijenhuis et al., 1969). This is used as a test serum for the human N-blood group.

Malpighiaceae

BANISTERIOPSIS CAAPI (Spruce ex Griseb.) Morton. 2n=20. S. America. A woody vine cultivated in the Amazon region as a drug and narcotic.

BUNCHOSIA ARMENIACA (Cav.) DC. 2n= . The Andean region. A shrub cultivated in Ecuador for its fruits.

MALPIGHIA GLABRA L. (syn. M. punicifolia L.). Barbado cherry, West Indian cherry. 2n= . West Indies and N. South America. Cultivated there and elsewhere for its fruits. It also makes a good hedge, like M. coccigera L. (Purseglove, 1968).

Malvaceae

ABUTILON OXYCARPUM F. Von Muell. 2n=14. South America and Australia. Cultivated for its fibres.

GOSSYPIUM BARBADENSE L. (syn. G. vitifolium Lam., G. peruvianum Cav.). Sea island cotton. 2n=52, genome formula $(AADD)_2$. It has been proposed that G. barbadense arose from a cross and amphidiploidization of G. arboreum* and G. raimondii*. G. arboreum could have been introduced into Peru by way of Asia and the Pacific islands. Another hypothesis is that an African diploid reached S. America by way of Atlantic. This diploid would probably have been G. herbaceum*.

As Bird (1948) found G. barbadense material

Distribution of the New World cottons in the 13th century: Gossypium barbadense (11), G. hirsutum var. marie-galante (12) and G. hirsutum punctatum (13)(Hutchinson,1962).

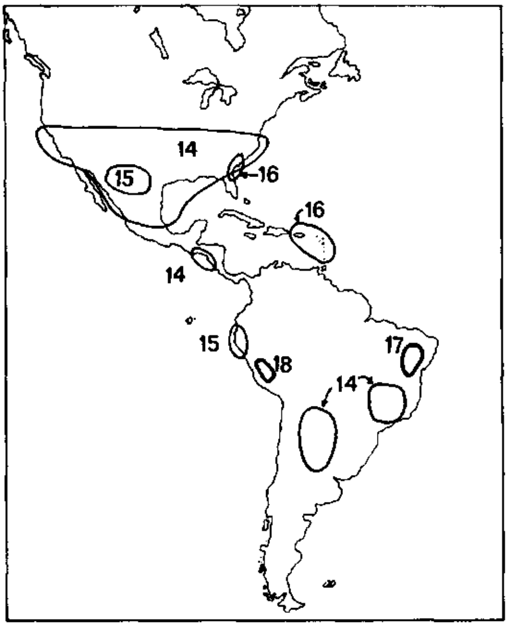
at Huaca Prieta, Peru which was dated 2400 BC. the introduction of the African Gossypium species and its amphidiploidization with G. raimondii must have taken place long before that time. The main point is how this African species reached Peru.

However, the centre of origin N. Peru is in the arid mountainous interior of the prov. Tumbes. The ssp. darwinii is closely related and is endemic in the Galapagos Islands. At present it is 'contaminated' by hybridization with exotic introductions. Secondary centre in Peru.

In S. America G. barbadense spread south and eastwards to NW. Argentina. Some other forms are found in S. America. The Tanguis variety is a selection from Tumbes. In Chile and Peru the Pacific assemblage is found, characterized by broad leaves and intense hairiness of the underside of the leaf. This character induces resistance to jassids, Empoasca ssp. The lint of G. barbadense is usually coarse with a length up to 34.5 mm. The lint of an Ecuador type, of Sea Islands and Egyptian is fine and silky with a length up to 37.5 mm. It is possible that the Ecuador type is the parent of the Sea Islands/Egyptian complex (p. 84, 139) (Harlan, 1970). The Atlantic assemblages include the kidney cottons (seeds fused in a kidney-shaped cross). They have a wide distribution in N. South America and the islands of C. America. They have been taken to Africa, India, Sri Lanka, Indonesia and elsewhere.

Secondary centres in Egypt (p. 139) and in Turkmenistan - Tadjikistan - S. Uzbekistan, USSR (p. 84).

On the Sea Islands of S. Carolina, USA the Sea Island cottons developed after cottons from Bahamas or Jamaica (p. 194) were introduced (Hutchinson, 1962).



Distribution of annual cottons in the New World at 1960: Gossypium hirsutum var. uplands (14), G. barbadense var. Egyptians (15) and G. barbadense var. Sea Islands (16)(Hutchinson, 1962). G. mustelinum (17) and G. raimondii (18)(Pickersgill et al., 1975).

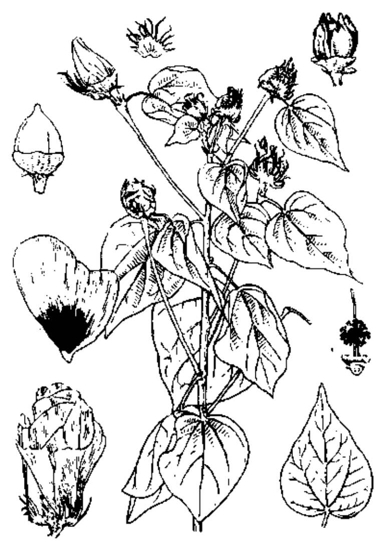
GOSSYPIUM HIRSUTUM L. Upland cotton. 2n=52, genome formula $(AADD)_1$. The common theory is that G. hirsutum arose from an amphiploidization of the Old World G. arboreum* or G. herbaceum* and G. raimondii. G. raimondii is the parent of the D genome and one of the first two the donor of the D genome. It is not known when this amphiploidization took place, but material collected from Tehuacan Valley in Mexico and dated 3500-2300 BC. appears to be fully domesticated (Smith & Stephens, 1971). It is also not known whether G. barbadense reached Peru by way of Asia or whether G. herbaceum reached eastern S. America from W. Africa. Harland (1970) observed wild plants of an exceedingly primitive perennial race marie galante in the state Rio Grande do Norte, N. Brazil. He suggested that this area is almost certainly the centre of origin of the whole Upland group. From here this cotton dispersed first northward to the Amazon, then along the Amazon and across the Andes into Ecuador, W. Colombia and possibly still further north. In another direction this cotton dispersed northward through the Guyanas passing the West Indies to E. Colombia and further northward into C. America via Yucatan. C. America must be considered as a secondary centre of diversity (p. 194). Wild and semi-wild marie galante cotton were observed in Florida until some years ago. Upland cotton also dispersed southward to E. Brazil. At present this race is also grown in Ghana. It is a source of resistance to Verticillium.

A second important perennial is race punctatum, which is found around the coast of the *Gulf of Mexico from Yucatan to Florida and the* Bahamas and some other islands (p. 199). At present G. hirsutum Cambodia (a latifolium type) is cultivated in S. India. Their way of spread was probably S. America-Philippines-Cambodia-S. India.

GOSSYPIUM KLOTZSCHIANUM Andersson. 2n=26, genome formula $D_{3-K}D_{3-K}$. Galapagos Islands. Var. davidsonii is found on the shores of Gulf of California and the Revilla Gigedo islands (p. 139).

GOSSYPIUM *MUSTELINUM* Miers ex Watt. (*syn*. G. caicoense Aranha, Leitao & Gridi-Papp). 2n= 52, genome formula AADD. NE. Brazil. A wild species distinct from G. hirsutum* and G. barbadense*, and not derived from either of them (Pickersgill et al., 1975).

GOSSYPIUM RAIMONDII Ulbr. 2n=26, genome formula D_5D_5. Formerly N. Peru. Now extinct in its original habitat and only found in collections (Harland, 1970). This species is a source of hairiness gene H_6 conditioning resistance to jassid, Empoasca ssp. Probably one *of the parental species of* G. barbadense* and G. hirsutum.



Gossypium raimondii

GOSSYPIUM TOMENTOSUM Nutt. ex Seem (syn. G. sandvicense Parl.). 2n=52, genome formula $(AADD)_1$. Hawaii. A fuzzy-seeded but not limited species. At one time it was believed that if the origin and relationship of this species were elucidated the problem of the origin of G. barbadense* and G. hirsutum* could be solved. However it appears that its origin is independent of those of the New World species (Hutchinson, 1962).

WISSADULA CONTRACTA (Link.) R.E. Fries. 2n=14. Trop. America. Cultivated in W. Java for fibre (van Borssum Waalkes, 1966).

WISSADULA PERIPLOCIFOLIA (L.) Presl ex Thw. 2n=14. Probably introduced in Sri Lanka as a source of fibre for which purpose it is still used (van Borssum Waalkes, 1966). The degree of variability of this species is very small in Malaysia. Some varieties and forms have been described for American representatives. This may point to an American origin. A pantropical weed.

Marantaceae

CALATHEA ALLOUIA (Aubl.) Lindb. Sweet corn root, Leren. 2n= . Native to Hispaniola, Puerto Rico, Lesser Antilles, the Guyanas, Brazil, Venezuela, Colombia, Ecuador and Peru. Introduced into Asia. A minor tuber crop.

MARANTA ARUNDINACEA L. Arrowroot, Bermuda arrowroot. 2n=18, 48. N. South America and the Lesser Antilles. Cultivated in the tropics for its rhizomes containing starch and as a medicinal crop.

Musaceae

MUSA cultivars. 2n=22, 33. Not much is known yet about the distribution of the clones of the various genome groups. In Venezuela, the relative frequency of these groups is AA 1, AAA 8, AAB c. 10 and ABB c. 3 (Borges, 1972). Trop. America is a secondary centre for the Plantain subgroup French Plantain or Horn Plantain, 2n=33, AAB.

Myrtaceae

ABBEVILLEA FENZLIANA Berg. 2n= . Brazil. A small tree cultivated for its edible fruits.

BRITOA ACIDA Berg. Para guava. 2n= . Brazil. A shrub cultivated for its fruits.

CAMPOMANESIA GUAVIROBA Benth. & Hook. 2n= S. Brazil. Cultivated for its edible fruits.

CAMPOMANESIA LINEATIFOLIA Ruiz. & Pav. (syn. C. cornifolia H.B.K.). 2n= . E. Andes. Cultivated as a fruit tree in Peru (Mansfeld, 1959).

EUCALYPTUS CAMALDULENSIS Dehn. Longbeak eucalyptus. 2n=22. Primary centre: Australia (p. 66). Secondary centres: Brazil, Argentina and the Mediterranean area (p. 117).

EUGENIA DOMBEYANA DC. Grumichama. 2n= . Peru and S. Brazil. A tree cultivated for its fruits.

EUGENIA UNIFLORA L. Pitange, Surinam cherry. 2n=22. Brazil. Cultivated in the tropics and subtropics.

EUGENIA UVALHA Camb. Uvalha. 2n= . S. Brazil. Cultivated for its fruits.

FEIJOA SELLOWIANA Berg. Feijoa. 2n=22. S. Brazil, Uruguay, Paraguay and N. Argentina. Also its primary centre of diversity. Sometimes cultivated for its fruit in hot countries e.g. the Caucasian coast of the Black Sea where it grows well.

MYRCIARIA CAULIFLORA Berg. (syn. Eugenia cauliflora (Berg.) DC.). Jabotica. 2n= . Brazil. Cultivated for its fruits (Purseglove, 1968).

MYRCIARIA JABOTICABA Berg. 2n= . Brazil. Cultivated in the tropics for its fruits.

PSIDIUM GUINEENSE SW. 2n= . The West Indies and trop. America. Occasionally cultivated.

PSIDIUM LITTORALE Raddi (syn. P. cattleianum Sabine). Strawberry guava. 2n=88. Brazil. A small tree introduced in the tropics and subtropics. Var. lucidum Degener, Chinese strawberry guave yields fruits of improved quality (Uphof, 1968).

Nyctaginaceae

MIRABILIS JALAPA L. Marvel of Peru, Four o'clock, False jalap. 2n=(54), 58. S. America. Spread over the whole world and in W. Africa as a fetish plant. Cultivated as an ornamental. Tuberous roots were used as jalap. Elsewhere a subtropical weed.

Onagraceae

FUCHSIA MAGELLANICA Lam. Fuchsia. 2n=22, 44. S. America. Planted as hedges in Azores, Ireland and W. Britain.

Oxalidaceae

OXALIS TUBEROSA Mol. Oca. 2n=(14), 60, 63-64, 68-70. Cultivated in the Andes from Colombia to Bolivia for an extremely long time. Introduced also in Europe where it was cultivated like the Mexican O. deppei Lodd. (2n=14, 56) as a vegetable by amateurs (Uphof, 1968). Several colours of the tubers have been observed. It should not be confused with Tropaeolum tuberosum*.

Palmae

COPERNICIA PRUNIFERA Moore. Carnauba wax palm. 2n=36. Brazil. Mostly semi-wild; sóme plantations for wax production.

COROZO OLEIFERA (H.B.K.) Bailey. (syn. Elaeis melanococca Gaertn.). Nolipalm. 2n=32. C. America to Colombia and Amazon area. Cultivated for its oily fruits. It can be crossed with the African oil palm, Elaeis guineensis* producing fertile hybrids.

GUILIELMA GASIPAES (H.B.K.) L.H. Bailey. Peach palm, Peribaye. 2n= . S. and C. America. Cultivated in S. America.

OENOCARPUS BACABA Martius. 2n= . Amazon area to Surinam and Guyana. A palm cultivated on compounds for its oily fruits.

Passifloraceae

PASSIFLORA ALATA Dryand. Winged passion flower, Maracuja. 2n= . Peru and Brazil. A woody vine cultivated in Brazil for its fruits.

PASSIFLORA ANTIOQUIENSIS Karst. (syn. P. vanvolxemii (Lem.) Triana & Planch.). 2n= . Banana passion fruit. Colombia. A woody vine cultivated e.g. in New Zealand for its fruits. P. x militaris hort. derives from P. antioquiensis x P. manicata (Juss.) Pers., 2n=18, and P. x exoniensis Bailey derives from P. antioquiensis x P. mollissima* (Ohle, 1975).

PASSIFLORA CAERULEA L. 2n=18. Blue passion flower. Brazil, Argentina, Paraguay. Cultivated for its fruits and as an ornamental.

PASSIFLORA COCCINEA Aubl. 2n= . Brazil, Bolivia, Amazon district of Peru.

PASSIFLORA EDULIS Sims. Passion fruit, Purple granadilla. 2n=18. S. Brazil. Widely distributed throughout the tropics and subtropics. The fruits are especially used for juice preparation. The mountain form. f. edulis occurs from Brazil to N. Argentina and in the tropics. It has run wild in Assam. The lowland form flavicarpa Degener is a mutant of it (Ohle, 1975).

PASSIFLORA FOETIDA L. Stinking passion flower, Love-in-a-mist. 2n=18, 20, 22. West Indies and S. America. Weedy. Distributed to many tropical countries in Africa and Asia, where it has naturalized. Its fruits are sometimes eaten. In Malaya and E. Africa it has been used as a cover crop.

PASSIFLORA LAURIFOLIA L. Water-lemon, Golden apple, Yellow grandilla, Jamaica honeysuckle, Belle apple, Pomme de liane. 2n=18. Thickets and forest fringes in the West Indies and NE. South America. Cultivated for its fruits in the 17th Century. Spread throughout the tropics (Purseglove, 1968). Cultivated on Java and in India as an ornamental and as a medicinal plant.

PASSIFLORA LIGULARIS Juss. Sweet granadilla. 2n=18. Trop. America. Spread to C. America. Its sweet fruits are much used in the mountainous regions of Mexico and C. America (Purseglove, 1968).

PASSIFLORA MALIFORMIS L. Curuba. 2n=18. Trop. America. A vine cultivated for its fruits.

PASSIFLORA MIXTA L.f. 2n=18. Venezuela, Colombia, Ecuador, S. Peru, P. x rosea (Karst.) Killip, 2n= . Derives from P. mollissima* x P. mixta.

PASSIFLORA MOLLISSIMA (H.B.K.) Bailey. Banana passion fruit, Tasco, Caruba de Castilla. 2n=18. The Andes. Especially cultivated in Ecuador and Bolivia. Introduced in other countries.

PASSIFLORA PINNATISTIPULA Cav. 2n= . Andes. Cultivated Colombia, Chile and Peru. It hybridizes with P. mollissima*.

PASSIFLORA POPENOVII Killip. 2n= . Andes (Ecuador). Resembles P. laurifolia* (Ohle, 1975).

PASSIFLORA PSILANTHA (Sodiro) Killip. Gullan. 2n= . Ecuador. A hybrid of P. mollissima* x P. partita* (Ohle, 1975). A vine cultivated for its fruits.

PASSIFLORA QUADRANGULARIS L. Giant granadilla, Barbadine. 2n=18. Trop. S. America. Cultivated since 18th Century for its fruits. Now widely distributed in the tropics. Possibly a hybrid (Ohle, 1975).

PASSIFLORA SERRATO-DIGITATA L. (syn. P. cearensis Barb.). 2n= . Trop. S. America, Amazon Basin.

PASSIFLORA TRIPARTITA (Juss.) Poir. Tasco. 2n=18. Ecuador. Cultivated there.

Peperomiaceae

PEPEROMIA PELLUCIDA H.B.K. 2n= . S. America. In Africa this pantropical weed is cultivated as a vegetable and medicinal crop.

Phytolaccaceae

PHYTOLACCA CHILENSIS Miers. 2n= . Chile. A perennial herb cultivated for its berries which are a source of red dye.

PHYTOLACCA DIOICA L. 2n=36. Temp. and subtrop. S. America. Cultivated as an ornamental and shade plant.

RIVINA HUMILIS L. Rouge plant. 2n=108. The tropics of the Old and New Worlds. Cultivated in Colombia for its berries which are a source of red dye.

Piperaceae

PIPER ADUNCUM L. 2n= . Trop. America. Used as a soil conservant.

Portulacaceae

TALINUM TRIANGULARE*

Rhamnaceae

COLUBRINA RUFA Reiss. 2n= . Brazil. Cultivated for its medicinal bark and other purposes.

Rosaceae

FRAGARIA CHILOENSIS L. Chiloe strawberry, Beach strawberry, Ambato strawberry. 2n=56, genome formula AAA'A'BBBB. The Pacific coastal region of N. and S. America and Hawaii. Dioecious; polygamodioecious or hermaphroditic types are occasionally found. Formerly cultivated there. It is one of the parents of F. x ananassa*.

RUBUS BRASILIENSIS Mart. 2n= . Brazil. A shrub cultivated for its fruits.

RUBUS GLAUCUS Benth. 2n= . Costa Rica to Ecuador. Cultivated in the Andes.

RUBUS MACROCARPUS Benth. Colombian berry. 2n= . Colombia and Ecuador. Cultivated for its very large fruits (5 cm long).

Rubiaceae

CEPHAËLIS IPECACUANHA (Stokes) Baill. Ipecac, Ipecacuanha. 2n=22. Brazil. Introduced into India and Malaya. There small plantings were established. Roots of wild and cultivated plants are the source of ipecac or ipecacuanha used to treat amoebic dysentery.

CINCHONA LEDGERIANA Moens ex Tremen (syn. C. calisaya var. ledgeriana How., C. officinalis L., C. calisaya Wedd. and C. succirubra Pav. ex Klotzsch.). Quinine. 2n=34 (all species). These species are taken together. They all come from the same centre of diversity: Andes mountains of S. Peru, Bolivia and S. Ecuador. Here many Cinchona species are found and the great diversity of botanical varieties is caused by natural hybridization between the species and varieties. Plantations in Indonesia and Sri Lanka and recently in E. Africa. The original introductions in the Asian countries were very probably a mixture of true species and their hybrids. From this material C. ledgeriana was derived but it is thought to be a variety of C. calisaya, and is also considered a hybrid of C. calisaya, C. succirubra and C. lancifolia Mutis. C. succirubra which is used as rootstock is probably a variety of C. pubescens Vahl. (van Harten, 1969).

Sapindaceae

MELIOCOCCUS BIJUGATUS Jacq. Kanappy tree, Kinnup tree, Bullace plum, Honey berry, Spanish lime, Geneps. 2n=32. Trop. America. Cultivated there for its edible fruits (Mansfeld, 1959).

PAULLINIA CUPANA (H.B.K.) Guarana. 2n= . S. America. Cultivated in Brazil for its seeds, used as a coffee.

SAPINDUS SAPONARIA L. Soap wood tree, Soap tree, Soap berry tree. 2n= . Trop. America. Cultivated there and elsewhere for its fruits.

Sapotaceae

LUCUMA NERVOSA A. DC. (syn. L. rivicoa Gaertn. f., Pouteria campechiana (H.B.K.) Baenhi). Egg fruit, Canistel. 2n= . NE. South America. Cultivated in trop. America for its fruits.

LUCUMA OBOVATA H.B.K. (syn. Pouteria lucuma (Ruiz & Pav.) O. Kuntze). Lucumo. 2n= . Chile and Peru. This tree is cultivated for its fruits.

LUCUMA PROCERA Mart. (syn. Urbanella procera Pierre). Macarandiba. 2n= . This fruit tree is cultivated in Brazil.

MANILKARA BIDENTATA (A. DC.) Chev. (syn. Mimusops balata Pierre). Balata, Bully, Bullet, Purgio, Quinilla. 2n= . S. America and Trinidad. The wild trees are tapped for latex (balata).

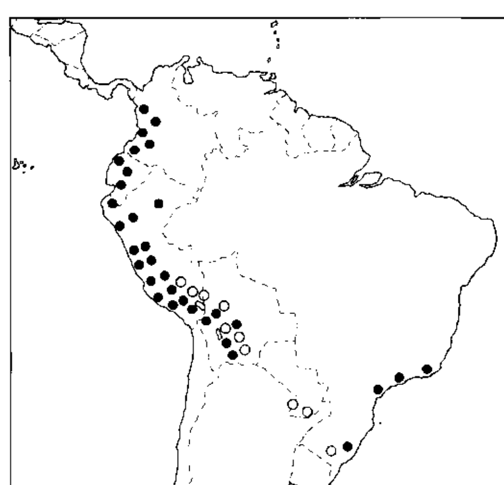
POUTERIA CAIMITA (Ruiz & Pav.) Radlk. 2n= . Peru to E. Ecuador and Guyanas. A tree cultivated for its fruits.

Simaroubaceae

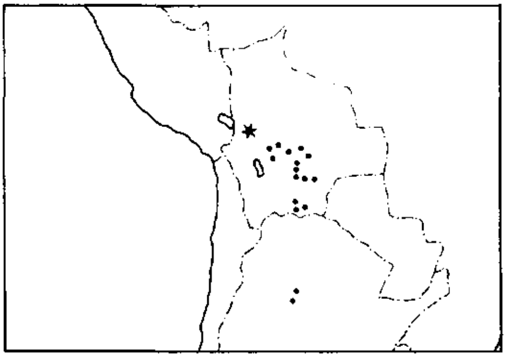
QUASSIA AMARA L. Surinam quassis, Bitter wood. 2n= . N. South America. Cultivated for its wood which is used medicinally, and also as an ornamental tree.

Solanaceae

CAPSICUM BACCATUM H.B.K. (syn. C. angulosum Miller). Pepper. 2n=24. The wild type is var.



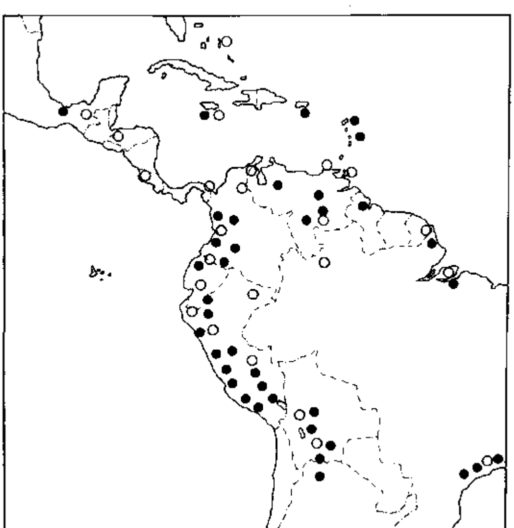
Capsicum bacatum var. baccatun (o) and var. pendulum (•)(Eshbough, 1975).



Capsicum eximium (•) and C. cardenasii (*) (Eshbough, 1980)

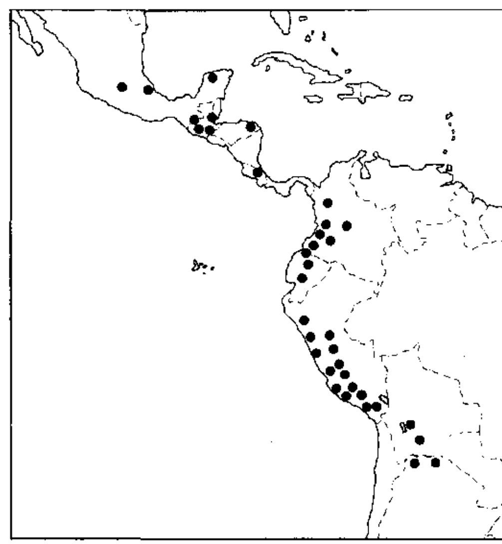
baccatum (syn. C. microcarpum Cav.). It occurs in Peru, Bolivia, Paraguay, N. Argentina and S. Brazil. It is the parental type of the cultivated type var. pendulum (Willd.) Eshbaugh (syn. C. pendulum Willd.). This cultigen was originally found in the same area as var. baccatum and in S. Colombia, Ecuador and in Chile. Now it is also cultivated elsewhere (Eshbaugh, 1970).

CAPSICUM CHINENSE Jacq. (syn. C. sinense Jacq.). 2n=24. This pepper was originally cultivated in the West Indies and lowland S. America, from S. Bolivia to S. Brazil. Closely related to C. frutescens*. It may have originated from it (Pickersgill, 1969).



Capsicum frutescens (o) and C. chinense (•) (Eshbough, 1975)

CAPSICUM PUBESCENS Ruiz & Pavon. 2n=24. Cultivated in the highlands of S. and C. America. It is related to the wild self-incompatible C. cardenasii Heiser & Smith, 2n=24, and the wild pseudo-self-compatible C. eximium Hunziker, 2n =24; these species together with C. tovari, 2n =24, form the purple-flowered group of Capsicum (Jensen et al., 1979). C. cardenasii is an endemic of the La Paz district of Bolivia; C. eximium is widely distributed from N. Argentina to C. Bolivia (Eshbaugh, 1977, 1980). Both species hybridize naturally and the hybrids are fully fertile. They also cross to a lesser extent with C. pubescens and may form one species complex deriving from a common wild ancestor (McLeod et al., 1979).



Capsicum pubescens (Eshbough, 1975).

CYPHOMANDRA BETACEA (Cav.) Sendt. (syn. C. crassifolia). Tree tomato. 2n=24. Peru. Unknown wild. Cultivated in the Andean region especially in Ecuador. Other species of this genus are found in S. America and partly in C. America. One of them, is C. hartwegi Sendt.; its fruits are harvested in Colombia, Chile and Argentina.

LYCOPERSICON CHEESMANII Riley (syn. L. esculentum Mill. ssp. minor Rick, L. minutum Rick). Galapagos tomato. 2n=24. Coasts of Galapagos Islands. Characterized by a very dense pubescence, compound yellow-green leaves, yellow or orange fruit (rich in beta-carotens), a calyx that expands after fertilization and seeds with a deep dormancy. The plants are drought and salt tolerant. They are eaten by the Galapagos tortoises and seeds can germinate after passing through their digestive tracts (Rick & Bowman, 1961).

LYCOPERSICON CHILENSE Dun. 2n= . The coastal strip of Peru and N. Chile. A wild tomato often found growing together with L. peruvianum. They do not cross. This species is characterized as a source for resistance to all tomato diseases except Phytophthora.

LYCOPERSICON CHMIELEWSKII Rick, Kesicki, Fobes & Holle. 2n= . C. and N. Peruvian Andes. Sympatric with its derivative L. parviflorum*. Formerly belonging with this species to 'L. minutum'. Cross-fertilizer (Rick et al., 1976).

LYCOPERSICON ESCULENTUM Mill. Tomato. 2n=24. The centre of the genus Lycopersicon is a narrow belt of the S. American west coast limited by the equator and 30°S and the Andes and the Galapagos Islands. The greatest variation of the tomato is however outside this area, in the Veracruz-Puebla area in Mexico (Jenkins, 1948). This area was very likely the source of the cultivated tomatoes of the Old World. The putative ancestor of the tomato is probably var. cerasiforme (Dun.) Alef. This variety was originally confined to the Peru and Ecuador area from where it spread in pre-Columbian times as a weed of fields and compound yards throughout much of trop. America, either with or without man's active co-operation. In Mexico it became cultivated because of its similarity to another food plant, Physalis ixocarpa*.

Outside its primary gene centre the tomato plant is self-compatible. In Peru and Ecuador it spontaneously crosses with L. pimpinellifolium*. Tomato flowers pollinated by pollen of L. peruvianum* result in the induction of parthenocarpic fruits. Some F_1 seeds may be set resulting in hybrid plants with varying degree of fertility.

Rick (1971) studied the geographical distribution of the alleles Ge^c, Ge^p, and Ge^n. He found that most European and US cultivars have the genotype Ge^nGe^n, only a few have Ge^cGe^c or Ge^pGe^p. The C. American varieties have Ge^nGe^n and occasionally Ge^cGe^c. In Ecuador Ge^n is also common among the cultivars. The C. American sources of var. cerasiforme have Ge^nGe^n, and an Ecuador source has Ge^c. So in Ecuador the cultivars differ from the wild type, but more sources should be investigated. Sources of L. pimpinellifolium* ex Ecuador carried Ge^n. This would suggest gene exchange between L. pimpinellifolium and the cultivars. The Peruvian cultivars carry Ge^p; the same allele is found in Peruvian sources of L. pimpinellifolium. This suggests gene exchange too. Rick concluded that the European and US tomato cultivars are qualitatively closer related to the cultivars of Peru, and quantitatively to those from C. America and Mexico.

LYCOPERSICON HIRSUTUM Humb. & Bonpl. 2n=24. The western slopes of the Andes in Peru. A green-fruited species. The glabratum is self-compatible. It is characterized by disease resistance, e.g. tomato mosaic virus (Marmon tabaci Holmes).

LYCOPERSICON PARVIFLORUM Rick, Kesicki, Fobes & Holle. 2n= . C. and N. Peruvian Andes. Compatric with its ancestor L. chmielewskii*. Formerly classed with this species to 'L. minutum'. Strict self-fertilizer (Rick et al., 1976).

LYCOPERSICON PERUVIANUM (L.) Mill. 2n=24. Chile and Peru. A green, small-fruited wild species. Most plants are gametophytic self-incompatible, although some plants have been found to be self-compatible (Hogenboom, 1968). It is a source of tomato mosaic virus tolerance.

LYCOPERSICON PIMPINELLIFOLIUM Mill. (syn. L. esculentum ssp. pimpinellifolium (Mill.) Brezhn.). Currant tomato. 2n=24. Primary centre: coastal Ecuador and Peru. This red-fruited species crosses with L. esculentum* and its genes introgress into tomato (Rick & Fobes, 1975). Because of the high frequency of outcrossing, it is highly heterogenous (Rick et al., 1977). It is cultivated and occurs as a weed. A source of tolerance for tomato.

METHYSTICODENDRON AMESIANUM R.E. Schultes. 2n = . S. America. Cultivated as a medicinal and witchcraft plant.

NICOTIANA RUSTICA L. Aztec Tobacco, Makhorka, Nicotine Tobacco. 2n=48. Unknown wild, with a possible exception of var. pavonii (Dunal) Goodspeed. This variety occurs as a ruderal in the Andes. Aztec Tobacco is a tetraploid having probably originated in Peru by amphiploidization of apparently N. paniculata L. (2n=24) and N. undulata Ruiz & Pavon (2n=24). Both species occur wild in Peru. Its cultivation is limited to some areas such as the USSR and India. In most other areas it is replaced by N. tabacum* which has a low nicotine content.

NICOTIANA TABACUM L. Tobacco. 2n=48, genome formula SSTT. Clausen (1932) showed that tobacco is a natural amphitetraploid of N. sylvestri Speg. & Comes, 2n=24, genome formula S'S' and N. tomentosiformis Goodsp., 2n=24, genome formula T'T'. Isozymic (Sheen, 1972) and cytoplasmic (Gray et al., 1974; Kawashima et al., 1976) evidence supports his view. The occasional wild plants are escapes of cultivation.

Interspecific crosses have been made to introduce male-sterilizing cytoplasma and genes conditioning resistance to diseases.

PHYSALIS PERUVIANA L. Cape gooseberry. 2n=24, 48. Andes. Cultivated in some S. American countries for its berries. Often observed as a weed or semi-wild.

SOLANUM ABANCAYENSE Ochoa. 2n= . Peru. Tubers are very small and white.

SOLANUM ACAULE Bitt. 2n=48, genome formula

$A_2A_2A_3A_3$. Wild tetraploid from C. Peru, Bolivia and NW. Argentina. A parent of S. x juzepczukii*. Frost resistant and resistant to X-virus disease, nematodes and the Colorado beetle. Very susceptible to Phytophthora.

SOLANUM AJANHUIRI Juz. & Buk. 2n=2x=24. Cultivated in N. Bolivia (dept. La Paz) and S. Peru. It derives from S. tuberosum* group stenotomum x S. megistacrolobum Bitt., 2n=24 (Huaman et al., 1976). It is frost resistant, the tubers are long and irregularly shaped. Also resistant to virus diseases.

SOLANUM CHACOENSE Bitt. 2n=24, (36). N. and C. Argentina, Paraguay, Uruguay and S. Brazil. A very polymorphic wild species. Only once an autotriploid was observed. This triploid has been described as 'S. calvescens Bitter'. 'S. muelleri Bitter' also belongs to S. chacoense (Brücher, 1975). Rich in tomatine alkaloid which is poisonous to the Colorado beetle.

Introgression between this species and S. microdontum exists in Argentina and possibly elsewhere. This resulted in an extension of this originally low altitude species of open places of the Argentinean plain to mountainous region (Hawkes, 1962a). Used as a source of resistance to common scab, virus diseases and Colorado beetle.

SOLANUM x CHAUCHA Juz. & Buk. (syn. S. tuberosum group chaucha). 2n=3x=36. This species is a hybrid of S. tuberosum* group Andigena x group Stenotomum or group Phureja, but Bukasov (1970) suggested that it is a triploid derivative of group Phureja. The hybridization may have occurred several times and because of the variation of the parents this species is very polymorphic. Cultivated from C. Peru to N. Bolivia. It has a rather low yield (Jackson et al., 1976).

This species has run wild in Simla hills, India. Initially it was established by vegetative propagation. The older the population the more plants flower and the more self-incompatibility breaks down (Nayar & Gohal, 1970).

SOLANUM COMMERSONII Dun. 2n=24, 36. E. Central Argentina, Paraguay, Uruguay and S. Brazil. 'S. acroleucon Bitter' belongs to this species (Brücher, 1975). A source of resistance to potato cancer and Colorado beetle. It withstands frost of -6°C.

SOLANUM CONTUMAZAENSE Ochoa. 2n= . N. Peru. With white-yellow tubers of 15-25 mm length.

SOLANUM x CURTILOBUM Juz. & Buk. 2n=60. The high Andes of Bolivia and Peru, where it has been cultivated. Probably a hybrid of S. x juzepczukii* and x S. tuberosum group Andigena. It reproduces itself vegetatively, although it is moderately fertile. It crosses readily with S. tuberosum group Tuberosum. Less frost resistant than its parent S. x juzepczukii (Hawkes, 1962b).

SOLANUM x FLAVOVIRIDENS Ochoa. 2n= . Humid trop. Bolivia. Its glandular hairs provide resistance to virus-spreading aphids. Its parents are not yet fully known.

SOLANUM GONIOCALYX Juz. & Buk. 2n=24. This potato is cultivated in C. Peru (dept. Junin). It is a northern derivative of S. tuberosum* group Stenotomum. It may be included in this species as an extreme variant (Hawkes, 1958). Bukasov (1970) suggested that it was a derivative of S. multi-interruptum. The tubers have a pale-yellow flesh owing to their richness in carotinoids. They have an excellent flavour.

SOLANUM HUMECTOPHILUM Ochoa. 2n= . Peru. With white-hyaline tubers of 8-12 mm length.

SOLANUM IMPROVIDUM Brücher. 2n=24. La Rioja and Catamarca, W. Argentina. Wild potato of deserts (Brücher, 1979).

SOLANUM x JUZEPCZUKII Buk. 2n=36. High Andes of Bolivia to Mendoza Prov. of W. Argentina. Wild potato of deserts. Self-incompatible. Source of resistance to nematode and tolerance to frost (Brücher, 1979).

SOLANUM KURTZIANUM Bitter & Wittmack. 2n= . S. Bolivia to Mendoza Prov. of W. Argentina. Wild potato of deserts. Self-incompatible. Source of resistance to nematode, and tolerance to frost (Brücher, 1979).

SOLANUM MACOLAE Bukasov. 2n=24. Mendoza Prov. of W. Argentina. Wild potato of deserts, with high content of solanin in tubers (Brücher, 1979).

SOLANUM MAGLIA Molina 2n=24, 36. The 2x 'andinum' occurs wild in the Cordillera Foothills of Mendoza, W. Argentina, and the 3x 'pacificum' grows wild on the Pacific coast between Valpraiso and Loquimbo. Both are partially male-sterile (Brücher, 1979).

SOLANUM MURICATUM Ait. Pepino morado. 2n=24. Unknown wild. Probably domesticated in the Andes. Cultivated in C. and S. America. Extremely variable and many types of fruits are recognized. There are two closely related species, either of which could be the parental species. These are S. caripense Humb. & Bonpl. (2n=24) and S. tabanoense Correll (2n=24). Both occur in Ecuador and Colombia. Pepino is cultivated for its fruits (Heiser, 1964).

SOLANUM NUBICOLA Ochoa. 2n=48. The Huánuco region, Peru. A tetraploid species of the Tuberosum group.

SOLANUM OCEANICUM Brücher. 2n=36. A weedy potato of the Pacific coast of Chiloe Island, Chile.

SOLANUM PELOQUINIANUM Ochoa. 2n=24. Wild potato species from the Peruvian Andes.

SOLANUM PENNELLII Corr. 2n= . Closely related to S. lycopersicoides Dunal. (2n=). Both species are representatives of a transition between Solanum and Lycopersicon. It can be crossed with L. esculentum* and it is a source of resistance to Tomato Mosaic Virus.

SOLANUM PHUREJA see S. tuberosum.

SOLANUM QUITOENSE Lam. Naranjillo, Lulo. 2n=24. Unknown wild. Cultivated for its fruits in Colombia and Ecuador. Var. septentrionale R.E. Schultes & Cautrecasan is spineless (Heiser, 1971). Closely related to S. pectinatum Dun. (syn. S. hirsutissimum Standl.), 2n=24.

SOLANUM RAPHANIFOLIUM Card. & Hawkes. 2n=24. The dept. of Cuzco, Peru. There it occurs as a weed. A stabilized hybrid of S. megistacrolobum Bitt. (2n=24), and S. canasense Hawkes (2n=24) (Ugent, 1970a).

SOLANUM RUIZ-LEALII Brücher. 2n=24. Mendoza Prov. of W. Argentina. Wild and self-incompatible. Source of resistance to nematode and tolerance to drought. Brücher (1979) concluded that it is not a hybrid of S. chacoense* and S. kurtzianum*.

SOLANUM SPARSIPILUM Bitt. 2n=24. Peru and Bolivia. A weedy species. Probably a clonal mixture of diploid hybrids of S. tuberosum groups Stenotomum and Phureja* and diploid related species like S. canasense Hawkes, S. raphanifolium Card. & Hawkes, and others which Ugent (1970a) grouped in one complex species S. brevicaule* Bitt. This weedy species may form a bridge for a gene flow from S. brevicaule s.l. to S. tuberosum* and vice versa (Ugent, 1970a)

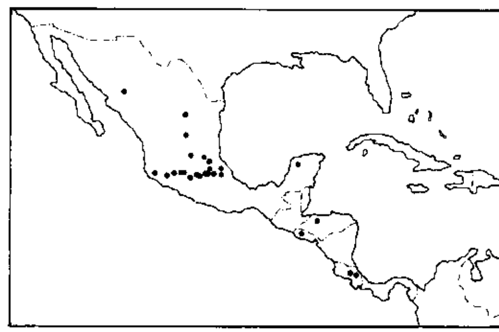
SOLANUM STENOTOMUM see S. tuberosum.

SOLANUM SUCRENSE Hawkes. 2n=48. Bolivia. A weedy potato in potato crops. It is a hybrid of S. tuberosum ssp. andigena and S. oplocense, 2n=48. Source of resistance to several pathotypes of Globodera nematodes (Astley & Hawkes, 1979).

SOLANUM TOPIRO Humbolt & Bonpland ex Dunal. Jibara, Uvilla, Cocona. 2n=24. S. America. Var. topiro is commonly cultivated for its fruits in the Upper Amazon valley. There are two fruit forms: ovoid named jibara and globose called uvilla. The latter has been described as S. alibile R.E. Schultes. A common weed in Ecuador is var. georgicum (R.E. Schultes) Heiser (syn. S. georgicum R.E. Schultes). Var. topiro has no spines and big fruits, while var. georgicum has spines and small fruits. It is believed that these differences are a result of domestication. The greatest variation in size, shape and content of anthocyanins of the fruits is found in the W. Amazon Basin (W. Brazil) (von der Pahlen, 1977). Self and cross compatible.

Artificial intervarietal hybrids have been made. It has been suggested that in nature such hybrids also occur (Heiser, 1971).

SOLANUM TUBEROSUM L. Potato. 2n=24, 48. There are two geographical regions where the largest number of the wild and cultivated potatoes grow; 1. C. Mexico (p. 197, 198) and 2. Andes of C. Peru, Bolivia and NW. Argentina. The greatest number of tuberous Solanum species is found in Peru where the potato was probably first domesticated.
This species is divided into 4 groups:
1. group Stenotomum (syn. S. stenotomum Juz. & Buk.), 2n=24, a cultivated type of very high altitudes from Peru to N. Bolivia. It is the parent of groups Andigena and Phureja, S. x chauca* and S. x juzepczukii*. Some provenances



Solanum tuberosum group Andigena (Ugent, 1968)

are frost-resistant, have a high yield of good quality. If introduced into Europe, its self-incompatibility may have hindered its small-scale propagation at that time (Zeven, 1980a).
2. group Phureja (syn. S. phureja Juz. & Buk.), criollo potato, 2n=24, genome formula A_1A_1, cultivated in most lowlands of Venezuela, Colombia, Ecuador, Peru and N. Bolivia. The tubers are the largest of the diploid species. Dormancy is very short (1-13 days) and may have prevented its introduction into Europe in the 16th Century and later (Zeven, 1980). It matures early. It is a selection of group Stenotomum with a short dormancy.
3. group Andigena (S. tuberosum ssp. andigena, S. andigena Juz. & Buk.), 2n=48, found in the Andes of Venezuela, Colombia, Ecuador, Peru, Bolivia and NW. Argentina. It evolved from group Stenotomum in C. Andes. Parental type of group Tuberosum.
4. group Tuberosum (syn. S. tuberosum ssp. tuberosum, S. tuberosum sensu stricto), derived from group Andigena introduced into the coastal region of S. Central Chile (Island of Chiloe and adjacent coastal mainland) (Brücher, 1971; Glendinning, 1975) and into Europe and N. America (Hawkes, 1958). Naturalized and culti-

vated Tuberosum from Chile and elsewhere have identical cytoplasmic factors (Grun, 1979). The evolution of Andigena into Tuberosum was simulated by Simmonds (1968). The distinction between Andigena and Tuberosum is that Tuberosum has less dissected leaves with wider leaflets, generally arched and set at a wider angle to the stem. The tubers form with long days, or in the tropics with short days only at lower altitudes.

In the Canary Islands, cultivar Negra has been cultivated. It is a triploid (2n=36) (Zubeldia et al., 1955). Sanudo (1970) suggested that it is a hybrid of group Stenotomum and group Andigena. Zubeldia L. et al. (1955) believed that it was introduced from Peru in the early part of the 17th Century together with tetraploid material.

Naturalized potatoes grow in the Kilimandjaro Mountains of Tanzania, in Lesotho and Botswana. They probably derive from cultivars introduced from Europe (Brücher, 1966). He described 30 types.

Andigena is a source of resistance to potato virus Y. Some plants have tubers with a very black flesh, which can be used as a source of pigments.

SOLANUM VIARUM Dunal. (syn. S. khasianum C.B. Clarke var. chatterjeeanum Sen Gupta). 2n=24. S. America. Fruits are source of solanidin. Related species are S. myriacanthum Dunal (syn. S. khasianum C.B. Clarke), 2n=24, naturalized in the Khasia Mountains of Assam; S. retroflexum Schrank, 2n=48; and S. platanifolium Hook., 2n=24, which is rare. S. viarum is naturalized in several places in trop. Asia (Babu & Hepper, 1977). A shrub.

Sterculiaceae

GUAZUMA GRANDIFLORA G. Don. (syn. Theobroma grandiflora Schum.). 2n= . Brazilian Amazon basin. A tree cultivated for its fruits.

THEOBROMA BICOLOR*

THEOBROMA CACAO L. Cacao. 2n=16, 20, 26. Primary gene centre: the area of the 'Upper waters of the Amazon'. Spread by man. Only in Mexico was the domestication of the cacao completed by the Maya. Elsewhere cacao was wild or semidomesticated. Cuatrecasas (1964) described 22 Theobroma species, which all are found in trop. S. and C. America. Relative isolation of cacao populations and their original parentage resulted in the development of two more or less uniform groups distinguished as Criollo (T. cacao ssp. cacao) and Forastero (ssp. sphaerocarpum).

The Criollo is located in C. America (Central American Criollo) and in N. Colombia (South American Criollo). The Forastero can be divided into the Upper Amazonian Forastero, indigenous to the Upper Amazon basin and the lower Amazonian Forastero, also named and found in the Guyanas (Cheesman, 1944; Toxopeus, 1969) and in Africa where it is known as the West African amelonado.

The Trinitario is a recently originated hybrid swarm of Criollo from C. America and Amelonado.

THEOBROMA MICROCARPA Mart. 2n= . Brazil. Cultivated in Bahia.

Thymelaeaceae

FUNIFERA BRASILIENSIS (Raddi) Mansf. 2n= . Brazil. Cultivated in the West Indies for its fibres.

Tropaeolaceae

TROPAEOLUM LEPTOPHYLLUM G. Don. 2n= . Ecuador and Peru. Cultivated for its tubers.

TROPAEOLUM MAJUS L. Nasturtium. 2n=28. S. America. A herbaceous vine cultivated as an ornamental plant. The flower buds and young fruits are used for flavouring vinegar. They are also used as capers.

TROPAEOLUM TUBEROSUM Ruiz & Pav. Tuber nasturtium. 2n=42. A very old cultivated food plant unknown wild in Peru, Chile and Bolivia. In Bolivia it is still cultivated in the mountains above Lake Titicaca.

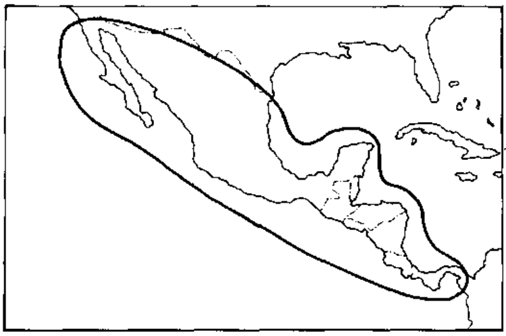
Umbelliferae

ARRACACIA XANTHORRHIZA Bancr. (syn. A. esculenta DC). Arracacha, Apio arracacia. 2n= . Unknown wild. Cultivated mainly in Venezuela and Colombia, also in Bolivia and Peru, and introduced into Brazil, C. America, E. Africa and India.

Verbenaceae

LIPPIA CITRIODORA H.B.K. (syn. L. triphylla (L. 'Hér.) Kuntze). Lemon verbena. 2n=36. S. America. Formerly much cultivated for its verbena oil, now as an ornamental.

11 Central American and Mexican Region



The Central American and Mexican Region has been described by Vavilov as the Central American and South Mexican Centre of Origin. Darlington & Janaki Ammal (1945) named Mexico as a centre of origin, while Darlington (1956) added C. America to Mexico. In this region agriculture developed since the 7th Millenium BC. Harlan (1971) called it centre C1 Mesoamerican centre.

Old farming sites have been discovered at Tamaulipas and in the Tehuacán Valley of Mexico. To the earliest plant remains belong Amaranthus sp., Avocado persica, Capsicum annuum, Cucurbita pepo, C. mixta, Gossypium hirsutum and Lagenaria siceraria.

Relatively a few but important crops have been domesticated in this region e.g. fruit trees, Agave sp., Capsicum sp., Cucurbita sp., Gossypium sp., Ipomoea batatas, Phaseolus sp., Zea mays etc.

Agavaceae

AGAVE AMERICANA L. Century plant, Magvey. 2n= 60, 120, (180, 240 and aneuploids). Mexico. Cultivated in Mexico, Europe, Africa and N. America as an ornamental, foliage plant, a hedge plant and for pulp.

AGAVE ATROVIRENS Salm-Dyck (syn. A. latissima Jacobi). Pulque. 2n=150, 180. Mexico. Extensively cultivated in Mexico. The inflorescence is cut off and the sweet juices that collect in the cavity produced are allowed to ferment to produce the alcoholic drink pulque or mexcal de pulque.

AGAVE CANTALA (Haw.). Roxb. (syn. A. candelabrum Tod.). Cantala. 2n=90. Probably Mexico. There a wild form occurs on the western coast. Smaller than the cultivated types. It was taken to the Philippines and later to Indonesia where it is cultivated for its fibre. In India cultivated as a hedge and anti-erosion plant (Purseglove, 1972).

AGAVE COMPULVIATA Trel. Pulque. 2n= . Mexico. Cultivated around Comitán in Mexico. Comiteca, a fine liquor, is distilled from a mixture of fermented sugar-cane juice and a mash made from the stems and leaves of this species.

AGAVE CRASSISPINA Trel. Maguey manso. 2n= Mexico. Cultivated there.

AGAVE DEWEANA Trel. Zapupe verde, Zapupe de Tantoyuca. 2n= . Cultivated for a long time by the Tantoyuca Indians in Mexico.

AGAVE FOURCROYDES Lem. Henequen agave. 2n=c. 140. Yucatan, Mexico. Primary centre also there. Secondary centre probably in E. Africa (p. 122). Cultivated in many countries for its excellent fibre.

AGAVE HETERACANTHA Zucc. (syn. A. funkiana Koch & Bouche). Ixtle de Juamava. 2n= . Arid NE. Mexico. Cultivated for its fine fibre, used to make cordage and brushes.

AGAVE LECHEGUILLA Torr. Lechuguilla, Tula Istle. 2n= . Texas and N. Mexico. Cultivated for fibre, used to make rugs, mats and brushes.

AGAVE LETONAE F.W. Taylor. Letona, Salvador henequen. El Salvador. Cultivated there for centuries.

AGAVE LOPHANTA Schiede. Lechuguilla. 2n= . Mexico. Cultivated by natives for its fibre.

AGAVE SCHOTTII Engllm. Amole. 2n= . Sonora of Mexico and arid Arizona. Cultivated by Amerindians. Dried pulp of leaves used as soap.

AGAVE SISALANA Perr. (syn. A. rigida Mill.): Sisal agave. 2n=(c. 138, 147, 149), 150. Mexico and C. America. Primary centre in Yucatan, OPUNTIA CRYSTALENIA Griff. 2n= . Mexico. Cultivated there for its edible fruits.

OPUNTIA DILLENIA (Ker-Gawler) Haw. Pest pear. 2n=22, 66. S. USA, Bermuda, West Indies, N. South America. Cultivated there and on Tenerife (Canaries), Italy, W. Africa, India, E. Asia and Australia for its edible fruits. It has often run wild.

OPUNTIA FICUS-INDICA (L.) Miller. Indian fig, Nopal, 2n=22, 88. Probably Mexico (Hammer, 1976). Cultivated in (sub)tropics for its edible fruits, and as a forage and hedge plant.

OPUNTIA FUSICAULIS Griff. 2n= . Not known wild. Thornless species cultivated in Mexico and S. USA as forage.

OPUNTIA HYPTIACANTHA Weber. 2n= . Mexico. Cultivated for its fruits.

OPUNTIA LANCEOLATA (Haw.) Haw. 2n=88. Mexico. Occasionally cultivated in the (sub)trop. Americas for its fruits.

OPUNTIA LEUCOTRICHA DC. 2n=44. Mexico. Cultivated there and around the Mediterranean area for its fruits, and as an ornamental and hedge plant.

OPUNTIA LINDHEIMERI Eng. 2n= . SW. Louisiana, SE. Texas (USA), and NE. Mexico. Cultivated for its fruits and as a forage.

OPUNTIA MAXIMA Mill. 2n= . Probably Mexico. Occasionally cultivated in the (sub)trop. Americas and Asia. Not known wild.

OPUNTIA MEGACANTHA Salm-Dyck (syn. O. castillae Griffith). Tuna, Nopal. 2n= . Mexico. Cultivated there and in Jamaica, S. California and Hawaii. Thornless strains cultivated as forage. Naturalized on Hawaii (Hammer, 1976).

OPUNTIA ROBUSTA Wendl. 2n= . Mexico. Cultivated there for its fruits.

OPUNTIA STREPTACANTHA Lem. 2n= . Mexico. Cultivated there. Var. streptacantha is thorny and is used as an animal deterrant, whereas var. pachona (Griff.) Hammer (syn. O. pachona Griff.) is thornless and is cultivated for its fruits.

OPUNTIA TOMENTOSA Salm-Dyck. 2n=44. Mexico. Cultivated there. Formerly used as feed for cochenilla.

OPUNTIA UNDULATA Griff. 2n= . Mexico. Cultivated there for its edible fruits.

PACHYCEREUS PECTEN-ABORIGINUM (Eng.) Britt. & Rose. 2n= . Mexico. Hedge plant.

PACHYCEREUS PRINGLEI (S. Wats.) Britt. & Rose. 2n= . Mexico. Cultivated as a hedge plant.

PERESKIOPSIS CHAPISTLE (Weber) Britt. & Rose. 2n= . Mexico. Cultivated as a hedge plant.

PERESKIOPSIS SPATHULATA (Otto) Britt. & Rose. 2n= . S. Mexico. Hedge plant.

RITTEROCEREUS PRUINOSUS (Otto) Backeb. 2n= C. and S. Mexico. Cultivated as a hedge plant and for its edible fruits.

SELENICEREUS GRANDIFLORUS (L.) Britt. & Rose (syn. Cereus grandiflorus Mill.). 2n=22. Jamaica, Cuba, Mexico. Cultivated as a source of drug, and widespread as an ornamental.

STENOCEREUS STELLATUS (Pfeiff.) Riccob. 2n= . Mexico. Cultivated for its edible fruits and as a hedge plant.

Caricaceae

CARICA PAPAYA L. Papaya, Pawpaw. 2n=18. Lowlands of C. America somewhere in the region between S. Mexico and Nicaragua. Unknown wild. The history of its domestication is not known. Papaya has now spread to all tropical countries and may have run wild as was observed in the forest fringes in N. trop. Argentina. Closely related to C. pelta Hook. & Arn., which also occurs in this area. This species may have contributed by hybridization (Purseglove, 1968).

Chenopodiaceae

CHENOPODIUM NUTTALLIAE Safford. 2n=allo 4x=36. This self-compatible species is grown as a vegetable (inflorescence) and a grain crop in C. Mexico. It is closely related to C. quinoa* and may derive from it. The weedy C. berlandieri Moq., 2n=36, forms a weed-cultigen complex with C. nuttalliae. C. berlandieri occurs from C. Mexico to W. USA where it is very polymorphic (Wilson, 1976). See for additional information Wilson & Heiser (1979) and Wilson (1981).

Compositae

DAHLIA VARIABILIS Desf. (syn. D. rosea Cav.). Dahlia. 2n=64. Mexico. A tuberous amphiploid of D. pinnata, 2n=32 and D. coccinea Cav., 2n =32, 64. Probably domesticated as a food crop but now grown as an ornamental.

PARTHENIUM ARGENTATUM A. Gray. Guayule. 2n= 36, 54, 72, 108 and many aneuploids. Mexico and Texas, USA. Cultivated as a rubber producer.

TAGETES ERECTA L. Big marigold. 2n=24, genome formula AeAe. Mexico. Cultivated as an ornamental and for its medicinal properties. Also used in religious rituals and celebrations (Neher, 1968). Probably a parent of T. patula*. The genus Tagetes extends from SW. USA into Argentina and the area of the greatest diversity is in S. Central Mexico (Neher, 1968).

TAGETES PATULA L. Marigold, Flor del muerto. 2n=48, genome formula ApApBpBp. Mexico. Probably originated by hybridization of T. erecta* and T. tenuifolia Cav. (2n=24, genome formula BtBt) or closely related species. Cultivated as an ornamental and for its medicinal properties. Spread throughout the world. At one time it was thought to have an Old World origin because of the sacred role in the Hindu religion (Anderson, 1952). However, its role might have been promoted by the sacredness of the yellow colour in India.

Convolvulaceae

IPOMOEA BATATAS (L.) Poir. in Lam. Sweet potato. 2n=6x=90, genome formula BBBBBB. Unknown wild. With long cultivation, mutation and hybridization, sweet potato is very variable and many types have been classed as separate species, like I. tiliacea (Willd.) Choisy and I. triloba L. So descriptions of Ipomoea species before Austin (1977, 1978) should be treated with care. Nishiyama's I. trifida is a feral I. batatas; Nishiyama's K233, Jones' 67.50 both from Mexico and Jones' 71.3 from Colombia and Jones' 73.1 from Ecuador are 4x derivatives of I. batatas x I. trifida* (Austin, 1977).

Sweet potato was already cultivated in Polynesia in pre-Columbian times. Whether it was brought there as tubers by man or reached it as capsules or on drifting material by sea-currents (Purseglove, 1968) is not yet known. Sweet potato is cultivated in many tropical countries.

IPOMOEA PURGA (Wender.) Hayne (syn. Exogonium purga (Wender.) Benth.). Jalap. 2n=24-28. E. Mexico, S. Mexico and C. Panama. Cultivated in Mexico, the West Indies and later India for its medicinal tubers.

IPOMOEA TRIFIDA (H.B.K.). G. Don. 2n=2x=30. Mexico and Caribbean to N. Colombia and Venezuela. Common weed. Many chromosome counts attributed to this species refer to I. batatas*. According to Austin (1977), Nishiyama's I. trifida is a feral I. batatas.

Cucurbitaceae

CUCURBITA FICIFOLIA Bouché. Malabar gourd, Fig-leaf gourd. 2n=40, (42). Highlands of Mexico and America. This species might be a derivative of C. lundelliana* (Whitaker & Davis, 1962).

CUCURBITA MIXTA Pang. Pumpkin, Winter squash, Walnut squash. 2n=40. It probably derives from C. lundelliana Baily in C. America and S. Mexico. It appears that it was widely distributed in N. Mexico and SW. USA in pre-Colombian times (Purseglove, 1968). It is a primitive horticultural crop with little fruit flesh. It crosses with C. moschata* and has been described as belonging to this species. It developed later than C. maxima* and C. pepo*.

CUCURBITA MOSCHATA Duch. Cushaw, China squash, Pumpkin, Winter squash. 2n=(24), 40. From Mexico to Peru. Domesticated in 1800-1400 BC. (Willey, 1962). Cultivated throughout the world. Whitaker & Davis (1962) suggested it to be a derivative of C. lundelliana*.

CUCURBITA PEPO L. Marrow, Zucchini, Pumpkin. 2n=(24, 28), 40, (40-42, 44-46). Whitaker & Davis (1962) suggested that his species is a possible derivative of C. lundelliana Bailey, wild gourd, 2n=40, spreading into N. Mexico and SW. USA. In Texas the related wild C. texana Gray is found. This species is either a weedy offspring of C. pepo or may have been involved in the latter's formation. Whitaker & Cutler (1969) observed one seed in a layer dated c. 8750-7840 BC. in a cave in Mexico.

Var. ovifera (L.) Alef. is cultivated for its ornamental fruits.

CYCLANTHERA PEDATA Schrad. 2n=32. Cultivated in Mexico for its young fruits and shoots.

POLAKOWSKIA TACACCO Pitt. Tacaco. 2n= . Costa Rica. Semi-cultivated for its fruits.

SECHIUM EDULE Schwartz (syn. Chayote edulis Jacq.). Chayote, Guisquil, Christophine. 2n=24. Mountanous America and Mexico. Centre of variation is from Guatemala to Panama. It was a common crop among the Aztecs before Spanish conquest. A perennial vine now grown in subtrop. N. America, Africa and Europe. Insect pollination, resulting in selfing, crossing and vivipary.

Dioscoreaceae

DIOSCOREA FLORIBUNDA Mart. & Gal. 2n=36, 54. S. Mexico and adjacent areas of C. America. Cultivated in America to yield sapogenin (Coursey, 1967).

Ebenaceae

DIOSPYROS EBENASTER Retz. Black sapote, Zapote negro. 2n= . Probably Mexico. Cultivated for its fruits.

Ehretiaceae

CORDIA DODECANDRA DC. Copte, Siricote. 2n= . Mexico. A tall tree cultivated for its fruits.

Elaeocarpaceae

MUNTINGIA CALCABURA L. Panama berry, Capulin. 2n= . Widely cultivated for its sweet edible fruits.

Euphorbiaceae

JATROPHA ACONITIFOLIA Mill. (syn. Cnidoscolus chayamansa McVaugh.). 2n= . A shrub. Cultivated in the Yucatan area, Mexico. Young shoots and leaves are eaten as a pot herb. During domestication, forms with fewer stinging hairs were selected for (Dressler, 1953).

MANIHOT ESCULENTA Crantz. Cassava, Manioc, Manihot, Yucca. 2n=36. Schmidt (1951, cited by Nassar, 1978) stated that cassava was taken by Amer-indians from the N. Amazon to Mexico some 1000 years ago. But Roger (1963) mentioned that cassava could have been domesticated in Mexico too, because there is no reason to exclude domestication of roots in the Mexican seed-type agriculture. If so, one would expect wild ancestral species there.

Cassava is cultivated in W. and S. Mexico, C. America including parts of Guatemala. There are only sweet cultivars in Mexico, where they have been developed and whence they have spread. However sweet types in Brazil could have developed locally. More research is needed.

Gramineae

AXONOPUS COMPRESSUS (Swartz) Beauv. Carpet grass. 2n=40, 50, 60. C. America and the West Indies. A perennial tropical grass suitable for lawns and permanent pasture.

ORYZA ALTA*

ORYZA LATIFOLIA*

ORYZA PERENNIS Moench. 2n=24, genome formula AA. For distribution see p. 74. In America var. cubensis (O. cubensis Ekman), the American race (2n=24, genome formula AA) of this species developed. Gopalakrishnan & Sampat (1966) suggested that O. perennis entered America as a weed of O. sativa in post-Columbian times.

PANICUM SONORUM Beal. Sauwi. 2n= . Sonora of of Mexico and adjacent Arizona. Cultivated by Guarijio Indians as a cereal (Dressler, 1953; Gentry, 1942).

PANICUM VIRGATUM L. Switch grass. 2n=36, 72 and aneuploids. N. and C. America. Cultivated as cattle food.

SETARIA GENICULATA (Lam.) Beauv. 2n=36, 72. An early crop in Tehuacan Valley, Mexico; now replaced by maize and European food crops.

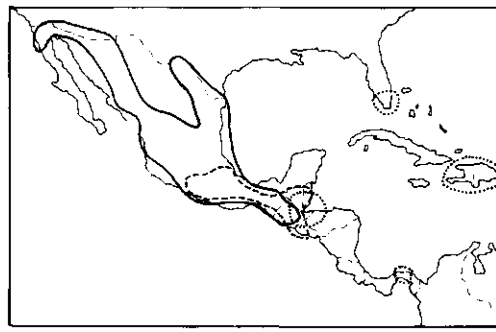
SETARIA MACROSTACHYA HBK. 2n=54, 72. An early crop in Tehuacan Valley, Mexico; now replaced by maize and European food crops.

TRIPSACUM ANDERSONII Gray. Guatemala grass. 2n=64. C. and S. America. This species combines 54 Tripsacum and 10 Zea chromosomes in its genome. It is widely cultivated in trop. America as a fodder, and to indicate property boundaries (de Wet et al., 1976).

TRIPSACUM DACTYLOIDES (L.) L. Gamma grass. 2n=36, 72. C. USA to Paraguay. Excellent cultivated fodder grass, often irrigated. Gene exchange with Zea mays is possible (Randolph, 1970; de Wet & Harlan, 1974).

TRIPSACUM LANCEOLATUM Rupr. ex Fourn. (syn. T. lemmoni Vasey). 2n=72. Mountains of arid S. Arizona and adjacent Sonora. Excellent fodder.

TRIPSACUM LATIFOLIUM Hitchc. 2n=36, 72. C. America. Excellent trop. fodder.



Tripsacum latifolium (···), T. lanceolatum (—) and T. laxum (---)(Randolph, 1970).

TRIPSACUM LAXUM Nash. 2n=36, 72. Veracruz Oaxaca, Mexico. Excellent fodder, for the wet tropics.

TRIPSACUM MAIZAR Hern. & Randolph. 2n=36, 72. C. Mexico. Robust species, widely grazed when young.

TRIPSACUM PILOSUM Scribn. & Merr. 2n=36, 72. C. America. Excellent fodder.

TRIPSACUM ZOPILOTENSE Hern. & Randolph. 2n=72, 76. Arid W. Central Mexico. The only Tripsacum species without rhizomes. Extensively grazed.

ZEA DIPLOPERENNIS Iltis, Doebley & Guzman. Diploid perennial teosinte. 2n=20. Jalisco, Mexico. Crosses with maize to produce fertile hybrids (Iltis et al., 1979).

ZEA LUSURIANS (Durieu & Ascherson) Bird. Guatemala teosinte. 2n=20. Guatemala and Honduras. Crosses readily with maize to produce fertile hybrids.

ZEA MAYS L. ssp. mays. Maize, Corn. 2n=20. The 'origin' of maize has been subject to much discussion and research. The present conclusion is that teosinte (Z. mexicana) is the wild parent of maize (de Wet et al., 1971; de Wet & Harlan, 1972; Galinat, 1971; J.C. Waines, see Galinat, 1971). Other theories were that maize derived from hybridization of primitive maize, teosinte and Tripsacum ssp. when the first reached C. America from S. America. If so wild maize - a podcorn - tunicata Sturt. - should have been extinct by now. This complete disappearance of wild maize would have been caused by a number of factors such as introgression of genes of domesticated maize, the use of the habitats of wild maize for maize cultivation and the grazing of Old World animals.

The earliest finds of maize were tiny cobs (2-3 cm) in the Bat Cave of Tehuacan, Mexico. They have been dated about 3600 BC. Two types have been observed: 1. a podcorn and 2. a popcorn - everata Sturt. (syn. praecox) (MacNeish, 1964; Mangelsdorf et al., 1964). In another cave, early Bat Cave-like maize and teosints have been identified. The material dates from about 2200 BC. Early tripsacoid maize dates from 2300-1500 BC. MacNeish (1964a, b) supposed that about 5000 BC. wild maize i.e. teosinte was cultivated.

From C. America maize reached S. America where its development became more advanced (p. 171). Advanced varieties were returned to C. America. For Mexico they have been described as Pre-Columbian Exotic Races comprising of 4 varieties: Cacahuacinthe, Harinoso de Ocho, Olotón and Maize Dulce (Wellhausen et al., 1952). Where they hybridized with primitive Mexican Ancient Indigenous Races: Palomero Toluqueno, Arrocillo Amarillo, Chapalote and Nal-Tel. This resulted in a new group of varieties called: Prehistoric Mestizos. Introgression with teosinte most likely has taken place too. Wellhausen et al. (1952) described 13 races.

Modern incipient Races have developed since the Conquest. Wellhausen et al. (1952) described four of them. Some being very recently developed. The same development took place in Guatemala (Wellhausen et al., 1957).

From C. America maize also spread to N. America (p. 203).

De Wet et al. (1972) suggested that the 'tripsacoid' races of maize in S. America were originally introduced from Mexico or C. America where they inherited their 'tripsacoid' characteristics through introgression with teosinte. It is also possible that these races represent relics which retain some original teosinte-like characteristics inherited from the maize progenitor.

The oldest domesticated maize varieties had a string (slender) cob. This primitive characteristic is still found in some relic cultivars like Confite Morocho, which is the most primitive living cultivar (Galinat, 1969). It comes from Peru. The domesticated recessive character thick cob is conditioned in the Corn Belt dent by 3 major loci. One allele derives from northern flint which obtained it from Maize de Ocho. It is possible that this allele introgressed from Tripsacum sp. probably T. dactyloides*. Perhaps this introgression could be traced to S. America by way of the cultivars Cabuya and Sabanero (Galinat, 1969). However, de Wet et al. (1972) believed that no introgression exists between maize and Tripsacum species. So cv. Chococena is not a hybrid of cv. Confite (ex Peru) and a Columbian Tripsacum as has been suggested.

The source(s) of other two recessive alleles is not fully understood. One of these alleles produces high condensation of staminate spikelets in the tassel branches and the other increases tassel branching. If the first allele is absent the expression of the second is complete resulting in profuse branching like the mutant ramosa. Some cultivars of the southern dent and 'bear paw' popcorn appear to have this high condensation-ramosa type of thick cob. The degree of fasciation with which this type of thick cob may be asociated seems to have been modified by teosinte introgression, teosinte gene(s) suppressing fasciation. It is suspected that the Corn Belt dents obtained these two pairs of recessive alleles from the southern dents (Galinat, 1969).

Other morphological changes due to domestication are a development of a complete husk coverage of the mature ear, the development of female inflorescense, a reduction of the glumes of the female inflorescense, an arrangement of spikelets in a higher row number, a development of the cupules and an increase of the length of the styles (silk). Some cultivars have an ear length up to 45 cm. Hybrid maize varieties may produce more than 1000 kernels per cob while the Tehuacan maize has about 40 kernels per cob.

The terminal inflorescense becomes entirely staminate being a lax plume with waving branches (Galinat, 1969).

A flow of teosinte genes to maize still exists where maize cultivation is primitive and teosinte is present. Maize x teosinte hybrids are actually cultivated. Maize may show pronounced signs of 'tripsacoid' i.e. teosinte germ plasm such as induration of the lower glume and a straight rigid ear.

Less genes flow from maize to teosinte since the genetic incorporation of a maize-like rachis results in the inability to disperse seed and so to the extinction of teosinte introgressed with maize (Wilkes, 1970). Extensive gene exchange in both directions is evident around Chalco, S. of Mexico City, where the weedy teosinte race mimics the local race of maize in size, colour and pubescence. These weeds remain teosintoid with respect to female inflorescense structure. In many other areas of Mexico, particular the Rio Balsas Valley on the W. escarpment, W. of Mexico City, teosinte behaves essentially as a wild grass, but modern development leads to an increased infiltration of maize genes into teosinte.

Several types of maize are cultivated. An improved popcorn is being cultivated in USA, Mexico and elsewhere. Softcorn - amylacea Sturt. - predominates in the Andean region. Flint maize, flint corn - indurata Sturt. - predominates in N. Colombia and E. S. America. Sweet corn - saccharata Sturt. (syn. rugosa Bonof.) - was cultivated for the preparation of South American and Mexican beer. At present it is mainly cultivated in USA. Waxy maize - ceritina Kulesh. - cultivated in the Americas and in E. Asia. Dent maize - indenta Sturt. is the main type of the Corn Belt of USA and N. Mexico. A hybrid of a late-maturing dent Gourd Slide cultivated in the south, and an early maturing flint maize, mainly cultivated in the north. The latter derives from Maiz Ocho.

From C. and S. America maize was taken to Europe (p. 135), Asia (p. 33) and Africa (p. 117), where secondary centres of diversity developed.

At present flint maize, flint corn - indurata Sturt. - is quite common in C. America.

Derivatives of Z. mays /2* Z. mexicana are used for fodder. These are called maisinte (Prasad & Chaudhuri, 1968).

ZEA MAYS ssp. mexicana (Schrader) Iltis (syn. Z. mexicana (Schrader) Kunze, Euchlaena mexicana Schrader). Mexican teosinte. 2n=20. C. Plateau and Valley of Mexico. MacNeish (1964a, b) suggested that about 5000 BC. wild maize i.e. teosinte was cultivated. It is the ancestor of maize, Zea mays*. Owing to natural hybridization between maize and teosinte there is a gene flow from teosinte to maize, while that

Zea mexicana (Wilkes, 1967).

gene flow from teosinte to maize, while that of maize to teosinte is very small (see p. 190). This may happen between the earliest flowering teosinte plants and the latest of maize. Teosinte plants may grow unnoticed in a maize field and may be harvested together with its leader crop. Seeds may be spread either during the transport or storage of the crop or in manure (Wilkes, 1967). Attempts have been made to cultivate teosinte as a fodder, but it yields less than sorghum. This subspecies is often found as a weed in fields of maize, and introgresses naturally with domesticated maize. See also Z. mays ssp. parviglumis*.

Iridaceae

TRIGIDIA PAVONIA (L.f.) DC. Cacomite, Tiger flower. 2n=26, 28. Mexico. Naturalized in most of C. America, Colombia, Bolivia, Peru and Brazil. Easily cultivated. Soon escapes into maize fields etc. as a weed. The Aztecs cultivated this species for almost a 1000 years. Cultivated now as an ornamental which resulted in spontaneous variations in colour and size (Molseed, 1970).

Juglandaceae

CARYA PECAN (Marsch.) Engl. & Graebn. Pecan. 2n=32. N. Mexico. Cultivated there. It resembles the walnut, Juglans regia* but the seed has a better taste.

JUGLANS MOLLIS Engelm. Guatemala walnut. 2n= . Mexico and Guatemala. Similar to the walnut (J. regia*).

Labiatae

HYPTIS SUAVEOLENS Poit. 2n=28, 32. Cultivated mainly in Mexico. A variable and weedy plant now occurring in many parts of the tropics.

SALVIA CHIA Fern. Chia. 2n= . Mexico. Seeds are used to prepare a beverage and for painting or medicine.

SALVIA DIVINORUM Epling & Jativa-M. 2n= . Wild unknown. Cultivated in NE. Oaxaca, Mexico. Vegetatively propagated (Schultes & Hofmann, 1973). Perhaps one clone. Closely related to S. cyanca Lindl. (2n=) of C. Mexico.

Lauraceae

PERSEA AMERICANA Miller. Avocado. 2n=24, (36, 48). Mexico and C. America. There are three geographical races: (1) Mexican (also named P. americana var. drymifolia Mez. syn. P. drymifolia Cham. & Schlecht.) from the Mexican highlands where wild progenitors have been found. Its anisescented leaves, hardiness and small fruits are characteristics. (2) Guatemalan, from the Guatemalan highlands. Wild progenitors have been found in this area. (3) West Indian, from the Guatemalan lowlands which has only spread to the West Indies in post-Columbian times (Purseglove, 1968). Where these races grow together - either in their native region or elsewhere - hybrids originate (Bergh, 1969). Electrophoretic studies showed that the Guatemalan race is the most ancient form (García & Tsunewaki, 1977). The Mexican and West Indian races have been described as var. americanum.

PERSEA FLOCCOSA. 2n=24. Semi-cultivated in Puebla-Veracruz area of Mexico.

PERSEA SCHIEDEANA Ness. Coyo avocado. 2n=24. From Guatemala to Mexico. Semi-cultivated chiefly in Orizaba, Mexico for its edible fruits (Bergh, 1969).

Leguminosae

CALOPOGONIUM MUCUNOIDES Desv. 2n= . Trop. America. A cover crop and green manure. Cultivated in the tropics where it has naturalized.

CANAVALIA CAMYLOCARPA Piper. Babricon bean.

2n= . The West Indies. Cultivated as a green manure.

CROTALARIA LONGIROSTRATA Hook. & Arn. Much of Mexico and C. America (Dressler, 1953). A large herb cultivated in Guatemala as a potherb.

DESMODIUM TORTUOSUM (Sw.) DC. (syn. Meibomia purpurea (Mill.) Vail.). Florida clover, Giant beggarsweed. 2n=22. C. America, Florida, West Indies and N. South America. A perennial herb used as a green manure and forage crop.

DESMODIUM UNCINATUM*

ENTEROLOBIUM CYCLOCARPUM (Jacq.) Griseb. 2n=26. Mexico, C. America, N. South America and West Indies. Cultivated as a shade tree.

INGA DULCIS. 2n= . Mexico. Used as a shade tree and hedge plant.

INGA EDULIS Mart. Food inga. 2n=26. Mexico and C. America. Used as a shade tree.

INGA GOLDMANII Pittier. 2n= . C. America. Used as a shade tree.

INGA LAURINA (Sw.) Willd. Sackysac. 2n= . C. America and the West Indies. It has edible fruits. Used as a shade tree in coffee plantations in the New World (Purseglove, 1968).

INGA LEPTOLOBA Schlecht. 2n= . Mexico, C. and S. America. Used as a shade tree.

INGA PITTIERI Micheli. 2n= . C. America. Used as a shade tree.

LEUCAENA LEUCOCEPHALA (Lam.) de Wit (syn. L. glauca (Willd.) Benth., L. latisiliqua (L.) Gillis. Leucaena. 2n=104. C. America, spread to the Caribbean islands, the Philippines, SE. Asia and elsewhere. Var. glabrata is L. glabrata Rose.

Three types are recognized: (1) Hawaiian type, a short bush with year round flowering causing a high seed production and easily becoming a pest weed. (2) Salvador type, a tall tree of the inland forests of C. America. Mexican material coming through the Philippines to Hawaii was the source of the Hawaiian Giants cultivar group bred for timber. (3) Peru type, an extensively branching tree extremely rich in foliage. Forage cultivars derive from this type; forage cultivar Cunningham is a hybrid of Salvador type and Peru type. Cultivars poor in mimosin are bred for.

Leucaena is autogamous. Since 1900 hybrids (2n=80) of L. leucocephala and L. pulverulenta (Schlecht.) Benth., 2n=56, have developed in Indonesia and shade trees and forage cultivars low in mimosin. They are partially sterile and cannot become a pest weed (Vietmeyer & Cottons. (1977).

MACROPTILUM ATROPURPUREUM (DC) Urb. (syn. Phaseolus atropurpureus DC). Siratro. 2n=22. S. Texas, New Mexico (USA), Mexico, C. America, Colombia, Ecuador, Peru and Argentina. Material from Mexico has recently been domesticated in Australia for tropical pasture.

MIMOSA INVISA Mart. 2n=24, 26. C. and S. America. In Java and elsewhere it is used as a cover and green manure. The spiny stem is a disadvantage. Var. inermis Adelb. is a useful selection.

PACHYRHIZUS EROSUS (L.) Urban. (syn. P. angulatus Rich. ex DC., P. bulbosus (L.) Kurz.). Yam bean, Jicama. 2n=22. Mexico and N. Central America. Cultivated there in pre-Columbian times. Taken to Asia and cultivated there. In S. China and Thailand it has run wild (Clausen, 1944). Var. palmatilobus (DC.) Clausen is probably P. palmatilobus Benth. & Hook.

PHASEOLUS ACUTIFOLIUS Gray. Tepary bean. 2n=2x=22. From N. Central Arizona (USA) to Guatemala. Found in Mexico in layers dating from 3000 BC. A very polymorphic species with drought resistance, high protein content and high productivity. Wild specimens are annuals with indeterminate climbing habit and cleistogamous flowers. They belong to var. tenuifolius Gray; cultivated types belong to var. latifolius Freeman (Baudet, 1977b). However Nabham & Felger (1978) stated that some wild types belong to the latter variety.

PHASEOLUS COCCINEUS L. Scarlet Runner, Runner bean. 2n=22. Mexico and Guatemala. Domesticated there before 300 BC., perhaps for its thick roots. The cultivated form is var. coccineus, the wild form has not yet been described. Cultivated in the Americas and Eurasia for food, for fodder and as an ornamental. For Ph. vulgaris* it is a source of halo blight resistance, absence of parchment and string. Smartt (1973) suggested that the cultigen ssp. darwinianus Hdz. X. & Miranda C. may have an independent domestication of a yet unknown ancestral form. He stated that a special taxonomic treatment may be necessary. Baudet (1977b) suggested that this subspecies is also described as Ph. polyanthus Greenm. but Smartt (1973) stated that this latter species is related to Ph. vulgaris*. It sometimes crosses with Ph. vulgaris*.

PHASEOLUS LUNATUS L. Sieva bean, Lima bean. 2n=22. C. America and in the Andes from Peru to Argentine. Kaplan (1965) showed that the small lima bean of Mexico may have arisen in the Pacific coastal foothills of Mexico and that the big lima bean of Peru was first domesticated in the Andean highlands (p. 174).

Baudet (1977a) divided the species into a wild form var. silvester Baudet and the cultivated form var. lunatus, which is subdivided into three cultivar groups: (1) Lima (Big Lima/True Lima) with large flat seeds corresponding to Ph. inamoenus L.; (2) Sieva (Small Lima) with medium-sized seeds corresponding to Ph. lunatus

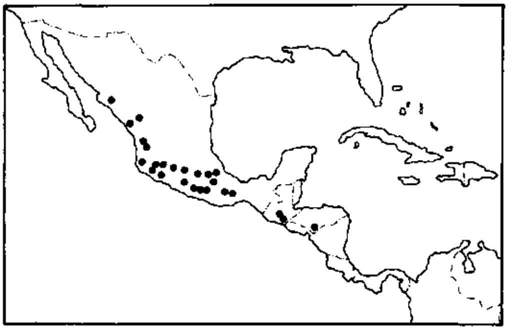
L. sensu stricto; and (3) Potato with small globular seeds corresponding to Ph. bipunctatus Jacq.

PHASEOLUS RETUSUS Benth. Metcalf bean. 2n= . Texas, Arizona and New Mexico, USA. Occasionally cultivated.

PHASEOLUS VULGARIS L. Common bean. 2n=22. Kaplan (1981) suggested a multiple domestication within C. America from a widespread and polymorphus species. It has been suggested that this domestication may have taken place between 5000 and 3000 BC. From C. America it would have spread to other parts of America (Kaplan, 1965). However, Heiser (1965) believed in an independent domestication from the closely related Ph. aborigineus Burk. (syn. Ph. vulgaris L. var. aborigineus (Burk.) Baudet), 2n=22, which occurs wild in N. Argentina, Bolivia, Peru, Ecuador, Colombia and Venezuela. In Argentina and Venezuela, the wild plant is harvested (Berglund-Brücher & Brücher, 1976). When Ph. vulgaris reached the area of Ph. aborigineus, aborigineus genes may have introgressed into vulgaris. However, Gentry (1969) and Baudet (1977b) suggested that Ph. aborigineus could be a naturalized type.

Gentry (1969) pointed out that a wild type of Ph. vulgaris grows in C. America and is the parent of the cultivated forms. From this wild type the cultivated forms derive.

Ph. arborigineus was reduced by Burkart & Bücher (1953) to a subspecies level of Ph. vulgaris. They suggested that this subspecies was not taken to S. America. A study of the wild and cultivated beans of this area should clarify whether this is so or whether ssp. arborigineus is an escape of early cultivated forms (Gentry, 1969). Its primary centre of diversity is in Mexico. Here introgression between cultivated and wild Ph. vulgaris and P. coccineus* occurs (Wall, 1970). The purple-marbled cultivars like Kievitsboon in the Netherlands may derive from such introgression. Secondary centres in Eurasia (p. 40).



Phaseolus vulgaris (Gentry, 1969).

PITHECELLOBIUM DULCE Benth. Manila tamarind. 2n=26. Mexico to N. South America. The arillus is edible. A tree planted in hedges.

SOPHORA SECUNDIFLORA (Ort.) Lagasca ex De Candolle. Mescal bean, Red bean, Coral bean. 2n= 18. N. Mexico to Texas and New Mexico. Used as hallucinogen. Often planted as an ornamental.

TEPHROSIA SINGAPOU (Buc'hoz) A. Cheval. (syn. T. toxicaria (Sw.) Pers.) 2n=22. Mexico and C. America to Peru and N. Brazil. Cultivated as a fish poison.

Malpighiaceae

BUNCHOSIA COSTARICENSIS Rose. 2n= . Costa Rica. Cultivated for its fruits.

MALPIGHIA URENS L. Barbados cherry. 2n= . The West Indies. Cultivated for its fruits.

Malvaceae

GOSSYPIUM ARIDUM (Rose & Standley) Skovsted. 2n=26, genome formula D_4D_4. Mexico.

GOSSYPIUM ARMOURIANUM Kearney. 2n=26, genome formula $D_{2-1}D_{2-1}$. San Marcos Islands, Gulf of California.

GOSSYPIUM GOSSYPIOIDES (Ulb.) Standley. 2n=26, genome formula D_6D_6. Mexico. It crosses poorly with most of the species of the D genome. Its seed-protein pattern is different from the D genome species. However, it is similar to the pattern of G. klotzschianum* (Cherry et al., 1970).

GOSSYPIUM HARKNESSII Brandg. 2n=26, genome formula $D_{2-2}D_{2-2}$. The islands and coasts of the Gulf of California. Var. davidsonii is, according to Bahavandoss & Jayaraman (1973), the progenitor of the D genome found in 4x species.

GOSSYPIUM HIRSUTUM L. Upland cotton. 2n=52, genome formula (AADD). The current theory is that this species originated in C. America. Harland (1970) suggested that its centre of origin is in S. America (p. 176), while C. America is an important secondary centre of diversity. Upland cotton is cultivated in USA, in Africa except for the Nile Delta (p. 176), in C. Asia, India (Cambodia type, p. 59), S. America, SE. China, Indochina and elsewhere. In C. America and the West Indian islands race marie galante is found while race punctatum is found around the coasts of the Gulf of Mexico from Florida to Yucatan in the Bahamas and on some West Indian islands. It was taken to W. Africa where it spread in the zone south of the Sahara, to Réunion, the Malabar Coast of India, Polynesia, the Marquesas, Fiji and N. Australia. A great diversity was found in N. Australia.

Race yucatense is probably a cotton that has run wild and is now naturalized into natural vegetation of the coastal sand dunes of the

Progeso area, Mexico.

Race morilli is found in Oaxaca, Peubla and Morelos, C. Mexico. A perennial cotton with a bushy form and broad, intensely hairy leaves.

Race palmeri in the state Guerrero, Mexico. It has deeply dissected leaves and strong anthocyanin pigmentation.

Race latifolium is found in Chiapas, Mexico and neighbouring regions of Guatemala. An annual cotton. Throughout its territory a small-fruited form is found. A large-fruited form grows in the vicinity of Acala, Chiapas. This race appears to be the foundation stock of all the annual G. hirsutum cottons (Hutchinson, 1962).

GOSSYPIUM KLOTZSCHIANUM Andersson var. davidsonii (Kellogs) Saunders. 2n=26, genome formula $D_{3-D}D_{3-D}$. Shores of the Gulf of California and the Revilla Gigedo islands. Related to the plants of this species found on the Galapagos Islands (p. 176).

GOSSYPIUM LOBATUM Gentry. 2n=26, genome formula D_7D_7. Mexico.

GOSSYPIUM THURBERI Todaro. 2n=26, genome formula D_1D_1. Arizona, USA and Sonora and SW. Chihuahua, Mexico. At one time it was thought to be the American parent of G. herbaceum* and G. barbadense*.

GOSSYPIUM TRILOBUM (Sess. & Moc. ex DC.) Skovsted. (syn. Ingenhouzia triloba Moc. & Sess. ex DC.). 2n=26. C. Mexico (Fryxell & Parks, 1967).

Moraceae

BROSIMUM ALICASTRUM Swartz. Ramon, Ramon breadnut tree. 2n=26. Trop. America. Seeds are edible when roasted. Probably planted by the Maya (Lundell, 1937).

CASTILLA ELASTICA Cerv. Arbol del Hule. 2n=28. S. Mexico and C. America. Cultivated in C. America, Trinidad and Tobago, and Java at the end of the 19th Century. Now replaced by hevea rubber.

Myrtaceae

PIMENTA DIOICA (L.) Merr. (syn. P. officinalis Lindl.). Allspice, Pimento. 2n=22. The West Indies and C. America. Spread to other countries.

PSIDIUM FRIEDRICHSTHALIANUM (Berg.) Nied. Costa Rican guava. 2n= . C. America. A small tree cultivated for its acid fruits.

PSIDIUM GUAJAVA L. Guava. 2n=22, 4x=44. Trop. America. Cultivated there. In 1526 Oviedo reported that improved forms were cultivated in the West Indies. Spread through the tropics, where guava may be found naturalized.

PSIDIUM MOLLE Bertol. Guisare. 2n=5x=55. S. Mexico and C. America. Cultivated for its fruits.

PSIDIUM SARTORIANUM (Berg.) Nied. Pichiché, Arrayan, Guayabillo. 2n= . Mexico. Cultivated there.

Onagraceae

OENOTHERA BIENNIS L. (syn. Onagra biennis Scop.). Evening primrose. 2n=14. N. America to Mexico. Run wild over a large part of the world. Cultivated as a fodder crop.

Orchidaceae

VANILLA FRAGRANS (Salisb.) Ames. (syn. V. planifolia Andrews). Vanilla. 2n=(28-32), 32. C. America, SE. Mexico and the Antilles. A perennial vine cultivated in the tropics and S. Mexico for its aromatic fruits.

VANILLA POMPONA Schiede (syn. V. grandiflora Lindl.). West Indian vanilla. 2n=32. SE. Mexico, C. America and N. South America. A perennial vine on Tahiti, Martinique and Guadeloupe for its aromatic fruits.

Palmae

CHAMAEDOREA TEPEJILOTE Liebm. 2n=32. Ch. wendlandiana (Oerst.) Hemsl. 2n= . At least one, and probably several, species of this genus are cultivated in S. Mexico and C. America. The young staminate flower clusters are used as a vegetable (Dressler, 1953).

GUILIELMA GASIPAES*

Papaveraceae

ARGEMONE MEXICANA L. Mexican prickly poppy. 2n=28. SW. USA and Mexico. Cultivated in Mali. Seeds are used to prepare oil. Also an ornamental.

Passifloraceae

PASSIFLORA SEEMANNII Griseb. 2n=18. Panama and Andes of Colombia.

Polygonaceae

COCCOLOBA UNIFERA L. Seaside grape. 2n= . Trop. America. A shrub or tree cultivated for its edible fruits.

RUMES HYMENOSEPALUS Torr. Canaigre, Wild rhubarb, Pie dock, Sour dock, Tanner's dock. 2n=100. SW. USA and adjacent Mexico. A perennial herb occasionally cultivated.

Portulacaceae

CLAYTONIA PERFOLIATA Donn. ex Willd. (syn. Montia perfoliata How.). Winter purslane, Miner's lettuce. 2n=36. N. America and Mexico. Cultivated as a vegetable.

PORTULACA OLERACEA L. Purslane. 2n=2x=18, 4x=36, 6x=54. Widespread. The distribution of the 2x, 4x and 6x wild and weedy subspecies shows that Mexico is one of the centres of diversity (Danin et al., 1978). The cultivated type probably developed in Europe (p. 158).

Rosaceae

CRATAEGUS PUBESCENS (H.B.K.) Steud. (syn. C. stipulosa (H.B.K.) Steud.). 2n=34. A tree widely cultivated in Mexico and Guatemala for its fruits.

Rutaceae

CASIMIROA EDULIS La Llave & Lex. White sapote, Zapote Blanco. 2n=36. Highlands of Mexico and C. America. A fruit tree introduced to other subtropical countries.

CITRUS PARADISI Macf. Grapefruit. 2n=18. Unknown wild. Closely related to C. grandis and it probably is a bud mutation or a hybrid product of C. grandis and sweet orange (C. sinensis*). This must have occurred in the West Indies some time before 1750 (Purseglove, 1968). It is widely cultivated in the (sub)tropics.

Hybrids with other Citrus-species have been obtained, Sopomaldin is a hybrid with C. mitis (Calamondin), Siamelo with C. reticulata* (King Orange), Tangelo with the same species var. deliciosa (Tangerine), Satsumelo with the same species (Satsuma) and Chironja with C. sinensis* (Sweet Orange). Tangelolo is a hybrid of grapefruit with Tangelo.

Sapotaceae

CALOCARPUM SAPOTA (Jacq.) Merr. (syn. C. mammosum Pierre, Achras mammosa L.). Mamey sapote, Sapote, Marmelade plum, Mamey colorado. 2n= . C. America. A tree cultivated in the tropics for its fruits.

CALOCARPUM VIRIDE Pitt. Green sapote. 2n= . Guatemala to Costa Rica. A tree cultivated for its fruits.

CHRYSOPHYLLIUM CAINITO L. Star apple. 2n=52. West Indies and C. America. The pulp is edible. Also an ornamental.

LUCUMA BIFERA Mol. Egg fruit. 2n= . Chile and Peru. Cultivated there for its fruits.

LUCUMA SALICIFOLIA H.B.K. (syn. Pouteria campechiana (H.B.K.) Baenhi). Yellow sapote, Zapote amarillo. 2n= . Mexico and C. America. Cultivated for its fruits.

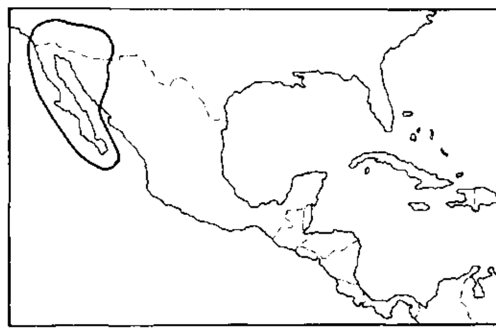
MANILKARA ACHRAS (Mill.) Fosberg (syn. Achras zapota L., M. zapotilla (Jacq.) Gilly). Sapodilla, Chiku. 2n=26. Mexico and C. America. Cultivated now in the tropics for its fruits and gum (chickle) for chewing-gum production.

Simaroubaceae

SIMAROUBA GLAUCA DC. Aceituno. 2n= . S. Florida to Costa Rica. In El Salvador and elsewhere attempts are made to cultivate it as an oil crop.

Simmondsiaceae

SIMMONDSIA CHINENSIS (Link) Nutt. (syn. S. californica Nutt). Jojoba, Pignut, Goatnut. 2n=56, c. 100. California and adjacent Mexico. Dioecious. It is now being domesticated in California. It yields a stable liquid wax, jojoba oil.



Simmondsia chinensis (Gentry, 1958).

Solanaceae

CAPSICUM ANNUUM L. Bell pepper, Cayenne pepper, Mexican chili. 2n=24. Wild variety in S. USA, West Indies, Mexico, C. America and Colombia. Primary centre in Mexico. Secondary centres in Europe (p. 162) and Asia (p. 79). Originally the cultivars were limited to C. America. The wild type is the bird pepper, var. aviculare (Dierbach) D'Arcy & Eshb. (syn. glabriusculum (Dunal) Heiser & Pickersgill). The domesticated type is var. annuum.

CAPSICUM FRUTESCENS L. Tobasco pepper. 2n=24. This species consists of wild types and derived cultivars, like the Tobasco peppers. Widespread as a weed and as cultivars in Mexico, C. America and lowland S. America. It might be the parental species of C. chinense*.

PHYSALIS IXOCARPA Brot. Tomatl, Miltomate, Husk tomato, Tomatillo. 2n=24. Mexico. There and in Guatemala this vegetable is cultivated.

SOLANUM AGRIMONIFOLIUM Rydb. 2n=48. From C. Mexico to Bolivia.

SOLANUM BRACHISTOTRICHUM (Bitt.) Rydb. 2n=24. NW. Mexico, in open pine and juniper forests and amongst bushes and rocks. Resistant to the green peach aphid, Myrus persicae Sulzer.

SOLANUM BREVICAULE Bitt. 2n=24. Ugent (1970a) grouped in this species wild diploid species as S. canasense Hawkes, S. brevicaule Bitt. s.s., S. raphanifolium Card. & Hawkes, S. leptophyes Bitt., S. soukupii Hawkes, S. multi-interruptum Bitt., S. abbottianum Juz., S. liriunianum Card. & Hawkes, S. spegazzinii Bitt. and S. vidaurrei Cárdenas. It is likely that from this complex species the diploid S. stenotomum* arose.

SOLANUM BULBOCASTANUM Dun. 2n=24, genome formula BB, (36, BBB). At medium altitudes from C. Mexico to Guatemala in grassland, waste places and forest glades and clearings. There are three subspecies (Hawkes, 1966):

Ssp. Bulbocastanum (2n=24, 36) is found in S. Mexico, ssp. dolichophyllum (2n=24) in the Mexican states Morelos and Guerrero and ssp. partitum (2n=24) in S. Mexico and Guatemala.

This B genome also constitutes two of the genomes of S. polytrichon* A_4A_4BB. The B genome is related to the A_4 genome and to the A_1 genome of S. phureja*. S. bulbocastanum crosses with S. tuberosum* and is used as a source of resistance to Phytophthora, X-virus, Y-virus, Colorado beetle and several aphids (vectors of virus diseases).

SOLANUM CARDIOPHYLLUM Lindl. 2n=24, 36. S. Mexico. In dry stony grassy and waste places, often as a weed in maize and bean fields. Ssp. ehrenbergii is found in N. Central to W. Mexico, ssp. cardiophyllum occurs in C. Mexico and ssp. lanceolatum in SE. to S. Mexico. Triploid forms are frequent in ssp. cardiophyllum. Ssp. ehrenbergii is one parent of S. sambucinum*.

SOLANUM CLARUM Corr. 2n=24. Guatemala, in the high mountains. Probably a link between Bulbocastana and Morelliformia series.

SOLANUM DEMISSUM Lindl. 2n=(36, 48), 72, genome formula $A_1A_1A_4A_4BB$. Nw. Mexico to Guatemala. An important source of disease resistance (Phytophthora, X-virus, Y-virus). The A_1-genome may have come from S. verrucosum*. One of the parental species of S. x edinense* and S. X semidemissum.

SOLANUM X EDINENSE Berthault. Mexican weed potato, Papa morado. 2n=60. Clones occur in and along the edges of cultivated field, irrigation ditches, roadsides thickets and forest fringes in the Central Volcani Cordillera of Mexico between 2000 and 3500 m. A source of Phytophthora and frost resistance. This 5x hybrid is a cross between S. tuberosum (group Andigena, 2n=4x=48) and S. demissum Lindl. (2n=6x=72) (Hawkes, 1966). S. demissum genes may introgress in the cultivated potato by backcrossing. Harvest of potato may contain tubers of S. X edinense and by trading the potato this weedy potato is also spread (Ugent, 1967).

SOLANUM GUERREROENSE Correll. 2n=72, genome formula $A_1A_1A_4A_4BB$. SW. Mexico. The A_1 genome may have come from S. verrucosum*.

SOLANUM HJERTINGII Hawk. 2n= . NE. Mexico, in pinon scrub and cultivated fields. Very similar to S. fendleri*. A source of resistance to the potato aphid, Macrosiphum euphorbiae Thomas.

SOLANUM HOUGASII Corr. 2n=72, genome formula $A_1A_1A_4A_4BB$. W. Central Mexico. The A_1 genome may have come from S. verrucosum*. Source of resistance to potato Y-virus.

SOLANUM IOPETALUM (Bitt.) Hawk. 2n=72, genome formula $A_1A_1A_4A_4BB$. W. and S. Mexico. It includes S. brachycarpum Corr. The A_1 genome may have come from S. verrucosum*.

SOLANUM JUGLANDIFOLIUM Dunn. 2n=24. Costa Rica. Little value to potato breeders because it does not bear stolons or tubers.

SOLANUM LEPTOSEPALUM Correll. 2n= . NE. Mexico and possibly in USA.

SOLANUM LESTERI Hawkes & Hjerting. 2n=24. Oaxaca, Mexico.

SOLANUM MICHOACANUM (Bitt.) Rydb. (syn. S. trifida Corr.). 2n=24. Michoacan and Jalisco, Mexico. In the pine forests and fields. Resistant to the green peach aphid, Myrus persicae Sulzer.

SOLANUM MORELLIFORME Bitt. & Muench. 2n=24. C. Mexico, southwards to Guatemala.

SOLANUM OXYCARPUM Schiede. 2n=48. E. Central Mexico, Honduras, Costa Rica and adjacent Panama.

SOLANUM PAPITA Rydb. 2n= . Similar to S. fendleri*.

SOLANUM PINNATISECTUM Dun. 2n=24. N. Central Mexico. A maize field weed. A source of resistance to Phytophthora, Y-virus and Colorado beetle. A parent of S. sambucinum*.

SOLANUM POLYADENIUM Greenm. 2n=24. C. Mexico. A source of Phytophthora resistance and, owing to its glandular hairs, of resistance to tarsonemid mite (Polyphago tarsonemus latus Banks).

SOLANUM POLYTRICHON Rydb. 2n=48, genome formula A_4A_4BB. NW. to N. Central Mexico. In waste places, shrubland and cultivated fields. Its genomes are related and also to the A_1 genome of S. phureja*. S. bulbocastanum* has the genome formula BB. S. polytrichon is used as a source or resistance to Phytophthora and potato aphid.

SOLANUM X SAMBUCINUM Rydb. 2n=24. In maize fields in N. Central Mexico. A natural hybrid of S. pinnatisectum* x S. cardiophyllum* ssp. ehrenbergii* (2n=24) and S. pinnatisectum* (2n=24) (Hawkes, 1966).

ATRIPLEX CANESCENS (Pursh.) Nutt. American shad scale, Hoary saltbush, Wing scale, Four-wing saltbush. 2n= . W. North America up to Mexico. Cultivated as a fodder plant on saline soils and as a hedge plant (Mansfeld, 1959). A. gardnesi (Moq.) Standl. (2n=) is from the same area and A. truncata (Torr.) A. Gray (2n=) is from Utah, USA.

CHENOPODIUM NUTTALLIAE Safford. 2n=4x=36. This species is named now Ch. berlandieri Moq. ssp. nuttalliae (Safford) Wilson & Heiser. It is cultivated in the highlands of C. Mexico and Arkansas and Missouri (USA). The weedy Ch. bushianum Aellen of E. North America is closely related (Wilson & Heiser, 1979; Wilson, 1981).

Compositae

HELIANTHUS ANNUUS L. Sunflower. 2n=14, genome formula Ba_1Ba_1. N. America. It is difficult to be more specific because of its spread as a food plant and weed. The wild type may have resembled ssp. jaegeri, a small-headed type found in SW. Utah and NE. Arizona to S. California in USA. In new areas the sunflower has introgressed with related species so that the morphological variation has increased. An important species is H. bolanderi A. Gray (2n=34) of C. and N. California. It may derive from crosses of H. annuus with H. exilus Gray, 2n= . Other species H. agrophyllus Torr. & A. Gray (2n=34) of Texas, H. debilis Nutt. ssp. cucumerifolius (2n=34) of Texas and H. petiolaris Nutt. (2n=34) of W. of N. America have also hybridized with the sunflower.

Various subspecies and varieties are recognized: ssp. lenticularis (Dougl.) Ckll, which is near to the original wild type and is found from W. Canada to N. Mexico. Ssp. texanus grows mainly in Texas. It may have arisen by hybridization of ssp. lenticularis and H. debilis.

Ssp. annuus L. is a ruderal weed, a weed sunflower, found in the settlements in the Midwest. It possibly derives from ssp. lenticularis. Var. macrocarpus (DC.) Ckll is probably the parental form of the cultivated types. It grows in NE. USA and Canada. It probably originated from ssp. annuus or this subspecies and var. macrocarpus developed together from ssp. lenticularis.

A weedy sunflower may have reached the Middle West where no other annual Helianthus species are found. Here the giant, large-headed sunflower may have developed (Heiser, 1955, 1965).

From N. America the sunflower was introduced into Europe where in USSR a secondary centre of diversity arose (p. 130).

HELIANTHUS EXILIS A. Gray. Serpentine sunflower. 2n= . Moist serpentine soils of Inner Coastal Range in California, USA. Almost extinct. H. bolanderi A. Gray, 2n=34, resulted from introgression of H. exilis genes into H. annuus* (Jain et al., 1977). Cold-tolerant.

HELIANTHUS TUBEROSUS L. Jerusalem artichoke. 2n=102, genome formula $At_1At_1At_2At_2Bt_1Bt_1$. N. America. Run wild in S. Ukraine and N. Caucasus. A perennial species introduced to Mexico and Eurasia.

The Bt_1 genome is related to the Ba_1 genome of H. annuus*. H. tuberosus is probably an amphiploid of a species with genome formula $At_1At_1At_2At_2$ and a B genome donor. This might be H. annuus or else a closely related species.

H. x laetiflorus Pers. (2n=102), a wild perennial species of USA is probably a hybrid of H. subrhomboidus Rydb. (2n=102) and H. tuberosus. The first parent is also native to USA (Clevenger & Heiser, 1963).

IVA ANNUA L. (syn. I. ciliata Willd.). Sump weed, Marsh elder. 3n=34. A large-'seeded' type (var. macrocarpa) is an extinct oil-crop cultivated from the early 1st Millenium BC. to the first half of the 2nd Millenium AD. (Yarnell, 1972).

STOKESIA LAEVIS (Hill) Green. Stokes aster. 2n= . A perennial native to Georgia, Florida, Alabama, Mississippi and Louisiana (USA), grown as an ornamental. A possible oil-crop?

Cucurbitaceae

CUCURBITA FOETIDISSIMA HBK. Feral buffala gourd, Fetid gourd, Missouri gourd, Calabazilla. 2n= . Will probably be domesticated (Bemis et al., 1978).

Cupressaceae

JUNIPERUS VIRGINIANA L. Eastern red cedar. 2n = . E. North America. Much variation is due to introgressive hybridization with other Juniperus species (Hemmerly, 1970).

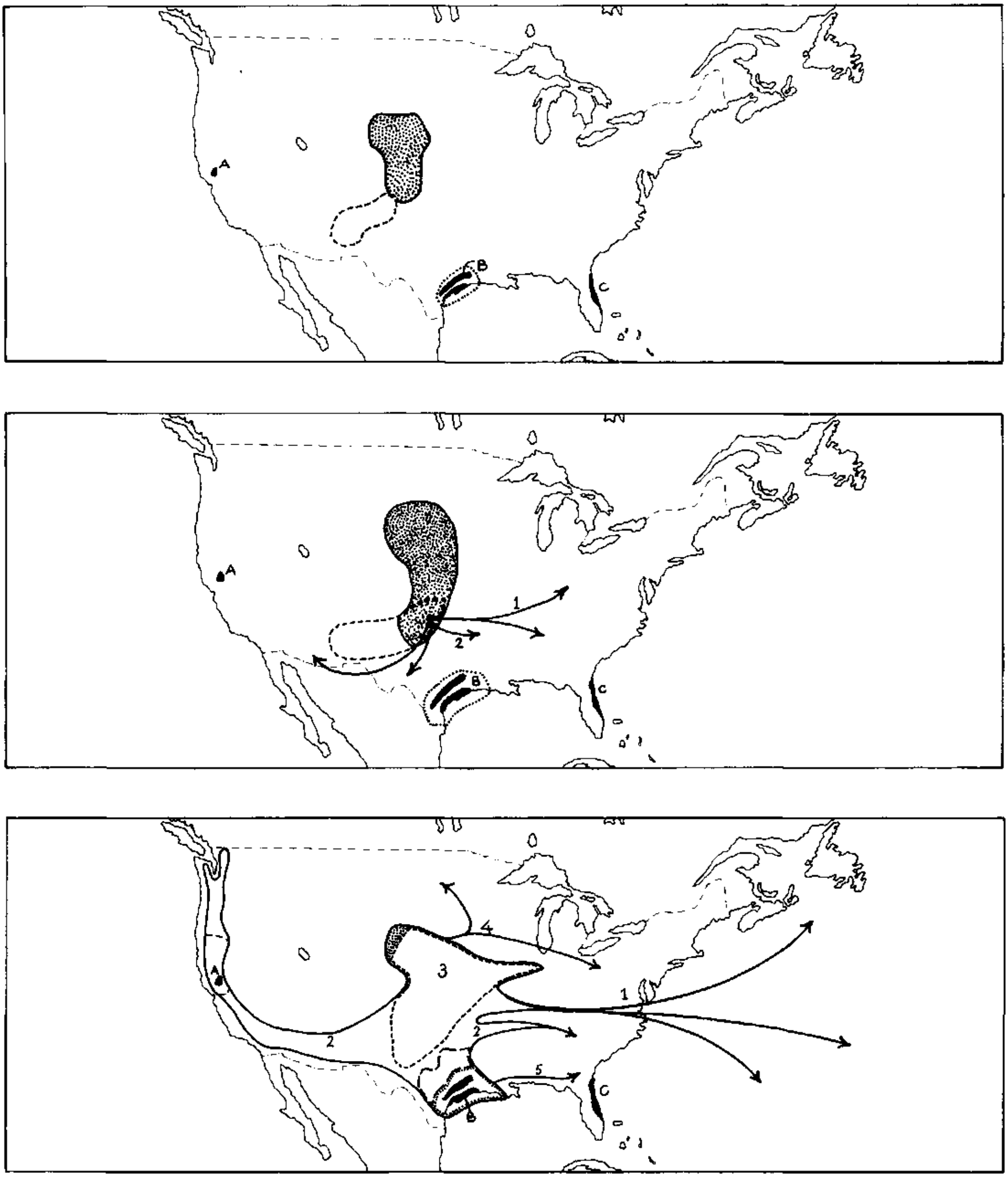
Ebenaceae

DIOSPYROS VIRGINIANA L. Common persimmon. 2n= . E. North America. Cultivated for its fruits. Also used as a rootstock of D. kaki*.

Ericaceae

VACCINIUM ASHEI Reade. Rabbiteye. 2n=72. N. America. Cultivated there. Wild plants are also harvested. According to Camp (1945) the wild types derive from hybridization of the tetraploid species V. arkansanum, V. australe Small, Southeastern highbush blueberry, V. darrowi-4x and V. myrsinites Lam., Ground blueberry.

VACCINIUM CORYMBOSUM L. Highbush berry. 2n=72. N. America. Cultivars have developed from the wild type which arose from hybridization of the tetraploid species V. lamarckii Camp (syn. V. angustifolium Ait.), V. alto-montanum Asche, V. simulatum and V. australe Small, Southeastern highbush blueberry.



Distribution of Helianthus spp. in pre-human (above), pre-columbian (middle) and modern(below) times. (H. annuus (---), H. petiolaris (speckled), H. exilis (A), H. argophyllus (B), H. debilis var. cucumerifolius (···), H. debilis var. debilis (C), H. bolanderi (——), cultivated sunflower (1), campflower (2), Great plains annuus (3), weed petiolaris (4) and weed cucumerifolius(5) (Anderson, 1956; based on Heiser's research).

crop and green manure.

ROBINIA HISPIDA L. 2n=30. SE. North America. Cultivated as an ornamental and in hedges.

ROBINIA PSEUDACACIA L. Locust, Black locust. 2n=20, c. 20, 22. C. and E. North America. This tree is planted as an ornamental and as a soil stabilizer.

SESBANIA EXALTATA (Raf.) Rydb. 2n=12. USA. Cultivated there as a green manure.

SESBANIA MACROCARPA Muhl. 2n=12. USA. Cultivated there. Closely related to S. exaltata* or is a synonym of this species.

VICIA LEAVENWORTHII Torr. & Gray. Leavenworth vetch. 2n=14. Missouri and Arkansas to Texas in USA. Occasionally cultivated.

Liliaceae

CAMASSIA LEICHTLINII (Baker) S. Wats. Camas. 2n=30. E. North America. Uncultivated bulb beds are divided into family plots, which have been passed down from generation to generation. These plots are not farmed, but stones, weeds and shrubs are removed every year. In most cases the plants are marked in bloom so that the bulb can be harvested when it is fully grown (Chapman Turner & Bell, 1971).

The camas is semi-domesticated i.e. the wild plant is protected and the growing circumstances are improved. The latter may result in more sites for the plant to grow.

CAMASSIA QUAMASH (Pursh) Greene. Blue camas. 2n= . E. North America. See further C. leichtlinii*.

Limnanthaceae

LIMNANTHES ALBA Benth. Meadow foam. 2n=10. NW. Pacific states of USA. Potential oil-crop. Erect types have been developed for cultivation. Self- and cross-compatible.

Malvaceae

GOSSYPIUM BARBADENSE L. Sea Islands cotton. 2n=52, genome formula $(AADD)_2$. Peru (p. 176). Sea Islands cotton developed on the Sea Islands of S. Carolina, USA after introduction from Bahamas or Jamaica. Cultivated in E. USA and some Caribbean islands. Maybe similar types in Ecuador are its parental material (Harlan, 1970).

Martyniaceae

PROBOSCIDEA LOUISIANICA (Mill.) Thell. (syn. Martynia proboscidea Glox.). Unicorn plant, Ram's horn, Double claw, Proboscis flower. 2n = . N. America. A herb cultivated for its fruits and as an ornamental.

Moraceae

MACLURA POMIFERA (Rafin.) C.K. Schneider (syn. M. aurantiaca Nuttall). Osage orange. Texas, Oklahoma and Arkansas, USA. Widely planted as living fence in USA from 1850-1875. Naturalized. Also used as a source of bows, yellow dye and building material. Dioecious, wind-pollinated. Macludrania hybrida André is a natural hybrid of Cudrania trisuspidata x Maclura pomifera var. inermis (Smith & Perino, 1981).

Passifloraceae

PASSIFLORA INCARNATA L. May-Pop, Yellow-fruited Virginian passion flower, Apricot-Vine. 2n=18, 36. E. North America, Florida and Texas. It was cultivated by indians in Virginia. Resembles P. edulis*.

Phytolaccaceae

PHYTOLACCA AMERICANA L. 2n=36. USA. It has run wild in S. Europe. Cultivated as a dye plant (berries) and ornamental. The berries are also used to colour wine.

Rosaceae

AMYGDALUS PERSICA L. Peach. 2n=16. Primary centre: China (p. 42). Secondary centre: California, USA.

FRAGARIA CHILOENSIS*

FRAGARIA OVALIS Lehm. 2n=8x=56. W. North America. Used in breeding F. x ananassa*.

FRAGARIA VESCA L. Wild strawberry. 2n=14, genome formula AA. Europe (p. 159), Asia and N. America. In California, it is found in a broad range of environments from the coastal fog belt to the Sierra Nevada and Cascade Mountains and from San Jacinto Mountains near the Mexican border to Oregon. Hermaphroditic, self-compatible, reproducing sexually and asexually by runners. There are many ecotypes, which aid survival under this wide range of environments (Hancock & Bringhurst, 1978). Some clones are used to test for viruses in F. x ananassa*.

FRAGARIA VIRGINIANA Duch. Virginian strawberry. 2n=56. N. America, especially in the eastern part. Cultivated. One of the parents of F. x ananassa* Duch. (syn. F. grandiflora Ehrh.), the pineapple strawberry (2n=56).

PRUNUS. The American Prunus species are valuable because of their longevity and winterhardiness.

PRUNUS AMERICANA Marsh. American Plum. 2n=16. A large territory of N. America between Manitoba and Texas. This small tree usually grows slowly. Cultivated. Valuable because of its longevity and winterhardiness. Cultivars have been developed from interspecific crosses.

PRUNUS ANGUSTIFOLIA Marsh. (syn. P. chicasa Mich.). Chickasaw plum, Florida sand plum, Mountain cherry. 2n=16. S. Delaware to Florida and westward to the Texas and S. Oklahoma. A small tree with a dense crown. The cultivated species lack hardiness. It hybridizes easily with P. munsoniana*.

PRUNUS BESSYI Bailey. Western sand cherry. 2n =16. N. America on sandy and saline soils. This perennial shrub is characterized by a good longevity, frost resistance and sweet, edible fruits. A source of a bush-type habit for ease of mechanical harvesting.It hybridizes with Armeniaca vulgaris* and Prunus ssp.

PRUNUS HORTULANA Bailey. Hortulan plum. 2n=16. C. USA. This tree is very cold resistant and has good fruits. It flowers late (Zylka, 1970). It hybridizes easily with other American Prunus species. According to Bailey (1898) it is a hybrid of P. angustifolia* and P. americana*.

PRUNUS MARITIMA Marsh. (syn. P. maritima Wangh., P. acuminata Michx.). Beach plum, Sand plum. 2n=16. E. USA and adjacent Canada. Some cultivars have been selected (Zylka, 1970) in the USA. Also used as a source of late flowering, cold resistance and very high fertility in the breeding of other cultivars. It is an ornamental.

PRUNUS MUNSONIANA Wight & Hedrick. Wild Goose Plum. 2n=16. N. Texas, E. Oklahoma and Missouri. It flowers late and the fruits are of good quality. It has a good longevity and winterhardiness. It hybridizes easily with P. angustifolia* and other species. Cultivars were bred from such interspecific crosses.

PRUNUS NIGRA Ait. Canada plum. 2n=16. The territory between S. New Foundland to the Strait of Mackinac and southward to Lansing, Michigan. Cultivated there to some extent. This species is valuable because of its longevity and winterhardiness. Cultivars have been developed from interspecific crosses.

PRUNUS PENSYLVANICA L. (syn. P. persicifolia Desf.). Bird cherry, Pigeon cherry, Pin cherry, Wild red cherry. 2n=16. N. America, from New Foundland to British Columbia and Colorado. A source of late flowering and cold resistance.

PRUNUS SEROTINA Ehrh. Black cherry, Run cherry. 2n=32. N. America from Ontario and North Dakota to Texas and Florida. The fruits are unpalatable. It could be a source of late flowering and frost resistance.

PRUNUS VIRGINIANA L. Common choke cherry, Eastern choke cherry, Choke cherry. 2n=30, 32. W. North America. Micurin selected Vinogradnaja from this species (Zylka, 1971b).

RUBUS ACAULIS Michx. 2n=14. The Canadian counter part of R. articus (Larsson, 1969). It could be one parent of R. stellatus*. Also named ssp. acaulis of R. arcticus.

RUBUS FLAGELLARIS Willd. (syn. R. villosus Ait.). Northern dewberry. 2n=63. E. North America. Cultivated for its fruits. Var. roribaccus Bailey is the Lucretia dewberry (Uphof, 1968).

RUBUS IDAEUS L. (syn. R. strigosus Michx.). American red raspberry. 2n=14. The NE. American counterpart of this species. Present cultivars are often hybrids between this subspecies and ssp. vulgatus*, the European red raspberry. Natural hybrids between ssp. strigosus and R. occidentalis* have been described as R. neglectus Peck., Purple cane raspberry (2n=14). They have been occasionally cultivated. In N. America such hybridization has led to introgression between the two parental species. See for other hybrids p. 141. Cultivars are often unarmed or have simple leaves. The loganberry (2n=42), genome formula $V_1V_1V_2V_2II$, is derived from the cross of a tetraploid form R. ursinus Cham. & Echt. (2n=28), genome formula $V_1V_1V_2V_2$ and R. idaeus (2n=14). Mayberry is a hybrid product of R. palmatus Thunb. x ssp. strigosus and Youngberry (2n=42, 49) of loganberry x Mayes dewberry (R. baileyanus x R. argutus). Other Rubus species like R. arcticus* have also been used in breeding work.

RUBUS OCCIDENTALIS L. Black raspberry. 2n=14. NE. North America, Colorado and British Columbia. It is cultivated. Present cultivars often derive from hybrids with R. idaeus*. Natural hybrids with the N. American ssp. strigosus of R. idaeus have been named R. neglectus Peck., purple cane raspberry (2n=14). This hybridization has led to introgression between these two parental species. It is for R. idaeus* a source of resistance to the rubus aphid, Amphorophora rubi Kalt.

RUBUS STELLATUS Sm. 2n=14. Wild from Alaska, Aleutian Islands and Kamchatka. Closely related to R. arcticus* and has been described as ssp. stellatus of this latter species. It could be a hybrid of R. arcticus and R. acaulis* (Larsson, 1969).

Salicaceae

SALIX RIGIDA Mühlenberg (syn. S. cordata Mühl.) American willow. 2n=44. N. America. Introduced in Europe for twig production.

Solanaceae

DATURA STRAMONIUM L. Thorn-apple, Jimson weed. 2n=24. N. America. Pantropical now. A poisonous plant cultivated as a medicinal plant yielding stramonium.

NICOTIANA QUADRIVALVIS Pursh. 2n=48. SW. USA along rivers and in rocky soils. The Indians cultivated it for smoking leaves and flowers.

An annual, frost-resistant, early maturing species. It hybridizes easily with N. tabacum*.

PHYSALIS PUBESCENS L. Strawberry tomato, Dwarf Cape gooseberry. 2n=24. N. America. Cultivated in Ukraine and elsewhere.

SOLANUM FENDLERI A. Gray. Navajo potato. 2n=48, genome formula A_4A_4BB. Arizona, New Mexico and W. Texas, USA and NW. Mexico. Very similar to S. hjertingii* and similar to S. papita*. It is resistant to Y virus.

SOLANUM JAMESII Torr. 2n=24, 36. Arizona, New Mexico and Colorado (USA) and in Mexico near the Arizona boundary.

Valerianaceae

VALERINA EDULIS Nutt. 2n= . N. America. This perennial herb is cultivated for its roots.

Vitadaceae

VITIS BERLANDIERI Planch. 2n=38. SE. USA to Texas. Used as a rootstock. Rootstocks of V. riparia* x V. berlandieri are also used. It can be crossed with V. vinifera*.

VITIS CINEREA Engelm. Downy grape, Sweet winter grape. 2n=38. SE. USA. Resistant to fungal diseases and to phylloxera. Viteus vitifolii Shimer, but it cannot be crossed with V. vinifera*.

VITIS CORDIFOLIA Michx. 2n=30, 38. SE. USA. It can be crossed with V. vinifera* to introduce resistance to fungal diseases.

VITIS LABRUSCA L. Fox grape. 2n=38. E. North America. It appears to have run wild in Georgia, USSR (p. 102). Introduced into the Old World. It is cultivated. It has been crossed with V. vinifera* to improve it and for this species it is used as a rootstock.

VITIS RIPARIA Michx. (syn. V. vulpina L.). 2n=38. E. and C. USA and in Ontario, Canada. Used as a rootstock. It can be crossed with V. vinifera* to introduce resistance to phylloxera, Viteus vitifolii Shimer. Such hybrids occur wild in USA and have been described as V. bourquina. Rootstocks of V. riparia x V. berlandieri* are also used.

VITIS ROTUNDIFOLIA Michx. Muscadine grape, Southern fox grape. 2n=40. Florida, the southern coast of USA and the east coast of Mexico. Dioecious, but hermaphrodite cultivars have been developed. Cv. Scuppernong was developed in 1584 from wild material in NE. North Carolina.

VITIS RUPESTRIS Scheele. 2n= . SW. USA. Used as a rootstock. It can be crossed with V. vinifera* to introduce resistance to phylloxera, Viteus vitifolii Shimer.

Species without an identified region

Some species could not be listed in one of the Regions. They have a very wide geographical distribution. Either their locality of cultivation has not been reported or they are cultivated at several places. Thus it is not known whether their wide distribution occurred before their domestication or not, i.e. it is not mentioned whether the wild species grew in a large area where it has been domesticated at several places, or whether wild plants were domesticated on one site after they had been spread by man.

Agavaceae

YUCCA GLORIOSA L. 2n=50. Cultivated in Georgia, (USSR).

Amaranthaceae

GOMPHRENA GLOBOSA L. Batchelor's button. 2n= 32, 40-44, 44-48. The tropics. Cultivated in some villages of mainly coastal districts in W. Africa as a curiosity and as a fetish plant. In Europe and elsewhere it is an ornamental.

Anacardiaceae

SPONDIAS CYTHEREA Sonner (syn. S. dulcis Forst.f.). Otaheita apple, Ambarella, Hog plum. 2n= . Cultivated for its fruits. Mansfeld (1959) reported the presence of var. cytherea on the Society Islands, Tahiti, Fidji, Samoa and Madagascar, var. mucroniserrata (Engl.) Mansf. in Mexico, var. macrocarpa (Engl.) Mansf. in Brazil, var. acida (BL.) Mansf. in Malaysia and var. integra (Engl.) Mansf. in Amboina.

Apocynaceae

APOCYNUM VENETUM L. (syn. A. sibiricum Pall. ex Roem. & Schult.). Kendyr. 2n=16, 22. Italy to E. Asia. A perennial fibre crop brought into cultivation in USSR.

Chenopodiaceae

CHENOPODIUM BOTRYS L. Jerusalem oak. 2n=18. S. Europe, Orient and C. Asia. Occasionally cultivated (Mansfeld, 1959).

Corynocarpaceae

CORYNOCARPUS LAEVIGATUS J.F. Forst. & G. Forst. Kopi, karaka. 2n=44. This species occurs wild on the New Hebrides and New Caledonia as C. similis and C. dissimilis respectively. The large kernels can be eaten after removing the poisonous karakin by heating. Therefore they were taken to New Zealand (Stevenson, 1978) where the species ran wild and became semi-domesticated.

Cruciferae

CRAMBE ABYSSINICA Hochst. ex. R.E. Vries. 2n= 90. Its wild distribution is obscure, but it may have developed in Turkey. Cultivars have been released in USA. See p. 89.

Cucurbitaceae

MOMORDICA BALSAMINA L. Bitter gourd, Bitter cucumber, Balsam pear, Balsam apple. 2n=22. Tropics of the Old World, especially India and SE. India. Leaves and stem are used for fodder.

MOMORDICA CHARANTIA L. Bitter gourd, Bitter cucumber, Balsam pear. 2n=22. Tropics of the Old World. Naturalized in nearly all tropics and subtropics. An edible, medicinal and toxic plant (Morton, 1967).

Cyperaceae

CYPERUS ARTICULATUS L. 2n= . Cultivated for its sweet scented roots.

MARISCUS UMBELLATUS Vahl. 2n= . The tropics of the Old World. Cultivated for its rhizomes.

Euphorbiaceae

EUPHORBIA TIRUCALLI L. 2n=20. Trials at Arizona (USA) to grow this plant for its sap as a raw material for petrol.

Gramineae

EREMOCHLOA OPHIUROIDES (Munro) Hack. 2n=28. Some cultivation on Puerto Rico.

HETEROPOGON HIRTUS Pers. (syn. H. contortus Beauv. ex Roem. & Schult., Andropogon contortus L.). Spearhead, Tangle grass. 2n=20, 40, (42-44, 50), 60, (80, c. 70-80). The Old and New World, subtropics and tropics. Cultivated as a fodder for live stock. Plants with 2n=20 come from India, with 2n=40 from Java, India, Madagascar, Tanzania, Kenya, Uganda, Zimbabwe and Zaïre, and with 2n=60 from S. Africa, Mexico and N. America.

Leguminoseae

CROTALARIA MUCRONATA Desv. (syn. C. striata DC.). 2n=16. Distributed in tropics and subtropics as a cover crop and green manure.

CROTALARIA RETUSA L. 2n=16. This fibre crop is widespread throughout the tropics. In E. Africa it is used for its pigments and in Florida as an ornamental.

DESMODIUM ADSCENDENS DC. 2n=22. Tropics. Cultivated in many regions as a cover crop and green manure.

DESMODIUM GANGATICUM DC. 2n= . Trop. Asia and Australia. Cultivated as a fodder plant and green manure.

INDIGOFERA HIRSUTA L. (syn. I. schimperi Jaub. & Spach.). Hairy indigo. 2n=16. Many tropical countries. It is cultivated.

TEPHROSIA PURPUREA Pers. Purple tephrosia. 2n =22, (24, 44). The tropics. Cultivated as a green manure and cover crop. Grows wild in N. India on waste places and road sites.

Malvaceae

ABUTILON GRAVEOLENS Sweet. 2n=14, 36. The tropics of the Old World. Cultivated especially in USSR for its oily seeds.

MALACHRA CAPITATA L. 2n=56. The tropics. A herb cultivated for its fibre.

URENA LOBATA L. Aramina fibre, Congo jute. 2n=28, 56. Wild or naturalized in the tropics and subtropics. Centre of origin very likely in the Old World (Purseglove, 1968).

Rutaceae

EVODIA HORTENSIS J.R. & G. Forst. (syn. Fagara euoda L.f., F. evoda L.f., Zanthoxylum varians Benth.). 2n= . A widespread shrub. Cultivated in many parts of the Pacific. Leaves are used for medicinal purposes.

Solanaceae

SOLANUM MAMMOSUM L. 2n= . It spread as a campfollower over C. and S. America. Its native habitat is not clear but it appears to be wild in the Caribbean. Primitive types are found in the savanna of Venezuela and Colombia, and it is widely used as fish poison and ornamental, and in fetish. In Panama, it is cultivated as a fish poison (Nee, 1979).

Umbelliferae

CONIUM MACULATUM L. Hemlock, Poison hemlock. 2n=16, 22. Europe, Asia, N. Africa and Ethiopia. Occasionally cultivated. Often occurring as a ruderal. Used as a poison and medicinal plant.

Urticaceae

BOEHMERIA STIPULARIS Wedd. Hawaian false nettle, Akola. 2n= . Probably from the Mascarene islands. According to Uphof (1968) this fibre crop grows wild on Hawaii, where it was formerly cultivated. This has resulted in many varieties.

TOUCHARDIA LATIFOLIA Gaudich. Olona. 2n= . The Hawaian Islands. At one time cultivated for its fibre (Hutchinson, 1962).

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Index of botanical names

The following pages give four blank distribution maps.

1. The Americas
2. Europe, the Middle East and Africa
3. Asia and Australia
4. World map

Maps 1-3 can be joined. -.-, national frontiers; --- borders of states and provinces. They can be photocopied by plant geographers to make their own distribution maps.