Dictionary of cultivated plants and their centres of diversity

Excluding ornamentals, forest trees and lower plants

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Preface

The aim of the work is to give the reader quick reference to the Centre of diversity of a cultivated plant species. For some important crops, the Centre of diversity of related wild species is also presented. These wild species are important sources of genes useful to man when incorporated in cultivated crops. Hence such wild species have to be included in genitor collections for breeding.

For some cultivated species, the region of diversity could not be identified. Future research may show where they have come from.

Species only cultivated as ornamentals or for timber and lower plants have not been included, as in previous work by Zhukovsky.

The cultivated species are arranged alphabetically by families and secondarily alphabetically by genera within a family and tertiarily by species. For several species, taxonomic synonyms and common names are given, if they seemed to be used. The taxonomic classification of families and genera is based on Willis's dictionary (1966).

Somatic chromosome numbers and genome constitutions 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.

This work concerns many more species than we could know. Corrections, critisisms and additions including data on chromosome number would be highly appreciated. They should be sent to A. C. Zeven, Institute of Plant Breeding, I. v. P., Agricultural University, Lawickse Allee 166, Wageningen, the Netherlands.

We hope that this work may directly help the plant breeder and 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 future needs for wild genes.

P. M. Zhukovsky
A. C. Zeven

History of the work

In 1968 Prof. P.M. Zhukovsky published a paper 'New centres of origin and new gene centres of cultivated plants including specifically endemic microcentres 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. Zhukovsky 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. Zhukovsky agreed to this proposal and the work has now been enlarged from 700 species to about 2300 species.

A.C. Zeven.

Origin of agriculture and plant domestication

INTRODUCTION

The origins of agriculture and plant domestication are, in general, closely related phenomena. However, plants may be domesticated without actually being cultivated; man may intentionally or unintentionally select for characters which are useful to him. Furthermore, agriculture can be carried out with wild plants. Helbaek (1966) suggested that about 7000 BC. wild barley was cultivated. Ruderal plants (campfollowers, dumpheap plants, habitation weeds) grow in an anthropogen environment which may result in idiotype changes of the plants making them less suited to survive in a wild environment. They have been, however slightly, domesticated.

The oldest findings of man and human dwellings point to man being a hunter and collector of plant parts and of small animals like snails, larves, eggs and small birds. Nowadays 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 recreational reasons. If he depended on them he would grow them or find a substitute. Some people may grow them, while others still collect them.

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 have been domesticated.

THE ORIGIN OF AGRICULTURE

Much has been written about man's change-over 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 enforcing the application of artificial methods (Spinden, 1917, see MacNeish, 1964). Sauer (1952) however, thought that agriculture cannot have originated solel from chronic food shortage, as four conditions have to be fulfilled first:

1. Previously acquired skills in other fields to start experiments.
2. A sedentary way of living.
3. The presence of wooded lands which are easier to clear than savannahs or forests. Large river valleys subject to periodical flooding are unsuitable, because man was not able to manage the water problems.

4. A marked diversity of the plant populations 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.

Actually, not much is known about the skills of the first farmers, and the information on the relation between pre-existing sedentism and incipient food production is limited. Extremely old sites with a year-round occupation have only been discovered in the Nile Valley of Upper Egypt (15 000 to 10 500 BC); they show no evidence of plant or animal domestication (Churcher & Smith, 1972). Perhaps the sites found in southern Africa dating from 47 000 BC. (Border Cave in Zululand), 43 000 BC. (Howieson's Poort near Montagu, southwest Cape Province), 42 000 BC. (Rose Cottage Cave near Ladybrand in eastern Orange Free State) belong to this category. However, no evidence has been found yet to show whether these sites were occupied all year round. The botanical material has not yet been analysed (Dart & Beaumont, 1971; Beaumont & Boshier, 1972).

The sites where agriculture developed first must have been in areas where plant collectors/hunters/fishermen roamed. It is most likely that they lived in the wooded lands for hunting game or near water for fishing. Fishing communities lead a sedentary live; nomads return to sites known to them for the richness in animal and plant food. This may have led to annual occupation of sites, each site for several weeks. On such sites the soil may have become bare because of disturbance by man; paths, loam pits, graves, dilapidated mudhouses, and abandoned compounds in general. Near water natural bare lands such as riverbanks, gravel, rocks, screes, landslides and esturial plains may have occurred. Plants pre-adapted to such environments would colonize such sites. Around dwellings many plants would derive from plant parts collected by man and brought to his house. Pre-adapted plants have a weedy tendency and prefer 'open' rich soil conditions. They grow quickly and have large food reserves which enables them to survive in adverse conditions. These make them very suitable for cultivation. They may grow wild in mountainous or hilly areas with a wide topographical diversity. In such areas with many microclimates variants have most chance to survive. After having moved to a disturbed area, man may have found some useful types among them.

Other sites where agriculture may have arisen are the refuse heaps (rubbish heaps, dump heaps) on the compounds. Many parts of plants (fruits, seeds, tubers, roots) must have accidently or purposefully been 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 in which agriculture arose may be summarized as follows:

1. Wild plants collected by man.
2. Wild plants moved into the temporary or (semi-)permanent dwelling site either by accident or as a gathered plant part, after which fruits, seeds, parts of tubers etc. were lost or thrown away on purpose. This must have continued for an extremely long time.
3. Only pre-adapted highly variable wild plants established and colonized disturbed soil around the dwelling. Man gathered wanted plant parts from some of these weedy plants.
4. Disadvantageous natural selection pressures were reduced and favourable selection pressures were introduced so that variation decreased counteracted by an increase of variation by hybridization and mutation, followed by isolation, protection and selection. This caused more deviants from the wild phenotype to survive. Such deviants belong to the ruderal flora or habitation weed flora. This stage could be called proto-agriculture.

5. The dependence of man on certain plants increased in such a way that when demand exceeded availability, man eradicated the wild weedy plant or started taking measures to improve its development. When man moved outside the natural range of a species on which he depended he was also forced to take measures. Thus man learned to retain seeds etc. when the plant was to grow outside its natural range, to disturb the soil on purpose i.e. to cultivate in order to reap a better harvest from the weed now turned into a crop. This stage might be called incipient agriculture. Modern examples are the eradication of some herbs, ornamentals and mushrooms. Near eradication has lead to incipient cultivation of Tabernanthe iboga and Camassia leightlinii.
6. Crops were further improved by a semi-intentional and intentional bettering of agricultural methods and plant types. This stage could be called 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 1. less energy required to obtain more food, 2. people becoming tied to the(ir) land and 3. spare time available for other pursuits (MacNeish, 1964).

Through the invention of agriculture mankind gained more from solar energy. Raising crops (and husbanding animals) are man's most important means of exploiting this energy (Rappaport, 1971).

DOMESTICATION OF PLANTS

The first fully domesticated plants derive from partially domesticated ones like ruderal plants, habitation weeds, refuse heap plants. Those plants with a use for man would be protected or at least damage would be avoided.

Domestication of plants is the change of the idiotype to adapt them better to man-made environments. Such changes often render the plants less likely to survive in a wild state. The above definition includes the origin of habitation weeds. In general the term domestication means the unintentional and intentional selection by man for idiotypes which are useful to him. Then the domesticated idiotypes are less suited to survive in a wild state.

The ancestors of the first crops must have had a weedy character and large food reserves to enable them to survive in very dry summer conditions in poor thin soil free from competition with perennial plants.

Due to cultivation some plants have changed very quickly, These changes may have been induced by cycles of differentiation and hybridization between species, forms, ecotypes and races. During differentiation the plants must have grown isolated by genetic, special, cultural and hybridization barriers. For instance hybridization is hampered by a shift from allogamy to autogamy, a shift in time of flowering or a shift in ecological adaptation. For generatively propagated diploid crop the period of differentiation will be much shorter than that for a vegetatively propagated polyploid crop. Special barriers may be a few hundred metres, for instance the slopes where wild types grow and the valley floor where the domesticant is cultivated. Hybridization occurs between the domesticants and weedy or wild relatives often resulting in a two-way gene flow. When 'cultivated' genes are dominant, they have little chance to survive in weeds or wild plants as is shown for maize - teosinte.

The impact of weedy and wild relatives can be very dominant (large) as has been shown by Heiser (1965) for sunflower. Because of hybridization, variability will increase and adaptation becomes wider; the greater the variability and the wider the adaptation, the larger the area where the crop can be cultivated.

Crane (1950) and Masefield et al. (1969) have presented classes of selection schemes from the wild plant to the present cultivated crop. Both classifications have been used to develop the following one which is based on taxonomy. It shows the change from a wild species A to new taxons.

1. Domestication, no apparent influx of foreign genic material
1.1. cultivated plant morphologically resembles the wild parent, Species A.
1.2. cultivated plant differs morphologically largely from wild parents, Species A, var. B, or Species B
1.3. autopolyploidization, the newly originated plant may differ from its parent, Species A or Species C
2. Domesticated with influx of foreign genic material
2.1. cultivated plant still resembles morphologically the wild plant (introgression), Species A
2.2. cultivated plant differs morphologically from the wild parent, Species A var. B or Species D
3. Amphipolyploidization
3.1. between a cultivated plant and a wild one of a different species, Species E
3.2. between a cultivated plant and another of a different species, Species F

The possible changes of the plant due to domestication have been listed by Polunin (1960) and Purseglove (1968). The domesticated plants

1. spread to a greater diversity of environments and a wider geographical range,
2. may come to have a different ecological preference,
3. may flower and fruit simultaneously,
4. may lack shattering or scattering seeds and sometimes may have lost the dispersal mechanism completely,
5. may have an increased size of fruits and seeds, which often reduces the dispersal efficiency,
6. may have been converted from a perennial to an annual,
7. may have lost seed dormancy,
8. may have lost photoperiodic controls,
9. may lack normal pollinating organs,
10. may have undergone a change in its breeding system. Usually the change is from complete or partial cross-fertilization to partial or complete self-fertilization. This change may be a result from a change in flower morphology, or a change from self-incompatibility to self-compatibility.
11. may have lost defensive adaptation such as hairs, spines, thorns etc.,
12. may have lost protective coverings and sturdiness,
13. may have undergone an improvement of its palatability and chemical composition thus rendering them more likely to be eaten by animals,
14. may have an increased susceptibility for diseases and pests,
15. may develop seedless parthenocarpic fruits,
16. may have undergone selection for double flowers which may involve conversion of stamens into petals,
17. may be multiplied vegetatively.

The speed of domestication depends on the duration of a generation. For cereals a generation usually takes one year, while in vegetatively propagated plants no fast changes may be expected. Braidwood & Howe (1962) estimated that all major changes in wheat and barley had taken place within 2 000 years. Helbaek (1966) suggested that this period is 1 500 years.

Several crops have been domesticated for several purposes. Examples are:

Sorghum bicolor: 1. annual forage grass, 2. perennial forage grass, 3. syrup sorghum, 4. grain sorghum, 5. broom corn, 6. popping sorghum used for confectionary, 7. inflorescenses are also used for decoration,
Cannabis sativus: 1. fibre, 2. drugs, 3. oil seeds; there are also 4. weedy forms,
Brassica napus: 1. rape, 2. swedes, 3. hungary gap kales, 4. oil seed colzas,
Brassica campestris: 1. rapeseed, 2. turnip, 3. leafy vegetables,
Brassica oleracea: 1. vegetable, 2. forage, 3. ornamental, 4. walking stick, 5. construction material,

Helianthus annuus: 1. oil, 2. silage, 3. ornamental, 4. bird's food, 5. ceremonies,
Elaeis guineensis: 1. mesocarp oil, 2. kernel oil, 3. wine
Vicia faba: 1. dry seed, 2. fresh seed, 3. forage (fresh silage), 4. green manure.

This list can easily be extended. Some plants may have been domesticated for a certain use that became obsolete. If no alternative use is present its cultivation will be abandoned; it will be lost as a cultigen, but may survive as a weed or in a living collection. Several crops had two uses or man found a new use which made them important again. For instance several medicinal crops and herbs are also grown as ornamentals like Viola tricolor and Digitalis purpurea. Some medicinal species are nowadays ornamentals only. Similarly fetish plants also became ornamentals. Many fence or stockade plants, which were planted to stop domestic and wild animals from running away or entering protected areas, are used nowadays as ornamentals or for hedges. Anderson (1960) and Chang (1970) supposed that the first crops were not food crops. Anderson suggested that plants were domesticated for body paints, living stockades, poisons, for chewing, for fatigue drugs and for ritual purposes. Chang believed the plants were used for making containers (bamboo trunks, fruits of bottle gourd), cordage or as herbs. These plants were needed and when man became dependent on them, he started to cultivate them. Most scientists, however, believe that food crops are the first domesticants. Burkill (1952) listed the sequence in which he believed the crops were domesticated:

1. cereals
2. pulses
3. greens
4. oil seeds
5. 'roots'
6. herbaceous fruits
7. fibre
8. woody plants, chiefly fruit trees
9. various industrial plants.

Several wild grasses are very adaptable to domestication: they form many fruits or seeds; they grow gregariously so that their fruits or seeds could be collectively harvested; they have fruits or seeds edible for man; the foliage is very excellent for fodder and the seeds are good to store. Man did not overlook these advantages of grasses (Burkill, 1952). Pulses must have followed quickly. Subsequently, several greens were also domesticated as oil crops. Many of the woody plants received individual attention. Purseglove (1968) stated that cereals were first domesticated in the arid and semi-arid regions whereas in the wet tropics cultivation started with root and tuber crops. Archeological research must elucidate the right sequence. It may differ from region to region.

The plant families have not contributed equally to the present supply of domesticated species. Harlan & de Wet (1965) have prepared a list classifying the families as contributing 1. many major crops, 2. a few major crops, 3. many minor crops and 4. no important crops.

Among the 167 families (see the table) included in the list of this book 51 families are represented by only one species, 23 by 2 items, 12 by 3 items and 82 by more than 3 items. The family with most items is the Gramineae (359, 15.6%); most of them coming from Africa. This continent is well-known for its forage grasses. The Leguminosae follow with 323 items (14.1%); Centres 2, 7, 8, 10 and 9 are the main sources. Gramineae and Leguminosae contribute about one third of the list. Rosaceae rank third with 154 items (6.7%), most of them come from Centres 1, 9 and 6.

Families with 100 to 50 items are the Solanaceae (100; 4.4%); the Compositae (75; 3.4%); the Myrtaceae (73; 3.2%); the Malvaceae (67; 2.9%) and the Labiatae (55; 2.8%).

Most Solanaceae come from Centres 10 and 11. 40 of the 73 items on Myrtaceae come from Centre 3. 38 of them belong to the genus Eucalyptus. One third of the Labiatae comes from Centre 7. The Compositae and Malvaceae have a more even distribution over the various regions.

Centre 2 has contributed the highest number: 303 items, closely followed by Centre 1 (284 items) and Centre 8 (276 items). Together they contributed 37.6%. If Centre 9 is added, almost the half (47.5%) of the items have been included.

Number of items per family per region, per family and per centre.
There are 167 families.

Family	Centre													Total
	1	2	3	4	5	6	7	8	9	10	11	12	Un-iden-tified	
Acanthaceae				1				1		1				3
Aceraceae												1		1
Actinidaceae	4													4
Agavaceae			1	1				6		2	15			25
Aizoaceae								3		1				4
Alismataceae	1													1
Alliaceae	9			1	2	5	2		2					21
Alstroemeriaceae											1			1
Amaranthaceae	1	3		2			1	1		5	3	3	1	20
Amaryllidaceae							2							2
Anacardiaceae	2	7		1			1	1		4	4		1	21
Annonaceae		2								4	8			14
Apocynaceae		1		2			1	4		2			1	11
Aquifoliaceae	1									1				2
Araceae	1	7		3					1	7	2	1		22
Araliaceae	4	4										1		9
Aristolochiaceae									1					1
Asclepiadaceae		1		1			1		1			1		5
Averrhoeaceae		2												2
Balanitaceae							1							1
Balsaminaceae	1													1
Basellaceae		1								2	1			4
Berberidaceae									1					1
Bignoniaceae								1			3			4
Bixaceae										1				1
Bombacaceae		4						1		3	1			9
Boraginaceae	1	1				1	2		1					6
Bromeliaceae											1			1
Burseraceae	1	4						2						7
Cabombaceae	1													1
Cactaceae										2	6			8
Campanulaceae	1								1			1		3
Cannabidaceae				1					2					3
Cannaceae								1		1				2
Capparidaceae							1							1
Caricaceae										3	1			4
Caryocaraceae										1				1
Caryophyllaceae							2		2					4
Casuarinaceae			1											1
Celastraceae	2							1						3
Chenopodiaceae	4		1	1	2	6	6		5	2	1	1	1	30
Chloranthaceae	1													1
Chrysobalanaceae										1				1
Cleomaceae								1						1
Combretaceae		4												4
Compositae	10	7		2	5	3	14	6	17	5	4	2		75
Convolvulaceae	2	1		1			1			3	2			10
Cornaceae						1								1
Corylaceae	4					3	1							8
Crassulaceae								1	2					3
Cruciferae	8			3		4	12	4	11	1				43
Cucurbitaceae	5	2		9	1	2	3	11	2	2	7		2	46
Cupressaceae												1		1
Cyperaceae	6	3					3		2				2	16
Datiscaceae					1									1
Dioscoreaceae	2	8		1				15		2	1			29
Dipsacaceae						2								2
Dipterocarpaceae		1												1

	Centre													
Family	1	2	3	4	5	6	7	8	9	10	11	12	Un-identified	Total
Ebenaceae	3	2			1						1	1		8
Ehretiaceae											1			1
Elaeagnaceae	3				1									4
Elaeocarpaceae	1	1										1		3
Ericaceae							1					3		4
Erythroxylaceae										2				2
Eucommiaceae	1													1
Euphorbiaceae	4	13		2			2	7		10	2	1		41
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	34	44	1	27	13	35	33	70	38	22	15	25	2	359
Grossulariaceae	3						1		6			2		12
Guttiferae		9		4						2				15
Hippocastanaceae					1		1							2
Hydrastidaceae												1		1
Hydrophyllaceae		1										1		2
Illiciaceae	2													2
Iridaceae	2					1	2				1			6
Juglandaceae	1				1				1	1	2	4		13
Labiatae	5	7			1	1	17	10	10		3	1		55
Lauraceae	2	3					1			2	2			10
Lecythidaceae										2				2
Leguminosae	13	46	8	23	7	21	48	42	35	41	23	10	6	323
Lemnaceae		1												1
Liliaceae	8	1			1	1	3		2			2		18
Linaceae				1	1	1	1	1	1					6
Lythraceae								1						1
Magnoliaceae	1	1												2
Malpighiaceae										3	2			5
Malvaceae	6	4	3	8	2	6	2	13	1	9	9	1	3	67
Marantaceae										2				2
Martynaceae												1		1
Melastomataceae								1						1
Meliaceae		3			1									4
Menispermaceae	1							2						3
Moraceae	3	6		4	2	1	1	2			1	1		21
Moringaceae				1				1						2
Musaceae	1	4	1	3				3		1				13
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	11		3			1	9		3	2			30
Pandaceae		4						1						5
Papaveraceae					1	1	1				1			4
Passifloraceae										12		1		13
Pedaliaceae	1			1				4						6
Pentaphragmaceae		1												1
Peperomiaceae										1				1
Perioplocaceae				1				1						2
Phytolaccaceae	1				1					3		1		6

	Centre													
Family	1	2	3	4	5	6	7	8	9	10	11	12	Un-iden-fied	Total
Pinaceae							1							1
Piperaceae		5		2				2		1				10
Pistaciaceae							2							2
Plantaginaceae	1			1			2							4
Polygalaceae								1						1
Polygonaceae	8	1		1	1	1		1	5		2			20
Potyulacaceae								3	1	1	1			6
Protaceae			3											3
Punicaceae						1								1
Ranunculaceae	2						2		3					7
Resedaceae						1	3		1					5
Rhamnaceae	3						3		2	1				9
Rosaceae	40	2		1	25	22	2	1	37	4	1	19		154
Rubiaceae	1	4		4		1		6	1					17
Rutaceae	12	12	1	4		1	5	3		2	2		1	43
Salicaceae					1				7			1		9
Sambucaceae									1					1
Santalaceae		1												1
Sapindaceae	3	5		1				1		3				13
Sapotaceae		3		3				2		5	6			19
Saurucaceae		1												1
Saxiphragaceae									1					1
Scrophulariaceae	1						1		3					5
Simaroubaceae	1									1	1			3
Simmondsiaceae											1			1
Solanaceae	1	2	6	4			2	11	4	34	31	5		100
Sterculiaceae								4		4	2			10
Stilaginaceae		1												1
Strychnaceae				1										1
Styraceae		1												1
Taccaceae		1												1
Tamaricaceae					1			1						2
Taxaceae	2													2
Tetragoniaceae	1													1
Theaceae	4			1										5
Thymelaeaceae	2									1				3
Tiliaceae	1			2				1						4
Trapaceae	3													3
Tropaeolaceae										3				3
Typhaceae	1													1
Ulmaceae					2		1							3
Umbelliferae	5	2		1	2	3	13		10	1			1	38
Urticaceae	1	1		2			1						2	7
Valerianaceae							2		6			1		9
Verbenaceae				1			1	2		1				5
Violaceae	1						1		1					3
Vitadaceae	2				1		1					7		11
Zingiberaceae	4	16		9		2		1						32
Total	284	303	66	152	79	129	221	276	229	250	181	104	23	2297
% of total	12.4	13.2	2.9	6.6	3.4	5.6	9.6	12.0	10.0	10.9	7.9	4.5	1.0	100

Cradles of agriculture and centres of diversity

A search for the geographical distribution of centres of plant domestication can not be carried out without studying the origins of agriculture, hearths or cradles of agriculture and the spread of agriculture. The latter may include a study of the spread of domesticated plants.

At present wild plants are still taken into cultivation, whereas an important crop like the oil palm in Africa is still largely semi-domesticated (Zeven, 1967, 1973). Other examples are the secondary crops i.e. crops which were first weeds in primary crop but developed later into a crop.

Sites of early farms have been discovered in Thailand, Near East and Mexico. They showed that incipient agriculture existed in Thailand at about 11 000 BC. (Gorman, 1969), in the Near East at about 9 000 BC. (Cambel & Braidwood, 1970) and Mexico at about 6 000 BC. (MacNeish, 1964a, 1964b). In other areas no such sites have (yet) been found, and at present it is accepted that from these cradles of agriculture, agriculture spread to other parts of the world. So agriculture may have reached China and Japan, and SE. Asia from Thailand, while agriculture may have reached Europe, Africa, W. Asia, SW. Asia and S. Asia from the Near East.

Probably Alexander Von Humboldt was the first 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 manioc, and maize have never been found in wild state' (cited by Hawkes, 1970). If alive Von Humboldt would be delighted to learn about the present available knowledge on the origin of cultivated plants.

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

De Candolle's first real effect in tracing the origin of the cultivated plants was published in 1882 in his book 'Origine des plantes cultivées'. This work is still very up-to-date (Harlan, 1961). De Candolle based his investigations on 1. Classical botany (plant geography, knowledge of adventive and ruderal species, understanding of history of development of whole floras), 2. Bio-archaeology (plant remains, pictorial records, especially from Egypt), 3. Palaeontology and 4. Philology. He concluded that the region where a species is abundant is not necessarily its centre of origin. Perhaps De Candolle (1882) was the

first to indicate regions where the first plant domestication might have taken place: 1. China, 2. SW. Asia and Egypt, 3. Tropical Asia (Smith, 1968). 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 indicated the cradles of agriculture. Vavilov at the height of his career had more facilities at his disposal than anyone before (Harlan, 1951). His abundant energy made full use of them. During the Fifth International Genetics Congress at Berlin in 1926, Vavilov (1927) developed his theory of centres of origin or gene centres: some regions of the world possess a concentration of variations of certain cultivated plants; for several cultivated plants these regions overlap. These regions can be identified by the Differential Method. This method is simply described by Burkill (1952):

1. Take a map,
2. select important cultivated plants,
3. mark on the map the sites where recognizable botanical varieties, 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.
4. Where those marks accumulate is a centre of origin. In such centre the greatest diversity of the cultivated crop is observed.

Vavilov concluded that a centre of origin was characterized by dominant alleles while towards the periphery of the centre, the frequency of recessive alleles increased and the diversity decreased. The cause was inbreeding and geographical isolation (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 brought this number up to eight by splitting Southwest Asia into Central Asia and the Near East. Later Zohary (1970) proposed to unite them again.

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

These centres are all between 20 and 45^{o} in mountainous regions and often in areas with a temperate climate. They are separated by great deserts. 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). It states that, in comparing wild species with similar modes of dispersal, those with the wider distribution are older and that the longer a species has been present in an area, the more diverse will be the derived species and subspecies found there. Vavilov may also have been influenced by the agro-geographical work of Engelbrecht (Zeven, 1973). At present, it is known that time is not the only factor that influences the dispersal of a species and its increase of variation.

In the thirties Vavilov established an 'ecological passport' for the accessions of his large collections by sowing them at various sites ('geographical sowing') after which he estimated:

1. differences in growth during the vegetative period.
2. differences in length of the various development stages, including growth rhythm,
3. economic characters, such as size of fruits and seeds,
4. vegetative characters,
5. resistance to different kinds of drought,
6. resistance to cold,
7. specific differences in flowering,
8. resistance to various fungi,
9. resistance to different bacteria and viruses,
10. resistance to various insects,
11. ecological type of plant: xerophyte, hydrophyte, mesophyte.

The diversity was enormous but within limits and with certain regularity. Vavilov discovered 'parallelisms which are especially clear for plants which belong to the same general group (annuals, herbaceous) and which are characterized by the same area of distribution and have followed geographically the same route in their evolution. As it appeared that each species has 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 N. Africa, tropical Asia) into 19 areas, each characterized by the plants with in general 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: same as preceding group.

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 winterhard); early dwarf, small seeded, xerophytic chickpeas; 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 Armenia. 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 vegetation 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 Southern Azerbaijan (Lenkoran), Northern Iran. Characteristics: hydrophytic, tall, leafy; late; rather resistant to different 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 non-irrigated regions of Iran, Afghanistan, Soviet Central Asia (Uzbekistan, Tadjikistan, Turkmenistan). 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 maturing; 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, characterized by late varieties of wheat, barley, flax and peas;
b) Kashgar subgroup: high plateaux near the Pamir, includes 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), Central and North Kafirstan, at very high altitudes (up to 3000 m and more). Includes types from Upper Himalayas and Tibet. Characteristics: mesophytic types; of medium height; broad leaves; short vegetative period; extremely susceptible to all European fungus diseases. Furthermore a gigantic 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: Northern India. Characteristics: as those for the Pamir-Badakhstan Group; notwithstanding 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; needs 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) not rough; grain (ditto) non-shattering.
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 groups 8 and 9 have been separated, despite the identity of the characteristics, is 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: cosmopolitic, hydrophytic types of tall, large-seeded varieties of barley and peas (Ethiopian wheats, though not outspokenly cosmopolitic, may be included here);
b) varieties sown at the end of the rainy season: flax, chickpeas, 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, several millenia ago, from Asia Minor by way of India, 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, bushy; 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 are 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: Southern France, Northern Italy, part of Yugoslavia, Bulgarian coast. Charateristics: tall plants; large leaves; big fruits; high yields. Examples: Triticum turgidum s.s., soft wheats; in Lombardy giant forms of oats, chickpeas, horse beans, and a polonicoid wheat, have been found.

16. European Steppe Group Agricultural territory: European steppes from Tirol to the Urals; transferred to North America, especially to the prairies. Examples: xerophytic spring and winter types of cereals and grain legumes, the winter types winterhard, the spring types drought resistant; rather small seeds, weak straw, narrow leaves. (Vavilov divided this Group into two subgroups, but he gives no grounds for this division.)

17. West-European Group Agricultural territory: Western Europe including South Finland and South 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, are tall and early.

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

19. Northern (Boreal) Group Agricultural territory: Northern European USSR, Siberia, North 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 the gene centres. The purpose of all his effort is obvious, however: 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 distribution, but it is sufficient to look for it in the group(s) where this property has already been found.

The gene microcentres as Harlan (1951) called them form another breakdown in the geobotanical patterns of variation. They are areas of relatively small size in which evolution is still proceeding at a rapid rate.

For wheat, Harlan identified three such microcentres in Turkey. Outside this country undoubtedly many more exist. With the introduction of high-yielding foreign wheat varieties these microcentres have disappeared.

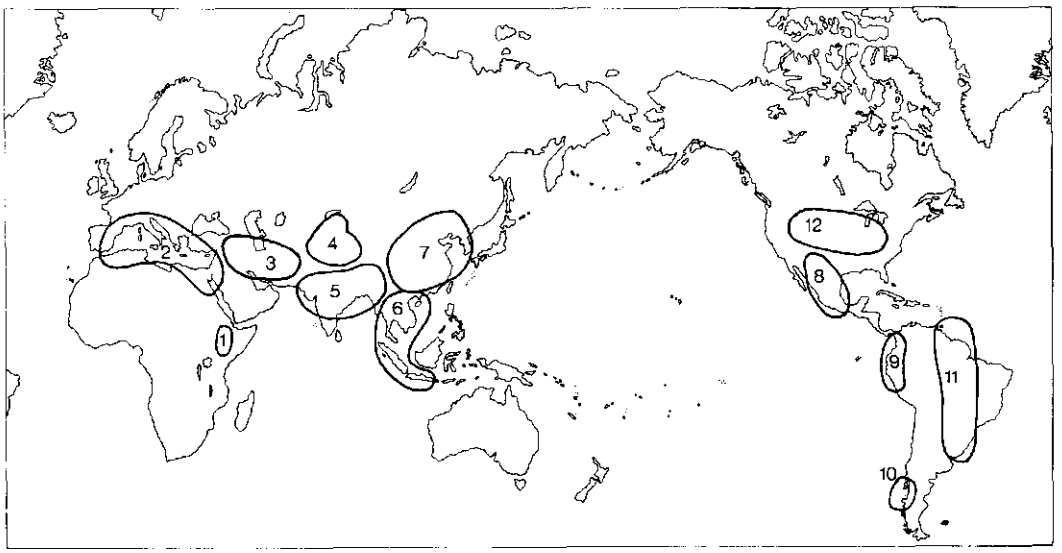
Harlan also identified gene microcentres in Turkey for a number of other crops. He found that such centres frequently coincide. They may be located in the plains or in mountainous regions, near civilization or remote from it, in areas with very primitive or more advanced husbandry.

With increasing knowledge of cultivated, weedy and wild plants it became evident that some parts of Vavilov's theory had to be changed (for a literature review see Kuckuck, 1962). Nevertheless it still forms a good base with which to search for wild or semi-wild relatives. The large collections made by Vavilov and his introduction of the genetic element in the investigations, still render these discussions very valuable. One point in Vavilov's theory is that a primary centre is marked by a high frequency of dominant alleles. Gökgöl (1941) showed that it was impossible to indicate such a centre for wheat. Brieger (1961) did not find one for maize, Zeven (1967, 1972) not for oil palm and Hanelt (1972) not for Vicia faba. Furthermore, 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 tenable, as was shown for crops like Triticum dicoccum and Hordeum vulgare in Ethiopia: they show a great diversity there, but no wild relatives are present.

Kuckuck (1962) concluded that Vavilov certainly would have altered his theories with the present available knowledge. Indeed he introduced changes during his research in the course of the years.

The number of cradles of agriculture has been much discussed. Vavilov believed in many, others suggested two (Sauer, 1952): one for the Old World: Birma and adjacent area and one for the New World: C. America. Darlington (1952, 1969) also suggested two: 1. the Fertile Crescent of the Near East and 2. Mexico. From these nuclear areas agriculture would have spread over 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 Eastern Turkey
4. Afghanistan
5. Indo-Burma
6. Siam-Malaya-Java
7. China
8. Mexico
9. Peru
10. Chile
11. Brazil-Paraguay
12. USA



Gene centres of cultivated plants of Darlington & Janaki Ammal (1945) based on Vavilov

As compared with list on p. 22 continental Chile instead of the Isle of Chiloe, the Brazil-Paraguay and the USA are added.

Darlington & Janaki Ammal considered the Mediterranean centre as a diffuse one. It is based on 'cultural rather than botanical considerations. 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 Central America) already mentioned by Vavilov). He furthermore used, without explanation, the term 'region', though the captions of his table and figure still mention 'centres'. This resulted in

1. Southwest Asia
2. Mediterranean
2a. Europe
3. Ethiopia
3a. Central Africa
4. Central Asia
5. Indo-Burma
6. Southeast Asia
7. China
8. Mexico
8a. USA
8b. Central America
9. Peru
9a. Chile
9b. Brazil-Paraguay

In 1950, Portères suggested independent cradles of agriculture in Africa south of the Sahara. One was located is East Africa, the other in Tropical West Africa. He divided the latter into 1. the Senegambian 'Subcradle', 2. the Central Niger 'Subcradle', 3. the Benin 'Subcradle' and 4. the Adamawa 'Subcradle'. Other African cradles of agriculture stood in North 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. Central Niger subsector
      c. Chad-Nilotic subsector
   II. Subequatorial sector
B. Nilo-Abyssinian cradle
   I. Nilotic sector
   II. Abyssinian sector
C. East African cradle
D. Central African cradle

The Nilo-Abyssinian cradle coincides with Vavilov's Ethiopia and a part of the Mediterranean centre

of origin. The last two cradles have not further been elaborated. Portères (1950, 1962) decided on a West 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. Southwest Asian agricultural complex developed by the Caucasoids
2. Southeast Asian complex developed by the Mongoloids
3. Central American complex developed by the American Indians
4. West African complex developed by the West 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 Central 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, while 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 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:

1. few of the domesticates are definitely known to derive from W. Africa;
2. several of the domesticates have so little differentiated from the wild that they cannot be of great antiquity as cultivated plants;
3. if cultivation had been practised locally for seven millenia, an associated weed flora rich in indigenous species should to have evolved.

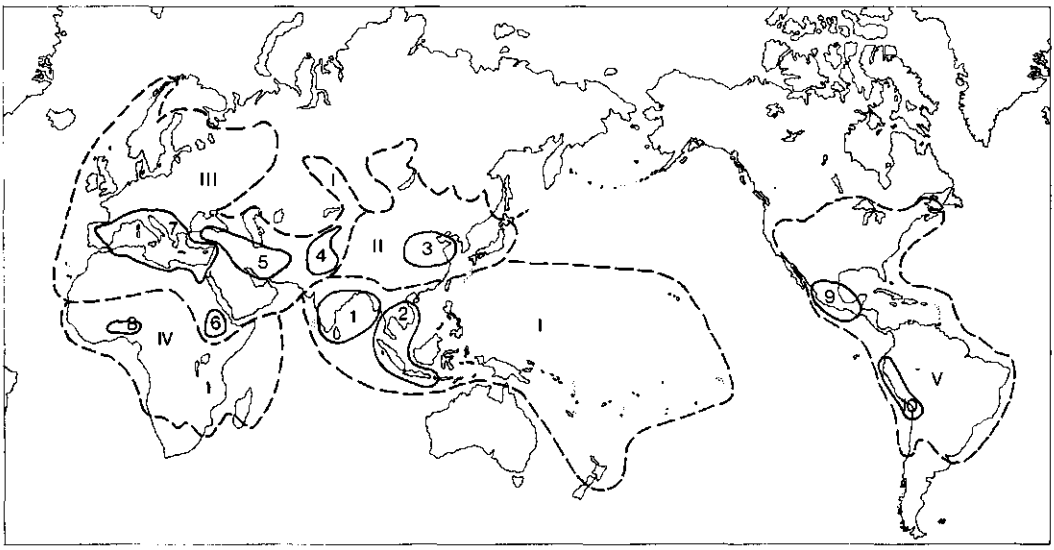
Harris (1967) concluded that the typically W. African crops are local additions to an intrusive agricultural complex, rather than compounds of an ancient indigenous one. After the introduction of agriculture into N. Africa it spread into the Sahara. Owing to the desiccation of this area in the third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

Kupzov (1955, cited by Darlington, 1956) showed which regions of the world 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. Central Asiatic 5. Near East 6. Ethiopian 7. Mediterranean	III. Europoid
8. Nigerian	IV. Negroid
9. Mexican 10. Peruvian	V. Americanoid

Except that of Nigeria they derive from a neolithic stage. Darlington (1956) who cited Kupzov does not explain why Kupzov came to this classification.

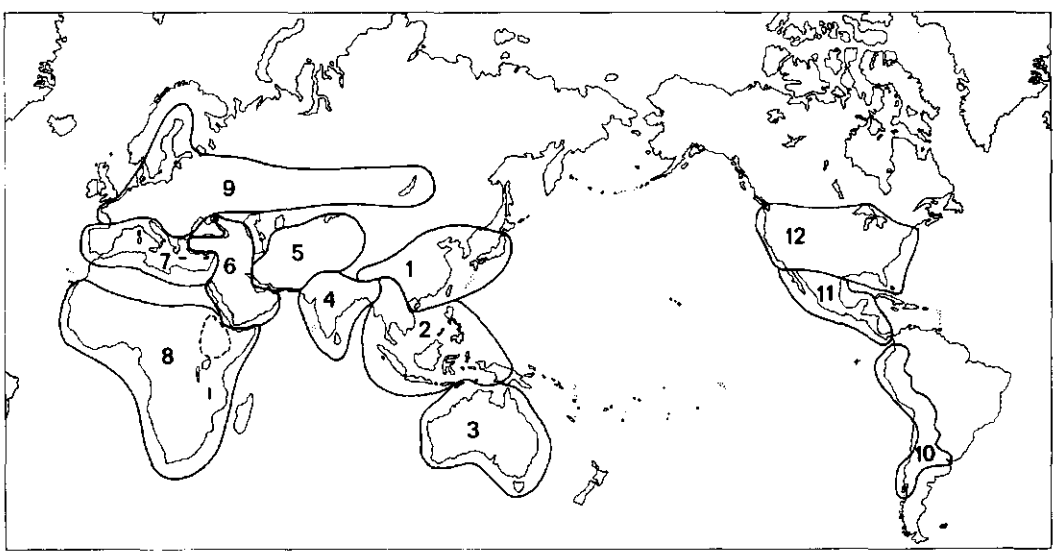
Zhukovsky (1965) was the first to refer to Siberia as a gene centre. Many Malus, Prunus, Pyrus and other species have been domesticated there. Further it is a rich source of wild relatives of these species.



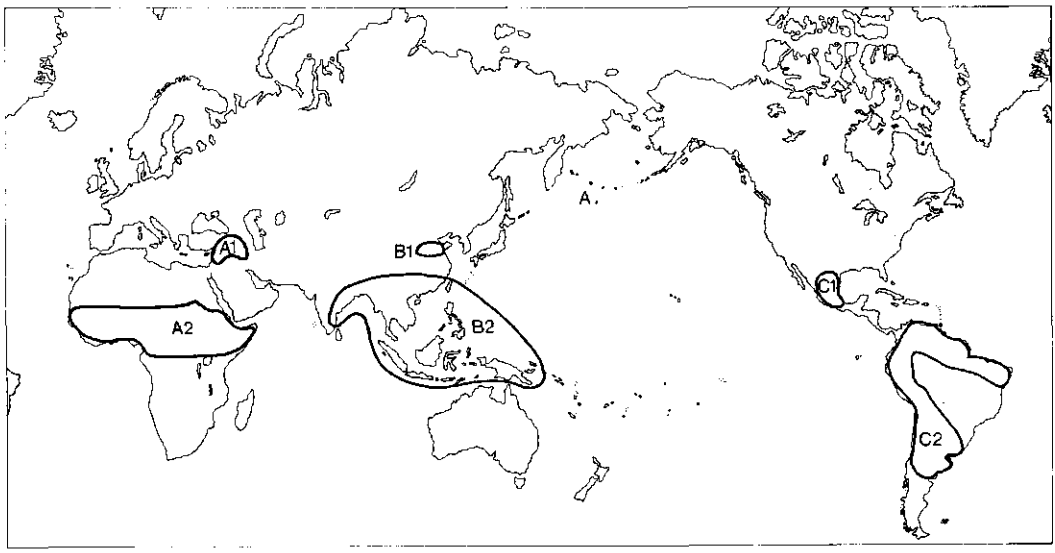
Primary regions of agriculture (——) and regions of expansion (---) of Darlington (1956) based on Kupzov (1955)

In 1968 Zhukovsky 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 world's land surface and adjoin over great distances. They are:

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



Megacentres of cultivated plants of Zhukovsky (1968)



Centres and noncentres of agricultural beginnings of Harlan (1971)

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

In 1970 Zhukovsky 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 noncentres. He suggested that agriculture began independently in three areas and that there was a system composed of a centre and a noncentre. In a noncentre, agriculture has been introduced after which many indigenous plant species were domesticated. Harlan (1971) preferred the term noncentre because of the large area involved. His classification is:

Centre	Noncentre
A1. Near Eastern	A2. African
B1. Chinese	B2. Southeastern Asian and S. Pacific
C1. Central American	C2. South American

Important crops domesticated in the noncentres may in some cases have spread to its centre in early times.

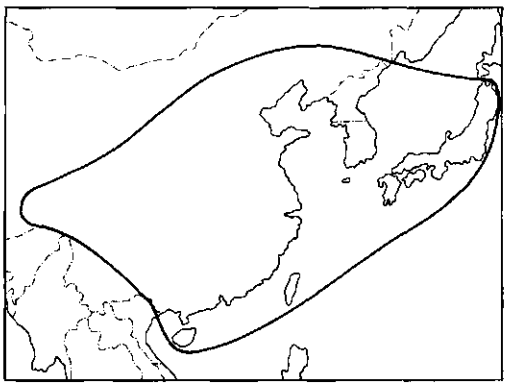
Zhukovsky's (1970) classification has been used as the base of the following list, though possibly some megacentres still have to be enlarged till at least they cover most of the world's surface. This holds especially for South America where a shift of the eastern boundary may include Brazil and Paraguay and the land west of these countries, as proposed by Darlington & Janaki Ammal (1945).

Zeven (unpublished) preferred the term Region instead of Megacentre.

Future research has to show whether there have been three cradles of the origins of agriculture: 1. Eastern Asia (China and Birma), 2. the Near East (Fertile Crescent) and 3. Central America and how from these cradles agriculture spread over the world.

A. C. Zeven.

1 Chinese-Japanese Centre



The Chinese-Japanese centre was called by Vavilov the East Asian Centre of Origin. It is mostly situated in China. For several crops is Japan a secondary centre of diversity. Sometimes this region is associated with the primary region of diversity of fruit crops in Amur-Ussuri area. Li (1966 quoted by Chang, 1970) divided China in two areas: 1. N. China with a seed and vegetable agriculture and 2. S. China which forms a buffer zone between N. China and centre 2 (vegetatively reproduced crops). Chang (1970) and Harlan (1971) suggested an independent origin of agriculture in N. China, which resulted in a wholly original assemblage of cultivated plants. Harlan called this centre B1 North Chinese centre.

The earliest site of agriculture lies at Yang-Shao. It is a strictly Chinese centre with no appreciable foreign influence upto 1300 BC. It is assessed at present about to be 4th millenium BC. It is very probably that still older farming sites will be found (Harlan, 1971).

China is one of the richest regions contributing many important crops particularly fruit trees. Other important crops are Brassica campestris and related species, Camellia sinensis, Colocasia esculenta, Corchorus sinensis, Glycine max, Panicum milaceum, Raphanus sativus, Setaria italica etc. It is a secondary centre for Oryza sativa ssp. japonica, Zea mays 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=16, 32. S. 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. 71). Var. pekinense Makino sometimes considered a native of N. China. Cultivated in N. China and Japan (Li, 1969).

ALLIUM SCHOENOPRASUM L. Chive. 2n=16, (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 e 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=28, 42. SE. Asia (p. 000). 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. 2n=44. 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).

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).

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. 129).

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

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

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 region 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. 130) as a medicinal plant.

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

CHRYSANTHEMUM CORONARIUM L. Garland chrysanthemum. 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= . 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 exists 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. Cultivated in China and Hongkong in fish ponds to provide spinach, pig and fish food (Purseglove, 1968). It is also grown on flooded rice fields and on raised beds.

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 walnut. 2n=28. Japan. Cultivated there.

Cruciferae

BRASSICA ALBOGLABRA Bailey. Chinese kale. 2n=18. China. Cultivation originated in S. China (Li, 1970).

BRASSICA CAMPESTRIS L. 2n=20, genome formula AA. See p. 131 for the origin of this species. In Centre 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 in 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 a 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 and 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 dark-green leaves.

EUTREMA WASABI Max. (syn. Wasabi japonica Matsum., W. pungens Matsum., Lunaria japonica Miq.). Wasabi. 2n=28. Cultivated in Japan and E. Siberia (Kihara, 1969).

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 de 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. 95).
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.

Cucurbitaceae

CUCUMIS MELO L. Melon, Muskmelon, Canteloupe. 2n=24. Centre of origin in Africa (p. 110). 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. 64). Secondary gene centre (a mesophytic type with very elongated fruits) arose there. Sources of resistance to 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 an auto- or alloploidization, which may have happened in Japan or China where their roots are used te 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*.

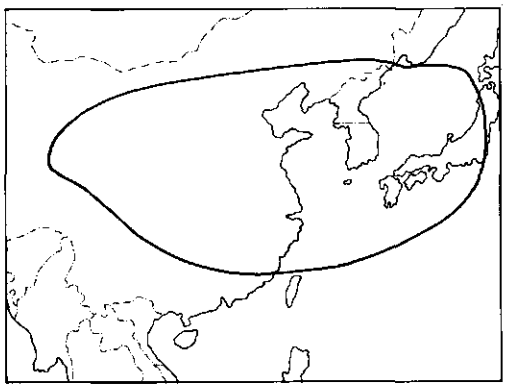
ELEOCHARIS DULCIS (Burm. f.). Trinius (syn. E. plantaginea R. Br.). Water chestnut. 2n= . W. Africa, upto India, China, Japan, Phillippines, Fiji and New-Caledonia. A herb. Cultivated in S. China for its tubers.

ELEOCHARIS TUBEROSA Schultes. Water chestnut. 2n= . E. India, China and Japan. Cultivated in the Far-East.

Dioscoreaceae

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

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 Central 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. 72). Both 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 elaeagnus. 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 Formosa. 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. 175). 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 damaga 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, Formosa, 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 from 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. 97). 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 Indo-China 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. 64) 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: Indo-China (p. 47) 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 occasionnally 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. 80. 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 SINENSIS Anderss. 2n=38. Cultivated as an 'arrow plant'. It may have played a role in the origin of the Pansahi group of Saccharum sinense* (Grassl, 1968).

ORYZA SATIVA L. ecospecies japonica (syn. ssp. japonica Kato). Japonica rice. 2n=24, genome formula AA. Indo-China. The origin of rice is discussed on p. 65. 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).

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.

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 (Riu-Kiu 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. 116). 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. 82). It arrived through Korea and Japan in about 300 B.C. (Kihara, 1969). Secondary centre of diversity in both countries. The Chinese wheats are characterized by very broad leaves, with 5 to 7 florets per spikelet, with squarehead ears, with daylength 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. 166). 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 waterrice. 2n=30, 34. China and adjacent regions. Cultivated as a cereal in N. China in ancient times. Later on, its cultivation moved to the south. Its use as a cereal gradually decreased. Now it is chiefly cultivated in the south for its fleshy shoots which yield the vegetable Chiaopai (Li, 1970).

Grossulariaceae

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

RIBES LONGERACEMOSUM Franch. 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 Willd. 2n= . China and Japan. A perennial plant introduced in other parts of Asia, Europe and America as an oil-seed 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.

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. Ceylon and SW. India. Cultivation started in Ceylon in 1770. Cultivated now in several countries.

Leguminosae

ASTRAGALUS 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. (syn. Soja hispida Moench, S. max (L.) Piper, Glycine hispida (Moench) Maxim., G. gracilis Skvortzow). Soya bean. 2n=(38), 40. It is unknown wild. It is believed to be a cultigen from G. ussuriensis Regel & Maack. (syn. G. javanica Thunb., G. soja Sieb. & Zucc.) (2n=40). This latter species is found in N. and C. China, Taiwan, Japan, Korea, Manchuria and adjacent USSR. Domestication may have taken place in E. half of N. China about the 11th century BC. (Hermann, 1962; Hymowitz, 1970). Semi-cultivated and weedy types described as G. gracilis Skvortzow (2n=40), might be hybrids of G. max and G. ussuriensis.

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 Central 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. 168. 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. 51).

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. 68). 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 is has a low breeding value.

HIBISCUS SYRIACUS L. Rose of Sharon. 2n=80, 80-84, 90, 92. China and Formosa. 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 A.D. 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 bark-cloth (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 road-side 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 OVAFOLIUM 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.

Pedaliaceae

SESAMUM INDICUM L. Sesame, Beni seed. 2n=26. Primary centre is discussed on p. 126. Secondary centre in China/Japan. There ssp. quadricarpellatum developed.

Phytolaccaceae

PHYTOLACCA ACINOSA Roxb. 2n=36. Trop. Asia, China and Japan. A perennial herb cultivated in India as a vegetable. In the Chinese pharmacy the berries are used.

Plantaginaceae

PLANTAGO MAJOR L. 2n= . Europe and temp. Asia. Var. asiaticum Dcne. is cultivated in China as a vegetable and as a medicinal herb.

Polygonaceae

FAGOPYRUM TATARICUM (L.) Gaertn. Tatary buckwheat. 2n=16. Primary centre is probably in East Asia. There, it is often found as a weed of barley and wheat fields. It is a source of rutine.

POLYGONUM HYDROPIPER L. Tade, Knotweed. 2n=20, (22). Cultivated in Japan (Kihara, 1969) and formerly, also in China. Var. maximowiczii is the edible type. In China and elsewhere it is a weed now (Li, 1969).

POLYGONUM MAXIMOWICZII Regel. 2n= Japan. Cultivated there as a vegetable.

POLYGONUM TINCTORIUM Ait. 2n=40. China. Formerly it was cultivated as a blue dye-plant. It is naturalized for instance in the Ukraine.

RHEUM HYBRIDUM Murray. Rhubarb. 2n= Originating probably in Mongolia. Probably a hybrid of R. rhaponticum and R. palmatum*.

RHEUM OFFICINALE Baill. Medicinal rhubarb. 2n=22, (44). Cultivated in China as a medicinal crop.

RHEUM PALMATUM L. East Indian rhubarb, China rhubarb, Turkey rhubarb. 2n=22, (44). Mongolia, or W. China. Cultivated formerly as a purgative (root) and at present as an ornamental. It is probably one of the parents of R. hybridum* (syn. R. rhabarbarum L.). It is related to R. rhaponticum* (syn. R. rhabarbarum L.).

RHEUM UNDULATUM L. 2n=22, 44. China. Cultivated as a vegetable.

Ranunculaceae

ACONITUM CARMICHAELI Debeaux (syn. A. wilsonii Stapf ex Mottet). 2n=64. China. Cultivated there as a medicinal crop.

COPTIS CHINENSIS Franch. 2n= . W. China. A herb cultivated as a medicinal plant.

Rhamnaceae

HOVENIA DULCIS Thunb. Japanese raisin tree. 2n=24. China, Korea and Japan. Cultivated in E. Asia upto India for its edible inflorescence and as an ornamental.

ZIZIPHUS JUJUBA Mill. non Lam. (syn. Z. vulgaris Lam.). Jujub, Chinese jujube. 2n=24, (40), 48, (60, 72), 96. Primary gene centre of the wild and cultivated types is probably in Central and S. China. Wild type grows in many Asian countries.

ZIZIPHUS MAURITIANA Lam. (syn. Z. jujuba (L.) Lam. non Mill.), Z. sosoria Roem. & Schult.). Indian jujube. 2n=48. Tropical Africa and Asia. Cultivated in India, Cochinchina and China since ancient times.

Rosaceae

AMYGDALUS BESSERIANA Schott. (syn. A. nana L.). Dwarf almond, Russian almond, Steppe almond. 2n=16. Primary gene centre is in E. Europe and Siberia (p. 139). Ssp. rosiflora types from China are sources of winterhardiness, precocious fruiting and prostrate-growing. Disadvantages are its small and white-fleshed fruits.

AMYGDALUS KANSUENSIS Skeels. (syn. Persica kansuensis (Rehd.) Kov. & Kost., Prunus kansuensis Rehd.). Chinese bush peach. 2n= . NW. China. It tolerates -35°C. It could be useful as a rootstock (Zylka, 1970).

AMYGDALUS MIRA (K.) Koch (syn. Prunus mira Koehne). Smoothpit peach. 2n= . W. China. It might be used as a source of late flowering (Zylka, 1970) and winterhardiness.

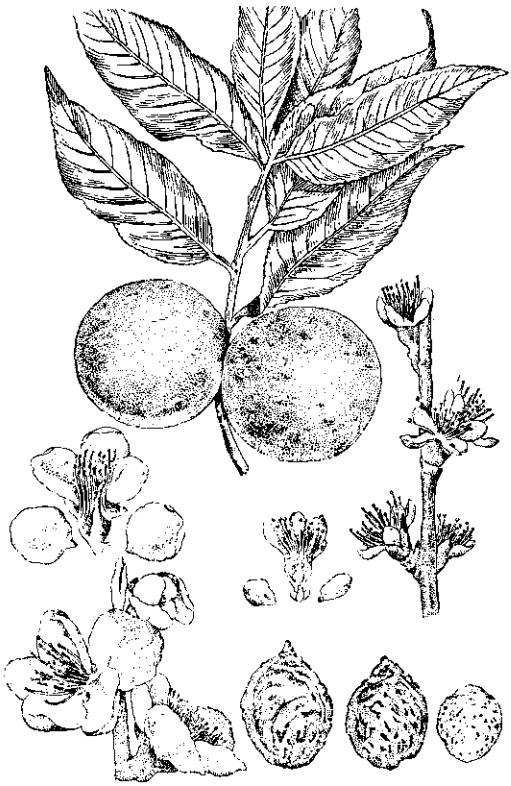
AMYGDALUS PERSICA L. (syn. A. pumila Lour., Persica vulgaris Mill., Prunus persica (L.) Batsch.). Peach. 2n=16. Primary centre: montane areas of Tibet and SW. China (Holub, 1969). Secondary centres: Iran, C. Asia (p. 74), Caucasus, Crimea (p. 89), Moldavia (USSR) (p. 139), Italy, Spain (p. 105) and California, USA (p. 177). Cultivated for its fruits and as an ornamental. Holub (1969) divided the cultivated varieties according to their morphology and geography into four groups viz. 1. Chinese, 2. Central Chinese, 3. Western Chinese and 4. Yellow-fleshed from Europe.

ARMENIACA MANDSHURICA (Koehne) Kost. (syn. Prunus mandshurica (Maxim.), P. armeniaca var. mandshurica Maxim.). Manchurian apricot. 2n=16. S. Ussuria, E. Manchuria upto N. Korea. It resists intense cold.

ARMENIACA MUME (Sieb. & Zucc.) Sieb. ex Carr. (syn. Prunus mume Sieb. & Zucc.). Japanese apricot. 2n=16, 24. Mountains in Central and N. China. Cultivated as an ornamental in China, Korea and Japan. Its kernel is eaten. It is not frost resistant.

ARMENIACA VULGARIS Lam. (syn. Prunus armeniaca L., P. tiliaefolia Salisb.). Apricot. 2n=16. Primary gene centre: NE. China. Secondary gene centre in E. Tian-Shan and in Trans-Ilii and Dzhungar-Alatau. A small area of wild apricots is found in Daghestan (p. 89) and in the Kotur Bulak canyon in the Alma-Ata region. Evreinoff (1955) believed that it occurred in a much larger region up to Armenia and Iran. The related A. ansu (Max.) Kost. (syn. Prunus ansu Komar) (2n=) could be used as a source of resistance to fungal diseases.

CHAENOMELES SINENSIS (Thouin) Koehne. Chinese quince, Japanese quince. 2n=32. Its fruits



Prunus bessyi

have the aroma of quince. Therefore it is mistakenly described as a species of C. donia.

CRATAEGUS HUPEHENSIS Wils. 2n= . Hupeh, China. Cultivated there for its fruits.

CRATAEGUS PENTAGYNA Waldst. & Kit. (syn. C. pinnatifida Bunge). Chinese hawthorn. 2n=34. N. China, Korea and Siberia. Cultivated in China for its fruits (Li, 1970).

DUCHESNEA FILIPENDULA (Hemsl.) Focke. (Syn. Fragaria filipendula Hemsl.). 2n= . A herb of China cultivated for its fruits.

ERIOBOTRYA JAPONICA (Thunb.) Lindl. Loquat, Japanese plum, Japanese medlar. 2n=32, 34. Cultivated in China, Japan, California and S. Europe.

MALUS ASIATICA Nakai (syn. M. prunifolia var. rinki). 2n= . NW. China. Used for cultivation.

MALUS BACCATA (L.) Borkh. var. mandchurica (Max.). Schneid. (syn. Pyrus baccata L.). Manchurian crab apple. 2n=34. Primary gene centre: the Shansi, Shensi, Kiangsi and other provinces in China. Centre of origin probably Siberia, SE. of Lake Baikal (p. 140). Used for rootstock material.

MALUS HALLIANA Koehne. 2n=34. Gene centre in China and Manchuria. A wild ornamental.

MALUS HUPEHENSIS (Pamp.) Rehd. (syn. Pyrus hupehensis Rehd.). Chinese crab apple. 2n=51, 68. C. and W. China and south into Assam. It is used as rootstock.

MALUS MICROMALUS Makino. 2n=34. China and Japan. Cultivated there. Its fruits are edible (Rehder, 1947). It is thought to be a hybrid of M. spectabilis x probably M. baccata.

MALUS PUMILA var. niedzwetskyana Dieck. 2n=34. Tian-Shan mountains, China.

MALUS SIEBOLDII Rehd. (syn. Pyrus toringo Sieb.). Toringa crab. 2n=34. Primary centre Japan. It is a profusely branching salt-tolerant shrub used as rootstock for dwarf plantings.

MALUS SPECTABILIS (Ait.) Borkh. Zamechatelnaya. 2n=34, 51. Primary centre: Central China. It is not known wild. It is probably a parent of M. micromalus*.

PRUNUS subgen. cerasus Pers. There are probably 150 species belonging to ssp. cerasus. The greatest number is located in the mountain regions of W. China. Some big fruited species are valuable for breeding.

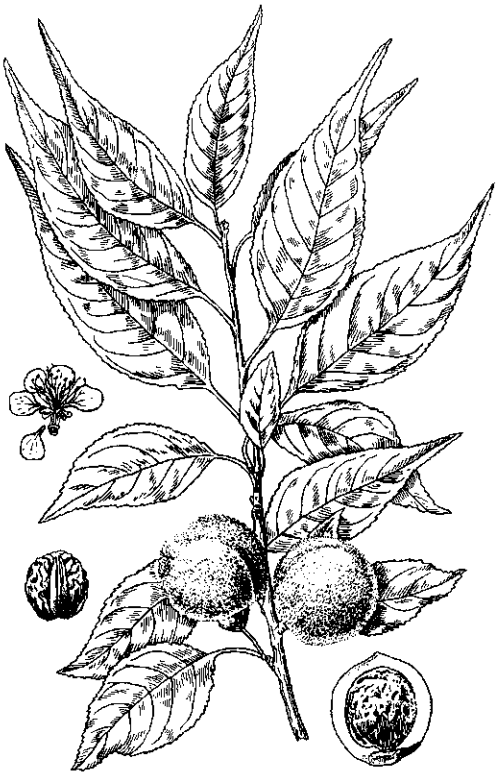
PRUNUS CANTABRIGIENSIS Stapf. (syn. P. pseudocerasus Koids.). Chinese sour cherry, Yingtao cherry. 2n= . Yangtze Valley in China. Cultivated in China (Uphof, 1968).

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



Prunus davidiana

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 in 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. 55. 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, Kongkong kumquat. 2n=18, (36). The Tziulun mountains of Honkong. 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. Trifoliata 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.

TRIPHASIA TRIFOLIA (Burm.f.) P. Wilson (syn. T. aurantiola Lour., T. trifoliata DC.). Lime berry, Trifoliata 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

NEPHELIUM LITCHI Camb. (syn. Litchi chinensis Sonn.). Litchi. 2n=28, 30. S. China. Cultivated there and elsewhere for its 'litchi nuts'.

NEPHELIUM LONGANA (Lam.) Camb. (syn. Euphoria longana Lam.). Longan. 2n=30. C. and S. China. Cultivated there for its fruits.

SAPINDUS MUKOROSSO Gaertn. Chinese soapberry. Soapnut tree. 2n= . China, Burma and Himalaya. Cultivated in China, Japan, India and elsewhere for its fruits.

Scrophulariaceae

VERONICA ANAGALLIS L. 2n=36. Temperate zone. Cultivated in Japan as a lettuce.

Simaroubaceae

AILANTHUS VILMORINIANA Dode. 2n= . W. China. Cultivated there as a source of food for silk worms.

Solanaceae

SOLANUM MELONGENA L. var. esculentum Nees. Chinese eggplant. 2n=24. Domesticated in India (p. 55). Secondary centre: China. There the small fruited-form already existed before 500 AD (Li, 1969).

Taxaceae

TORREYA GRANDIS Fort. Chinese torreya. 2n= . China. Cultivated in Szechuan and Anhwei, China.

TORREYA NUCIFERA Sieb. & Zucc. Japanese torreya, Kaya. 2n= . Japan. Cultivated there.

Tetragoniaceae

TETRAGONIA EXPANSA Murr. New Zealand spinach, Tsuruna. 2n=32. Japan. Cultivated there (Kihara, 1969). However, Uphof (1968) restricted its native area to Australia and New Zealand.

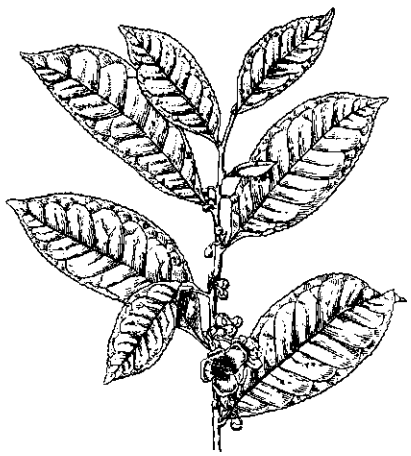
Theaceae

CAMELLIA JAPONICA L. Camellia. 2n=30. From Taiwan northwards through the Riu Kiu islands and Yakushima to S. Japan, also in S. Korea and Dagelet islands (Sealy, 1958). Cultivated for its Tsubaki Oil and as an ornamental. Attempts to cross it with tea, C. sinensis* have failed so far, although C. wabiske* might be a natural hybrid of C. sinensis and C. japonica. If so this species might be used to introduce japonica characters such as cold resistance into tea.

CAMELLIA OLEIFERA Abel. (syn. C. sasanqua Thunb.). Sasanqua camellia. 2n=90. China. Cultivated there and Indo-China to yield 'tea oil' (Sealy, 1958).

CAMELLIA SINENSIS (L.). O. Kuntze (syn. C. thea Link., Thea sinensis L.). Tea. 2n=30, (45,

60). Primary centre: the mountains of China, north of NE. India (Simura et al., 1967). It spread to SE. China, Indo-China, Assam and later to other countries. Secondary centres: Assam, other parts of India (p. 70) and Ceylon. The taxonomy of Camellia is confusing. Some group the cultivated escapes and putative wild plants in one species C. sinensis, and recognize subspecies, varieties and types; others have given some subspecies/varieties/types specific rank. Wu et al. (1970) suggested that the wild tea populations originated from heterogeneous populations of species hybrids. The main types are China tea (C. sinensis var. sinensis L., syn. C. sinensis L.) and Assam tea (C. sinensis var. assamica (Masters) Wight, syn. C. assamica Masters). The latter type includes the Cambodia race (C. assamica ssp. lasiocalyx Planch. -MS, syn. Thea lasiocalyx Planch.). At Tocklai, Assam Wilson's Camellia (C. irrawadiensis P.K. Barua) is found. The Forest's Camellia (C. taliensis Sealy) produces tea of low quality. It is probably a hybrid of C. sinensis and C. irrawadiensis and should be included in the latter species. Darjeeling tea also is a possible product of C. sinensis introgression in C. assamica (C. irrawadiensis) (Visser, 1969).
Leaves are widely used to make tea; in Burma leaves are used to prepare pickled tea as food (Simura et al., 1967).
C. wabiske* might be a natural hybrid of C. sinensis and C. japonica* and so are the 'China hybrids' and Cambodian varieties of tea (Bezbaruah & Gogoi, 1972).



Camellia sinensis

CAMELLIA WABISKE Kitamura. Wabisuke. 2n=30. Cultivated in Japan. This species is considered as a natural hybrid of C. sinensis* and C. japonica* L. If so it could probably be used as a bridge species between these two species, because hybridization of them has failed so far.

Thymelaeaceae

DAPHNE ODORA Thunb. 2n=(18, 27), 28, 30. Japan. A shrub cultivated there for its fragrant flowers.

EDGEWORTHIA PAPYRIFERA Sieb. & Zucc. (syn. Daphne papyrifera Sieb.). 2n=36, (72). Japan. Occasionally cultivated there.

Tiliaceae

CORCHORUS OLITORIUS L. Jute, Tossa jute, Jew's mallow. 2n=14. S. China and probably taken to India/Pakistan. Cultivated as a spinach in the Ganges-Brahmaputra delta, where it may have run wild and in the Middle East, Egypt, Sudan and trop. Africa.

Trapaceae

TRAPA BICORNIS L. 2n= , China. A waterplant cultivated there, Korea and Japan.

TRAPA BISPINOSA Roxb. Singhara nut. 2n= India, China and Japan. A waterplant cultivated for the seeds in India.

TRAPA NATANS L. Water chestnut, Water caltrop. 2n=c. 36, 40, 48, c. 48. Europe, Mediterranean region and Asia. It was cultivated in S. China (Li, 1970). Elsewhere the seeds have been consumed since neolithic times.

Typhaceae

TYPHA LATIFOLIA L. Cat-tail, Reeds mace, Bull rush, Marsh beetle. 2n=30. A cosmopolitic plant cultivated in China.

Umbelliferae

ANGELICA KIUSIANA Maxim. 2n=22. China. An old Chinese vegetable. It is a weed now (Li, 1969).

ANGELICA POLYMORPHA Maxim. 2n=22. China. Cultivated there as a medicinal crop.

CRYPTOTAENIA JAPONICA Hassk. Mitsube. 2n=(18), 20, 22. Cultivated in Japan.

GLEHNIA LITORALIS F. Schmidt. 2n=22. N. and E. Asia. Cultivated in Shantung, China.

PHELLOPTERUS LITTORALIS Benth. Hama-bôhû. 2n=22. Sachalin, Japan and China. Cultivated in Japan (Uphof, 1968; Kihara, 1969).

Urticaceae

BOEHMERIA NIVEA (L.). Gaud. Ramie, Rhea, China grass. 2n=28, (42). S. and C. China, on Taiwan and S. Japan. Cultivated in China since ancient times, where there are many varieties, Japan, Philippines and other trop. countries. Var. chinensis, Chinese ramie, White ramie, (2n=28) may have originated in SW. China, while var. indicum (syn. B. utilis Blume, B. tenacissima Gaud. (2n=), Indian ramie. Green ramie

might be a derivative of a cross between var. chinensis and an unknown species.

Violaceae

VIOLA VERUCUNDA A. Gray. Chin. 2n=24. China. An old chinese vegetable. Now it is a weed (Li, 1969).

Vitadaceae

VITIS AMURENSIS Rupr. (syn. V. thunbergii Regel, V. shiragai Makino). Amut grape. 2n=38. Primorye and Khabarovak and NE. China. This species belongs to the Chinese centre of origin of Vitis-species. It withstands -40°C. It is a possible source of winterhardiness for V. vinifera*. Occasionally cultivated.

VITIS DAVIDII (Rom.) Foex. Spring vitis. 2n= The Tziansu and Yunna Provinces, China. Occasionally cultivated there.

Zingiberaceae

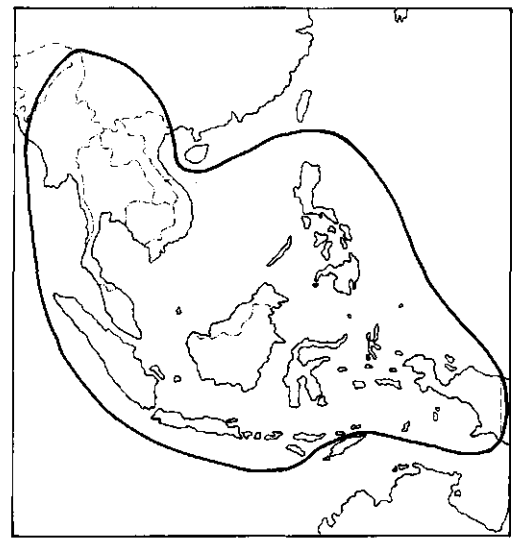
ALPINIA CHINENSIS Rosc. 2n=48. China and Indo-China. The rhizomes are used in Chinese medicine and the leaves for fibre. Sometimes cultivated.

ALPINIA OFFICINARUM Hance. Lesser galangal, Small galangal. 2n= . E. and SE. Asia. Cultivated in China.

AMOMUM GLOBOSUM Lour. Round Chinese cardamon. 2n= . China. Cultivated there.

ZINGIBER MIOGA (Thunb.) Rosc. Mioga ginger, Myôga. 2n=55. Japan. Cultivated there (Kihara, 1969).

2 Indochinese-Indonesian Centre



Vavilov called the Indochinese-Indonesian centre 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: Malay peninsula and the Malay achipelago. Li described for Centre 2 an agriculture mainly based on vegetatively propagated crops. Harlan (1971) considered this region as a noncentre B_2 Southeast Asian and South Pacific noncentre, as agriculture may have been introduced into this Centre.

The oldest agricultural remains come from centre 2: the Spirit Cave 60 km N. of Mae Hongson, Nw. Thailand (Gorman, 1969). This coincides with Sauer's (1959) conclusion that the Old World centre of development of agriculture was situated in the NW. part of Centre 2 (about present Burma). The 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., while during 15 000 - 8 000 BC. there was further domestication of plants and domestication of animals, resulting in large-scale agriculture and animal husbandry.

Another archeological site is at Non Nok Tha, NE. Thailand. It dates from perhaps 5 000 BC.

In the Spirit Cave remains of Prunus, Terminalia, Areca, Vicia or Phaseolus, Pisum or Raphia, Lagenaria and Trapa, in another layer Piper, Madhuca, Canarium, Aleurites and Areca had been found, while in a third layer Canarium, Lagenaria and Cucumis had been discovered (Gorman, 1969). Further work should support the taxonomic identifications. For instance Schultz-Motel (1972) could not accept that Vicia faba* could have been found. Chang (1970) used the presence of Vicia faba/Phaseolus, Pisum/(Raphia), Lagenaria, Trapa and Cucumis as proofs that these plants were actually cultivated.

If this conclusion is correct this centre should be according to Harlan (1971) a centre and not a noncentre.

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

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 potherb. 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 potherb 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. Indo-China 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= . 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. 63).

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

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

COLOCASIA ESCULENTA (L.) Schott. Dasheen, Taro, Cocoyam. 2n=28, 42. SE. Asia. It was an early domesticant introduced into China and Japan, where var. antiquorum* developed, the Mediterranean region, W. Africa, the Pacific islands, New Guinea, Samoa and New Zealand. In SE. Asia var. esculenta (syn. C. esculenta s.s., C. esculenta var. typica A.E. Hill) developed.

Many socalled wild plants are probably derivates of plants that have run wild (Purseglove, 1972).

Colocasia esculenta

CYRTOSPERMA CHAMISSONIS (Schott.) Merr. (syn. C. edule Schott, C. merkusii (Hassk.) Schott. 2n= . Indo-Malaysian region. 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 en 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.

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 PENTANDRA Gaertn., var. indica (DC.) Bakh. Kapok tree, Silk cotton tree. 2n=72, 80, 88. Secondary gene centre: SE. Asia. Introduced from Africa (p. 108) 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 spread now 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, the Moluccas, Celebes, S. Philippines, Indonesia and Malaya. Introduced to Indochina, Thailand, Burma, Ceylon 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= The Moluccas (Indonesia). 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= . The 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 Cochinchina.

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 manu-

facturing 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.

CARUM ROXBURGHIANUM Benth. (syn. Trachyspermum roxburghianum (DC.) Wolff). Ajmud. 2n=18. Trop. Asia. Unknown wild. Cultivated in Indochina, Ceylon and India.

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.

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 Choisy. 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. 64) to Australia.

Cyperaceae

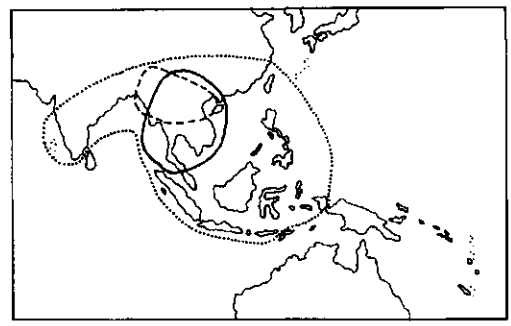
FIMBRISTYLIS GLOBULOSA (Retz.) Kunth. 2n= . Trop. Asia, Ceylon, India, Malaysia and Mariannes. Cultivated on Malaysia for matmaking etc.

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= .



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. 111). Cultivated in Trop. Asia, Africa, Oceania and the West Indies. The tubers and bulbils are edible. The African form (p. 111) 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. Indo-China. Cultivated in S. China, and later throughout the tropics.

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

DIOSCOREA HISPIDA Roxb. (syn. D. hirsuta Dennst, D. triphylla L.). 2n=40, (80). India (p. 64) 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 Bangla Desh 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, Bamucalang. 2n=22. The Philippines. Cultivated there, in Malaya and Indonesia. Crosses with A. montana did not succeed (Wit, 1969).

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= The Malayan Archipelago. Cultivated there for its fruits.

GLOCHIDION BLANCOI Lowe. 2n= . A tree cultivated in the 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. 148). 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. 148 and 165). Secondary centre of diversity in Indonesia.

PLUKENETIA CORNICULATA Smith. (syn. Pterococcus corniculatus Pax & Hoffm.). Painapaina. 2n= . SE. Asia. Cultivated as a 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= . The Malayan 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 Siam. Cultivated in many trop. 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 tropical 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 Fidji. 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.

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. 64). 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. 64). Secondary centres: Indochina and S. China (p. 32).

BAMBUSA TULDA Roxb. 2n= . India, Burma (p. 64) and Tahiti. Secondary centre: Java.

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

COIX LACRYMA-JOBI L. Job tears, Adlay. 2n=20. Trop. Asia. Probably first domesticated as a cereal in Indochina. Cultivated in the tropics now.

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

CYMBOPOGON NARDUS (L.) Rendle (syn. Andropogon nardus L.). Citronella grass. 2n=20, (40, 60). Cultivated in Indonesia, Ceylon and elsewhere for its citronella oil. There are two types of oil: 1. Ceylon type obtained from var. lenabatu which is cultivated in S. Ceylon and 2. Java type obtained from var. mahapengiri (syn. C. winterianus Jowett, 2n=20). The latter was introduced into Java from Ceylon early in 20th Century. It is now widely distributed throughout the tropics.

DENDROCALAMUS ASPER (Schult.) Becker ex Heyne (syn. Bambusa asper Schult.). 2n= Probably from the Malay Peninsula and adjacent areas. Unknown wild. Secondary centre: Malay 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= Philippines. 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= . Malaya 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 Malaya Peninsula (Tenasserim). Secondary centre: Java.

GIGANTOCHLOA LIGULATA Gamble. 2n= N. part of Malaya 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= The Malaysian 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= . Unknown wild. Cultivated on the Malay Archipelago. Its stems are used as building material and for the paper industry. The sprouts are eaten. There are several varieties.

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

ORYZA GRANULATA Nees & Arn. (incl. O. meyeriana Baill.). 2n=24, 48. Malaya. It belongs to the 'officinalis' group of Oryza (p. 47).

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. It may include the 'old' species O. fatua*, O. sativa f. spontanea* and O. rufipogon*.

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. 65. 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*.

Recent views of taxonomists include in O. ru-

fipogon: 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. The primary centre: SE. Himalaya region (p. 65). Ecotype Tjereh and Bulu developed in Indonesia. Thereh belongs to the ecospecies 'aman' (ssp. indica Kato) (Morinaga, 1968).

ORYZA SCHLECHTERI Pilger. 2n= . New Guinea.

PASPALUM SCROBICULATUM*

SACCHARUM EDULE Hassk. 2n=70-120. Probably near Maprik, New Guinea. Cultivated for its edible inflorescens. It may have developed as a hybrid of S. robustum and Miscanthus floridulus*. A group of closely related cultivars is found in Fiji. It may derive from S. officinarum* x M. floridulus (See S. officinarum*) (Grassl, 1964, 1967, 1968; Price 1963).

SACCHARUM OFFICINARUM L. Sugarcane, Noble sugarcane. 2n=40II=80. New Guinea. Modern clones resulting from hybridization (2n=100-125). Sugarcane derives from S. robustum Brandes & Jeswiet ex Grassl. which grows wild in New Guinea, Celebes, Borneo upto New Hebrides. Basic types of northern 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 sugarcane was developed.

S. robustum is cultivated for its large stalks which are used for fences and for construction. During the domestication of sugarcane, geographical types may have hybridized. Due to selection, sugarcane has a much lower fibre content, increased juiciness and sugar content throughout the stalk.

S. robustum has been spread from its original habitat to other places. At higher altitude it hybridizes with Miscanthus floridulus (Labill.) Warb. (2n=38) which has lead to hybrid swarms. From such a hybrid S. edule* and probably the Hawaiian Original sugarcanes derive. Some hybrids between S. officinarum and M. floridulus have been described as Erianthus maximus Brongn. and S. pedicellare Trin. The present sugarcane clones have been derived from artificial hybridization with S. spontaneum*.

Moriya (1950) suggested that the sugarcane plants in SE. Asia and its vicinity can be divided into three sections when the chromosome number is considered:

1. Malay Archipelago and South Seas Section ----- Philippines, Micronesia, New Guinea included
2. India-Burma Section ----- Turkmenistan included, and
3. Japan islands Section ----- Formosa and Okinawa included.

He further proposed that clones with the highest chromosome number are found in S. Sumatra and W. Java. From here the chromosome number decreases with distance. Clones with the smallest chromosome numbers are observed in India. Here the widest variation of this number is found.

SACCHARUM SPONTANEUM L. 2n=112. Plants with 2n=112 occur in Indonesia especially in Java and Sumatra. A hybrid origin has been suggested e.g. S. officinarum* (2n=80) x S. spontaneum (2n=64).

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

SCHIZOSTACHYUS GRANDE Ridl. 2n= . Malaysian Peninsula.

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

SCHIZOSTACHYUS ZOLLINGERI Steud. 2n= Malaysian 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.

VETIVERIA ZIZANIOIDES Stapf (syn. V. odorata Virey, Andropogon muricatus Retz.). Vetiver. 2n=20. A grass of trop. Asia. Cultivated for its roots and planted as a hedge.

ZEA MAYS L. Maize. 2n=20. Domesticated in C. America (p. 166). 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= . Cochinchina. Cultivated for its fruits.

GARCINIA DULCIS (Roxb.) Kurz. Baniti. 2n= Philippines to Java. The bark yields a green dye, while 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. 66).

GARCINIA MANGOSTANA L. Mangosteen. 2n=c. 76, 96. Malaysia. It is considered to be the

most delecious of all tropical fruits. It is derived from wild G. silvestris, which is also found in India (p. 66).

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 (Bangla Desh). Cultivated for its fruits.

GARCINIA TINCTORIA (DC.) W. F. Wight. Matau, Gamboge tree. 2n=c. 80. India (p. 66) 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, Daoon ajenton 2n=32. Indonesia. Cultivated in SE. Asia and West 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 BASILICUM L. (syn. O. americanum L.). Basil, Sweet basil. 2n=48. Trop. Asia. Cultivated in China since 500 AD (Li, 1969). It has spread to many regions now.

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

OCIMUM SANCTUM L. Holy basil. 2n=64. A shrub of the 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 upto N. Australia. Cultivated in the tropics and subtropics as a fodder crop and as a shade tree.

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

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

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

CANAVALIA GLADIATA (Jacq.) DC. Sword bean. 2n=22, 44. The Old World. Probably derived from C. gladiolata Sauer (2n=22), which occurs in the Burma-Yunnan region (Sauer, 1964). Wild in tropical Asia and Africa. Cultivated in Asia especially in India as a food, forage and cover crop or as a green manure. In some areas it has naturalized (Purseglove, 1968). In Japan the white seeded cultigen (var. alba) is cultivated (p. 34).
C. polystacha (Forsk.) Schweinf. (2n=). Cultivated from SW. China upto Ethiopia/Somaliland for its pulses and seed. It is also considered as the parental type of C. gladiata.

CASSIA DIDYMOBOTRYA Fresen. Candelabra tree. 2n=28. A shrub used for green manure in Malaya and Ceylon.

CASSIA HIRSUTA L. 2n=28, 56. A vigorous bush used in Malaya, Indochina and Uganda for soil cover.

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

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

CASSIA OCCIDENTALIS L. Coffee senna, Negro coffee, Stink weed. 2n=26, 28. Tropics. Used in Indochina for 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 a fodder crop. Introduced on Cuba as a 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 Ceylon and Indonesia and formerly in Tanzania as a green manure.

CLITORIA TERNATEA L. Butterfly pea, Kordofan pea. 2n=16. Probably trop. Asia. Widespread in the tropics and cultivated as a fodder and soil cover crop.

CROTALARIA ALATA Ham. 2n=16. Malaya/Indonesia. It is an excellent green manure.

DERRIS DALBERGIOIDES Baker. 2n= . It is used as a shade tree in SE. Asia.

DERRIS ELLIPTICA Benth. Derris. 2n=22, 24, 36. From E. India to New Guinea except in 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. It is like D. elliptica* 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 the seeds and as a shade tree.

MELILOTUS SUAVEOLENS Ledeb. (syn. M. graveolens Bunge). Daghestan sweet clover. 2n=16. E. Asia and Indochina. Cultivated in the 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. Cochinchina. Cultivated in tropics as a vegetable, for its seeds, as a 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 a cover crop, green manure and forage crop.

MUCUNA PRURIENS DC. var. utilis Wahl. (syn. Stizolobium aterrimum Piper & Tracy). Bengal bean. 2n=22. Probably trop. Asia. Widely cultivated as a cover crop and green manure in the tropics.

NEPTUNIA OLERACEA Lour. 2n=c. 52, 54. The Tropics. A water plant cultivated as a vegetable in Indochina.

PARKIA SPECIOSA Hassk. 2n= . Malaysia. It is cultivated.

PELTOPHORUM PTEROCARPUM Backer (syn. Caesalpinia arborea Zoll., Inga pterocarpa DC.). Soga. 2n= . SE. Asia upto Australia. Cultivated on Java for its bark which is a source of brown dye.

PHASEOLUS AUREUS Roxb. (syn. Vigna radiata (L.) Wilczek, P. radiatus L.). Green gram, Golden gram, Mung bean, Oregon pea. 2n=22. India and Burma. This crop is probably derived from var. sublobata (Roxb.) Verdc. (2n=22), which grows wild in India and Burma. Sometimes cultivated. Spread to S. China, Indochina and Java and later to other countries. It is closely related to P. mungo*, which probably also derived from var. sublobata.

PHASEOLUS CALCARATUS Roxb. (syn. Vigna umbellata (Thunb.) Ohwi & Ohashi, Dolichos umbellatus Thunb.). Rice bean. 2n=22. Himalaya and India. Primary centre: India. Cultivated in many Asian countries and elsewhere. Characterized by late maturing and dehiscent pods.

PITHECELLOBIUM BIGEMINUM Mart. 2n= E. and SE. Asia. Cultivated on Java for its edible seeds.

PITHECELLOBIUM JIRINGA Prain. 2n= Malaysia and Philippines. On Java it is cultivated for its edible seeds.

PITHECELLOBIUM LOBATUM Benth. 2n= SE. Asia. Cultivated for its leaves, fruits and flowers which are eaten as a vegetable.

PSOPHOCARPUS TETRAGONOLOBUS (L.) DC. Goa bean, Asparagus bean. Winged bean, Manila bean. 2n=26. Probably Tropical Asia. Burkill (1935) believed that it came from the African coast bordering the Indian ocean. However as it is cul-

tivated in SE. Asia and not in Africa its African origin is doubtful.

PUERARIA PHASEOLOIDES (Roxb.) Benth. Tropical kudzu. 2n=22. Malaysia. Used as a cover crop and green manure throughout the tropics.

PUERARIA THUNBERGIANA (Sieb. & Zucc.) Benth. (syn. P. lobata (Willd.) Ohwi). 2n=24. Asia and the W. Pacific islands. Cultivated in Central Highlands of New Guinea and in New Caledonia for its edible tubers. Formerly it may have been a staple crop replaced by Ipomoea batatas* (Watson, 1968). See also p. 34.

SESBANIA AEGYPTIACA Poir. (syn. S. sesban (L.) Merr.). 2n=12. E. Africa. S. Asia and Australia. In India and Java it is used as a hedge and shade plant.

SESBANIA GRANDIFLORA (L.) Poir. Agati sesbania. 2n=14, 24. E. India to Australia. Cultivated in the tropics for its flowers and green pods used in S. Asia as a vegetable.

TEPHROSIA CANDIDA DC. White tephrosia. 2n=22. Asia. Used as a green manure and cover crop.

VIGNA HOSEI (Craib) Backer. Sarawak bean. 2n=20. The origin of this cover crop is not clear. It is only known that material cultivated in Malaya was obtained from Sarawak. It rarely fruits in these regions. Morphologically it is very similar to V. parkeri Bak. ssp. acutifolia Verdc., which is found in E. Africa. The number of chromosomes of this subspecies is not given, but another subspecies maraguënsis (Taub.) Verdc., (syn. V. maraguënsis (Taub.) Harms.) has 2n=22. Ssp. maraguënsis also grows in E. Africa (Verdcourt, 1970).

With no evidence for the origins of V. hosei this species is included in Centre 2. Further research into its origin is needed. For instance its karyotype could be compared with those of other species. The cause of its almost lack of fruits (propagation by cuttings) could be studied. And interspecific crosses should be made to study species affinity.

Lemnaceae

WOLFFIA ARRHIZA Wimm. Khai-nam. 2n= . Burma, Laos, Thailand, Bangladesh and India. An aquatic plant cultivated as a vegetable by Burmese and Laotians. Cultivated in N. Thailand in rainfed open ponds. It produces a very high protein yield, much higher than the traditional crops including soya bean.

Liliaceae

TAETSIA FRUTICOSA (L.) Merr. 2n= . Pacific islands and Malaya. The leaves were used for cloths. Cultivated in Samoa for this purpose.

Magnoliaceae

MICHELIA CHAMPACA L. 2n=38. Cultivated for perfumery.

Malvaceae

ABUTILON INDICUM (Torner) Sweet. Country mallow. Indian abutilon. 2n=(36), 42. Malaysia, India and Philippines. Cultivated in India and elsewhere for its fibres and its oily seed. It is a weed in the tropics now.

GOSSYPIUM ARBOREUM L. Tree cotton. 2n=26, genome formula A_2A_2. Probably originated in India (p. 68) of Africa (p. 121). Race burmanicum was selected in Indochina. It is an annual form with a very short day length requirement and which is characterized by the presence of short hairs resembling wool.

GOSSYPIUM HIRSUTUM L. Cambodia. 2n=52, genome formula (AADD). The origin of this species is given on p. 154 and 169. Cambodia type developed in Cambodia. Introduced into India where it is cultivated on a large scale. There it was named Cambodia.

THESPESIA POPULNEA (L.). Sol. ex Correa. Portia tree, Tulip tree. 2n=26. The New Guinean species T. patellifera Borss., T. robusta Borss., T. fissicalyx Borss., T. multibracteata Borss. belong together with T. populnea to the section Thespedia of this genus. This may point to an E. New Guinean origin of T. populnea. It is widely distributed in trop. countries as shade tree. This wide distribution is due to the capacity of the seeds to float in sea water for months and remain alive.

Meliaceae

LANSIUM DOMESTICUM Jack. Langsat. 2n=72. Malaysian Archipelago and Indochina. Cultivated there and elsewhere for its fruits.

MELIA AZADIRACHTA L. (syn. Melia indica Brand., M. japonica Hassk., M. parviflora Moon, Azadirachata indica A. Juss.). Margosa, Nim, Neem. 2n=28. Dry region of Irrawadi valley. Cultivated and naturalized throughout India and in Pakistan, Ceylon, Burma and Malaya. It is a minor oil crop in India; the seeds are the source of margosa oil.

SANDORICUM KOETJAPE (Burm.f.) Merrill. Santol. 2n=22, 44. Malaysia and Indochina. Cultivated in this area and elsewhere for its fruits.

Moraceae

ALLAEANTHUS LUZONICUS F. Vill. 2n= This tree is cultivated in Philippines.

ARTOCARPUS ALTILIS (Park.) Fosberg (syn. A. communis Forst.) Breadfruit. 2n=54, 56, c. 81. Wild in the forests of Malayan Peninsula and those of the Moluccas. Secondary gene centre on the islands of Oceania.

Diverse forms are found in Philippines. They are products of hybridization between the breadfruit and A. blancoi (Elm.) Merr., which grows in that country. Similarly variants are observed in Micronesia being products of introgression between breadfruit and the wild A. mariannensis Trécul.

The introgressed characters of this wild species are seeded fruits, entire leaves and reddish hairs on veins (Fosberg, 1960a; Coenen & Barrau, 1961).

ARTOCARPUS CAMANSI Blanco. Kamansi. 2n= . Philippines. Cultivated near Manila for its fruits.

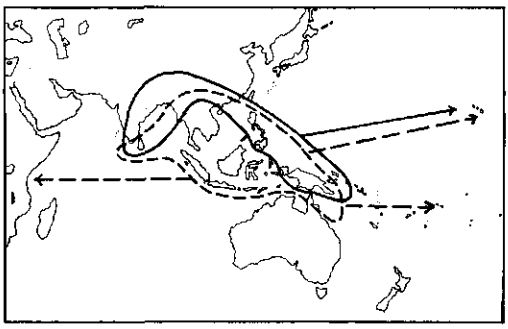
ARTOCARPUS CHAMPEDEN (Lour.) Spreng. Champedak. 2n= . Malaya. Selected forms are cultivated in SE. Asia.

ARTOCARPUS LAKOOCHA Roxb. 2n= . India and Malaysia. Cultivated in the tropics for its fruits.

ARTOCARPUS RIGIDUS Blume (syn. A. dimorphophylla Miq.). Monkey jack. 2n= . Malaysian Archipelago. Cultivated for its fruits.

Musaceae

MUSA (Eumusa) edible cultivars. Banana. 2n=22, 33, 44. The genus Musa is divided into four main sections of which Eumusa includes the important cultivars. The edible cultivars are improved types of M. acuminata Colla (2n=22, genome formula AA), triploids of this species and diploid, triploid and tetraploid hybrids of this species and M. balbisiana Colla (2n=22, genome formula BB) (p. 69). The latter types have often been named M. x sapientum L. and M. x paradisiaca L.



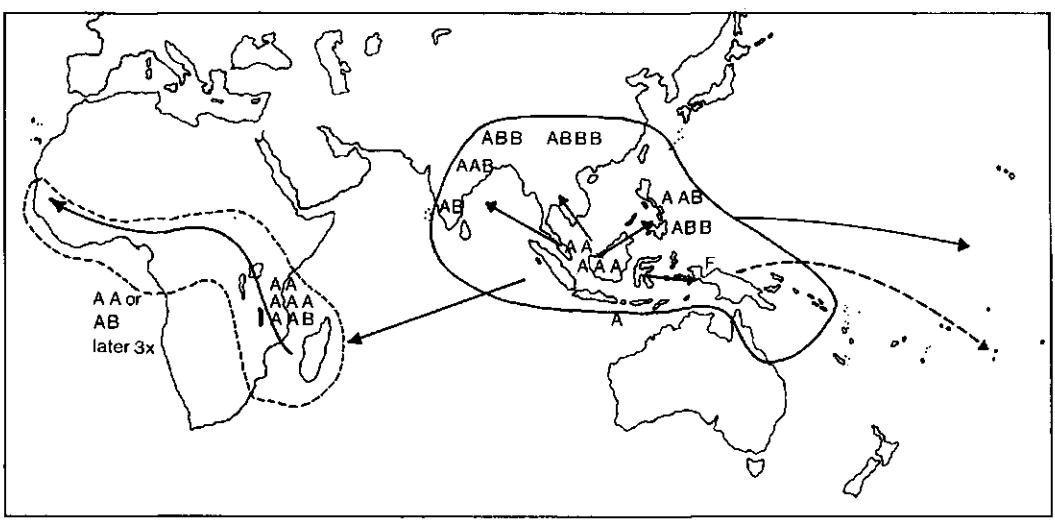
The wild Musa balbisiana (——) and M. acuminata (---) types (Simmonds, 1962)

M. acuminata is a polymorphous species. The primary centre of origin is the Malayan region, but at present the greatest diversity is known in New Guinea (Simmonds, 1964).

The cultivars of the AA-group are found throughout the tropics. In Malaya region the primary centre of diversity is observed. A secondary is found in E. Africa (p. 125). The main cultivars as Gros Michel, Cavendish subgroup and Red/Green Red belong to the AAA-group. The Dwarf Cavendish cultivars of the Cavendish group grown e.g. on Samoa and Canary Islands originated from Indo-China. These cultivars have often been referred to as M. cavendishii Lambert or M. sinensis Sweet ex Saget. (Simmonds, 1964).

The first M. x acuminata x balbisiana hybrid group is the diploid AB group. This small group is of S. Indian origin (Simmonds, 1964) (p. 68).

The second hybrid group is the triploid AAB group. Its major centre of origin lies in India



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

(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 lies very probably 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*

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 and Cruickshank, 1969).

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

Myrtaceae

EUGENIA AQUEA Burm.f. (syn. Syzygium aqueum (Burm.f.). Alston. Water rose apple. 2n= Bangla Desh, Burma, Ceylon, 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 in many islands of the Moluccas and in New Guinea. Is has bigger leaves and flower buds and is less aromatic than the cultivated tree. Cultivated for a long time.

Some variability exists in and outside its centre of origin.

EUGENIA FORMOSA Wall. (syn. Syzygium mappaceum (Korth.) Mansf.). 2n= . Trop. Asia. This tree is cultivated in Cochin-China for its 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). Rose apple. 2n=28, 33, c. 42, 44, 46, c. 54. This tree has been cultivated for a long time in Indo-Malaysia. Its exact centre of origin is not known.

EUGENIA JAVANICA Lam. (syn. Syzygium samarangense (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. Malay. 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 for the purpose of drying up swamps, and as an ornamental.

PIMENTA ACRIS Kostel. 2n=22. Indonesia. Cultivated there for its oil which is 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. (2n=) (syn. P. grandis R.Br.). Cultivated for its leaves which are used as a vegetable

Palmae

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

ARENGA PINNATA (Wurmb.) Merr. Sugar palm. 2n=26, 32. Primary centre: the Indonesian-Hindustani gene centre (p. 69). Secondary gene centre: possibly India.

BORASSUS FLABELLIFER*

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

COCOS NUCIFERA L. Coconut palm. 2n=32. Centre of diversity SE. Asia, Indonesia and W. Pacific islands. It is not known whether it comes from S. America or SE. Asia, Indonesia and W. Pacific islands. From its native area it spread to all tropical countries. Dennis and Gunn (1971) suggested that sea currents may have helped in the dispersal over small distances (from island group to island group), but that man distributed the coconut over the world.

It is possible that in Centre 4 a secondary centre arose (p. 69).

COELOCOCCUS ARMICARUM Warb. Polynesian ivory-nut palm. 2n= . Carolina Islands. Cul-

tivated 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 species is occasionally split in M. sagu - the wild type and M. rumphii (Willd.) Mart. (2n=) - the cultigen.

NYPA FRUTICANS Wurmb. (syn. Nipa fruticana 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 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 ODORUS Ridl. 2n= . Cultivated by Malays for its fragrant leaves (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., R. 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 the section Pandanus. Maybe this 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 and Smith, 1971).

Pentaphragmaceae

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

Piperaceae

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

PIPER CUBEBA L.f. Cubeb, Cubebe, Tailed pepper. 2n= . Cultivated there and 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 quantities it is a stimulant, in large quantities 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 the region of Tonkin.

Polygonaceae

POLYGONUM ODORATUM Lour. 2n= . Indo-China. Cultivated as a potherb in Vietnam.

Rosaceae

RUBUS ALBESCENS*

RUBUS ROSAEFOLIUS Smith. Cape bramble, Mauritius raspberry. 2n= . Tropical Asia. Introduced in other continents. Cultivated. It is considered as 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 Lower Siam. Cultivated as a substitute of 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 tropical countries for its fruits which are used medicinally.

CITRUS AURANTIFOLIA (Christm.) Swing. Lime. 2n=18, (27). Probably the Indonesian Archipelago or N. India. Wild trees are reported to grow in N. India. Spread throughout the tropics. The cultivar Tahiti is triploid. Interspecific hybrids have been obtained. Mandarin lime is probably a hybrid of this species with C. reticulata* and sweet lime with C. medica*, while limequat is a

hybrid with Fortunella margarita*.
The nakoor lime (named C. nakoor) is a complex natural hybrid of this species and some Papeda group parentage.

CITRUS AURANTIUM L. Sour orange, Seville orange, Bigarade. 2n=18. Probably SE. Asia or Cochin China. Unknown wild. Spread throughout the (sub)tropics. In some areas it has run wild. The ssp. bergamia (Risso & Poit.) Wight & Arn., Bergamot, (2n=18) is especially cultivated 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 the 17th Century). Unknown wild. The best fruits come from Thailand where the plants are cultivated on ridges surrounded by brackish water.

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

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. A secondary centre: the Mediterranean Region (p. 105). Scora and Malik (1970) suggested that this species might be a stabilized hybrid of C. medica* - C. aurantifolia* assemblage. Cultivated in several (sub)tropical regions. Rough lemon is probably a hybrid with C. medica*. It became naturalized in Rhodesia.

CITRUS MITIS Blanco. Calamondin. 2n=18. Philippines. A tree occasionally cultivated in (sub)tropics. Hybrids of this species have been produced, so are Calarin and Calashu hybrids with C. reticulata* (Satsuma).

CITRUS RETICULATA Blanco (C. nobilis Andr. non Lour.). Manderin, Tangerine. 2n=18. Probably Philippines, or Cochin China. Unknown wild. Secondary centre arose in Japan (p. 39). 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* distant. Var. austera Swing is the sour manderin. 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), while Tangor is a natural hybrid of the same parents C. reticulata*. Its origin is in Siam. Tangor has been described as C. nobilis Lour.

CITRUS SINENSIS (L.) Osbeck (syn. C. aurantium L. var. sinensis L.). Sweet orange. 2n=18, (27, 36). Probably S. China or Cochin-China. Unknown wild. Secondary centres: Israel and Spain (p. 105). It was already mentioned in Chinese sources dated 2200 BC.
Scora and Malik (1970) showed that this species is not a mutant of C. aurantium* or a hybrid of this latter species and C. reticulata* which had been suggested. It shows close affinities to C. reticulata*.

It is widely distributed in the (sub)tropics. There are many cultivars. Citrange is a hybrid product with Poncirus trifoliata*, while chironja is a spontaneous hybrid with C. paradiso*. It originated in Puerto Rico. Owing to apomixis it breeds true.

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

MURRAYA PANICULATA (L.) Jacq. Cosmetic barktree, 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.). Sandal wood. 2n=10. E. India to Malaysia. Cultivated there and elsewhere for its 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 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 culture will probably be replaced by that of 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 Malay-

sian 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 (Teysm. & 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 a medicinal crop.

Solanaceae

LYCINUM CHINENSE Mill. Chinese wolfberry. 2n= . E. Asia. Cultivated in Java as a vegetable.

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

Stilagninaceae

ANTIDESMA BUNIUS (L.) Spreng. Bignay, China laurel. 2n= . 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. leontopataloides (L.) Kuntze). 2n=30. SE. Asia (Massal and Barrau, 1956). Spread to the South Sea islands, Asia and Africa. Cultivated for its starchy tubers.

Umbelliferae

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 in Java. A leafy vegetable that often occurs as a weed.

Urticaceae

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

Zingiberaceae

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

ALPINA 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.

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

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

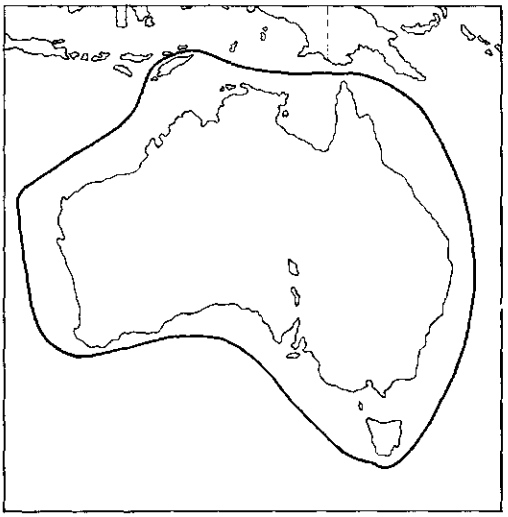
KAEMPFERIA ROTUNDA L. 2n=33, 54. Trop. Asia. Cultivated for its rhizomes.

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

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

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

3 Australian Centre



The Australian Centre was not described by Vavilov, but it was marked out by Zhukovsky (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 centre 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 a soil stabilizer.

Chenopodiaceae

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

Gramineae

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 an ornamental and as a stabilizer of coastal dunes in Europe.

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

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

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

PHASEOLUS LATHYROIDES L. Phasemy bean. 2n=22. Queensland, Australia. Used in E. Africa in pastures (Whyte et al., 1953).

TRIFOLIUM SUBTERRANEUM L. Sub clover. 2n=16. Primary centre in the Mediterranean region (p. 103). Secondary centre: Australia.

Malvaceae

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

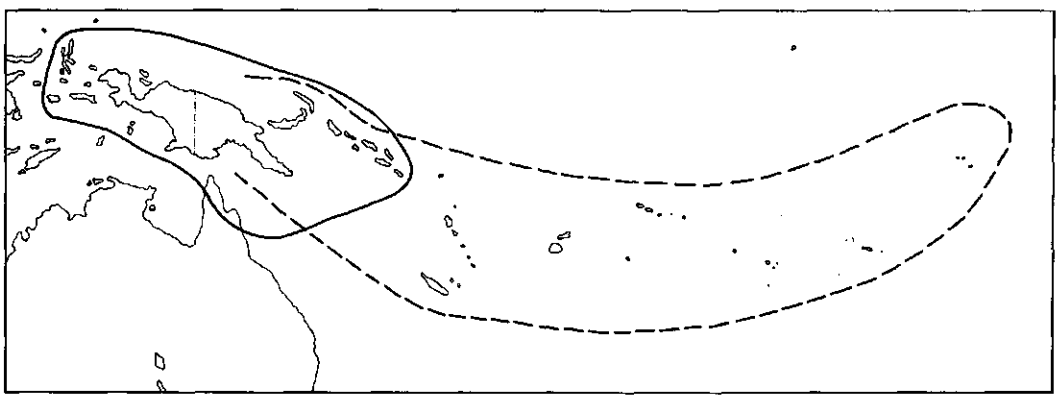
GOSSYPIUM ROBINSONII V. Muell. 2n=26, genome formula C_2C_2. W. Australia

GOSSYPIUM STURTII 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).

Gossypium sturtii



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

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 Chile, Zaire and W. Georgia, USSR. Closely related to E. regnans*.

EUCALYPTUS ASTRINGENS Maiden. Brown mallet. 2n=22. SW. Australia. Cultivated in Marocco, 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 Zaire. 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. 104), Brazil (p. 115) and Argentine (p. 115). 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. 104).

EUCALYPTUS CINERA F. Muell. 2n=22. S. areas of New South Wales, Australia. Used as an 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). The N. coast of Queensland, Australia. Cultivated in many (sub)tropical countries for an essential oil rich in citronellal.

EUCALYPTUS CLADOCALYX F. Muell. (syn. E. corynocalyx F. Muell). Sugar gum. 2n=22. S. Australia. Cultivated in Australia, the Mediterranean region 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. Muell. 2n= . Queensland, reaching New South Wales, Australia. Cultivated in several countries of Africa, India and Argentine. Some spontaneous hybrids are known.

EUCALYPTUS CYPELLOCARPA L. Johnst. (E. goniocalyx pl. anct.). 2n=22. SW. Australia attaining 900-1200 m altitude. Cultivated in the Mediterranean region, 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 in USSR 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 for better types.

EUCALYPTUS DELEGATENSIS R.T. Baker. (syn. E. gigantea Hook.f.). Alpine ash, Woolybutt, 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 a breeding parent in the USSR.

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

EUCALYPTUS EUGENIOIDES Sieb. (syn. E. scabra Dum-Cours.). White stringbark, 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 in Tasmania under cultivation.

EUCALYPTUS GOMPHOCEPHALA A.DC. 2n=22. SW. coasts of W. 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 Northern 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. Muell. (syn. E. conoidea Benth.). White ironbark, White gum. 2n=22. Central areas of Victoria and South Australia. In the latter area it is rare. Cultivated in the Mediterranean region, S. America esp. Argentine and Cyprus. Used for its wood and oil. Some geographical races and spontaneous hybrids have been described.

EUCALYPTUS MACARTHURI Dean & Maiden. 2n=22. Central New South Wales, Australia. Cultivated in Africa esp. Zaire, 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. Muell.). Spotted gum. 2n=22. Coastal areas of SE. Queensland, New South Wales and E. Victoria. Cultivated in Africa esp. Cameroon, Zaire, Kenya and Madagascar; the Mediterranean region esp. Spain, France; Chile and Uruguay. The wood is very valuable.

EUCALYPTUS MAIDENII F. Muell. Maiden's gum. Spotted blue gum. 2n=22. Mountains of SE. Australia. Cultivated in Africa esp. Cameroon, Congo and Kenya; the Mediterranean region 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 region, in Africa esp. Zaire and Eritrea. Used for its wood and as an ornamental tree. It is extremely

melliferous. There are geographical races and spontaneous hybrids known.

EUCALYPTUS MICROCORYS F. Muell. Fallow wood. 2n= . Coastal areas of the N. part of New South Wales and SE. Queensland. Cultivated in the Mediterranean region and Africa esp. Zaire and Eritrea. Used for its 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, Australia. Cultivated in Africa esp. Kenya and Tripoli; the Mediterranean region, 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 geographical races and spontaneous hybrids are known.

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

EUCALYPTUS REGNANS F. Muell. Mountain ash, Swamp gum, Australian oak. 2n= . Mountains of the 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. Muell., E. hemilampra F. Muell.). Kino eucalyptus, Red mahogany, Forests mahogany. 2n=22. Coastal zone of S. Queensland and central part of New South Wales. Cultivated in Argentine, Ceylon, 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 the Mediterranean region, Africa esp. Cameroon, Zaire and Kenya; Argentine, 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, Australia. Cultivated in Africa, esp. Cameroon, Kenya and Rhodesia; S. America esp. Argentine 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, Zaire and Rhodesia; the Mediterranean region, 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 the USSR interspecific hybrids are produced. The strains 'C' of Zanzibar and 'Mysore Hybrid' of India belong to this species (Larsen & Cromer, 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 the Mediterranean region, in countries of C. and S. Africa, India, New Zealand and USA. In subtropical areas of the 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. 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.

Protaceae

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 these countries.

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

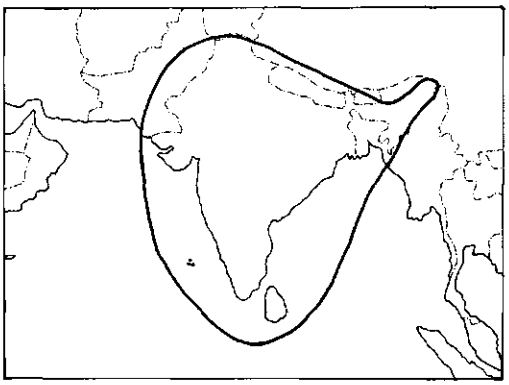
DUBOISIA MYOPOROIDES R.Br. Corkwood, Mgmeo. 2n=60. Australia. Cultivated to yield atropine.

NICOTIANA DEBNEYI Domin. 2n= . 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 W. Australia. Is 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. suaveolens Lehm., 2n=(24), 32, (48, 64), and N. rotundifolia Lindl., 2n=44.

SOLANUM LACIANIATUM Aiton. 2n= . Australia and New Zealand. Cultivated in Europe and elsewhere for the foliage which is a source of steroid precursors (Tutin et al., 1972).

4 Hindustani Centre



The Hindustani Centre of diversity was included by Vavilov in the Tropical South Asian Centre of Origin. Zhukovsky (1968) separated this centre only by number (IV), but in 1970 he drew on the map a line between both centres. He based this separation on the existence of specific species of this Centre 4.

Although this centre is not far from the 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 crops cultivated. At Mūan-jo Daro (Mohenjodaro) and Harappa on the Indus, Pakistan more or less on the boundary between Centres 4 and 5, a site of the Harappan culture dating 2500 - 2000 BC. was discovered. Some remains of Gossypium arboreum have been discovered. At a site, Navdatoli-Mahesvar on the Narbada River, in Central India, dated from 2000 BC. remains of wheat, peas, broad beans, lentils, Lathyrus sativus and rice have been found. Except rice all these crops have been first domesticated outside India.

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

Species of this centre have influenced the development of crops in other areas mainly due to an active distribution between this region and areas such as Ancient Egypt, Assyria, Sumeria, the Hittite Empire. Much exchange has existed with Africa while many crops were distributed especially to the Mediterranean region by the Arabs in the 8th-10th centuries AD. Such crops are citrus trees, cotton species, jute, rice, sugarcane etc.

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= . Ceylon. 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. 129) and in Kashmir (Koul & Gojil, 1970). The wild and cultivated types are both extremely variable. This species is related to A. sativum*, A. porrum* and A. scorodoprasum*.

Amaranthaceae

AMARANTHUS ANGUSTIFOLIUS Lam. 2n=32, (34). S. and C. Europe, Ante-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 potherb, fodder and fibre crop and an ornamental.

Annacardiaceae

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 consists of hybrids developed in Florida and Hawaii. M. odorata* and M. zeylanica Hook.f. are not closely related.

Apocynaceae

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

RAUVOLFIA SERPENTINA Benth. 2n=(20), 22, (24, 44). India, Ceylon, 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 cultivations could be extended to India and elsewhere (Dutta et al., 1963).

Araceae

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

ALOCASIA MACRORRHIZA (L.) Schott. Giant Alocasia. 2n=26, (28). Probably Ceylon. Spread in the Malay Archipelago and to India and further to tropical 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. 43). Cultivated in India and elsewhere as a tuber crop.

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. 130). Spread to India in early times. The Indian type is cultivated for its narcotic properties. From this country it must have spread to the Middle East and other countries. C. ruderalis Janisch, (2n=), SE. Russia and C. Asia. This weed perhaps derived from the cultivated form.

Chenopodiaceae

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

Compositae

CARUM COPTICUM (L.) Benth. & Hook. (syn. Trachyspermum ammi (L.) Sprague. Ammi. 2n=18. India. It yields an essential oil.

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

Convolvulaceae

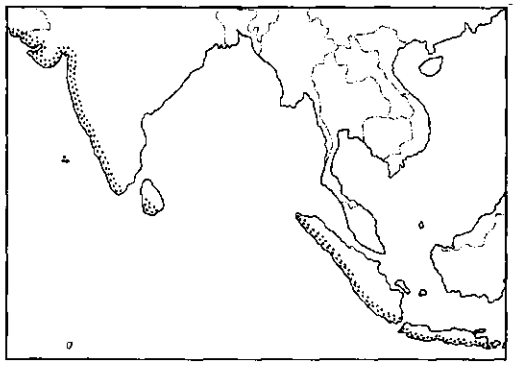
IPOMOEA ERIOCARPA R.Br. 2n= . India. Used as a spinach and as a green fodder.

Cruciferae

BRASSICA CAMPESTRIS L. 2n=20, genome formula AA. See p. 135 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 this locus (Swamy Rao, 1971).

ERUCA VESICARIA (L.). Cav. (syn. E. sativa L.). 2n=22. The Mediterranean region (p. 95) 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. This group of cultivars var. mougri Helm. 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.



Raphanus sativus var. mougri (Sinskaya, 1931)

Cucurbitaceae

CITRULLUS COLOCYNTHIS*

CITRULLUS LANATUS (Thunb.) Mansf. Watermelon. 2n=22. Var. fistulosus (Stocks) Duthie & Fuller (syn. C. fistulosus Stocks) is cultivated in India for its small round fruits (Purseglove, 1968). It is only known cultivated.

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

CUCUMIS SATIVUS L. Cucumber, Gherkin. 2n=14. Primary gene centre probably the Himalayas. Introduced into Europe, Near East, China and other countries. Secondary gene centres in China and Near East (p. 30 and 79). In India cucumbers have been cultivated at least 3 000 years (Leppik, 1965). The closely related wild species C. hardwickii Royle also grows in this centre. It might, however, be a weedy form of the cultigen.

Sources of resistance to mildew (Erisyphe cichoracearum DC (ex Merat emend. Salm.) and/or 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. 147. 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 here. It was found in Karakoram/Hindukush 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 prime species. From this species two species derived: the wild dioecious L. echinata Roxb. (2n=26) and the cultivated monoecious L. aegyptica*. These authors 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 this species arose. The latter type is also named 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 as a medicine, isolation material etc.

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 this latter species and to L. cylindrica (see L. aegyptiaca*), but has besides bisexual flowers, oblong-ellipsoidal fruits and smooth shining black seeds. Maybe this species is a hybrid of one of these two species. Types described as L. racemosa Roxb. and included in L. cylindrica also are bisexual (Singh & Bhandari, 1963).

Dutt & Roy (1971) included L. hermaphrodita in L. acutangula*. They consider it as the hermaphrodite type of this 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 Ceylon for its seeds (Purseglove, 1968).

Flacourtiaceae

DORYALIS (DOVYALIS) HEBECARPA (Gardn.) Walb. (syn. Aberia gardneri Clos.). Ceylon gooseberry. 2n= . Trop. Asia especially India and Ceylon. 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 as high as 900 m. Much cultivated in Java, rarely in Indochina. Secondary gene centre in Java (p. 46). 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. Bangla Desh. 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. 32) and S. China (p. 32). In forests in dry areas. It is drought resistant.

BAMBUSA TULDA Roxb. 2n= . India, Burma (p. 47) and Tahiti. Secondary centre Java.

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

CYMBOGON FLEXUOSUS (Nees ex Steud.) Wats. (syn. Andropogon flexuosus Nees). Malabar grass, Cochin grass. 2n=20, 40. India. Cultivated for its essential 'East Indian lemongrass' oil.

CYMBOGON MARTINI (Roxb.) Wats. Rosha grass. 2n=20, 40. E. India. Cultivated in India and Indonesia for palmarosa oil. Var. motia (syn. C. motia Gupta) (2n=40) produces palmarosa oil, while var. sofia (2n=20) is the source of gingergrass oil.

CYNODON DACTYLON (L.) Pers. Bermuda grass. 2n=(18, genome formula AA, 27, 30), 36, genome formula AABB, 40, (54, genome formula AAAABB), aneupl., B-chromosomes. Primary centre: India, although Indo-Malaysia and trop. Africa have also been mentioned. Spread all over the world. Malik & Tripathi (1968) report that the A and B genome have segments in common. The hexaploid AAAABB-type is found in Udaipur, India. It has a recent origin and hence a restricted distribution. Harlan & de Wet (1969) suggested two putative parents. One of them is the diploid var. aridus Harlan & de Wet, (2n=18), which originally had a small range but is now found in India, Ceylon, Israel, Zambia, Tanzania and S. Africa. The other putative parent is the diploid variety afghanistan Harlan & de Wet. From var. aridus arose var. dactylon, (2n=36). From this race the temperate race of var. dactylon arose. Through crossing with tetraploids of var. afghanistan and intercrossing the seleucidus race of var. dactylon developed.

Other botanical varieties are var. elegans Rendle, (2n=36), of Southern Africa, var. polevansii (Stent.) Harlan & de Wet (2n=36) of S. Africa and var. coursii (A. Camus) Harlan & de Wet (2n=36) of Madagascar.

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 low places and forms large thickets.

DENDROCALAMUS LONGISPATHUS Kurz. 2n=72. Bangla Desh 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 bolder 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 SANQUINALIS Scop. 2n=(18, 28), 36 (-48, 54, 76). This cereal was cultivated in India and E. Europe (p. 133) (Portères, 1955).

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 also used in Egypt.

Yabuno (1968) considered the genome formula of this species to be the same as that of E. frumentacea*.

ELEUSINE COROCANA (L.) Gaertn. Finger millet, Ragi. 2n=36. Introduced from Africa (p. 113). Kempanna (1969) recognized various types in India.

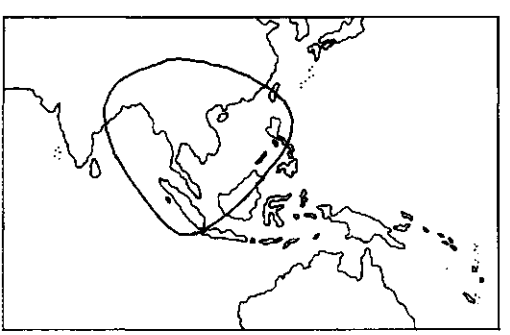
MELOCANNA BACCIFORA (Roxb.). Kurz. 2n= . Burma from Garo to Arakan. Primary centre: Bangla Desh. Its stems are used as building material.

NEOHOUZEAUA DULLOSA (Munro) A. Camus. 2n= . S. and SE. Burma. It has a very long fibre and produces much paper mass.

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

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

ORYZA SATIVA L. Rice. 2n=24, genome formula AA. Primary centre SE. Himalayan region (Morinaga, 1968). The cultivated rice developed from O. perennis Moench (syn. O. rufipogon - perennial, Nayar, 1973), 2n=24, genome formula AA. O. perennis has a wide distribution in the tropics of Asia, the Americas, the Mediterranean Region and N. Australia. There are four main geographical races mainly based on breeding behaviour and interracial sterility: 1. Asian, (floating and procumbent habit, partial self-incompatibility), 2. American (p. 165) (caespitose), 3. African (p. 115) (erect, well developed rhizomes), self-incompatibility), and 4. Oceanian (p. 47). However, floating types have been found in the Amazone, erect types with rhizomes in Asia and non-rhizomatous, floating types in C. Africa.
The Asian race is the parent of O. sativa (Nayar, 1973), while annual types (rufipogon-annual, var. fatua, f. spontanea, O. nivara*) are intermediates of perennial plants and cultivated rice. Much gene exchange exists between wild-perennial, weedy-annual and cultivated-annual rice, resulting in forms described as var. fatua or f. spontanea or as O. rufipogon* and O. nivara*.



Centre of origin of rice (Chatterjee, 1951)

Morinaga (1968) classified rice in 4 genecological groups:
1. ecospecies 'aman' (ssp. indica Kato) divided in three ecotypes 1. aman (winter rice), 2. boro (summer rice) and 3. tjereh

2. ecospecies 'aus' (autumn rice)
3. ecospecies 'bulu'
4. ecospecies 'japonica' divided in 1. ecotype 'japonica' (ssp. japonica Kato) and 2. ecotype 'nuda'.

He based his classification on the extent of their affinity as shown by the hybrid fertility.

The ecotypes aman, boro and aus are found in the Bengal-Assam region of India. The ecotypes tjereh and bulu developed in Indonesia (p. 48) and ecotypes japonica and nuda together comprising ecospecies 'japonica' developed in Indo-China (p. 48). In parts of Asia, notably in Bangla Desh and in Burma floating paddy is cultivated on a large scale. The floating habit is the capability to lengthen the stem with increasing water depth. It is conditioned by two recessive genes. Nayar (1973) showed that O. sativa is the ancestral species of the African rice, O. glaberrima*.

PASPALUM SCROBICULATUM L. Koda millet, Ditch millet. 2n=40. Wild types var. commersonii (Lam.) Stapf (syn. P. commersonii Lamk.) and var. polystachyum (R. Br.) Cheval., and the cultivated type var. acrobiculatum. Var. commersonii is found in the tropics of the Old World, and var. polystachyum in Africa (Mansfeld, 1959). Koda millet is cultivated in China, Japan, Ante-India and Australia.

SACCHARUM SINENSE Roxb. Chinese sugarcanes, North Indian sugarcanes. Mungo group 2n=81-83, Dhaulu group 2n=82, 83, Saretha group 2n=91, 91 + fragrants, 92, Nargori group 2n=105-119, 124, Pansahi group 2n=106-120, and unclassified 2n=c. 104-121. The first four groups have also been classified as S. barberi Jesw., the North Indian sugarcanes, so then the Pansahi group (Chinese sugarcanes) is the only group of S. sinense. It is possible that the original North India sugarcanes have derived from wild S. spontaneum* (Grassl, 1968) while after introduction of S. officinarum* hybridization may have taken place. The present North Indian sugarcanes are considered as complex polyploid hybrids of S. officinarum* (x=17) and types of S. spontaneum* (n=40, 48, 56). This hybridization would have occurred in Bengal, Orissa and Bihar, India (Parthasarathy, 1946, 1948; Bremer, 1966). Price (1968) suggested that the Mungo group derives from one plant possibly a mutant of the closely related Dhaulu group. However, Grassl (1968) suggested an Erianthus sp. introgression in the origin of the Mungo group. The Saretha group may also originate from one plant and so may the Nargori group (2n=124). The Pansahi group may be a hybrid of S. officinarum* and S. spontaneum* or a Miscanthus species. The latter may be M. sinensis*, but no tetraploid types have yet been found.

S. sinense is found in SE. Asia and N. India. In India it is a cottage industry crop from which a crude brown sugar is obtained (Price, 1963).

SACCHARUM SPONTANEUM L. Wild sugarcane, Kassoer, Thatch grass, Bagberi, Dharb, Khus. 2n=40-128, with euploids 40, 48, 64, 80, 96, 104, 112, 128 and possibly 54. Probably India at the foothills of the Himalaya Mountains. Now it is distributed in innumerable groups of different ranks and significance from Africa over Asia to Japan and the Solomon Islands. One group (2n=112) is found in Indonesia (p. 48), while another one (2n=104-128) occurs in E. Africa (p. 116). 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. 116). Secondary centre: India. No hybridization has occurred with wild sorghums as these 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. 82). Ssp. sphaerococcum is indigenous to NW. India and adjacent Afghanistan. It is characterized by short, non-lodging culms, erect leaves, globular grains and susceptibility to diseases.

VETIVERIA ZIZANIOIDES (L.). Nash. Vetiver. 2n=20. Ceylon, India up to Burma. A grass cultivated in the tropics for its essential oil.

ZEA MAYS L. 2n=20. Probably domesticated in C. America (p. 166). Secondary centre: the S. Himalayas (Brandolini, 1970). Flint maize (indurata Sturt.) is common here.

Guttiferae

GARCINIA INDICA*.

GARCINIA SILVESTRIS Boerl. Wild mangosteen. 2n= . Malaysia (p. 49) 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 lighting.

Leguminosae

ALBIZIA STIPULATA Boiv. (syn. A. chinensis (Osb.) Merr.). 2n= . Cultivated in India and Ceylon 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. Africa (p. 118). Secondary centre: India (Purseglove, 1968).

CANAVALIA ENSIFORMIS (L.) DC. Jack bean, Horse bean. 2n=22. S. America (p. 151). Secondary centre: India.

CASSIA AURICULATA L. Tanner's cassia. 2n=14, 16, 28. Cultivated there for its 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 of which the pulp round the seeds is used as a purgative (Purseglove, 1968).

CASSIA SIAMEA*.

CICER ARIETINUM L. Gram, Chickpea. 2n=14, 16, (24, 32, 33). Probably W. Asia (p. 000). Probably a secondary centre in India. Introduced in India in early times. Cultivated much in India now. Strains with fine dark-brown and black seed have been cultivated for a long time. 'Kabuli' types have been introduced from Afghanistan in 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 crop (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 that seeds of C. senegalensis* arrived in Africa as flotsam in Arab-Indian (horse) trade. Subsequently it became domesticated in India. Cultivated in India, Pakistan and elsewhere for fodder, food and as a source of gum. No wild forms in the Indo-Pakistan continent.

DOLICHOS UNIFLORUS Lam. (syn. D. biflorus auct. non Linn). Horsegram. 2n=20, 22, (24). The tropics of the Old World. Especially found in India and the Himalayas where it is also cultivated.

INDIGOFERA PILOSA Poir. 2n=16, 32. Used in Ceylon as a green manure.

MELILOTUS INDICUS All. Indian clover, Yellow annual sweet clover, Sour clover. 2n=16. Punjab, India to the Mediterranean region and Turkestan. Cultivated in N. India as a fodder crop and in the USA as a cover crop.

MUCUNA CAPITATA*.

MUCUNA PACHYLOBIA (Piper & Tracy) Rock (syn. Stizolobium pachylobium Piper & Tracy). Fleshy pod bean. 2n= . India. Cultivated as a vegetable.

MUCUNA UTILIS Wall. ex Wight. Velvet bean. 2n= . India. Cultivated as a vegetable, as cattle food and as a green manure.

PHASEOLUS ACONITIFOLIUS Jacq. (Ph. trilobus Wall.). Mat bean, Moth bean. 2n=12. India, Bangla Desh and Burma. Cultivated in these countries and also in Ceylon and China. In the USA it is cultivated as a fodder crop.

PHASEOLUS MUNGO L. (syn. Vigna mungo (L.) Hepper.). Black gram, Urd. 2n=22, (24). Unknown wild. Closely related to P. aureus* and may together even form one species (Verdcourt, 1970). Ph. *aureus* var. *sublobata* (syn. P. sublobatus Roxb., P. trinervis Wight & Arn.) is likely the wild form. (It is certainly the ancestor of P. aureus.)

SESBANIA ACULEATA (Pers.) Poir. Dhanchia. 2n=(12), 24, 32. Cultivated in Bengal for its fibre and especially as a green manure crop.

SESBANIA AEGYPTIACA*.

SESBANIA SPECIOSA Taub. ex Engl. 2n=12. India (?). Cultivated there as a green manure of rice fields.

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. 120).

From Africa cowpea was taken to the Indian subcontinent. In Africa the large-seeded type was selected for, while in India ssp. cylindrica (L.) Van Eseltine and ssp. sesquipedalis (L.) Verdc. were obtained. In N. Nigeria a fibre form was developed. The fibre is obtained from the peduncles.

From W. Africa and India cowpea cultivars spread over the world (Faris, 1965).

The explosive opening of the pod of the wild type (ssp. dekindtiana (Harms) Verdc., syn. V. dekindtiana Harms) distinguishes this type from the cultivated types.

Linaceae

LINUM USITATISSIMUM L. Flax. 2n=30, (32). Its possible origin is given on p. 87. In India and adjacent regions flax of the ssp. indo-abyssinicum Vav. & Ell. are found. It is identical to flax of Ethiopia and Eritrea and it may have originated in these countries. This subspecies 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. 2n=72-132. Probably a cultigen developed from a wild species in trop. Asia. A. tuberculatus Pal & Singh (2n=). 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.

A. esculentus is commonly known by its synonym.

ABELMOSCHUS MANIHOT (L.) Medicus. (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 which 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 Medicus. (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 and often as an ornamental. It is commonly known by its synonym.

ABUTILON INDICUM*.

GOSSYPIUM ARBOREUM L. Tree cotton. 2n=26, genome formula A_2A_2. Primary centre: peninsular of India. Unknown wild. Spread in E. and SE. direction to Burma, Indochina and the Malaysian Archipelago. Centre of domestication probably lies in Gujarat which is the westermost state of India (Hutchinson, 1971). Close to this region a fragment of textile and a string dated 2500-1700 BC. have been found in Mohenjo-Daro, Pakistan. Race indicum of peninsular India 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 while 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 towards the 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 and 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 an ornamental; cultivated in Java as a vegetable and a drug plant.

It is a source of root-knot nematode resistance for H. sabdariffa*.

It is an allotetraploid of H. cannabinus* and another diploid species. If this species is an indigenous species of India the amphiploidization must have taken place in that country after the introduction of H. cannabinus as a fibre crop. However, the only known diploid B-carrier is the African H. surattensis* (Menzel and Martin, 1971). If the origin of H. furcatus Roxb. non Willd. (2n=144), genome formula BBGGWWZZ from India and Ceylon is studied, the origin of H. radiatus may also be solved.

SIDA RHOMBIFOLIA L. Queensland hemp, Broomjue sida, Cuba jute. 2n=14, 28. The tropics. Cultivated in India and later in Queensland, Australia 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.). Jackfruit. 2n=56. Unknown wild. It has a very ancient cultivation in India. There and in Ceylon it is popular, elsewhere in the tropics it is also cultivated (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 Anuradhapura in Ceylon in 288 BC. (Purseglove, 1968) died in 1971.

FICUS ROXBURGHII Wall. 2n= . Cultivated for its figs.

Moringaceae

MORINGA OLEIFERA Lam. Horse-radish tree. 2n=28. India. Cultivated throughout the tropics.

Musaceae

MUSA cultivars of the AB group. Ney poovan and synonyms and homonyms. 2n=22. Cultivated on a small scale now (p. 52). See p. 52 for discussion.

MUSA cultivars of the AAB group. 2n=33. Mostly India (see p. 52). Only the clone Maia maoli has probably arisen in Philippines.

MUSA BALBISIANA Colla. Pisang bau, Klue Tani. 2n=22, genome formula BB. India, Burma, Ceylon and maybe 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. 52) of the cultivated bananas.

Myrtaceae

EUGENIA JAMBOLANA *.

RHODOMYRTUS TORMENTOSA*.

Oleaceae

JASMINUM GRANDIFLORUM L. Catalonian jasmine, Italian jasmine. 2n=26. The Himalayas. Cultivated for its fragrant flowers and used in perfumery.

JASMINUM SAMBAC (L.). Ait. Arabian jasmine. 2n=26, 39. India and Ceylon. Cultivated in the tropics. The flowers are used for scenting tea and are a source of an essential oil.

Palmae

ARENGA PINNATA (Wurmb.) Merr. Sugar palm. 2n= . Primary centre: possibly Malaysian Archipelago (p. 53). 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 (p. 53). Secondary centre: possibly India.

Pedaliaceae

SESAMUM INDICUM L. Sesame, Beni seed. 2n=26. Primary centre: Africa (p. 126). Secondary centre: India. From here it is believed to have been spread towards the east, through China, Indo-China into Japan, and towards the west, through Afghanistan, Asia Minor and Iran to the Mediterranean region to reach N. Africa.

Perioplocaceae

CRYPTOSTEGIA GRANDIFLORA*.

Piperaceae

PIPER LONGUM L. Indian long pepper, Jaborandi pepper. 2n=24, 48, 52, 96. The foot of the Himalayas. Cultivated in India and Ceylon for its spike which is used as a spice. It resembles P. retrofractum Vahl*.

PIPER NIGRUM L. Black pepper. 2n=48, 52, 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 region, C. Asia and India. Cultivated in India.

Polygonaceae

RUMEX VESICARIUS L. 2n=18, (20). Greece, N. Africa, India and Malaysia. Cultivated in India as a medicinal plant.

Rosaceae

RUBUS ALBESCENS Roxb. Mysore raspberry. 2n= . The mountains of India, Ceylon, 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 its bark and wood which is a source of yellow dye.

MORINDA CITRIFOLIA L. (M. bracteata Roxb.). Indian mulberry. 2n= . S. India and Malaysia upto 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= . The 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 Ceylon. Cultivated now 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. Soapnut tree, Arceta. 2n= . India, Pakistan and Ceylon. Cultivated for its fruits.

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. A 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. 171). Secondary centre: Asia.

DATURA METEL L. Hindu datura. 2n=24. India. This medicinal plant is introduced into many parts of the (sub)tropics. It is often cultivated as an ornamental.

SOLANUM MELONGENA L. Eggplant, Aubergine, Melongene. 2n=24, (36, 48). India. Cultivated there. Secondary centre: China (p. 70). Cultivated now throughout the tropics.

Strychnaceae

STRYCHNOS NUX-VOMICA L. Strychnine tree. 2n=24, 44. India, Ceylon 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 Ceylon.

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, Ceylon and elsewhere for its fruits.

Umbelliferae

ANETHUM GRAVEOLENS L. (syn. Peucedanum graveolens (L.) Hiern.) Dill. 2n=22. Eurasia. Cultivated in Greece, Rome and Palestine (p. 105). Indian types have longer fruits. This species includes A. sowa*.

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= . A 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 an 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 region. Cultivated for its starchy rhizomes.

CURCUMA CAESIA Roxb. Kalihaldi. 2n= Bengal. Occasionally cultivated for its rhizomes.

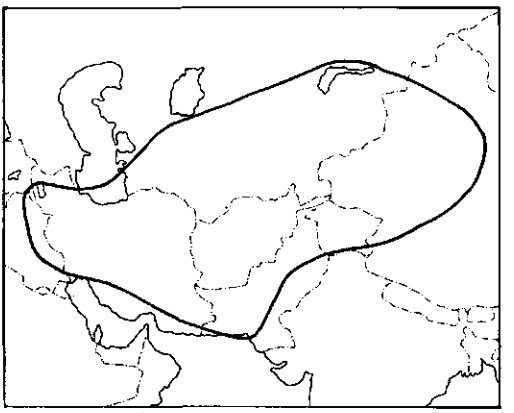
CURCUMA DOMESTICA Val. (syn. C. longa Koenig non L.). Turmeric, Curcuma. 2n=(32), 62, (63, 64). A completely sterile triploid which probably arose with the wild C. aromatica Salisb., Wild turmeric, Yellow zedoary (2n=42) as one parent. C. aromatica grows in India. At first turmeric may have been used as a sacred plant; later is 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, Ceylon and Madagascar. Rhizomes are a source of a condiment. Young flowers are used for flavouring food.

ELETTARIA CARDAMONUM (L.) Maton. Cardamon. 2n=48. S. India and Ceylon. Cultivated in India and Malayan 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 viz. group major Thwaites includes the Ceylon variety and 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 Centre



The Central Asian Centre was called by Vavilov Southwestern Asian Centre. Zohary (1970) prefered to join it with Centre 6: the Near Eastern Centre, like Zhukovsky (1968) did, who separated both areas by number only. But in 1970 both centres were on the map, separated by a line, while Centre 5 was extended northerly (Zhukovsky, 1970).

This centre served as a transfer zone between centres 1 and 4. Furthermore, the Himalayas have provided many species as parental stocks for crops.

Agriculture must have reached this centre from Centre 6 at about 5000 BC.

Important crops of this centre are fruit trees, Allium cepa, A. sativum, Daucus carota, Lathyrus sativus, Spinacea oleracea, Vicia faba etc. It is a secondary centre of diversity for Cucumis melo.

Alliaceae

ALLIUM CEPA L. Onion. 2n=16. Probably C. Asia and esp. NW. India, Afghanistan, Uzbekistan and W. Tienshan where related species A. pskemense B. Fedtsch. (2n=16) and A. vavilovi Popov & Vved. (2n=16) grew wild (Vavilov, 1949/50). Secondary centre is Centre 7 (p. 91). Another related wild species is A. oschaninii O. Fedtsch. from Pamir-Alai and Tien Shan regions. 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 (var. viviparum (Metzger) Alefeld) is probably a hybrid of A. cepa and A. fistulosum*. Such hybrids have been described as A. aobanum Araki (2n=16).

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 became cultivated in China (p. 28). Secondary centres developed in Centres 6 and 7 (p. 78, 91) (Kazakova, 1971). Garlic was already known in Egypt before 3000 BC.

Chenopodiaceae

BETA VULGARIS L. Beet. 2n=18, (27, 36). Primary centre is discussed on p. 92. Secondary centre developed in Centre 5.

SPINACIA OLERACEA L. Spinach. 2n=12. Iran up to Manchuria. Primary centre in Afghanistan and Tadzikistan. In this area the wild, related S. tetrandra Stev. (2n=12) also grows.

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. The 'Russian' tarragon (2n=90), a decaploid, is fertile, while 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 Centre 6 (p. 78). Secondary centre near Kabul, Afghanistan. The great variability of the safflower population here, that led Vavilov to believe this area to be a centre of origin, is very likely caused by the meeting of the Middle Eastern and West Pakistan safflower types in this area (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 was cultivated and had various uses.

TARAXACUM KOKSAGHYZ Rodin (syn. T. bicorne Dahlst.). Kok-saghyz. 2n=16. Turkestan, USSR. Cultivated in USSR as a rubber crop.

Cucurbitaceae

CUCUMIS MELO L. Melon, Muskmelon, Canteloupe. 2n=24. Probably Africa (p. 110). Secondary centre in Centre 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 latter 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. Subtropical China (p. 31) 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 Himalaya. 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*

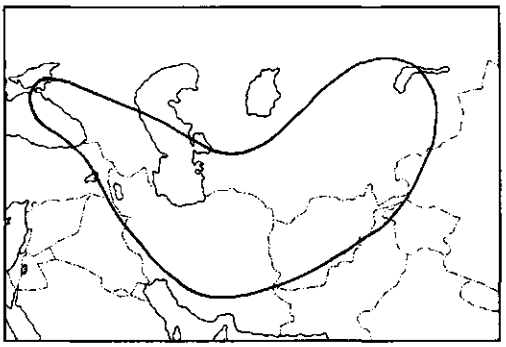
AEGILOPS JUVENALIS*

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 and Crimea and Caucasus, USSR (Zohary et al., 1969) in the west, and Pakistan and Kashmir in the east. Primary centre in the South Caspian area. This wild species is the D genome parent of T. aestivum*. Often as a weed in wheatfields. Useful as a source of genes for wheat improvement.



Aegilops squarrosa

AEGILOPS TRIARISTATA*

AEGILOPS TRIUNCIALIS*

SECALE CEREALE L. Weedy and cultivated rye. 2n=14. The origin of this species is discussed on p. 82. Secondary centre in E. Iran and Afghanistan where S. afghanicum (Van.) 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 the 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., the liguleless rye was found by Vavilov in this 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 Hindu-Kush.

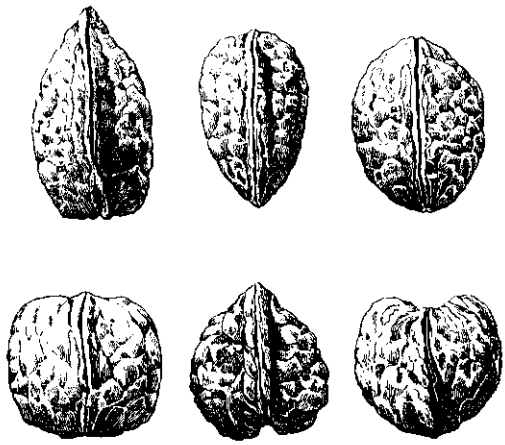
TRITICUM TURGIDUM ssp. turgidum conv. polonicum (L.) MK. 2n=28, genome formula AABB. The type 'T. ispahanicum Heslot' was found in Ispahan, Iran where it has adapted to irrigated cultivation. It is marked by its narrow and elongated glumes.

Hippocastanaceae

AESCULUS HIPPOCASTANUM*

Juglandaceae

JUGLANS REGIA L. Walnut, Persian walnut, English walnut. 2n=32, 36. Primary centre: Region 5. Secondary centre: Moldavia, SE. Europe and SW. Europe (p. 135). Many varieties have been described.



Juglans regia

Labiatae

LALLEMANTIA ROYLEANA (Wall. & Benth.) Benth. 2n=14. From Iran to Himalaya. Cultivated in E. India as an oil crop.

Leguminosae

CICER ARIETINUM L. Chickpeas, Gram. 2n=14, 16, (24, 32, 33). Secondary centre in Afghanistan. From this area the 'Kabuli' types of India derive. They were introduced there about 1700 (van der Maesen, 1972).

CICER MICROPHYLLUM Royle (syn. C. songaricum Steph., C. jaquemontii Jaub. & Spach.). 2n=14. Tibet, Afghanistan and W. Himalaya. Cultivated in W. Himalaya for its seeds.

LATHYRUS SATIVUS L. Grass pea, Chickling pea. 2n=14. Probably W. Asia. A centre of diversity in the Mediterranean centre. Cultivated in Europe since ancient times and in Centre 7 (p. 101). Unknown wild.

MEDICAGO SATIVA L. Lucerne. Blue alfalfa. 2n=16, genome formula SS, 32, genome formula SSSS. Transcaucasia (p. 86). The centre of diversity of the blue lucerne is in NW. Iran and adjacent regions up to Tibet.

MEDICAGO TIANSCHANICA Vass. Tien-shan lucerne. 2n=32, 36. Tien-shan, USSR. In USSR attempts have been made to domesticate it.

MOGHANIA VESTITA (Benth. ex Baker) O. Kuntze (syn. Flemingia vestita Benth. ex Baker). Sohphlong. 2n=22. W. Himalayas, N. India. Cultivated for its edible tubers especially in Assam, E. India.

VICIA FABA L. (syn. Faba vulgaris Moench). Field bean, Broad bean, Horse bean, Pigeon bean, Tick bean, Windsor bean. 2n=12, 14. Probably SW. Asia. Broad bean is unknown wild.

V. faba may have derived from the weed V. angustifolia L., (2n=14) or V. narbonensis*. The field bean is divided into three varieties according to the size of the seed: var. minuta (Alef.) Mansf. (syn. var. minor (Pieterm.) Harz.,) the pigeon 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 region. In the Mediterranean region a secondary centre of diversity arose (p. 103). The pigeon and horse beans are used as animal food, while the broad bean is a vegetable.

Schultze-Motel (1972) has listed all data on archeological remains of the field bean. Most of these remnants belong almost exclusively 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 probable. Only once was var. faba, the broad bean found i.e. in Iraq. It dated ca. 1000 AD, which may point to a late development of the large size of the 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. 87. Primary centre of origin probably in Centre 5 (Vavilov, 1957). This conclusion is based on the great diversity of flax in India and adjacent northerly area. Spread from Centre 5 into Centre 4 (p. 67).

In the mountains of C. Asia the 'curly oil flax' was 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 - Tadzhikistan - S. Uzbekistan, USSR.

GOSSYPIUM HERBACEUM L. Short staple American cotton. 2n=26, genome formula A_1A_1. S. Africa (p. 121). Introduced into Ethiopia, S. Arabia and Belutchistan where race acerifolium (p. 88) 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 the 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 production.

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.

Papaveraceae

PAPAVER SOMNIFERUM L. Opium poppy. 2n=22. Primary centre either in Centre 5 or in the Mediterranean centre (p. 104). The cultigen ssp. somniferum (incl. ssp. hortense (Hussenot) Corb.) is suggested to derive from ssp. setigerum (DC) Corb. (syn. P. setigerum DC.). In Centre 5 the greatest variability is observed. In Turkestan the actual domestication could have taken place.

Another classification of subspecies is:
1. ssp. subspontaneum N. Bas. Asia Minor, Iran, Afghanistan, India and Europe. It has dehiscent fruits,
2. ssp. tianshanicum N. Bas. N. Kirghiz regions. It also has dehiscent fruits,
3. ssp. persicum N. Bas. Iran, Afghanistan, India, Egypt and C. Asia. It has dehiscent fruits,
4. ssp. turcicum N. Bas. Anatolia, Turkey. It has indehiscent fruits,
5. ssp. chinense N. Bas. China. It has indehiscent fruits,
6. ssp. tabargataicum N. Bas. the mountains of Tabargataï. W. China. It has indehiscent fruits,
7. ssp. songaricum N. Bas. W. Europe, USSR and W. China. It has indehiscent fruits.

Phytolaccaceae

PISTACIA VERA L. Pistachio. 2n=30. It grows on mountain slopes and sometimes forms thin forests. Cultivated in Centre 5, in the Mediterranean region and elsewhere for its seeds. In Turkmenia there are relic populations which formerly belonged to one large area of this species (Kabulov, 1969).

Polygonaceae

RHEUM RHAPONTICUM L. Rhubarb. 2n=44. SE. USSR. Cultivated as a vegetable. Probably one of the parents of R. hybridum*. Related to R. palmatum*.

Rosaceae

AMYGDALUS BUCHARICA Korsh. (syn. Prunus bucharica (Korsh.) Fedtsch.). Bokhari almond. 2n=16. W. Tian-Shan and Pamir-Alai, 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, Afghanistan and W. Tien-Shan (p. 89). Primary centres: W. Kopet-Dagh and W. Tien-Shan. Extensively cultivated in S. Europe and California. In this centre and in Centre 6 (p. 89) other Amygdalus species are found. In Georgia, 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. 36). 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 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, W. Tien-Shan and Pamir-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 for marmelades etc. 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. 36). Secondary centre for the cultivated apricot E. Tien-Shan. For the wild apricot this is a primary gene centre which was formerly connected with the main part in China (p. 36).

CRATAEGUS AZAROLUS L. (syn. C. aronia Bosc.). Azarolier. 2n= . S. Europe, Africa

(p. 105) and the Orient. In Uzbekistan, a large-fruited type, var. turcomanica Popoff, is found. It is poor in vigour.

FRAGARIA BUCHARICA Losinsk. Bokhara strawberry. 2n= . Centre 5.

MALUS KIRGHIZORUM Al. & Fed. 2n= . W. Tien-Shan found 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 kirghizorum

MALUS PUMILA*

MALUS SIEVERSII (Ledeb.) M. Roem. 2n= W. Tian-Shan and in Alatan of Jungar in the underbush of the wild walnut (Juglans regia L.).

Malus sieversii

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 winterhard. Used as a rootstock. Where it grows together with M. pumila, hybrids occur and therefore M. sylvestris must have been involved in the remote 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).

PRUNUS subgen CERASUS Pers. In Centre 5 wild *cherries with small fruits (sect. Microcerasus* Webb.) occur.

PRUNUS CERASIFERA Ehrh. Cherry plum, Myrobalan. 2n=16, genome formula CC, (24, 32, 48). Primary centre is in the Caucasus (p. 89). Secondary centre: the W. Tian-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 Tian-Shan and in Pamir-Alai (USSR). It is a true-breeding hybrid of a spontaneous cross Amygdalus communis* and Prunus cerasifera*.

PYRUS BUCHARICA Litv. 2n= . W. Tian-Shan and the mountains of Tadjikistan. It is thought to be a hybrid of P. regelii* and P. korshinskyi* (Vavilov, 1930).

PYRUS KORSHINSKYI Nak. & Kik. 2n= Pamir-Alai and in W. Tian-Shan. It is considered as one parent of P. bucharica*.

PYRUS REGELII Rehd. 2n= . W. Tian-Shan, Pamir-Alai and the Bokhara Uplands. It is very resistant to drought.

PYRUS SOGDIANA S. Kudr. 2n= . Shakhrisibai region.

PYRUS VAVILOVII M. Pop. 2n= . E. Ferghana. It is considered as a hybrid of P. communis* x P. korshinskyi* (Vavilov, 1930).

ROSA MOSCHATA J. Hermann. 2n=14, (28). Himalaya 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. 141). Asia and N. Africa. Cultivated in the Kashmir for lopping for 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. The genus Daucus occurs mainly in South-West Asia and the Mediterranean countries but some species are found in the New World, tropical Africa, Australia and New Zealand.

D. carota includes many wild (ssp. carota) and cultivated forms (D. sativus (Hoffm.) Roehl.) which occur in Europe, N. Africa, SW. and C. Asia. Primary centre of the oldest cultivated forms is in Afghanistan. These types are characterized by carrots purple coloured with anthocyanins. From Afghanistan it spread to Asia Minor. During its distribution the yellow and white carrots originated probably through mutation (see however, p. 142). The white mutants (albus) were used for fodder and did not participate in the development of the European carrot (Banga, 1957).

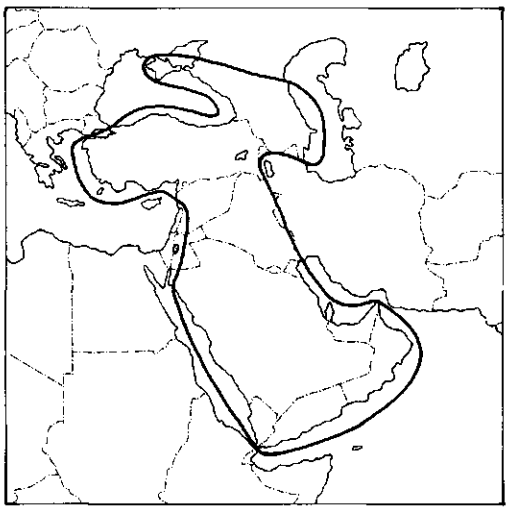
In Asia Minor and during its further distribution in Europe and Mediterranean countries, introgression occurred with local wild carrots (p. 105).

After having reached Iran it probably spread from this country to China (Banga, 1962).

Vitadaceae

VITIS VINIFERA L. Common grape. 2n=38. Canyons of Tian-Shan and adjacent areas. Primary centre for the cultivated grape lies in this centre (see further p. 90).

6 Near Eastern Centre



The Near Eastern Centre was called by Vavilov the Near Eastern Centre of Origin. This last centre included a part of Centre V.

Darlington (1956) called this area the SW. Asian region. Zhukovsky (1968) gave it two numbers 5 and 6, but in 1970 he separated both by drawing a line on the map. Zohary (1969) preferred to fuse both regions into one. In this region lies the Fertile Crescent. Here agriculture may have independently been developed about 9 000 BC. (Cambal & Braidwood, 1970). Hence, Harlan (1971) called the area of the Fertile Crescent, a centre A1 Near East centre. From this centre agriculture spread to Europe, the Mediterranean region, Afghanistan, India and possibly Africa.

Important crops are fruit trees, Brassica oleracea, Hordeum vulgare, Lens esculenta, Medicago sp., Secale sp., Triticum sp., Vicia sativa, Vitis vinifera etc.

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 sp., Cucumis melo, C. sativus, Cucurbita moschata, C. pepo, Lens esculentum, Lupinus sp., Malus sp., Medicago sativa, other annual Medicago species, Onobrychis viceaefolia, Phaseolus vulgaris, Pistacea sp., Prunus sp., Pyrus sp., Trifolium sp., 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, Caucasus to Iran and N. Africa. A type resembling ssp. iranicum P.W. is cultivated near Teheran (Tahbaz, 1971). At Israel the diploid is rare, whereas the triploid is a vegetatively propagated triploid weed (Kollmann, 1972).

ALLIUM ASCOLINICUM L. Shallot. 2n=16. Probably W. Asia. This species is often included in A. cepa*.

ALLIUM KURRAT Schweinf. Salad leek, kurrat. 2n=32. Probably Arabia and Sinai (Uphof, 1968). The geographical distribution is not known. Cultivated in the Nile region, Arabia and Palestine for its leaves (Uphof, 1968). It might be derived from A. ampeloprasum* (Kuckuck, 1962). Because of its close relationship to A. ampeloprasum* it is often included in this latter species as var. kurrat Schweinf. ex Krause.

ALLIUM PORRUM L. Leek. 2n=32. Asia Minor. Probably gene centre for cultivated forms (Kuckuck, 1968). Leek is a cultivated form derived from A. ampeloprasum*. In this case 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. 71). Secondary centre in Region 6 (Kazakova, 1971).

Boraginaceae

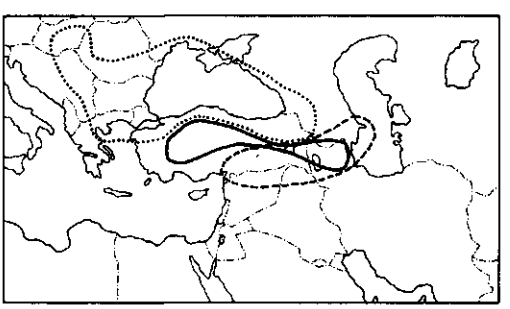
SYMPHYTUM ASPERUM Lepechin (syn. S. asperrimum Donn.). Prickly comfrey. 2n=40. Caucasia to Armenia and N. Iran. Cultivated as a forage crop. It is probably one of the parents of S. X uplandicum Nyman, (2n=36), a forage crop. The other is S. officinale L., common comfrey, (2n=26, c. 36, 40, c. 40, 48) which is native to Europe, W. Siberia and Asia Minor.

Chenopodiaceae

BETA COROLLIFLORA Zos. 2n=36, genome formula CCCC. Iran, Transcaucasia and the Pontian range of Asia Minor. It is 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 both 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 that of B. trigyna overlaps tetraploid B. lomatogona are 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 the mountains in Iran, Turkish Armenia (Lake Van) and the Caucasus. A winterhardy species with a sugar content (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 variability and ancient culture, in Afghanistan, based on variability and proximity of wild species, and in Ethiopia because of the presence of wild safflower species. However Hanelt (1961), Ashri and 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 Libanon, and C. palaestinus Eig. (2n=24, genome formula BB), found in deserts of W. Iraq and Israel (Khidir and Knowles, 1970). In this area introgression between wild and cultivated safflower may still take place.

The great variability of the Afghanistan safflower population must be caused by the meeting of the Middle Eastern and the Pakistani types (Knowles, 1969) (p. 71). The wild safflower of Ethiopia cannot be the progenitor of safflower in this centre because it has 32 pairs of chromosomes while 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 have mainly Sudanese material as parent. These varieties are now cultivated too in Egypt, Spain and some other countries 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. At present it is cultivated for its seeds which yield an edible oil. Its high level of polyunsaturation due to its high content of linoleic acid makes it very suitable for consumption.

Imrie and Knowles (1970) suggested that C. palaestinus is a wild species. From this species the weedy species C. flavescens and C. oxyantha M. B. (2n=24, genome formula BB) and the cultivated species C. tinctorius derive.

CHRYSANTHEMUM COCCINEUM Willd. (syn. C. roseum Adam). 2n= . Wild in N. Iran, Caucasia and Armenia. Cultivated as a garden plant. The flowers contain the insecticide pyrethrine, but its toxity is less than C. cinerariaefolium*.

CHRYSANTHEMUM PARTHENIUM*

Cornaceae

CORNUS MAS L. (syn. C. mascula Hort.). Cornelian cherry. 2n=18, 54. Caucasus 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 Cornoulle, an alcoholic beverage.

Corylaceae

CORYLUS AVELLANA L. European hazel, Cobnut, Hazel nut. 2n=22, 28. Europe and Caucasus. Primary centre in the Caucasus. Cultivated widely.

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*.

CORYLUS COLURNA L. Turkish hazel. 2n=28. Occasionally cultivated in Turkey for its nuts.

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 parent form occurs probably C. microcarpa Andrz. (2n=40). It became a weed in cereal crops and flax. Later it was cultivated for its oily seeds, the cultigen being called C. sativa. An intermediate form of this latter species and its wild parent 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 this species being divided into subspecies microcarpa (Andrz.) Hegi, sativa, pilosa (DC.) Hegi and alyssum (Miller) Hegi. Its cultivation has almost disappeared.

CRAMBE CORDIFOLIA Steven. (syn. C. tatarica Jacq.). Tatarian sea-kale. 2n= . Highlands of Asia Minor, India and Ethiopia. The perennial herb is cultivated for the young leaves.

IBERIS TINCTORIA L. (syn. I canescens DC., I. littoralis Steven, I. taurica Bieb.). 2n=28. Most of Europe. Cultivated as a source of dye, and therefore probably introduced.

Cucurbitaceae

CUCUMIS MELO L. Melon, Musk melon, Canteloupe. 2n=24. Africa (p. 110). Secondary centre arose in Centre 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 and convar. flexuosus (L.) Greb., tarra melons, adjur melons, snake melons, serpent melons are found.

CUCUMIS SATIVUS L. Cucumber, Gherkin. 2n=14. India (p. 64). Secondary centre (a xerophytic type) arose in this centre.

Dipsacaceae

CEPHALARIA SYRIACA Schrad. Pelemir. 2n=10. This pestweed of wheat fields is occasionally cultivated on the central-anatolian peneplane as an oil crop.

DIPSACUS SATIVUS (L.) Scholler (syn. D. fullonum L.). Teasel. 2n=16, 18. Cultivated in Europe and elsewhere. It has developed from D. sylvestris Huds. (2n=16, 18) or D. ferox Loisel (2n=16, 18).

Fagaceae

CASTANEA SATIVA Mill. (syn. C. vesca Gaertn.). Sweet chestnut, Spanish chestnut. 2n=22, 24. From Italy northwards to Hungary and eastwards up to Asia Minor and W. Georgia, Caucasia. Cultivated for its nuts and timber. Outside the above 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 on the T. aestivum* nucleus.

AEGILOPS COLUMNARIS Zhuk. 2n=28, genome formula $C^uC^uM^cM^c$. Turkey, Iraq, Iran and Caucasus. It is a weed of cultivation and looks quite similar to Ae. triaristata* (Bor, 1970).

AEGILOPS COMOSA*

AEGILOPS CRASSA Boiss. (syn. Triticum crassum (Boiss.) Aitch. & Hemsl., 2n=28, genome formula $DDM^{cr}M^{cr}$, 42, $DDD^2D^2M^{cr}M^{cr}$. Turkey, Iraq, Iran, Afghanistan and Palestina. Hybrids between 6x forms and T. aestivum* produce a few fertile 10x amphiploid plant. This might be useful for introducing useful genes of Ae. crassa into wheat.

AEGILOPS CYLINDRICA Host. (syn. Triticum cylindricum Ces., Pass. & Gib.). 2n=28, genome formula CCDD. Balkan peninsula, Crete, Turkey, Caucasus, S. USSR, Iraq, Iran and Afghanistan. It is a weed in fallow fields and on hillsides.

AEGILOPS JUVENALIS (Thell.) Eig. (syn. Ae. turcomanica Roshev., Triticum turcomanicum (Rosh.) Bowden). 2n=42, genome formula $DDC^uC^uM^JM^J$. Iraq, Iran, Turcomania and Turkestan, USSR.

AEGILOPS KOTSCHYI Boiss. (syn. Ae. triuncialis var. kotschyi (Boiss.) Boiss., Triticum kotschyi (Boiss.) Bowden). 2n=28, genome formula $C^uC^uS^vS^v$. N. Africa, Palestina, Iraq, Iran, Afghanistan and Caucasus.

AEGILOPS LORENTII Hochst. (syn. Ae. biuncialis Vis., Ae. macrochaeta Shuttl. & Huet., syn. Triticum macrochaetum (Shuttl. & Huet. ex Duval-

Jouve) Richter, Triticum lorentii (Hochst.) Zeven). 2n=28, genome formula $C^uC^uM^bM^b$. S. Europe, USSR, Turkey, Israel, Iraq and Iran.

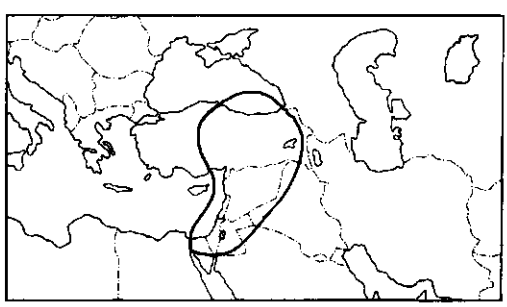
The name Ae. lorentii antedates Ae. biuncialis Vis. (Bor, 1970).

AEGILOPS MUTICA Boiss. (syn. Triticum tripsacoides (Jaub. & Spach) Bowden. 2n=28 (+B), genome formula C^uC^uCC. Anatolia and Armenia. Jones and Majisu (1968) consider it related to the A, S or D genomes (p. 83 and p. 72), but not to the B genome (p. 84). It is a cross-fertilizer.

AEGILOPS OVATA L. (syn. Triticum ovatum (L.) Raspail. 2n=28, genome formula $C^uC^uM^oM^o$. The Mediterranean region, Palestina, Syria, Turkey, Iraq, Iran, Afghanistan. A weed in cultivation. Its cytoplasm has a male sterilizing action on the nucleus of T. aestivum* and T. turgidum*.

AEGILOPS SPELTOIDES Tausch. (syn. Triticum speltoides (Tausch.) Gren. ex Richter. 2n=14, genome formula SS (formerly it was believed that the S genome was identical to the B genome of T. turgidum* and T. aestivum*. However, new investigations showed that this is not so (Johnson, 1972; Kimber & Athwal, 1972). Primary centre: S. Turkey, N. Syria and N. Iraq. It is less common in the remaining part of Turkey and Thrace, Greece and in Syria, N. and C. Israel. It is often found together with the wild T. boeoticum*.

This species includes Ae. speltoides s.s., Ae. ligustica (Savign.) Cosson and probably Ae. longissima Schweinf. ex Muschl., genome formula S^bS^b and is synonymous to Ae. sharonensis Eig., genome formula S^bS^b and Ae. aucheri Boiss. Ssp. speltoides is a B-chromosome carrier and a cross-fertilizer.



Aegilops speltoides

Waines and Johnson (1969) considered Ae. sharonensis (Triticum x sharonense (Eig.) Waines & Johnson as a hybrid of Ae. longissima and Ae. bicornis*. They based this conclusion on the similarity of grain-protein electrophoretic patterns of this hybrid and that of the summation of its putative parents, the intermediate spike characters, the intermediate ecological preference and on its distribution in Israel: the area of overlap between both parent species. At present Ae. sharonensis is effectively reproductively isolated.

Maan (1973) concluded from his nucleo-cytoplasmic and cytogenetic studies that the cytoplasm of Ae. speltoides is closely related to that of T. timopheevi* and differs from that of T. monococcum* and T. turgidum*.

AEGILOPS SQUARROSA*

AEGILOPS TRIARISTATA Willd. (syn. Triticum triaristatum (Willd.) Godr. & Gren.). 2n=28, genome formula $C^uC^uM^tM^t$, 42, genome formula $C^uC^uM^tM^tM^{t2}M^{t2}$. The Mediterranean region, W. Asia, Iraq, Iran and S. of USSR. The hexaploid is also described as Ae. recta (Zhuk.) Chenn.

AEGILOPS TRIUNCIALIS L. (syn. Triticum triuncialis (L.) Raspail. 2n=28, genome formula C^uC^uCC. The Mediterranean region, Turkey, Palestina, Syria, Lebanon, Iraq, Iran, Turcomania, Afghanistan and Caucasus.

Ae. bushirica Rosh. might be a synonym. However Bor (1970) suggested that it could be a hybrid product of Ae. triuncialis and Ae. cylindrica*.

AEGILOPS UMBELLULATA Zhuk. (syn. Triticum umbellulata (Zhuk.) Bowden). 2n=14, genome formula C^uC^u. Moist steppes, dry hills and as a weed in cultivation in the Greek islands, Turkey, N. Syria, Iraq, N. and W. Iran and Transcaucasia. Used in wheat breeding as a source of resistance to leaf rust, Puccinia triticina Eriks.

AEGILOPS VARIABILIS*

AGROPYRON INTERMEDIUM*

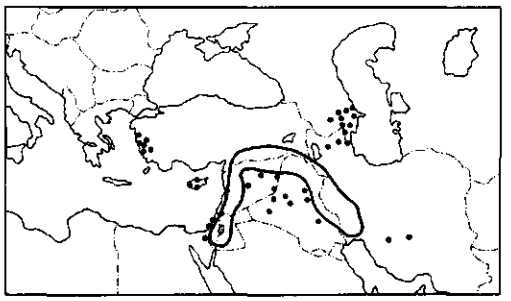
AGROSTIS TENUIS*

AVENA SATIVA L. Byzantina type, Red oat, Algerian oat. 2n=42, genome formula AACCDD. The Mediterranean centre (p. 97). Cultivated in the south and extreme west of Asia Minor, where it may come in contact with other Avena species.

CYNOSURUS CRISTATUS*

HORDEUM VULGARE L. Barley. 2n=14, genome formula VV. The wild parent of barley is H. spontaneum C. Koch (2n=14). E. Mediterranean region - - W. Asiatic countries to Turkmenia and Afghanistan. In the peripheral areas it only grows as a weed. In the Upper Jordan valley catchments robust types with very large seeds and very long awns are found. A slender type occurs in dry steppes of Negev, Transjordan-Turkish border area - Iran - Afghanistan. In E. Galilee small grassy types are found while everywhere intermediates are observed (Zohary, 1969).

H. spontaneum is two rowed and has a brittle rachis. Its domestication probably took place in the Fertile Crescent resulting in the two-rowed type (ssp. distichon, syn. H. distichon L.). The start of its domestication might have been about 7 000 BC. Helbaek (1966) suggested that the barley



Hordeum spontaneum (Harlan & Zohary, 1969)

found at Beidha dating c. 7 000 BC was cultivated wild barley.

Braidwood et al. (1967) found 'evidently domesticated barley' at Cayönü, Turkey, in layers dated c. 7 000 BC.

Domesticated barley has a tough rachis and the change of brittle to tough rachis may have taken place in 7 000 - 6 000 BC. The tough-rachis is conditioned by two recessive alleles bt and bt_2.

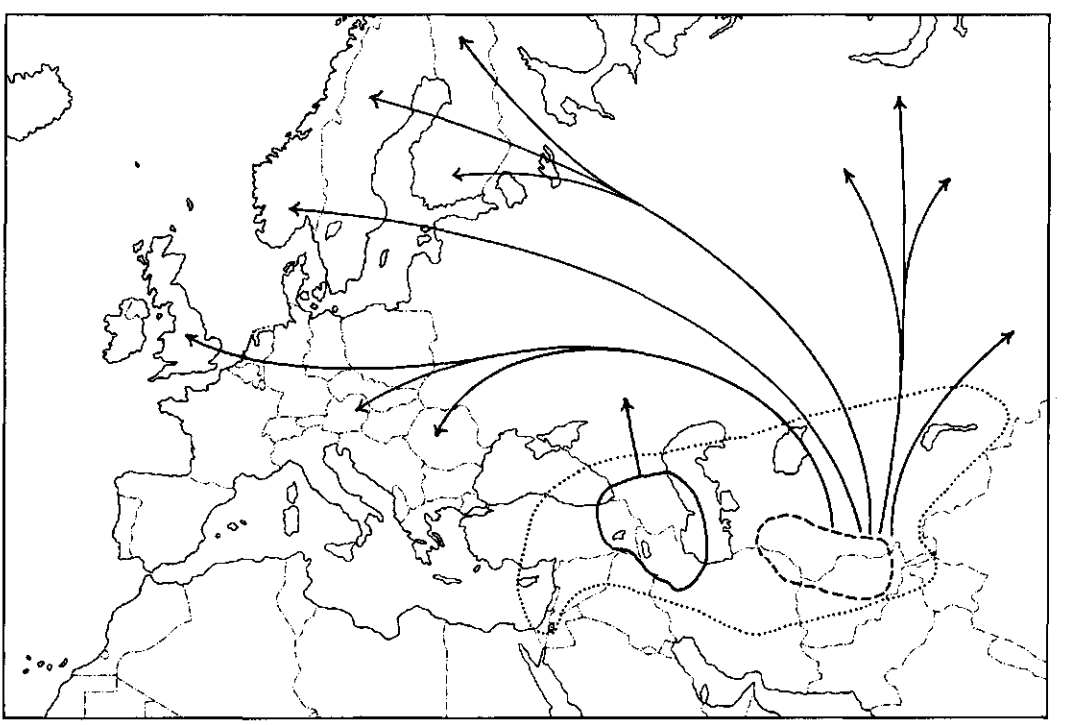
Both genes are closely linked and the genotype for tough rachis is either $BtBtbt_2bt_2$ or $btbtBt_2Bt_2$. No plants with $btbtbt_2bt_2$ have yet been found or bred probably due to the close linkage of the genes. Takahashi (1964) observed that the genotype $BtBtbt_2bt_2$ is very common (90-100%) in the 'Oriental' region: C. and S. Japan, S. Korea, China, Tibet and N. Central Nepal (naked forms), while the genotype $btbtBt_2Bt_2$ is common (60-95%) in the 'Occidental' region: N. Japan, N. Korea, Manchuria, India, Nepal (hulled forms), Kashmir, Turkey, Europe, USSR, Egypt and Ethiopia. In Pakistan, Afghanistan, Iran, Iraq and Syria both types occur (65-75%) $BtBtbt_2bt_2$).

C. 7 000 BC. 'naked barley' was first identified at Beidha, Aceramic Hacilar and Ali Kosh (Bus Mordesh period). In this material the first six-rowed types (ssp. hexastichon, syn. H. hexastichon L.) appears (Braidwood et al., 1969).

Formerly H. agriocrithon Åberg was thought to be the wild parent of the six-rowed barley. It has a brittle rachis. It is however a hybrid product of H. spontaneum and six-rowed barley. They were first observed in Tibet as weeds in barley fields. Later it has also been found elsewhere where H. spontaneum comes in contact with cultivated six-rowed barley. Lagunculiforme and intermedium types (H. lagunculiforme Bakhteyev) have very probably the same origin.

In Centre 6 ssp. humile* arose and in Centre 7 ssp. mediterraneum*.

Lagunciliforme (H. lagunculiforme) and intermedium (H. intermedium Carlet) have a similar origin. Zohary (1971) suggested that these brittle types are ill-adapted to survive under stable, wild conditions (at least in Israel).



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)

POA BULBOSA L. 2n=14, 28, (39), 42, 45, (40-58, 56). A grass of Europe, W. Asia and W. of N. Africa. Cultivated in USA.

Var. vivipara of C. and Ante-Asia is a very valuable forage plant of dry steppes.

SECALE ANATOLICUM Boiss. (syn. S. montaneum var. anatolicum (Boiss.) Boiss.). 2n=14. Turkey and W. Iran and Iraq. It is a highly polymorphic weedy form.

SECALE CEREALE L. Weedy and cultivated rye. 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. 72) is in Afghanistan and that the cultivated rye of Europe and N. and C. Asia derives from this 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 which could be 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 which occur in grain fields and along ditchbanks and roadsides throughout the Middle East countries (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.

S. turkestanicum Bensin. A self-compatible cultigen of C. Asia (p. 72) and Transcaucasia.

The weedy types have been derived mainly from S. vavilovii* by introgression with S. montanum* and its derivative species S. anatolicum*. In some places suboptimum 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 its contact with other species, because a high incidence of genotypically controlled chromosomal breaks in outcrossed hybrids leads to sterility (Stutz, 1971).

Hybridization between wheat (p. 82) and rye may have increased the variability of wheat. Rye is a source of resistance to diseases in wheat breeding and a parent of octaploid and hexaploid triticales.

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 eastward in isolated pockets in the mountains of Sicily, Italy, Yugoslavia, Greece, Lebanon, Turkey, Iran and Iraq (Stutz, 1972). It is a highly polymorphic perennial, cross-fertilizing form. 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 non-fragile 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 is the parental species of S. anatolicum* and S. silvestre* (Stutz, 1972). Owing to hybridization with S. vavilovii* weedy types belonging to S. cereale* arose (Stutz, 1972).

SECALE SILVESTRE Host. (syn. S. fragile Marsch.). 2n=14. C. Hungaria eastward throughout the sandy steppes of S. Russia up to W. Siberia and Pamir-Alaj (Bor, 1970; Stutz, 1972). A low growing annual psammophyte with fragile rachis. It has the same chromosome arrangement as S. montanum*. It is suggested that this species derives from S. montanum and that it is the ancestor of S. vavilovii* (Stutz, 1972).

SECALE VAVILOVII Grossh. 2n=14. Common to the lower slopes of Mount Ararat and along the banks of the Araxis 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 to be the same as S. afghanicum*. Khush (1960) suggested that it derived from S. montanum, but Stutz (1972) made it clear that this species derives from S. silvestre* and that it 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 pollination within the species and between subspecies, other Triticum-species and related species Aegilops and Secale is still taking place. 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*. There is a continuous exchange of genes from wild species to cultivated and vice ver-

sa. This has resulted in numerous botanical 'varieties'.

This hybridization has led to hexaploid types with a very brittle ear. This is a 'wild' character and it could be concluded that there are wild hexaploid wheats. However these segregants can not 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. vavilovi (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 classified. They have originated in another centre.

Spelt wheats have been found in Iran, in Central Europe (p. 134) and Africa (p. 117).

Ssp. vavilovi wheat is indigenous to Armenia. It is characterized by its branching spikelet.

Makha wheat is indigenous to W. Georgia. It is often mixed with T. turgidum ssp. paleocolchicum*.

Bread wheat is now widespread. Primary centre in Transcaucasia and adjacent regions. Secondary centres in Hindukush and adjacent regions (p. 66), in China and Japan (p. 33) and probably in African Sahara (p. 117).

Club wheat developed in Afghanistan and adjacent regions (p. 72) and probably in Switzerland/Austria (p. 134). A secondary centre of diversity is in Armenia.

Indian dwarf wheat originated in NW. India and adjacent regions (p. 66). Its presence has been reported in N. Africa.

Dorofejev (1971) suggested that ssp. macha is the oldest hexaploid. From this subspecies ssp. vulgare developed. Ssp. spelta and ssp. vavilovii are secondary spelts. They may have been derived from ssp. vulgare.

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. 72). Secondary centre in 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.); furthermore 'T. spontaneum Flaksb.' and 'T. urartu Tuman.'. It is spread over Greece, Turkey, Syria, N. Iraq and Transcaucasus. Aegilopoides is characterized by one grain and one awn per spikelet, while 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 first centre thaoudar is found. Aegilopoides type occurs in the cooler 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 c. 6 500 BC., thus later than the first appearance of T. turgidum ssp. dicoccum.

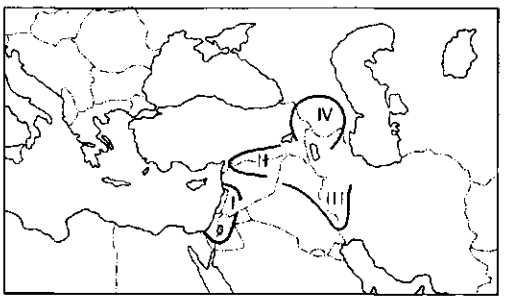
Einkorn was spread over Europe, N. Africa, Asia Minor, Caucasus, Iraq and Iran. Cultivated in some areas as a fodder crop. It forms a component of the Zanduri wheat which is a mixture of einkorn, T. timopheevi ssp. timopheevi* and T. zhukovskyi*. This population is cultivated in Georgia, USSR. This species forms an important 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, this subspecies only crosses easily with ssp. timopheevi.
Ssp. timopheevi is a part of the Zanduri wheat, which is 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 and (timopheevi) durum and aestivum plants often are male sterile.

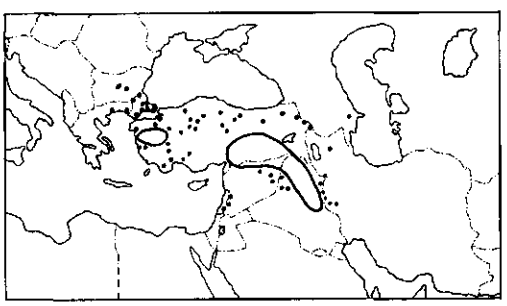
Maan (1973) concluded from his nucleo-cytoplasmic and cytogenic studies that T. timopheevi ssp. timopheevi and ssp. araraticum and T. dicoccoides var. nudiglumis ex Turkey-Iran-Iraq area have the same type of cytoplasm and the genome formula AAGG. The cytoplasm of Ae. speltoides* is closer to the above cytoplasm than to T. turgidum*-cultivated wheats.

TRITICUM TURGIDUM (L.) Thell. Wild emmer wheats. 2n=28, genome formula AABB. The distribution area of the wild ssp. dicoccoides can be divided into two regions. One northern region is S. Turkey - Iran - Iraq where var. nudiglumis is found, the Southern region is Israel, S. Syria and Jordan. The cytoplasm of var. nudiglumis is similar to that of T. timopheevi*, while 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.). is derived from a natural amphidiploidization of an unknown diploid species and T. monococcum ssp. boeoticum*. This amphidiploidization must have occurred probably in the Syrio-Palestine probably at several places. Much research has been carried out to identify the unknown diploid parent. Until 1971 Ae. speltoides* was widely accepted as the source of the B genome while ssp. boeoticum was the A genome donor. However, results of new research showed that Ae. speltoides*



Wild tetraploid *Triticum* species: *Triticum* tugidum ssp. dicoccoides (1, 2, 3), spp. dicoccoides var. nudiglumis (3) and T. timopheevi ssp. araraticum (4) (Johnson, 1972)

cannot be the parent (Johnson, 1972; Kimber and Athwal, 1972). Kimber and Athwal (1972) have speculated about the most likely origin of the B genome. They concluded that the tetraploid wheats are polyphyletic in origin i.e. they are hybrids of amphiploids which originated as a result of hybridization between ssp. boeoticum and the other species.



Triticum boeoticum (Harlan & Zohary, 1969)

Furthermore, Maan (1973) concluded from his nucleo-cytoplasmic and cytogenetic studies that possibly the cytoplasm of T. turgidum* is not derived from ssp. boeoticum, Ae. speltoides* and Ae. bicornis*. The latter species has also been mentioned as the possible source of the B genome.

From ssp. dicoccoides several cultivated subspecies have been derived. These are dicoccum*, paleocolchicum*, turgidum* and carthlicum*. The ssp. turgidum includes conv. turgidum, conv. durum, conv. turanicum and conv. polonicum. Ssp. dicoccoides is an important source of disease resistance; it also carries a restorer gene of (timopheevi) cytoplasmic male sterility.

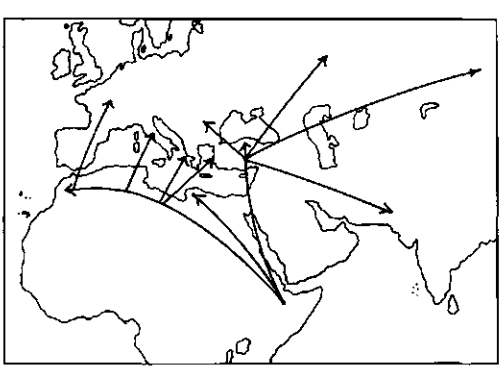
TRITICUM TURGIDUM (L.) Thell. Cultivated emmer wheats. 2n=28, genome formula AABB. The cultivated tetraploid wheat can be subdivided as follows (Mac Key, 1966): ssp. dicoccum (Schrank) Thell. (syn. T. dicoccum Schubl.)., emmer, ssp. paleocolchicum (Men.) Mac Key (syn. T. paleocolchicum Men., T. georgicum 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.), khorassan wheat, conv. polonicum (L.) Mac Key (syn. T. polonicum L.) Polish wheat, and ssp. carthlicum (Nevski) Mac Key (syn. T. carthlicum Nevski, T. persicum Vav. ex Zhuk.), Persian wheat. They have originated through cultivation from ssp. dicoccoides* and maybe by intergeneric and interspecific hybridization.

Primary centre in 6. Secondary centres in Ethiopia (p. 117) and in the Mediterranean centre (p. 99).

Emmer is the oldest cultivated wheat. Its cultivation is declining. Until recently it was cultivated in Ethiopia (p. 117), Iran, E. Turkey, Transcaucasia, Volga-area, Yugoslavia, Czechoslovakia and India. Its domestication may have taken place c. 8 000 BC. in the 'Fertile Crescent Belt'. The first appearance of domesticated emmer dates from c. 7 000 BC. at Aceramic Neolithic Beidha, Ali Kosh, Jericho and Ramad. Already in 4 000 - 3 000 BC. it had reached the Atlantic coast from Scandinavia to Spain and also 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 should be investigated whether the idiotypes of the various dicoccum populations also correspond to each other for characters 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 dicoccum.

Durum wheat is cultivated over a large area. It is cultivated in the Mediterranean coastal region, in Ethiopia where a secondary centre (p. 117). exists, and in areas north of the Black Sea. It is rarely observed in wheats of Iran and Afghanistan. It is also cultivated in the Americas and elsewhere. The spread in the Old World is shown by Ciferri (1939). It is the second most important wheat in the world.



Spread of durum wheat in the Old World (Ciferri, 1939)

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 the spread to Iran and Iraq. Kuckuck (1970) suggested that it is a hybrid of durum x polonicum.

Polonicum wheat, marked by its long glumes and kernels was cultivated in S. Europe, Turkey, Iraq, Iran, Afghanistan and NW. India. According to Kihara et al. (1956) it 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. paleo-colchicum) 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. It was cultivated in W. Georgia, USSR. It 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 an identical male sterilizing action on the durum and aestivum nuclei as ssp. timopheevi. It carries genes for stem rust and mildew resistance.

ZEA MAYS L. Maize. 2n=20. Secondary centre in the Near East (Brandolini, 1970). Domesticated in C. America (p. 166). Flint maize - indurata Sturt. is common here.

Iridiaceae

CROCUS SATIVUS*

Labiatae

LALLEMANTIA IBERICA Fisch. & Mey. Lallemantia. 2n=14. 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. Alpine and subalpine zones of Asia Minor, Transcaucasia, Armenia and Iran.

CICER ARIETINUM L. Chickpea, Gram, Garbanzos. 2n=14, 16, (24, 32, 33). Unknown wild. Secondary centres of diversity probably developed in the centres 4 (p. 67), 5 (p. 73) and 7 (p. 101). Cultivated in S. Europe and N. Africa from the Atlantic eastwards, the Nile Delta and Ethiopia and northwards and eastwards up to NW. Burma, W. China, Kazachskaya 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, Armenian SSR., 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).

Race orientale Pop. is characterized by its very small seeds (1000 seed weight 100-120 g). It is common in Ethiopia, Sudan, Egypt, India, Pamir, Tadzhikistan 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 medium large seeds, (1000 seed weight 200-300 g). It is cultivated in the Near East, Armenia, Azerbaydzan, 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, Tunesia and W. Turkey. The seeds are white.

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 L. orientalis (Boiss.) Hand.-Mazz. as the wild parent of lentil. It looks like a miniaturized lentil. It grows wild in Centre 6.

In ancient times it was cultivated in Egypt, S. Europe and W. Asia.

The primary gene centre of lentil is W. Asia. Spread to other parts of Europe, to India, and China and Ethiopia. Vavilov (1949-50) suggested that L. lenticula (Schreb.) Alef., L. nigricans (M.B.) Godr., L. kotschyana (Boiss.) Alef. or L. orientalis Hand. is the progenitor of lentil. They grow wild in this centre. He classified three varieties: var. macrosperma Baumg. from the Mediterranean region, var. syrica Barul. a medium-sized seed 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. The latter is found in all prehistoric excavations (van Zeist & Bottema, 1971).

Agro-ecological groups meet each other in Turkey and here microcentres have developed (Harlan, 1951).

MEDICAGO CANCELLATA Prod. 2n=48. Caucasus, in the Stavropol elevation. A wild perennial hexaploid species. It has a rhizome.

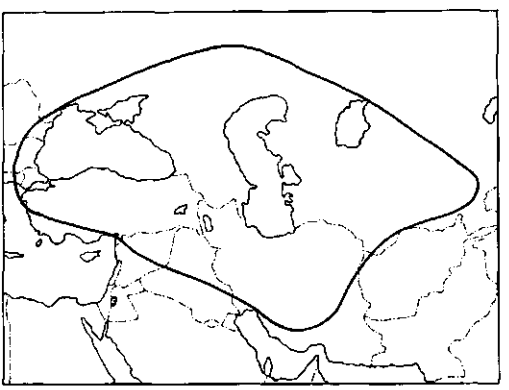
MEDICAGO DAGHESTANICA Rupr. 2n=16. Caucasus. A wild perennial alpine species. It is a good fodder plant.

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. timofeevii Troitz., (2n=32) is endemic to the Transcaucasian Mountains. 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 HEMICYCLA Grossh. 2n=16, 32. The alpine meadows of Transcaucasia and Daghestan. It is a source of cold resistance, and resistance to Verticillium wilt and Bacterial wilt. A wild perennial species. It has been suggested that it is a parent of M. sativa*.

MEDICAGO ROMANICA Prod. 2n=16. Caucasus. A wild variable perennial species

MEDICAGO SATIVA L. Lucerne, Blue alfalfa. 2n=16, genome formula SS, 32, genome formula SSSS, (64). Transcaucasia. Wild types in Anatolia, S. Caucasia and SW. Asia. Secondary centre NW. Iran. From Iran it reached Italy through Greece. Italy through Greece.



Medicago sativa (Fischer, 1938)

Another route of distribution is from Arabia through N. Africa to Spain and then through S. France (Provence) to W. and C. Europe. A third route was from Media over Asia Minor through the Balkans to C. Europe. The French population 'met' the Balkan population in Thuringia, Germany (p. 137) Lucerne also spread eastwards and reached China in the 2nd Century BC. It has also been used in China as a vegetable. Two main introductions were made to America. One from the Spanish population and another from C. Europe (p. 137).
'M. medica Pers.' originated and still does so where M. sativa and M. falcata grow together and hybridize.

Because of the extreme variability of this species, its taxonomy is not yet fully defined. The following subspecies have also been put on a species level. Ssp. ambigua (Trautv.) Tutin = M. falcata var. ambigua Trautv. = M. trautvetteri Sumnev (2n=16). It is a source of cold and drought resistance. Ssp. coerulea (Less. ex Ledeb.) Schmalh. = M. coerulea Less. ex Ledeb. (2n=16). It is a source of resistances to salinity of the soil and drought.
Ssp. glomerata (Balbis) Tutin = M. glomerata Balbis (2n=16) = M. glutinosa Bieb., (2n=16, 32) = M. polychroa Grossh. (2n=32). It is a source of disease resistance and persistency.

MEDICAGO SAXATILIS Bieb. 2n=28, genome formula S'S'X X X X. The S'genome of this species is related to the S genome of M. sativa*. The X-genome is possibly related to that of M. rhodopaea Velen. (2n=16), genome formula RpRp

ONOBRYCHIS ALTISSIMA Grossh. 2n=14. Transcaucasia.

ONOBRYCHIS VICIIFOLIA Scop. Esparcette. 2n=28. Cultivation of this crop started in S. France (p. 137). 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. abyssinium (p. 119), ssp. jomardi (p. 102), ssp. syriacum Berger, ssp. elatius (Stev.) Alef., ssp. arvense Poir. and ssp. hortense Asch. et Graeb. (Gentry, 1971).

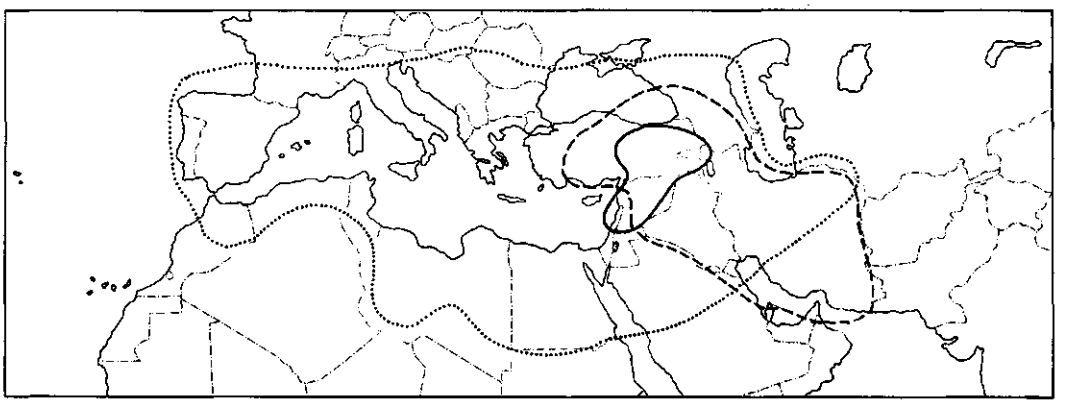
Ssp. syriacum (syn. P. humile Boiss. et Noë, P. sativum var. humile, P. syriacum Berger) is found in N. Iraq, Jordan, Syria, N., NW. and W. Iran, Israel, Turkey and Cyprus. Some forms are robust (30-70 cm tall), others slender and small (20-40 cm) (Ben-Ze'ev and Zohary, 1973).

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, Tunesia, S. Spain, S. France, N. Italy and the Black Sea coast of Turkey, Crimea and Caucasia (Ben Ze'ev and Zohary, 1973).

In the E. Mediterranean countries (esp. S. Turkey) intermediate types are found.

Ben Ze'ev and 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 area (p. 102). Its domestication may have taken place in SW. Asia. The crop reached the Greeks via 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).



Pisum humile (——), P. elatius (. . .) and Alophotropis formosum (---) (Govorov, 1937)

TRIFOLIUM AMBIGUUM M. B. 2n=16, (32, 48). Caucasus and Crimea, USSR and Turkey. This valuable fodder plant forms an essential part of the pastures and meadows.

TRIGONELLA FOENUM-GRAECUM L. Fenugreek, Fenugrec. 2n=16. 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.

VICIA ERVILEA (L.) Willd. Bitter vetch, Ervil. 2n=14. Primary centre in the Mediterranean region (p. 103). In Asia Minor a characteristic group developed.
At present it is cultivated as a fodder, but in prehistoric times it was cultivated for food by man. It was already cultivated in Turkey in 5 750 BC. and probably in Greece in about 5 500 BC. (van Zeist & Bottema, 1971).

VICIA NARBONENSIS L. Narbonne vetch. 2n=14. Primary gene centre probably in E. Georgia. Secondary gene centre in the Mediterranean. This species is a weed in wheat and barley fields in Transcaucasia and other areas in SW. 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). Primary centre of diversity in Centre 6. Widely cultivated in the world as a green manure, fodder crop and for hay production. A polymorphic species. It may have derived from the weed V. angustifolia L. (2n=12).

This latter species can be divided into the wild ssp. angustifolia and the segetal type ssp. segetalis (Mettin & Hanelt, 1964). The latter is a weed of cereal fields. It easily crosses with V. sativa. This species might be divided into convar. consentini, a segetal type which may include primitive cultivars, and convar. sativa, the cultivated forms.
The following ancestry of common vetch has been suggested (Mettin & Hanelt, 1964):
Ancestor (2n=14?) -----> V. angustifolia ssp. angustifolia (2n=12) -----> V. ang. ssp. segetalis (2n=12) ---?----> V sativa convar. cosentini (2n=12) -----> V. sat. convar. sativa (2n=12).
It is reasonable to assume that during this development introgression with other varieties took place. V. cordata Wulf. (2n=10) is probably a derivative of V. angustifolia ssp. angustifolia x V. sativa convar. consentini.

Plants belonging to ssp. amphicarpa collected in C. Anatolia are very persistant as they can resist severe cold, drought and grazing.

VICIA VILLOSA Roth. Sand vetch, Hairy vetch, Winter vetch. 2n=14. W. and C. Europe, the Mediterranean area, N. Iraq, N. Iran and SW. of USSR. Primary centre probably in W. 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.

Linaceae

LINUM USITATISSIMUM L. Flax, Linseed. 2n=30, (32). Primary centre probably in centre 5 (Vavilov, 1957).
This conclusion is based on the great variation of flax 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 more or less domesticated at the same time as emmer and barley in the mountainous region of the Near East. From here it spread to other parts in the Old World.

Linum usitatissimum, various length and branching types

L. bienne can be divided into two main geographical races. The first is the continental winter annual of the semi-arid foothills of Iraqi Kurdistan and Iran. This 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 Kolchid 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). This race has the highest seed oil content and the highest seed weight of all wild species (Seetharam, 1972).

During its domestication and further development, types for fibre (flax) and oil (linseed) were 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. 121). Introduced to Ethiopia, S. Arabia and Belutchistan 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. At present varieties of G. herbaceum are often cultivated. In C. Asia race kuljianum developed. It will mature in three months from sowing, resulting in a small crop.

GOSSYPIUM INCANUM (Schwartz) Hillcoat. 2n=26, genome formula E_4E_4. Aden. 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). Cultivated for a long time. In 4 000 BC. figs were already cultivated in Egypt. In Transcaucasia, Crimea, C. Asia, Baluchistan and the Mediterranean countries it ran wild a long time ago.

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 (Helmqvist, 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.

Punicaceae

PUNICA GRANATUM L. Pomegranate. 2n=16, 18, 19. Wild in the Near East and C. Asia. An old 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. 74) and in Centre 6.

AMYGDALUS FENZLIANA (Fritsch) Lipsky (syn. A. divaricata Fenzl., A. urartu S. Tam., Prunus fenzliana Fritsch.). Fenzel almond. 2n=16. S. Transcaucasia and Anatolia, Turkey. An ornamental. It easily crosses with A. communis* and it might be a source of cold and drought resistance for this species.

AMYGDALUS PERSICA L. Peach. 2n=16. Primary centre in China (p. 36). Secondary centre in Caucasus and Crimea.

ARMENIACA VULGARIS L. Apricot. 2n=16. Primary centres in NE. China (p. 36) and in Daghestan on the slopes of the Khunzakh plateau at an altitude of 1 200-1 800 m. The latter centre probably linked formerly with the main one (p. 36). The tree has a shrubby growth habit. Cultivated over the entire area of the centre.

CYDONIA OBLONGA Mill. Quince. 2n=34. Talysh, S. Daghestan, the Ior valleys and in Azalan, Georgia, in the Terter valley, Azerbaijan and in the canyons of Aidero and Yuz-Begi, Kojet-Dagh, USSR. Primary centre lies here. Cultivated for a long time.

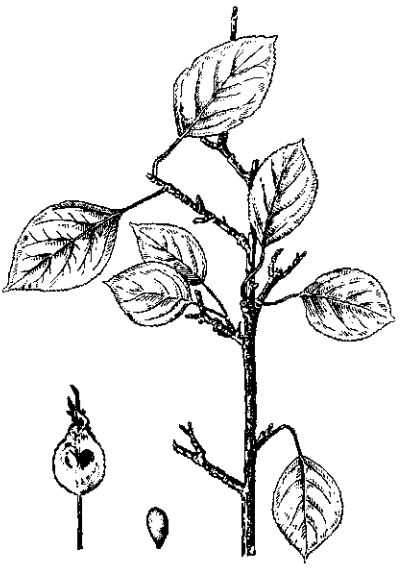
MALUS ORIENTALIS Uglits. 2n= . This is the only wild Malus species in the especially sparse oak forest of the Caucasus. It is polymorphous. Through introgression, characteristics such as tallness, late ripening, good transportability of fruits, high sugar content and unfortunately low winterhardiness entered the cultivated apple (Malus pumila Mill.), which 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 very resistant to frost and drought, much used by I.V. Michurin to breed hybrid varieties such as Kandil-kitaika, Bellefleur-kitaika, Saffran Peppin, Saffran-kitaika.

MALUS PUMILA*

MALUS TURKMENORUM Juz. & M. Pop. 2n= Turkemenia, in the gorges of the Kopet-Dagh Mountains. Primary gene centre also there. The cultivated form is locally known as 'Baba-arabka', meaning: 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. Caucasus, N. Iran and Asia Minor. Cultivated elsewhere and run wild there. It crosses with Crataegus oxyacantha* and Sorbus aucuparia*.



Malus prunifolia

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 Ukrain could be grouped into four classes viz. 1. dark-coloured fruit: a. bitter and b. sweet and 2. light-coloured fruit: c. bitter and d. sweet. The sweet-fruited types had elongated stones and longer fruit stalks and petioles than the bitter-fruited types (M'yakushko and M'yakushko, 1970). It is likely that man selected the sweet-fruited types.

Rjadnova (1967) suggested that the domestication occurred in various places. This resulted in several ecotypes differing in resistance to unfavourable conditions, in quality of fruit etc. Constant selection resulted in large-fruited, winterhardy 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 the Caucasus, Transcaucasia, Iran, Altai, Asia Minor and C. Asia. Primary centre C. and southern part of the Caucasian coast of the Black Sea. From there it spread eastwards and westwards. Secondary centre in W. Tian-Shan (p. 75). It is a very polymorphic species.

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 the Caucasus 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 'Vladimirskaya vishnia' originated in centre 9 (p. 140).

PRUNUS DOMESTICA L. Garden plum, Domestic plum. 2n=48, genome formula CCSSSS or $CdCdSSS_1S_1$ or $CdCdD_1D_1D_2D_2$. Caucasus. This species is thought to be a natural hexaploid of P. cerasifera* and P. spinosa*. This alloploidization apparently took place in the Caucasus, where both species occur and natural hybrids with 2n=24 and 48 are still found. However it may have happened elsewhere. Too e.g. Werneck (1958) considered the garden plum to have arisen in Upper Austria (p. 140).

It is interesting to note that Rybin (1936) resynthesized the garden plum. Artificially obtained hexaploids resembled it.

PRUNUS SPINOSA L. Blackthorn, Sloe. 2n=32, genome formula SSSS or 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 winterhardiness. It is one of the parents of P. domestica*. Some natural hybrids with this latter species are described as P. fruticans Weihe (2n=40).

PYRUS. This centre is the main geographic centre of formation of Pyrus species. Of the about 60 Pyrus species in the world about 25 have been described for the Caucasus. Some of them also occur in Iran or in Asia Minor.

PYRUS CAUCASICA Fed. 2n= . The entire forest zone of the Caucasus except the Talysb Mts. A polymorphic species. In open areas it spreads quickly and vigorously.

PYRUS SYRIACA Boiss. 2n= . Armenia. It is cold-resistant. It probably played a part in the origin of the cultivated pear (Evreinoff, 1944). Cultivated locally.

PYRUS TAKHTADZHIANA Fed. 2n= . It has the habit of a cultivated tree. Cultivated in ancient times, but later it 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, Mountain ash. 2n=34. Its distribution is given on p. 141. 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 the 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*

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.

Vitadaceae

VITIS LABRUSCA L. Fox grape. 2n=38. N. America (p. 179). Introduced into W. Georgia, USSR as a cultivated grape.

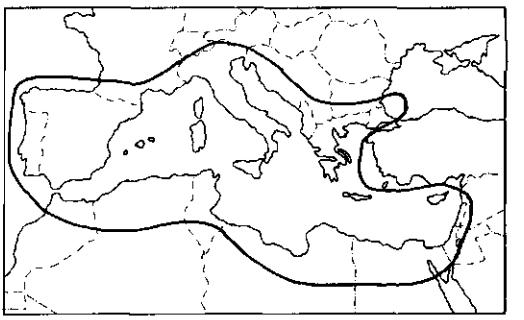
VITIS VINIFERA L. Common grape, European grape. 2n=38, (40, 57, 76). Primary centres: the Central Asian (p. 76), the Near East and the Mediterranean centres (p. 106). The wild vine ssp. sylvestris Gmel. is found in regions bordering the Mediterranean Sea with Libya and Egypt excepting, up to Turkestan and Kashmir. Primary centre: probably Armenia, USSR and N. Iran. The western wild types have been called ssp. silvestris, while the eastern types are ssp. caucasia Vav. The wild and cultivated (ssp. sativa DC., ssp. vinifera) types are very variable resulting in many forms. The domestication took place by selecting natural bud mutants and hybrids.

The actual domestication may have taken place in SE. Europe where types with large bunches and seedless grapes have developed. Natural hybridization is still taking place in several areas e.g. the mountains of S. Tajikistan, USSR where many new forms are observed.

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 winterhardiness.

7 Mediterranean Centre



The Mediterranean Centre was called by Vavilov the Mediterranean Centre of Origin, while Darlington (1956) suggested Mediterranean Region of Origin.

Its situation near a cradle of agriculture Centre 6 led to an early introduction of plant cultivation.

Early farming sites were found at Nea Nikomedeia, Greece dating c. 5 470 BC. (van Zeist & Bottema, 1971) and at Fayum, Egypt dating from the 5th millenium, reaching the Atlantic Ocean maybe in c. 3rd millenium.

A very old site at Kom Ombo, in the Nile Valley, 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 this region: Avena sp., Beta vulgaris, Brassica napus, B. oleracea, Lathyrus sp., Linum usitatissimum, Lolium sp., Lupinus sp., Olea europaea, Raphanus sativus, Trifolium sp., Vitis vinifera, etc.

Alliaceae

ALLIUM CEPA L. Spanish Onion. 2n=16. Secondary centre in the Mediterranean Centre.

ALLIUM SATIVUM L. Garlic, 2n=16, genome formula SS. C. Asia (p. 71). Secondary centre in Centre 7 (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 type of var. ascendens. Cultivated in Europe and elsewhere as a vegetable (Mansfeld, 1959).

Amaryllidaceae

NARCISSUS JONQUILLA L. Jonquille. 2n=14. Europe, Ante-Asia up 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 region. A shrub cultivated in Sicilia 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 region. Cultivated as an ornamental and for other purposes.

Asclepiadiaceae

CYNANCHUM VINCETOXICUM*

Balanitaceae

BALANITES AEGYPTIACA Del. Betu, Desert date. 2n=16, 18. This shrub grows wild in N. trop. Africa, Arabia, Palestine and also in 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 for ornament. as a potherb and for bees.

Capparidaceae

CAPPARIS SPINOSA L. Caper bush. 2n=24, 38. The cultivated forms: (large) flower head, var. spinosa and small flower head, var. parviflora J. Gray probably derived from the wild var. aegyptia (Lam.) Boiss. This variety grows wild in S. and SE. Mediterranean region up to the Sudanian and Eritro-Arabian regions. Var. spinosa was developed in the N. Mediterranean region. From here this form spread to other areas where it is cultivated for its use as a condiment. Var. parviflora is also cultivated and might be a mutant type of var. spinosa. Hybrids with C. ovata Desf. are found.

Caryophyllaceae

DIANTHUS CARYOPHYLLUS L. Carnation, Clove, Pink, Picotes. 2n=30. Mediterranean region. A perennial herb cultivated as an ornamental and also as a source of an essential oil.

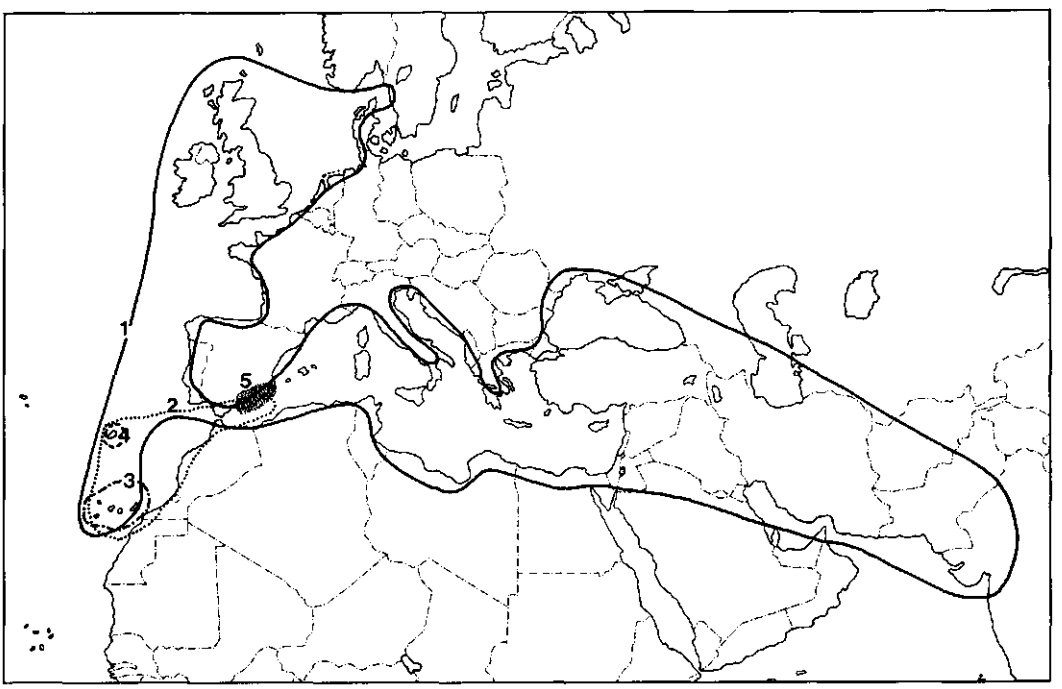
GYPSOPHILA PANICULATA L. Baby's breath. 2n=34. S. and C. Europe and Caucasus. Cultivated formerly for its roots which contain saponin. Now it is an ornamental.

Chenopodiaceae

BETA PATELLARIS Moq. 2n=18, (36). Mediterranean and Atlantic coasts of NW. Africa, Canary Islands, the Cape Verde Islands and Madeira. A source of nematode and Cercospora resistance and yellow mosaic tolerance for B. vulgaris*.

BETA PROCUMBENS Chr. 2n=18. Canary Islands and the Cape Verde Islands. A source of nematode resistance for B. vulgaris*.

BETA VULGARIS L. Beet. 2n=18. 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 western direction along the coast of the Mediterranean, W. coast of Europe and to Cape Verde Islands and Canary Islands. In the Mediterranean region, leaves and roots of this wild plant may have been collected. This may have led to the development of the Swiss chard (var. vulgaris, var. cicla) of which the leaves and stalks are eaten and to the garden beet, table beet and red beet (var. cruenta, var. esculenta). This development may have been influenced by hybridization with wild types like spp. macrocarpa (syn. B. macrocarpa Guss.) in N. Africa. The fodder beet (var. rapa) probably developed in the Netherlands (p. 130) after introduction of



Beta vulgaris (1), B. patellaris (2), B. procumbens and B. webbiana (3), B. patula (4) and B. atriplicifolia (5) (Ulbrich, 1934)

types from Spain, and the sugar-beet in Silecia, Poland (p. 140). 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. They may be included as subspecies in this species.
In NW. Europe, hybrid plants of cultivated sugar-beet and spp. maritima are occasionally observed. They derive from material propagated in France and Italy. Such hybrids bolt in the first year producing seeds. These seeds drop and may result in a weed (F_2 plants) for several years to come. It is possible that on a very small scale, wild genes derived from these hybrids introgress in the cultivated population.
The wild plants may form sources of resistance to disease such as Cercospora, yellow mosaic and to increase the variability to select for 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 in 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 as it yields a base-rich ash when burned.

Compositae

ANACYCLUS OFFICINARUM Hayne. Bertram. 2n=18. Probably the Mediterranean region. Cultivated formerly in C. Europe.

ANACYCLUS PYRETHRUM (L.) Link. Pellitoria of Spain. 2n=18. N. Africa, Arabia and Syria. Cultivated formerly 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.

CHRYSANTHEMUM CINERARIAEFOLIUM (Trev.) Brocc. Pyrethrum. 2n=18. Dalmatian coast of Yugoslavia. Introduced to other countries. Kenya is the main producer of the insecticidal pyrethrine.

CHRYSANTHEMUM PARTHENIUM (L.) Bernh. Feverfew, Wild chamomile. 2n=18. The Mediterranean region, Balkans, Asia Minor and Caucasia. Cultivated as medicinal plant in Europe.

CNICUS BENEDICTUS L. (syn. Centaurea benedicta L., Garberia benedicta Adans.). Blessed thistle. 2n=22. The Mediterranean region up to Transcaucasia, Syria and Iran. Cultivated formerly in Germany.

CYNARA CARDUNCULUS L. Cardoon. 2n=34. The Mediterranean region. Cultivated for its leaf stalks. Several varieties are known.

CYNARA SCOLYMUS L. Artichoke, Globe artichoke. 2n=34. The Mediterranean region. Cultivated for its soft fleshy edible receptacles of the flowerhead buds and thick bases of the scales around the flowerhead and also as a source of a bitter compound. Several varieties are known.

LACTUA VIROSA L. Bitter lettuce, Lettuce opium. 2n=18. Primary centre round the Mediterranean (Linqvist. 1960). Cultivated on a small scale for its latex in some parts of Europe. The latex has narcotic properties.

SCOLYMUS HISPANICUS L. Golden thistle, Spanish oyster plant. 2n=20. The Mediterranean region. A root vegetable. Its cultivation is on the decline.

SCORZONERA HISPANICA L. Scorzonera, Black salsify. 2n=14. C. Europe, the Mediterranean region, Caucasia and S. Siberia. A vegetable of especially 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.

TRAGOPOGON PORRIFOLIUS L. Salsify, Oyster plant, Purple goats beard. 2n=12. The Mediterranean region. This vegetable was first cultivated for its roots long ago. It may have been domesticated by the Greeks and Romans (Mansfeld, 1959). The wild type is var. australis (Jord.) Braun-Blanquet (syn. T. australis Gater.) and the cultivated one is var. sativus (Gater.) Braun-Blanquet (syn. T. sativus Gater.).

Convolvulaceae

CONVOLVULUS SCAMMONIA L. 2n=24. The Mediterranean region and Asia Minor. Cultivated for medicinal purposes.

Corylaceae

CORYLUS TUBULOSA Willd. Lambert's filbert, Kentish cob. 2n= . Cultivated. Hybrids with C. avellana* have been cultivated.

Cruciferae

BRASSICA CAMPESTRIS*

BRASSICA CRETICA Lam. 2n=18. Wild in Greece, Crete, Cyprus, Syria and Lebanon. May have played a role in the origin of B oleracea* var. botrytis. This species has also been described as var. sylvestris, the wild cabbage.

BRASSICA NAPOBRASSICA (L.) Mill. Rutabaga, Swedish turnip. 2n=38. Secondary gene centre in Europe. The cultigen developed in the Mediterranean region and further in Europe (p. 131).

BRASSICA NAPUS L. Rape, Colza. 2n=38, genome formula AACC. This species is an amphiploid of B. oleracea spp oleracea (2n=18, genome formula CC, see p. 94) and B. campestris (2n=20, genome formula AA, see p. 131). The first amphiploid was the "primitive leaf rape" (spp. pabularia (DC.) Jancken). This primitive type may have developed in the W. Mediterranean region. From this type cultivated types as spp. oleifera DC., rape and spp. rapifera Metzger derive, while B. napobrassica* formerly described as B. napus var. napobrassica (L.) Reichenb. is probably a derivative of B. oleracea* x B. napus, The wild var. napus may be the weedy derivative. B. napus is one of the parents of the artificially made B. napocampestris (2n=58, genome formula $AAA_1A_1C_1C_1$).

BRASSICA OLERACEA L. Cabbage. 2n=18, genome formula CC. The C genome is related to the T or D. genome of B. tournefortii Gouan (2n=20). It forms one pair of the genomes of B. carinata* and B. napus*. The wild form, var. sylvestris L. (syn. B. sylvestris (L.) Miller), grows on the maritime cliffs of the west coasts of Britain, France and the Mediterranean coastal areas.
The wild type is very variable. When cultivated it shows an enormous increase in size. Up to now this variability has not yet been fully studied. It is possible that through introgression some geographical races have a different genetic potency than other races. Some related species are: B. incana Tenore (2n=) from W. and S. coasts of Italy, Sicily and Yugoslavia, B. montana Pourret (including B. oleracea spp robertiana (Gay) Rouy & Fouc.) (2n=) from S. Europe, NE. Spain to S. Italy, B. rupestris Raf. (2n=18) from Sicily and S. Italy and B. villosa Biv. -Bern. (2n=) from Sicily.
Other related species are B. cretica*, B. balearica Persoon (2n=18) from Mallorca, B. insularis Moris. (2n=18) from Corsica and Sardinia, B. macrocarpa Guss. (2n=) from Isole Egadi, Sicily and B. scopularum Coss. & Dur. (2n=). Helm (1963a) preferred to include all related wild species into one species group B. oleracea.
The wild and cultivated types of B. oleracea s.s. cross with wild related species. By absorbing genetic material from these species its variability and adaptability has greatly increased. B. oleracea has become a compilospecies (A.C. Zeven, unpubl.). This may also have resulted in the variation of karyotypes. Furthermore, the present variation may also have been influenced by neighbouring cultivars.
There are several classifications of the cultivated B. oleracea-types. See e.g. Helm (1963a). The origin of these types is not yet fully understood and it is supposed that they developed gradually from several wild cabbage populations by introgression with wild species and other cultivated types and by mutation under human selection pressure.
A simplified pedigree is presented by Helm (1963a). He suggested that from (1) the wild cabbage (var. sylvestris, syn. var. oleracea) developed the types (2) var. ramosa DC., cottager's kale, (5) convar. acephala (DC.) Alef., (6) var. medullosa Thell. and convar. botrytis (L.) Alef. The cottager's kale was used as forage. It has almost disappeared now. From this crop (3) var. gemmifera DC., Brussels sprouts was derived. This type may have developed in Belgium (p. 131). From the Brussels sprouts, monstrosities such as (4) var. dalechampii Helm derived. However, Nieuwhof (1969) suggested that the monstrosity pictured by Dalechamp (Helm, 1963a) is a cabbage with the axil buds developed after the head had been removed.
Convar. acephala can be subdivided in many types as var. acephala, kale, borecole, collard, cow cabbage. This cabbage type belongs to the oldest cultivated types. The main use is forage crop. On Jersey and Guernsey f. exaltata, Cesarean cabbage, Jersey cabbage was cultivated. When closely planted the branches and stalks can be used as walking sticks (Jersey canes) and in house building. Other varieties belong to this group. These are var. selenisia L., var. sabellica L., var. palmifolia DC., var. medullosa Thell. and var. gongylodes L.
Var. selenisia, parsley colewort, ornamental kale has been used as an ornamental.
Var. sabellica is curled kitchen kale, ornamental Scotch kale, curlies.
F. sabellica is mostly cultivated as a vegetable, while f. rubra is used as an ornamental.
Var. palmifolia, palm-leaved kale probably originated in Portugal. It is likely used only as an ornamental.
Var. medullosa, marrow stem kale is a forage crop. Maybe Pliny's Pompeian cabbage is an ancestor of this type. From this same type or from marrow stem kale the (7) var. gongylodes , kohlrabi, turnip kale derives.
From the old cultivars of convar. acephala convar. capitata (L.) Alef. developed. The oldest type is probably (8) Tronchuda kale, Portugese kale, var. costata DC. which developed in Portugal. From this variety (9) var. sabauda L. and (10) var. capitata L. developed.
Var. sabauda, Savoy cabbage, Milan cabbage is probably developed in Italy.
Var. capitata, cabbage and red cabbage has developed from the same stock as var. sabauda. Their history is not known.
Convar. botrytis exists of (11) var. italica Plenck, sprouting broccoli, asparagus broccoli and (12) var. botrytis L., cauliflower. The latter may have derived from var. italica. Both types developed in the eastern part of the Mediterranean countries.
It is possible that B. cretica* has played a role (Jensma, 1957). This author suggested that from Cyprus and other E. Mediterranean countries the cauliflower was brought to Venice and to Vienna from where it spread to N. countries.

CAPSELLA BURSA-PASTORIS (L.). Medik. Shepherd's purse, Capsell. 2n=32. The Mediterranean region. Spread over almost the whole world. Cultivated in China as a vegetable.

CHEIRANTHUS CHEIRI L. Wallflower. 2n=14. S. and C. Europe. Herb commonly cultivated as an ornamental, formerly as a medicinal crop.

CRAMBE HISPANICA L. 2n=60. The Mediterranean region. Cultivated in the Ukraine, USSR for its oil.

ERUCA VESICARIA (L.) Cav. (syn. E. sativa L.). Rocket salad, Roquette. 2n=22. The Mediterranean region and Asia. Cultivated since ancient times as a salad plant. Cultivated in India as a source of jamba oil (p. 63).

LEPIDIUM LATIFOLIUM L. Dittander. 2n=24. Europe, temperate Asia and N. Africa. A perennial herb. Once it was cultivated by the Ancient Greeks as a salad plant.

RAPHANUS SATIVUS L. Radish, Small radish. 2n=18, genome formula RR. Primary centre probably an E. Mediterranean region (Wein, 1964). He suggested that the radish is derived from R. maritimus Smith (2n=18) and the small radish from R. landra Moretti (2n=18). He stated that the radish cannot come from R. raphanistrum L.* (2n=18) because of the difference in structure of the fruits. Various varieties have been described (Mansfeld, 1959). Var. oleiformis Pers. (R. chinensis Mill.) is the oil-seed radish cultivated in India, Japan, China (p. 30) 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 of oil-seed radish in France. More research is needed to ascertain the origin of radish and the various botanical and agricultural varieties. Through natural (and artificial) hybridization with Brassica-species genes of this genus may introgress into R. sativus.

SINAPIS ALBA L (syn. Brassica alba (L.) Boiss.). White mustard. 2n=24. The Mediterranean region. Weedy or naturalized plants may be found from Spain over Asia Minor to E. India. Young seedlings are used as salad. Seeds are the source of white mustard.

Cucurbitaceae

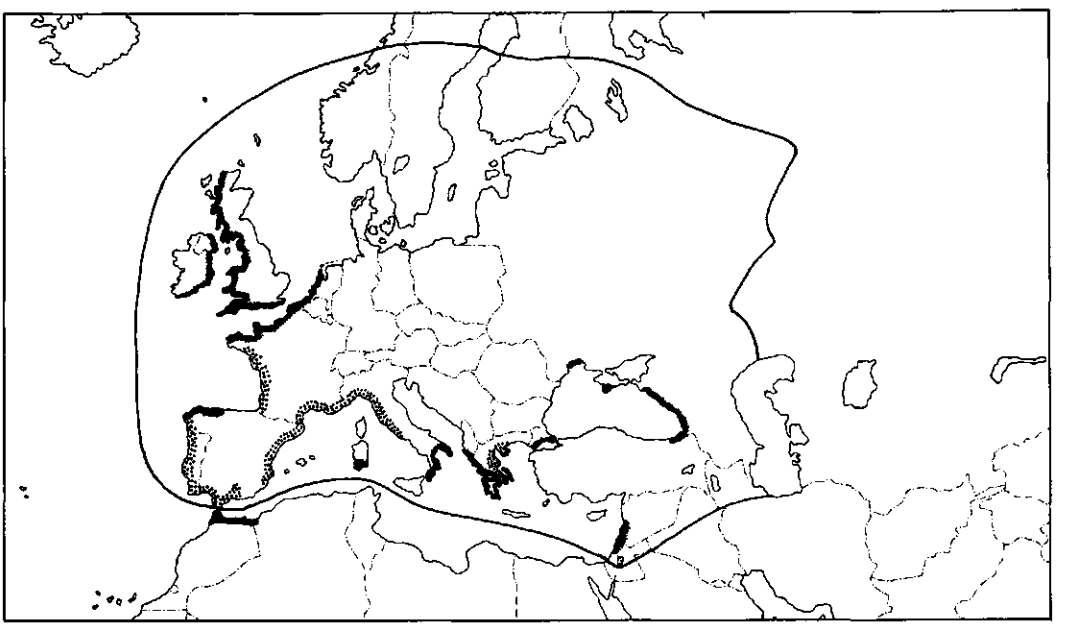
BRYONIA CRETICA*

CITRULLUS COLOCYNTHIS (L.) Schrad. Colocynth. 2n=22, (34). Arid regions of N. Africa and trop. Asia. Cultivated in India and the Mediterranean region for its purgative fruits.

ECBALLIUM ELATERIUM (L.) A. Rich. Squirting cucumber. 2n=(18), 24. The Mediterranean region, Azores, Asia Minor and Crim. Cultivated in England as a medicinal plant.

Cyperaceae

CYPERUS ALOPECUROIDES Rottb. Mat sedge. 2n= . Tropics of the Old World. Cultivated in Egypt for mat making (Mansfeld, 1959).



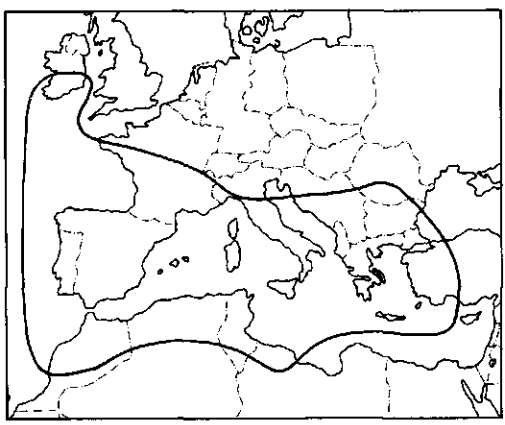
Wild and weedy Raphanus species: R. raphanistrum (—), R. maritimus (black) and R. landra (grey) (Sinskaia, 1931)

CYPERUS ESCULENTUS L. Chufa, Earth almond, Tiger nut, Rush nut, Zulu nut, Yellow nut grass. 2n=(18), 108. White Nile region and in the tropics. Introduced in S. Europe by the Arabs. Cultivated in Spain and Italy and elsewhere for its flavoursome tubers. Var. aureus (Ten.) Richt. is described as the wild form. Var. esculentus is the cultivated form.

CYPERUS PAPYRUS L. Papyrus plant. 2n=c. 102. Africa. Cultivated formerly in Egypt, Palestine and in the Mediterranean region. Now occasionally cultivated.

Ericaceae

ARBUTUS UNEDO L. Strawberry tree, Arbutus. 2n=26. The Mediterranean region. Occasionally cultivated for its edible fruits.



Arbutus unedo (Hutchinson, 1969)

Euphorbiaceae

CHROZOPHORA TINCTORIA (L.) Juss. Giradol. The Mediterranean region, France, Yugoslavia, Crim to W. Asia, NW. India, Arabia. Cultivated formerly 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. part of centre 7. A very variable species. Cultivated in S. France, Portugal, Spain, Sardinia, Corsica, Istria, Dalmatia and Algeria.

Geraniaceae

ERODIUM CICUTARIUM (L.) L'Herit. ex Ait. Storko bill, Red stem filaree, Alfilaree. 2n=(20, 30-40, 36), 40, (48, 54). S., W. and C. Europe, Mediterranean region, temp. Asia. Cultivated as sheep food in N. and S. America.

ERODIUM MOSCHATUM (L.) L'Herit. ex Ait. White stem filaree. 2n=20. The Mediterranean region. Cultivated formerly 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. It is sometimes believed to be the B donor of tetraploid and hexaploid Triticum species (p. 83, 84).

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, the Marmara sea area and the Adriatic zone 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.

AEGILOPS VENTRICOSA Tausch. (syn. Triticum ventricosum Ces., Pass. & Gib.). 2n=28, genome formula M^vM^vDD. The W. Mediterranean region. 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). The coasts of Europe, N. Africa and Asia Minor. Occasionally cultivated to stabilize dunes.

AGROSTIS TENUIS*

ARUNDO DONAX L. Giant reed. 2n=(c. 60), 110. The Mediterranean region to Caucasia and Syria. A grass cultivated since ancient times in S.

Europe. Also cultivated elsewhere now.

AVENA CANARIENSIS Baum, Rajhathy & Sampson. 2n=14. The uplands of Fuerteventura, Canary Islands. Baum et al. (1973) discovered that its genome formula is closely related to the A genome. They suggested that A. canariensis is the diploid parent of A. magna* and hence is one of the parental species of hexaploid A. sterilis (see A. sativa*).

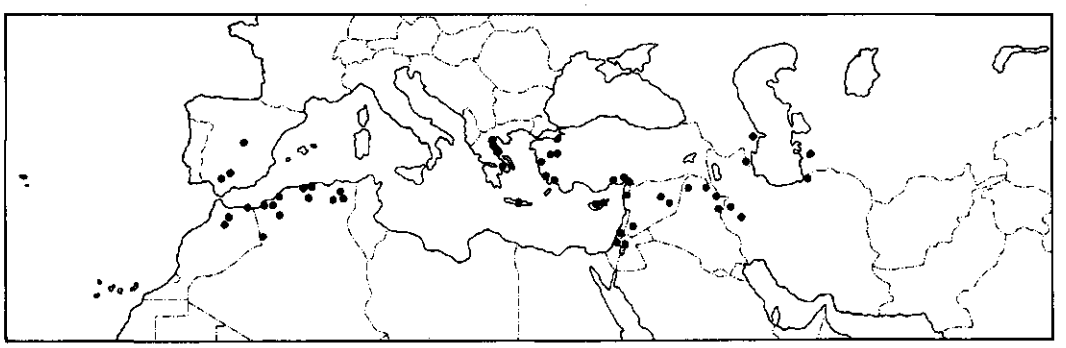
AVENA CLAUDA Dur. 2n=14. The whole Mediterranean basin from Morocco to Iran. It usually grows together with A. sativa type sterilis* and A. strigosa type barbata* (Ladizinsky & Zohary, 1971).
This wild species includes type eriantha (syn. A. eriantha Dur. = A. pilosa MB, genome formula ApAp) and type 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 relicts of a once common population, but are now separated by some 2500 km (Rajhathy & Baum, 1972). It resembles A. strigosa.

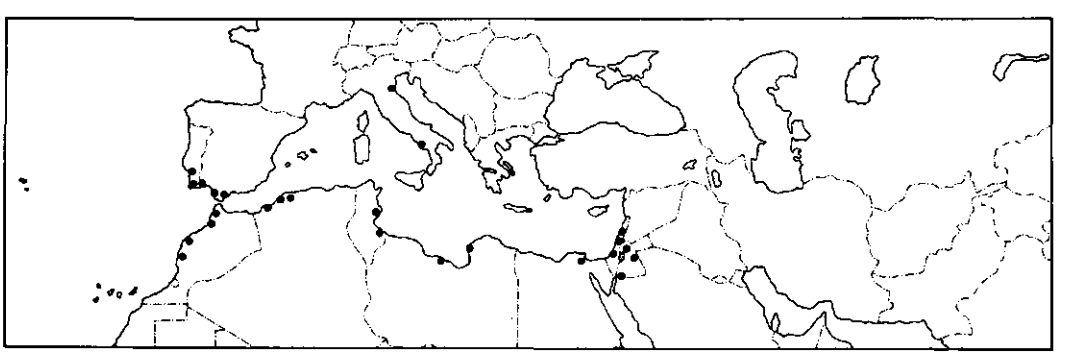
AVENA LONGIGLUMIS Dur. 2n=14, genome formula ApAp. The coastal belts of Mediterranean countries and Morocco, Portugal and Spain. Mediterranean and Negev desert ecogeographic races are recognized (Ladizinsky & Zohary, 1971.

AVENA PROSTRATA Ladizinsky. 2n=14, genome formula ApAp. A species of oat from SE. Spain. Morphologically similar to the diploid wiestii and hirtula forms of A. strigosa*, but can be distinguished from them by its prostrate habit and by shorter bristles at the tip of the lemma. Hybrids between these two species are completely sterile (Ladizinsky, 1971).

AVENA SATIVA L. Oat. 2n=42, genome formula AACCDD. The origin of A. sativa is not yet fully understood. It is believed that it derives from the sterilis type. This type is related to the wild tetraploid species A. magna Murphy & Terrell, found in the Rabat-Tiflet area of Morocco and A. murphyi Ladiz. found in the region between Tarifa and Vejer de la Frontera at the southern tip of Spain. These two species may form the genetic background of A. sativa.
According to Ladizinsky and Zohary (1971), this species forms a complex of wild, weedy and cultivated types, including A. sterilis L., A. fatua L., A. byzantina C. Koch* and A. sativa L. s. str. The last two are the cultivated types. The wild



Avena clauda (Ladizinsky & Zohary, 1971)



Avena longiglumis (Ladizinsky & Zohary, 1971)

type sterilis is found in the Mediterranean countries, where it builds massive stands from the Atlantic coast of Morocco and Portugal to the western flanks of the Zagros mountains of Iran. They also are agressive pioneers and noxious weeds in wheat and barley fields, etc. Sterilis type with small spikelets has been described as A. ludoviciana Dur., and that with bigger spikelets and 3-4 fertile florets as A. macrocarpa Monch. The fatua type is distinctly weedy. It also occurs in the Mediterranean countries.
The main characters of the cultivated types are non-shattering spikelets, decrease in lemma hairiness and reduction in the size and development of awns. Nakedness (A. nuda L*) is also associated with domestication. Cultivated oat is found in many countries now.
Rajhathy et al. (1971) concluded from chromatographic studies that A. magna has the genome formula AACC rather than AADD. If so the C genome would have mediated through A. magna to A. sativa.
A diploid sterilis-like type has not yet been found. It might be either 2x A. strigosa* or A. longiglumis*.
The parent species of these tetraploids are also not determined, although it is thought that one or more diploid species (A. clauda*, A. ventricosa*, A. longiglumis* and 2x A. strigosa*) have been involved.
The D genome is probably derived from or related to the A genome of A. ventricosa (Steer et al., 1970).
Gene exchange exists between the cultivated sativa and byzantina, and sterilis.
Sterilis is a source of resistance to Puccinia coronata Cda.f. sp. avenae.

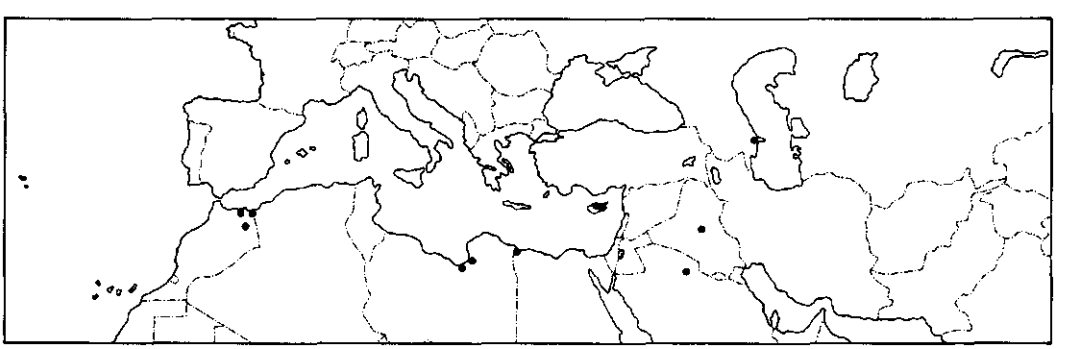
AVENA STRIGOSA Schreb. Black oat, Bristle oat. 2n=14, genome formula AsAs, 2n=28, genome formula AsAsBB, AABB or AsAsAsAs. The As and B genomes are partially homologous and may derive from a common parent (Ladizinsky & Zohary, 1971; Ladizinsky, 1973). The As genome might be the prototype of the A genome of the polyploid species (Rajhathy et al., 1971).
Ladizinsky and Zohary (1971) included in this species the wild A. hirtula Lag. (2n=14), A. wiestii Schreb. (2n=14), A. barbata Pott. (2n=28), A. vaviloviana Malz.* (2n=28) and the cultivated A. strigosa Schreb. (2n=14) and A. abyssinica Hochst.* (2n=28).
All over the Mediterranean region, 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 steppes of the northern fringes of the Sahara and the Arabian deserts. The cultivated strigosa of W. and N. Europe derives from the weedy forms which are common in cereal fields and edges of cultivation in the Iberian peninsula. The As and B genome are partially homologous and many 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).
Introgression between diploid and tetraploid cytotypes takes place by means of triploids.

AVENA VENTRICOSA Balansa. 2n=14, genome formula CpCp. This wild species includes spp. bruhnsiana (Gruner) Malzew (syn. A. bruhnsiana Gruner) and spp. ventricosa (Balansa) Malzew (syn. A. ventricosa Balansa s. str., genome formula AvAv).
Spp. bruhnsiana is found in Apsheron Peninsula, Azerbeidjan, USSR, while spp. ventricosa is observed is Algeria and Cyprus. The karyotype of spp. ventricosa is c_v^1 and of spp. bruhnsiana c_v^3 and c_v^2 (Rajhathy, 1971).
A. ventricosa is also found in Lybia (Cyrenaica) and Iraq (Ladizinsky & Zohary, 1971).

CHRYSOPOGON GRYLLUS (Torner) Trin. (syn. Andropogon gryllus Torner). 2n=20, 40. From the Mediterranean region to India. Cultivated in the Po plain, Italy for its essential oil.

HORDEUM VULGARE L. 2n=14. For origin of barley see p. 96. Centre 7 is the centre of origin of spp. mediterraneum Vav. & Bacht.

LOLIUM MULTIFLORUM Lam. spp. 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



Avena ventricosa (Ladizinsky & Zohary, 1971)

Century (Beddows, 1953). Spread to N. Europe.

LOLIUM PERENNE*

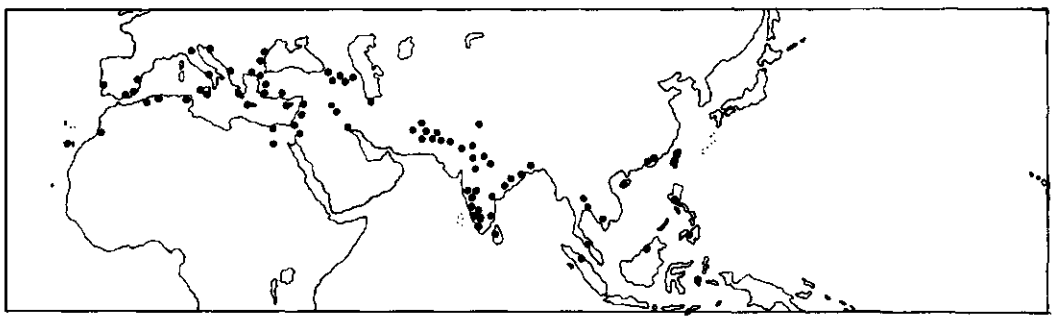
PHALARIS CANARIENSIS L. Canary grass. 2n=12. The W. Mediterranean region. Canary Islands, Spain, Portugal. Cultivated for bird seed.

PHALARIS TUBEROSA L. Towoonba grass, Harding grass. 2n=28. The Mediterranean region. Cultivated in warm countries.

SORGHUM BICOLOR (L.) Moench. Broomcorn. 2n=20. Sorghum originated in Africa (see p. 116). The broomcorns were developed in the Mediterranean region from material which came from India/Iran or Africa. Introduced there via the Middle East from India, Iran or Africa.

SORGHUM HALEPENSE (L.). Pers. Johnson grass. 2n=(20), 40. The Mediterranean region. A perennial grass. Primary centre in the east of Centre 7. Secondary centre runs eastwards to Indonesia. It has prominent rhizomes and differs as such from S. bicolor*.
Some new perennial diploid types were selected from the cross S. halepense x S. bicolor. These types combine high yield and palatibility with a degree of frost tolerance and disease resistance. Their origin is similar to S. almum*.

Sorghum halepense

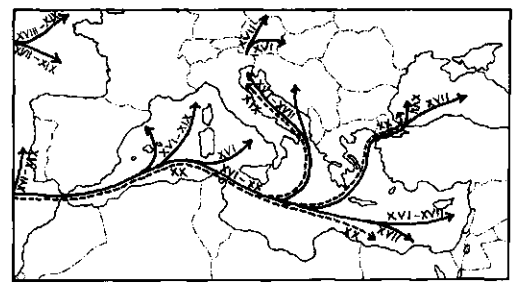


Sorghum halepense (de Wet & Huckabay, 1967)

STIPA TENACISSIMA L. Halfa, Esparto. 2n= The Mediterranean region. In Spain some cultivation is done with the cv. Albardin which has a larger fibre than wild ones. This variety seems to have developed there. In N. Africa and Spain wild halfa yields a paper-making fibre.

TRITICUM TURGIDUM spp. turgidum conv. durum (Desf.) Mac Key. 2n=28, genome formula AABB. It originated under cultivation of emmer (p. 84). Secondary centre in the Mediterranean region.

ZEA MAYS L. 2n=20. Maize was domesticated in C. America (p. 166). Secondary centres in the north of the Mediterranean region 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. The Mediterranean region. It is one of the parental species of the present-day red currant cultivars (p. 135).

Hippocastanaceae

AESCULUS HIPPOCASTANUM L. Horse chestnut. 2n=40. The central part of the Balkan peninsula, E. Bulgaria, W. Iran and the Himalayas. Cultivated as an ornamental, 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). The Mediterranean region and Ante-Asia. Cultivated since ancient times for its styles which are a source of saffron. Cultivated formerly for this purpose in Europe and N. America and now in S. Europe, Asia Minor, Iran, N. India and China.
The actual origin of the present cultivars is not known.

IRIS GERMANICA L. German iris, Flag iris. 2n=24, (34, 36), 44, 48, (60). The Mediterranean region. A perennial herb widely cultivated as an ornamental and also for its rootstocks used for perfumery.

Labiatae

HYSSOPUS OFFICINALIS L. 2n=12. The Mediterranean region, Asia Minor and Iran. Cultivated for its essential oil, as a medicinal plant and as an ornamental.

LAVANDULA LATIFOLIA Medik. Broadleaved 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 in Centre 7. An old cultivated plant for perfumery. First it was used as an insect repellant. Many cultivated varieties are hybrids with wild plants and L. latifolia*.

MAJORANA HORTENSIS Moench. (syn. Origanum majorana L.). Majoram. 2n= . S. Europe, the Mediterranean region to India. Cultivated in Europe and elsewhere as a medicinal plant.

MELISSA OFFICINALIS L. Common balm. 2n=32, 64. E. Mediterranean region to Caucasia, SW. Siberia, S. Iran, Turkestan and Syria. Cultivated formerly in Europe and elsewhere for diverse purposes. It is suggested that the commonest cultivated type var. officinalis is 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 to the A genome of M. arvensis var. piperascens* (Ikedo & Ono, 1969). It is one of the parents of M. x piperita*. This species is cultivated as M. citrata in the USA for its lavender-like oil for perfumery (Todd & Murray, 1968).
Patented hybrids of this species 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 and C. Asia. Formerly it was much cultivated. At present 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). The Mediterranean region, Europe to Iran. Cultivated formerly in Europe and elsewhere.

ROSMARINUS OFFICINALIS L. Rosemary. 2n=24. The Mediterranean region. Cultivated for ornament and for its aromatic oils.

SALVIA OFFICINALIS L. Sage. 2n=14, (16). The Mediterranean region. A culinary herb cultivated now in many gardens in temperate and tropic countries.

SALVIA SCLAREA L. Clary sage, Clary wort. 2n=22. The Mediterranean region to Iran and Transcaucasia. Cultivated formerly in the Mediterranean region and S. Europe for various purposes, e.g. for flavouring wine and beer.

SALVIA VIRIDIS L. Bluebeard. 2n=16. The Mediterranean region to Iran. Cultivated here and there 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. The Mediterranean region, C. Europe and Siberia. Cultivated for its oil of savoury and as a potherb.

SATUREJA MONTANA L. (syn. S. obovata Lag., S. illyrica Host). Winter savory. 2n=12, 30. The Mediterranean region to Ukraine. Cultivated in S. Europe and in Germany.

TEUCRIUM CHAMAEDRYS L. (syn. T. officinale Lam.). Common germander. 2n=32, 60, 64. The Mediterranean region, France, C. Germany to S. Ural, Iran, N. Syria and Morocco. Cultivated formerly as a medicinal crop.

TEUCRIUM MARUM L. 2n= . The W. Mediterranean region and S. France. Cultivated in S. Europe. Cultivated formerly in Germany.

THYMUS VULGARIS L. Thyme. 2n=30. The Mediterranean countries. Cultivated now in temperate and tropical countries.

Lauraceae

LAURUS NOBILIS L. Laurel, True bay, Sweet bay. 2n=42, 48. The Mediterranean region. Primary centre also there. Cultivated there and elsewhere for its leaves which are used as a condiment.

Leguminosae

ASTRAGALUS BOETICUS L. 2n=16, 30. S. Europe and Mediterranean region. Cultivated as a substitute for coffee.

CERATONIA SILIQUA L. Carob, St. John's bread. 2n=24. The Mediterranean region, Syria and adjacent countries. Primary centre in Centre 7. Cultivated especially on Cyprus as a fodder crop. The fruits are eaten, while 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 Crim and Iran. Cultivated for its leaves (vegetable).

CICER ARIETINUM L. Garbanzos, Chickpea. 2n=14, 16, (24, 32, 33). Probably W. Asia (p. 85). 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. Tree lucerne, Tree alfalfa, Tagasaste, Escabon. 2n=48. Canary Islands (Uphof (1968) says Hungary). Cultivated there as a forage plant. Introduced into New Zealand.

GLYCYRRHIZA GLABRA*

HEDYSARUM CORONARIUM L. Spanish esparcet. 2n=16. The Mediterranean region. Cultivated as a fodder crop.

LATHYRUS ANNUUS L. 2n=14. The Mediterranean region and Portugal. Sometimes cultivated as a fodder.

LATHYRUS CICERA L. Vetchling, Flat pod pea vine, Jurosse, Garousse. 2n=14. The Mediterranean region, 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. The Mediterranean region and Madeira. Cultivated in S. Europe.

LATHYRUS HIRSUTUS L. Rough pea, Caley pea, Singletary pea. 2n=14. The Mediterranean region. Cultivated especially in USA as a pasture hay, winter cover and soil improvement crop.

LATHYRUS OCHRUS DC. 2n=14. The Mediterranean region. Cultivated in Greece occasionally as a fodder.

LATHYRUS ODORATUS L. Sweet pea. 2n=14. The Mediterranean region. 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. 73). Primary centre in the Mediterranean region.

LATHYRUS TINGITANUS L. Tangier pea. 2n=14. The Mediterranean region. A micro-centre is in Morocco. Cultivated as a winter annual, also in USA.

LOTUS EDULIS L. Asparagus pea, Winged pea. 2n=14. The Mediterranean region to Asia Minor and Syria. Occasionally cultivated for its young pods.

LUPINUS ALBUS L. (syn. L. sativus Gaertn.). White lupine. 2n=50. Wild in Corsica, Sardinia, Sicily and Israel. Primary centre is in Centre 7. Domesticated in Spain and in N. Africa. 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 4 000 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 species would derive from L. jugoslavicus Kazim. & Now. (2n=50). It is found in Yugoslavia. Gladstone (1970) considered L. termis, L. graecus and L. jugoslavicus as synonyms of L. albus.

LUPINUS ANGUSTIFOLIUS L. (syn. L. varius L., L. linifolius Roth, L. reticulatus Desv.). Narrow-leaved lupine, Blue lupine. 2n=40. The primary centre in the Mediterranean region. The present European cultivars probably derive from wild types from Palestine. Cultivated also in S. Africa and Australia. Widely cultivated as an ornamental too.

LUPINUS COSENTINI Guss. (syn. L. varius L., spp. varius Franco & P. Silva). Western Australian blue lupine, Sandplain lupine, Geraldton lupine. 2n=32. Coastal Morocco and other sites in W. Mediterranean region. Introduced into W. Australia about the middle of the 19th Century and has become 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 lupine. 2n=(46, 48, 50), 52. Mediterranean countries. Primary centre in Centre 7. The present European cultivars derive probably from wild Palestinean plants. Cultivated as a fodder crop, green manure and as an ornamental. Closely related to L. hispanicus Boiss. & Reut. and L. rothmaleri Klink (2n=50, 52).

LUPINUS PILOSUS L. (syn. L. varius L. spp. orientalis Franco & P. Silva). Greater blue lupine, Mairy lupine. 2n=42, (50). NE. Mediterranean region. It may occasionally be cultivated. It is characterized by its big seeds, the biggest of all Lupinus-species.

LUPINUS TERMIS Forsk. (syn. L. graecus Boiss., L. albus spp. albus). Egyptian lupine. 2n= . Palestine and Egypt. Cultivated in Egypt since ancient times. 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 HISPIDA Gaertn. Bur clover. 2n=14, (16). The Mediterranean region. Cultivated as a green manure, for pasture and as a hay crop.

MEDICAGO SATIVA L. Lucerne, Blue alfalfa. 2n=(16, genome formula SS), 32 genome formula SSSS, 64, Transcaucasia (p. 86). Secondary centre in N. Africa, especially Algeria. The great variability may have arisen due to introgression of M. gaetula which is endemic in N. Africa. Prostrate types are found in the mountains of Anatolia, Turkey.

MELILOTUS INFESTUS Guss. 2n=16. A plant of W. Mediterranean region 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 region. Plants belonging to spp. brachystachus Maire are coumarin deficient and resistant to drought, and most pests including the sweet clover weevil. Spp. segetalis (Brot.) Maire has also been described as M. segetalis Ser. (2n=16).

ORNITHOPUS COMPRESSUS L. 2n=14. Spain, Portugal and the Mediterranean regions. Its northermost point of occurrence is Bretagne, 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 plant.
Spp. sativus (syn. O. roseus Dufour) is native to SW. France, N. half of the Iberian Peninsula and the Azores. Cultivated elsewhere.
A related species is O. isthmocarpus Coss. (syn. O. sativus spp. 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. spp. hortense Asch. & Graeb. Garden pea. 2n=14. Secondary centre in the Mediterranean region. Spp. hortense is domesticated in SW. Asia (p. 86).

PISUM SATIVUM spp. jomardi (Schrank) Alef. (syn. ecotype arvense s. str., P. elatius (M. B.) Stev., P. jomardi Schrank, P. transcaucasicum Stankov). 2n=14. Cultivated in Egypt.

PSORALEA BITUMINOSA L. Asphalt clover. 2n=20. The Mediterranean region and Canary Islands. Cultivated for cattle food.

SPARTIUM JUNCEUM L. Spanish broom, Weaver's broom. 2n=48, 52, 52-56. The Mediterranean regions and Europe. Some cultivation is done in France near Aspiran (Hérault).

TRIFOLIUM ALEXANDRINUM L. Alexandrian clover, Egyptian clover, Berseem. 2n=16. The E. Mediterranean regions. 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 is closely related to T. berytheum Boiss. (syn. T. alexandrinum var. berytheum) and T. salmoneum Mout. These species are self-incompatible, while T. alexandrinum is self-compatible. This may be a domestic characteristic.

TRIFOLIUM FRAGIFERUM L. (syn. T. neglectum Fisch & Mey). Strawberry clover. 2n=16. Europe, Canary Islands, Madeira, N. Africa and W. Asia. Cultivated as a fodder crop.

TRIFOLIUM INCARNATUM L. Crimson clover. 2n=14. C. and S. Europe, in the Balkans and N. Africa. The cultivated type (var. sativum Duc., spp. incarnatum) probably derives from the wild var. molinerii (Balbis ex Hornem.) Syme. The latter is found in Spain. Cultivated since long 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. 137). An excellent fodder crop.

TRIFOLIUM SUBTERRANEUM L. Subterranean clover, Sub clover. 2n=16. The Mediterranean region, in SE. and W. Europe, the 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. 58). Naturalized in Australia, S. Africa and N. and S. America.
T. subterraneum can be divided into three subspecies: 1. spp. subterraneum (syn. T. blesense Dodart) which is the commonest taxon sympatric with the species, 2. spp. yanninicum Katzn. & Morley, which occurs in Istria, Dalmatia, Albania, Serbia and N. Greece and 3. spp. brachycalycinum Katzn. & Morley (syn. var. oxaloides Eig) which occurs from W. Thracia to the 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).
Railey and 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 while spp. brachycalycinum is probably the earliest forms of subterranean clover. They postulated that spp. subterraneum evolved later and colonized a wider range of environments.
Furthermore, 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, this species belongs to another subsection.

TRIFOLIUM VAVILOVII Eig. 2n=16. Israel.

VICIA ARTICULATA Hornem. One-flowered vetch. 2n= . The Mediterranean region, Asia Minor, Madeira and Canary Islands. Cultivated.

VICIA BENGHALENSIS L. (syn. V. atropurpurea Desf.). Purple vetch. 2n=12, 14. The Mediterranean area. Naturalized in the USA. Cultivated there as a cover crop and green manure.

VICIA CALCARATA Desf. Demehi. 2n=12, 14. The Sahara oasis. There it is cultivated for its seeds.

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. 87).

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. 73). Unknown wild.
Schultze-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. part of the Mediterranean region 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 in not known.

VICIA NARBONENSIS L. Narbonne vetch. 2n=14. SW. Asia (p. 87). Secondary gene centre in the Mediterranean areas where it is cultivated.

Liliaceae

ALOË BARBADENSIS Mill. (syn. A. vera L.). Curacao aloë, Barbados aloë. 2n=(10), 14. The Mediterranean region, S. Arabia, E. Africa, NW. India and S. China. The wild var. barbadensis of the Mediterranean region has run wild in C. America, W. Indies to Bolivia. It probably came there through Spain. Cultivated in W. Indies.

LILIUM CANDIDUM L. Madonna lily, Bourbon lily. 2n=24. The Mediterranean region 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 the European gardens.

URGINEA MARITIMA (L.) Baker. (syn. U. scilla Steinh.). Sea onion. 2n=20, (30), 40, 60. Mediterranean coast; the highest concentration in E. Algeria. Wild and cultivated plants are used for their pharmaceutic and rat toxic properties.

Linaceae

LINUM USITATISSIMUM L. Flax, Linseed. 2n=30, (32). For origin see p. 87. In the Mediterranean region the oil flax (spp. mediterraneum Vav. & Ell.) is cultivated. In Italy hybrid forms (spp. transitorium Vav. & Ell.) of spp. eurasiaticum and spp. 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 region 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, Balkan and Crete. Ran wild in Italy, S. France and S. Tirol. Cultivated in Europe since the 16th Century especially var. nigra hort. which has blackish purple petals. These are used to colour wine and as medicine. Cultivated now in many types as an ornamental.

Moraceae

FICUS SYCOMORUS L. Sycomore fig. 2n=26. A tree from N. Africa.

Myrtaceae

EUCALYPTUS CAMALDULENSIS Dehn. Longbeak eucalyptus. 2n=22. Primary centre in Australia (p. 58). Secondary centre in Centre 7 and in S. America (p. 155). 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 this species anywhere in Australia.

EUCALYPTUS GLOBULUS Labell. Fever tree, Blue gum. 2n=20, 22, 28. SE. Tasmania. Cultivated. Secondary centre in Centre 7.

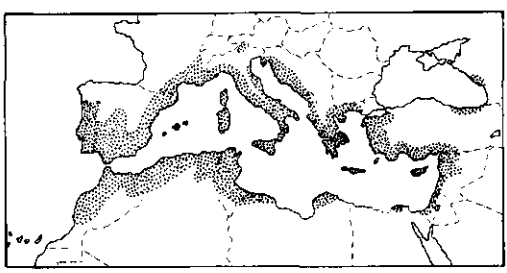
MYRTUS COMMUNIS L. Myrtle. 2n=22. The Mediterranean region and SW. Europe. Cultivated since ancient times for its fruits and for its medicinal properties.

Oleaceae

FRAXINUS ORNUS L. Flowering ash, Manna ash. 2n=46. A tree of C. and E. Mediterranean region 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 region. 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. The Mediterranean region. Primary centre in Centre 7. 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 difference between these varieties are spiny lower branches and small leaves and drupes which are present in var. sylvestris. Some cultivars are developed as table olive varieties, others for oil. See also O. chrysophylla*.



Olea europea (Polunin & Huxley, 1972)

Palmae

CHAMAEROPS HUMULIS L. Dwarf palm. 2n=36. Wild in the W. Mediterranean regions. Cultivated in some parts of Morocco. Often planted as an ornamental. A source of fibre (crin végétable).

Papaveraceae

PAPAVER SOMNIFERUM L. Opium poppy. 2n=22. Primary centre in Centre 7 or in the Central Asian centre (p. 74). It probably derives from ssp. setigerum (DC.) Corb. (syn. S. setigerum DC.) which occurs wild in W. Mediterranean region and elsewhere as a weed. The cultigen (spp. somniferum incl. spp. hortense (Hussenot) Corb.) is cultivated for its medicinal and narcotic latex, and seeds for its oil and as an ornamental. It may escape from cultivation.

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. The Mediterranean region. A small tree cultivated for its chewing gum.

PISTACIA TEREBINTHUS L. Terebinth pistache. 2n= . The Mediterranean region. On the Greek 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 region.

Ranunculaceae

AQUILEGIA VULGARIS L. Columbine. 2n=14. S. and C. Europe (p. 138), N. Africa and temp. Asia. Cultivated widely as an ornamental, formerly also for medicinal purposes.

NIGELLA SATIVA L. Black cummin. 2n=12. C. (p. 138) and S. Europe, N. Africa and W. Asia. Cultivated for its seed in the Mediterranean region and in the Orient. Cultivated formerly in C. Europe.

Resedaceae

RESEDA LUTEOLA L. Weld. 2n=24, (26, 28). C. Europe (p. 138), Mediterranean region, Iran and Afghanistan. Cultivated formerly as a source of deep yellow dye.

RESEDA ODORATA L. Mignonette. 2n=12, (14). N. Africa. Material was sent to Paris between 1733 and 1737. From here its cultivation spread as a perfumery plant (Mansfeld, 1959).

RESEDA PHYTEUMA L. 2n=12. The Mediterranean region and Asia Minor (p. 88). It is occasionally grown as a vegetable.

Rhamnaceae

RHAMNUS CATHARTICUS*

RHAMNUS FRANGULA*

ZIZIPHUS LOTUS (L.) Lam. 2n=24. The Mediterranean region. A tree cultivated in Italy, S. Spain and Egypt. It is probably the lotophagus of the ancient peoples of Lybia.

Rosaceae

AMYGDALUS PERSICA L. Peach. 2n=16. Primary centre in China (p. 36). Secondary centre in Italy and Spain.

CRATAEGUS AZAROLUS L. (syn. C aronia Bosc.). Azerolier. 2n= . S. Europe, N. Africa and the Orient (p. 74). This shrub or small tree is often cultivated for its edible fruits. Var. aronia 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. 55). Cultivated for its bergamot oil in Calabria, Italy.

CITRUS LIMON (L.) Burm. Lemon. 2n=18, (36). Primary centre probably in SE. Asia (p. 55). Secondary centre in this 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 Cochin-China (p. 55). Secondary centres in Israel (e.g. the varieties Shamuti, Beladi, Khalili) and in Spain (e.g. the variety Valencia, the blood orange).

RUTA CHALEPENSIS L. Fringed rue. 2n=36. The Mediterranean region. Cultivated there and elsewhere as a medicinal plant.

RUTA GRAVEOLENS L. Common rute, Rue. 2n=72, 81. Wild in the Mediterranean regions. Introduced in many tropical countries. The leaves are used as condiment and medicinally.

Scrophulariaceae

DIGITALIS PURPUREA*

Solanaceae

ATROPA BELLADONNA L. Belladonna. 2n=72. From Spain, the Balkan, Asia Minor to India (p. 70). Cultivated in Europe, India and USA as a medicinal plant. A. martiana F.Q. is considered as a hybrid of A. belladonna and A. baetica Willk. (2n=72). The latter species is found in Spain.

HYOSCYAMUS NIGER L. Black henbane. 2n=34. The Mediterranean region. A medicinal plant cultivated in some countries to yield alkaloids.

Ulmaceae

CELTIS AUSTRALIS L. (syn. C. excelsa Salisb.). Hackberry. 2n=40. The Mediterranean region. A tree cultivated there as an ornamental and in Asia Minor for its edible fruits (Mansfeld, 1959).

Umbelliferae

AMMADAUCUS LEUCOTRICHUS (Coss. & Bur.). 2n=16. N. Africa. Cultivated there.

AMMI MAJUS L. (syn. Apium ammi Crantz). Bishop's weed. 2n=22. The Mediterranean region to Iran and to Switzerland and Belgium. Cultivated since the Middle Ages for its aromatic seeds.

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. 70).

APIUM GRAVEOLENS L. Celery. 2n=22. *Cultivation started in the Mediterranean region.* The wild parent A. graveolens var. silvestre Presl. (syn. var. graveolens) is cosmopolite. Not much is known about the development of the three botanical varieties A. graveolens, var. silvestre f. secalinum Alef. (syn. var. secalinum Alef.), the leafy celery, smallage or soup celery, var. rapaceum (Mill.) DC., the celeriac, turnip-rooted celery or German celery and var. dulce (Mill.) Pers., the blanching celery (Becker, 1962).

CORIANDRUM SATIVUM L. Coriander. 2n=22. The Mediterranean region and W. Asia. Cultivated for its aromatic fruits.

CRITHMUM MARITIMUM L. Samphire, Sea samphire, Sea fennel, Piercestone. 2n=20, (22). Canary Islands, Madeira, coasts of Portugal to S. England and those of the Mediterranean region and Crimea. Cultivated in the USA as a kitchen plant.

CUMINUM CYMINUM L. Cumin. 2n=14. The Mediterranean region to Turkestan. Cultivated in SE. Europe, N. Africa, India and China.

DAUCUS CAROTA L. Yellow carrot. 2n=18. Wild species from Afghanistan (p. 76) 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 Region 7 from crossing with the wild D. carota spp. maximum.

FOENICULUM VULGARE Mill. (syn. F. officinale Gaertn.). Fennel. 2n=22. The Mediterranean countries. Cultivated there for a long time and has been introduced into many other temperate countries.
Var. piperitum (Ucr.) Cout. (syn. F. piperitum Acr., 2n=22) is the 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 Mediterranean region. 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 region. Occasionally cultivated for its edible tuberous roots (var. sisarum).

SMYRNIUM OLUSATRUM L. Alisander, Alexanders, Maceron. 2n=22. Mediterranean region, S. and W. Europe and Caucasus. Was much cultivated but is now replaced by celery.

Urticaceae

SOLEIROLIA SOLEIROLII (Req.) Dandy. 2n= The islands of W. Mediterranean region. Cultivated.

Valerianaceae

FEDIA CORNUCOPIAE Gaertn. African valerian, Valeriane d'Alger. 2n=32. The Mediterranean region. Cultivated as a potherb and during famine.

VALERIANA ERIOCARPA Desv. Italian corn salad. 2n= . The Mediterranean region. Cultivated for salad.

Verbenaceae

VITEX AGNUS-CASTUS L. Chaste tree. 2n=24, 32. The Mediterranean region. Cultivated in the Old and New Worlds for various purposes.

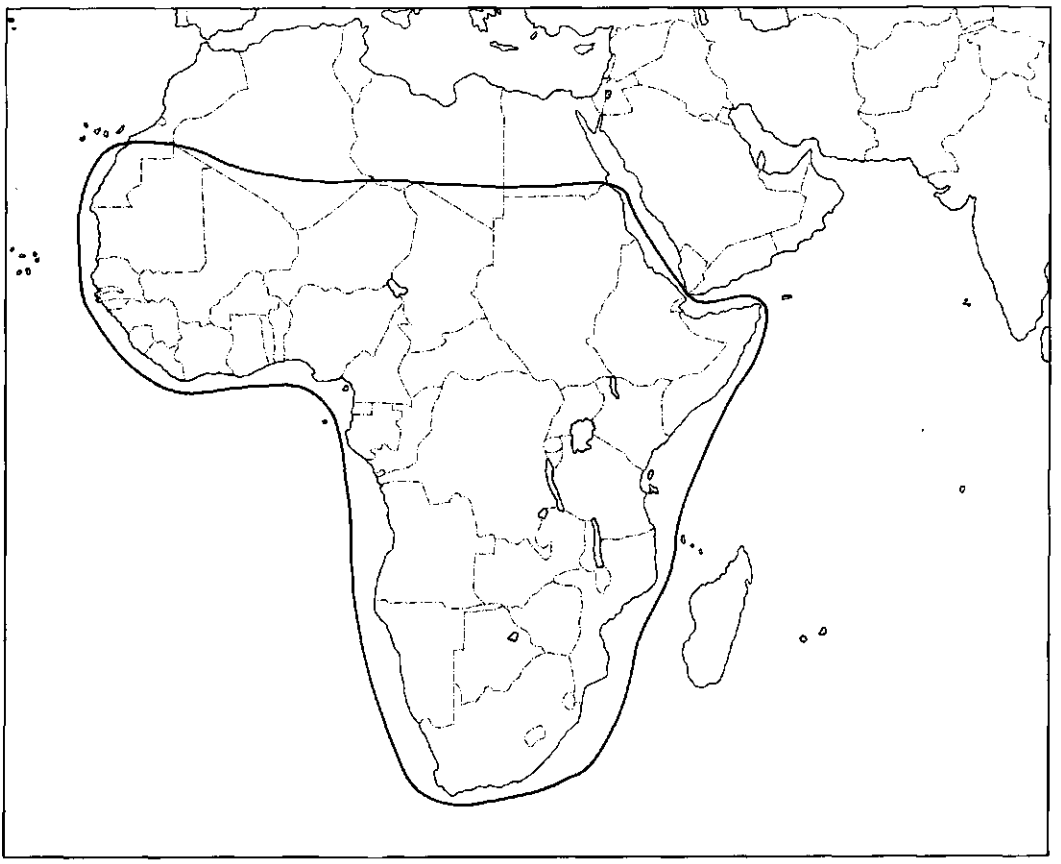
Violaceae

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. 2n=38, (40, 57, 76). Centre 7 is one of the three primary centres of diversity. On p. 90 the domestication of the grape is discussed and other data are presented. Several secondary centres are observed, e.g. the varieties for currants in Greece, and the varieties for wine in Italy, Spain and Algeria.

8 African Centre



The African Centre includes Vavilov's Abyssian Centre of Origin. Darlington (1956) described two areas in Africa as region of origin: Ethiopia and C. Africa. Portères (1950) established three cradles of agriculture in Africa viz. 1. the Mediterranean cradle which lies in Centre 7, 2. the Ethiopian cradle 3. the East African cradle and 4. the West African cradle. The West African was the most important and could be subdivided into A. the Senegambian 'subcradle', B. the Central Niger 'subcradle', C. the Benin 'subcradle' and D. the Adamawa 'subcradle'. The independent origin of agriculture in W. Africa has been supported by Anderson (1960) and especially by Murdock (1960). However, this claim has been refuted by for instance Wrigley (1960), Clark (1962), Baker (1962), Harris (1967) and Harlan (1972). They found grounds to suppose that the knowledge of how to apply agriculture had been introduced from Centre 6, while the tropical African crops had been locally domesticated.

The African centre has a very important influence on the crops of the world. Many crops have an African origin. Examples are Brassica juncea, Ceiba pentandra, Coffea sp., Cola sp., Cucumis sp., Ensete ventricosum, Gossypium sp., Hibiscus sp., Lablab purpureus, Oryza sp., Pennisetum sp., Phoenix sp., Ricinus communis, Sesamum indicum, Setaria sp., Sorghum bicolor, Vigna unguiculata etc.

Acanthaceae

JUSTICIA INSULARIS T. And. 2n= . Africa. Cultivated in W. Africa for its leaves.

Agavaceae

AGAVE FOURCROYDES Lem. Henequen agave. 2n=c. 140. Yucatan (p. 162). Secondary centre possibly in Africa.

DRACAENA ARBOREA Link, D. mannii Baker. Asparagus tree, Soap tree. D. fragrans (L.) Garol. 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 Congo.

Aizoaceae

MESEMBRYANTHEMUM ANGULATUM Thunb. Marygold. 2n=18. S. Africa. An annual cultivated in Congo and Mediterranean region as a spinach.

MESEMBRYANTHEMUM CRISTALLINUM L. (syn. Cryophytum cristallinum L.) N.E. Brown. Ice plant. Cristalline. 2n=18. S. Africa. Cultivated as salad vegetable or as a stabilizer.

MESEMBRYANTHEMUM EDULE L. (syn. Carpobrotus edulis (L.) L. Bolus). Hottentot fig. 2n=18. S. Africa. A dune stabilizer.

Amaranthaceae

CELOSIA TRIGYNA L. 2n=18. Trop. Africa. Madagascar and Arabia. Cultivated as a vegetable in Africa.

Annonaceae

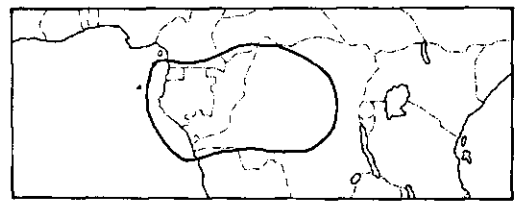
XYLOPIA AETHIOPICA (Dun.) A. Rich. African pepper, Guinea pepper, Ethiopian pepper, Spice tree. 2n= . Trop. Africa. (Semi-)cultivated in W. Africa.

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 the Hevea rubber.

TABERNANTHE IBOGA Baillon. Iboga. 2n=22. Gabon, Republic of Congo and the NW. Zaire. Cultivated in Gabon. The roots contain several indol alkaloids. The most important is ibogaine which is a stimulant and in large doses a hallucinogen. Roots of wild plants are collected which has almost resulted in the extinction of this plant in several districts in Gabon.



Tabernanthe iboga (Pope, 1969)

VINCA ROSEA L. Madagascar periwinkle, Cape periwinkle. 2n=16, (32). Probably Madagascar. A shrub cultivated as a medicinal plant.

Bignoniaceae

KIGELIA AFRICANA (Lam.). Benth. 2n=40. 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 (see p. 163). If America is the sole centre of origin than the African centre is secondary. The African kapok tree is divided in the caribaea-forest type and the caribaea-savannah 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 Somaliland. Formerly (11th-17th century) cultivated in Egypt and Palestina (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. Kat, Flower of paradise, Miraa. 2n= . Ethiopia/Somalia to Cape of Good Hope, and also in Yemen and Saudi Arabia where it probably has been introduced. Cultivated in Ethiopia and Arabia. Its leaves are used to prepare African, Abyssinian, Arabian or wild tea. The leaves and shoots are also eaten (Margetts, 1967).

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 an ornamental.

Compositae

CRASSOCEPHALUM BIAFRAE S. Moore. 2n= W. Africa. Cultivated as a vegetable. Several types are known (Terra, 1967).

GUIZOTIA ABYSSINICA (L. f.) Cass. Niger seed. 2n=30. Sporadically from Ethiopia to Malawi. Spread to other countries where it was cultivated and may have run wild. Cultivated as an oil-seed crop in India and Africa.

GYNURA CERNUA Benth. 2n=20. W. Africa. A herb cultivated for its leaves.

LACTUA 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.

SENECIO BIAFRAE Oliv. 2n= . Africa. Occasionally cultivated in W. Africa.

SENECIO GABONICUS Oliv. 2n= . Trop. W. Africa. Occasionally cultivated.

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 hybrid of B. nigra* and B. oleracea*.

BRASSICA JUNCEA (L.) Czern. & Coss. (syn. Sinapsis juncea L.). Sarepta-mustard, Brown mustard, Leaf mustard, Indian mustard. 2n=36, genome formula AABB. Africa. Spread to Asia, E. Europe and China. Now distributed from Europe to E. Asia. Often as a weed. It is cultivated for its oily seeds.
This species originated from the amphiploidization of B. campestris* and B. nigra*.
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= The Sahara. Occasionally cultivated in oases for 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. There the seeds are used for medicinal purposes and for oil production. Also used as a vegetable.

Cucurbitaceae

CITRULLUS LANATUS (Thunb.) Mansf. (syn. C. vulgaris Schrad.). Watermelon. 2n=22. Trop. and subtropical Africa. Still found in the semi-deserts of the Kalahari. Cultivated since ancient times in the Mediterranean area and in 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 wild form, var. colocynthoides (syn. C. colocynthoides Pang.) is characterized by its white flesh with bitter or non-bitter flavour while the cultivated form var. edulis (syn. C. edulis Pang.) has red or yellow flesh with sweet flavour (Shimotsuma, 1965).

The citron - a fodder melon - is adapted to very dry regions. It is both a weedy and a cultivated plant.

COCCINIA ABYSSINICA (W. & A.) Cogn. Anchoté. 2n= . Ethiopia. Sporadic cultivation in SW. provinces for its tubers. The tubers of the wild plants are inedible, while the fruits are edible. The fruits of the cultivated anchoté are however not eaten.

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 ANGURIA L. West Indian gherkin, Gooseberry gourd. 2n=24. This cultigen (also C. anguria var. anguria) derives from the non-bitter wild species C. longipes*. This last species was probably taken by slaves to the New World where the cultigen was developed (Meeuse, 1958).

CUCUMIS DIPSACEUS Ehrb. Teasel Gourd. 2n=24. Africa. An ornamental.

CUCUMIS LONGIPES Hook. f. (syn. C. anguria L. var. longipes (Hook. f.) Meeuse). 2n=24. The wild ancestor of the cultigen C. anguria* which has been developed in the West Indies (Meeuse, 1958).

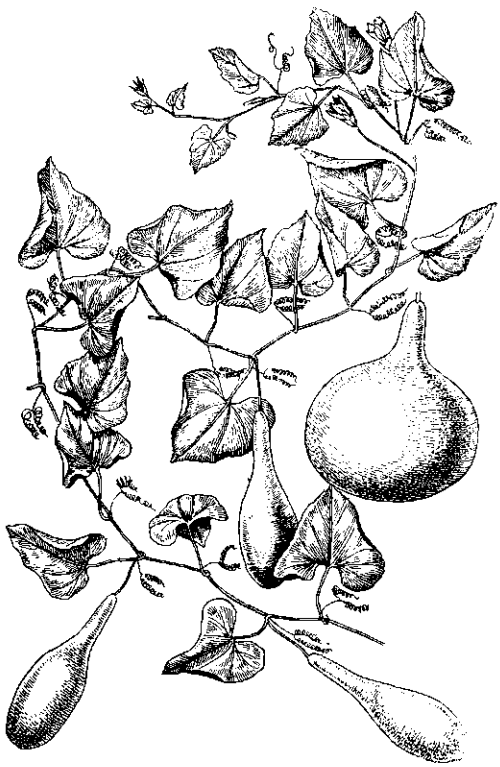
CUCUMIS MELO L. Muskmelon, Melon, Canteloupe. 2n=24. As most Cucumis species come from Africa this species probably originates from the tropical part of this continent. From there it spread to other regions producing secondary gene centres in Iran (p. 79), China (p. 30), Iran and S. USSR (p. 72) (Leppik, 1966).

CUCUMIS METULIFERUS E. Mey. African horned cucumber. 2n=24. Cultivated as an ornamental and in some parts of Africa for its fruits.

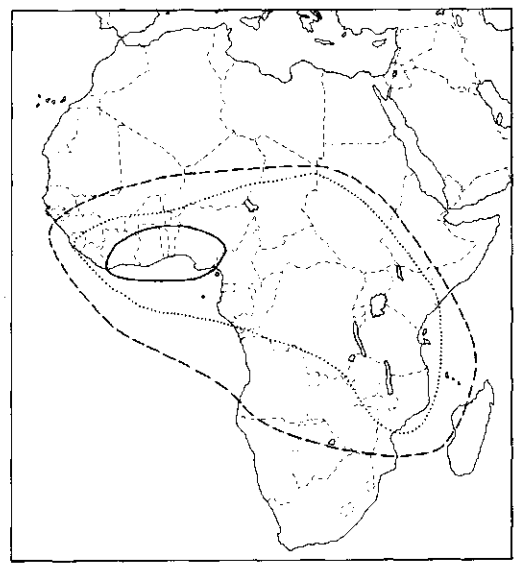
LAGENARIA SICERARIA (Molina) Standl. (syn. L. vulgaris Ser.) Bottle gourd, White-flowered gourd, Calabash gourd. 2n=22. This species has most likely a tropical African origin as in this continent wild plants of this species and closely related species have been found. At present it occurs subspontaneously and is cultivated in tropical Africa, tropical Asia and tropical America. It has been shown that gourds float for a long time while seeds remain viable. This may explain a 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 10 000–6 000 BC. (Gorman, 1970). Remains of the bottle gourd were found in Mexico dated 7 000–5 500 BC. (Whitaker & Cutler, 1971) in Peru 4 000–3 000 BC., in the Egyptian tombs dated 3 500–3 000 BC. (Purseglove, 1968) and in China 500 AD. (Li, 1969). Material found in Mexico and dated 700–1 300 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.



Lagenaria siceraria



Dioscorea cayenensis and D. rotundata (——), D. dumetorum (. . .) and D. bulbifera (- - -) (Harris, 1972)

Dioscoreaceae

DIOSCOREA ABYSSINICA Hochst. 2n=40. Ethiopia. Savannah regions 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. 31) and Africa. It might be domesticated in both regions.

DIOSCOREA CAYENENSIS Lam. Yellow yam, Yellow Guinea yam, Twelve month yam, Cut-and-come yam. 2n=c. 34, c. 54, c. 120. W. Africa. Also cultivated in the West Indies and in W. Africa.

DIOSCOREA COLOCASIIFOLIA Pax. False water yam. 2n= . W. Africa. Cultivated in E. Ghana, Cameroon and Mayumbe area of Zaire.

DIOSCOREA DUMENTORUM (Kunth) Pax. Bitter yam, Cluster yam. 2n=36, 40, 45, 54. Cultivated throughout Africa between 15°N and 15°S. It is closely related to the Asian D. hispida*.

DIOSCOREA ELEPHANTIDES (L'Her.) 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 upto 350 kg.

DIOSCOREA HIRTIFLORA Benth. 2n=40. Savannah regions 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 ROTUNDATA Poir. White yam, White Guinea yam, Guinea yam, Eboe yam. 2n=40. W. Africa. The most important yam cultivated there. Probably derived from D. praehensilis*. There exists a great variability. Closely related to D. cayenensis* and is often included in this species.

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= . Cultivated formerly in Madagascar, but at present, it is 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.

Euphorbiaceae

BRIDELIA MICRANTHA (Hochst.) Baillon. 2n= . Trop. Africa. Cultivated as food plant of the African silk caterpillar.

EUPHORBIA DREGEANA E. Mey. 2n= Namaqualand, Africa. Sometimes 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. 148). 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 to Angola and Usambara. Fruits and seeds are used as a source of oil. Also cultivated in Cameroon.

RICINUS COMMUNIS L. Castor bean, Castor oil plant. 2n=20. Trop. E. Africa and India. Cultivated now in most tropical countries where it runs wild in clearings, roadsides and dumpheaps. It probably originated as a dumpheap-camp-follower growing in to 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.

Geraniaceae

PELARGONIUM x ASPERUM Ehrh. ex Willd. (syn. P. radula L'Her. var. roseum Willd., Pelargonium roseum Willd.). 2n=77, 81. S. Africa. Cultivated for its geranium oil. The plant is male sterile. Autotetraploids (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 and 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 than the above new oil-rich hybrids are results of crossing a 4x hybrid (P. radens x P. denticulatum) with 4x P. denticulatum and backcrossing with the 4x original hybrid.

PELARGONIUM CRISPUM (L.). L'Her. ex Ait. (syn. P. rigidum Willd.). 2n= . 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'Her. (syn. P. terebinthinaceum (Cav.) Small). Rose-geranium. 2n=90 S Africa. A pelargonium with rose-scented leaves. Cultivated for its 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 Stapp. (syn. Panicum zizanoides Hbk. var. angustatum Stapf). 2n= . W. Africa. Cultivated in Gambia as a vegetable (Terra, 1967).

ACROCERAS MACRUM Stapf. 2n=36. S. Africa. Cultivated as a pasture grass.

ANDROPOGON GAYANUS Kunth. 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. It is possible that the tetraploid plants found in var. tridentatus are hybrids of A. gayanus (2n=20) in the far north of Nigeria and A. tectorum (2n=20) in the S. of N. Nigeria.

ARUNDINARIA ALPINA K. Schum. 2n= Kenya, Tanzania, Uganda, Sudan, Ethiopia, Rwanda and Urundi in mountain forests at an altitude of about 2 400-3 000 m. Its stems are used in paper industry and as building material.

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=54, Trop. and S. Africa, esp. cultivated in Ceylon. A hexaploid grass.

BRACHIARIA DECUMBENS Stapf. Sinal grass. 2n=36, Trop. Africa. Cultivated throughout the tropics for cattle fodder.

BRACHIARIA DEFLEXA C.E. Hubbard. 2n= Ivory Coast to the Red Sea and Yemen and to Angola, Mozambique, Transvaal and Madagascar. Cultivated in Fouta Djalan (Guinea). It often is a companion weed of other cereals. The cultivated type var. sativa Port. looks similar to B. ramosa Stapf (Portères, 1951).

BRACHIARIA MUTICA (Forsk.) Stapf (syn. Panicum barbinode Trin.). Paragrass, Buffalo grass, Mauritius grass, Watergrass. 2n=36. Trop. Africa and S. America. A tetraploid grass. Cultivated as a fodder crop.

BRACHIARIA RUZIZIENSIS Germain & C. Evrard. Ruzigrass. 2n= . E. Africa. In Australia Kennedy ruzigrass is cultivated.

CHLORIS GAYANA Kunth. Rhodes grass. 2n=20, (30), 40. Trop. and S. Africa. Cultivated in the tropics for forage.

CYNODON INCOMPLETUS Nees. var. hirsutus (Stent) De Wet & Harlan (syn. C. bradleyi Stent. 2n=18, S. Africa. Widely cultivated lawn-grass.

CYNODON x MAGENISSII Hurcombe. Sunturf grass. 2n=27. S. Africa. It is a triploid single clone derived from a putative, natural hybrid of a tetraploid and a diploid species, which are not known.

CYNODON PLECTOSTACHYUS Pilger. Star grass. 2n=18, 54. Trop. Africa. Cultivated for grazing and hay in the tropics. A cultivar of S. Nigeria is derived from a cross of this species x C. coursii A. Camus.

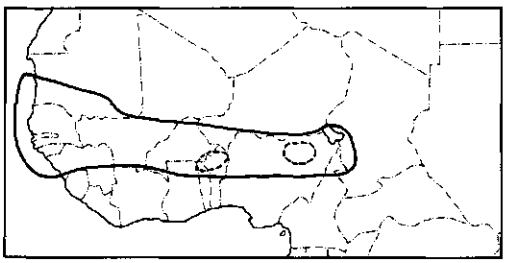
CYNODON TRANSVAALENSIS Burtt-Davy. African Bermuda grass. 2n=18. S. Africa. Used as turf grass. It appears to share the same genome with C. aethiopicus Clayton & Harlan (2n=18, 36) and C. nlemfuensis Vanderyst var. nlemfuensis (2n=18, 36). The first species occurs in E. of Africa and the second in Angola and E. Africa. Although C. aethiopicus occurs sympatric with the other two species no introgression exists due to strong crossing barriers (Chedda & Rawal, 1971).

DIGITARIA ABYSSINICA (Hochst.) Stapf. Abyssinian finger grass. 2n= . Trop. Africa. Used in S. Africa to control erosion.

DIGITARIA DECUMBENS Stent. Digit grass. 2n=27, (37). S. Africa. In 1935, material of this species was collected in E. Transvaal and was introduced to the USA PI 111110 was vegetably multiplied to give a clone widely grown in the tropics.

This clone was named Pangola grass.

DIGITARIA EXILIS Stapf. Fonto, Fonia, Fundi, Hungary rice. 2n=18, 36, 40. W. Africa. Unknown wild. Its first cultivation may have started somewhere in C. Africa close to the Sahara about 5 000 BC. It may derive from the wild D. barbinodis Henr.



Digitaria exilis (—) and D. iburua (---) (Portères, 1950)

DIGITARIA IBURUA Stapf. Iburu, Aburo. 2n= Africa. Cultivated in N. Nigeria, adjacent Niger Republic, and in Togoland. It may derive from the wild D. barbinodis Henr.

DIGITARIA PENTZII Stent. Taiwan pangola grass. 2n=(18, 27), 36, (45), 54. S. Africa. Related to D. decumbens*. It can be used as a source of virus disease resistance.

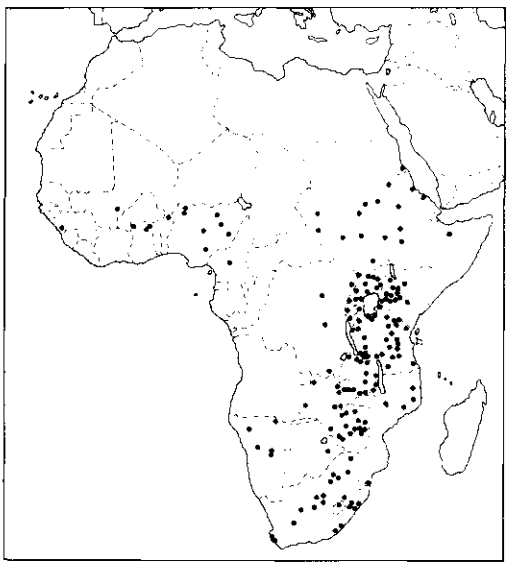
DIGITARIA TRICOSTULATA (Hack.) Henr. 2n= . Africa. Related to D. iburua*.

DIGITARIA VALIDA Stent. Giant pangola grass. 2n=24, 30, 36. S. Africa. A source of disease resistant for D. decumbens*.

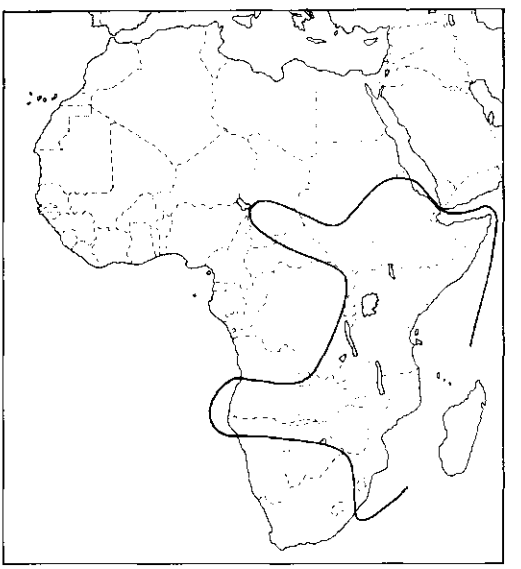
EHRHARTA CALYCINA Smith. Veldtgrass. 2n=24, 30, 48. S. Africa. Used as a soil stabilizer in W. of USA. Cv. California veldtgrass has an open panicle and sheds its caryopses. The new cv. Mission veldtgrass has a compact panicle and is non-shedding.

ELEUSINE AFRICANA Kennedy-O'Bryan. 2n=36. This species was formerly included in E. indica*. It probably originated as an amphiploid of E. indica and a closely related taxon, or as an autotetraploid of E. indica. It is suggested that E. coracana* African highland type derives from E. africana.

ELEUSINE CORACANA (L.) Gaertn. Finger millet, Ragi. 2n=36. Mehra (1963) recognized two types: 1. African highland type and 2. Afro-Asiatic type. The first has longer lemmas, glumes and spikelets and the spikelets are enclosed, while the second has naked grains. The African highland type probably derives from E. africana*. Wild in Africa. Probably an allotetraploid. Formerly included as the tetraploid form of E. indica*, which may be



Eleusine africana (Phillips, 1972)

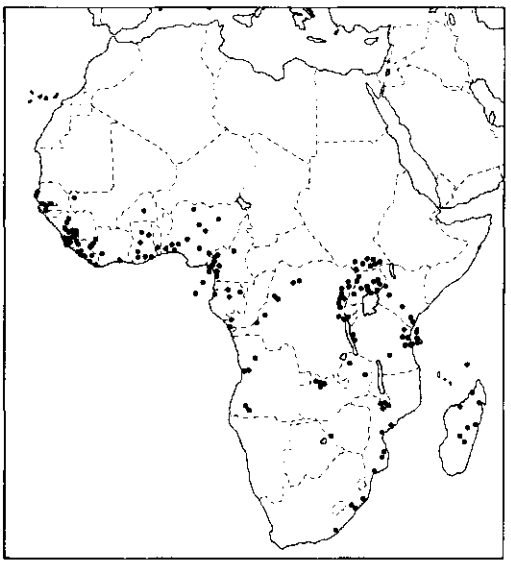


Eleusine coracana (Portères, 1950)

one of the parents of E. africana. The Afro-Asiatic form derives from the African highland form. It has some characteristics of E. indica. It is the form that was taken to India (Mehra, 1963).

ELEUSINE INDICA (L.) Gaertn. 2n=18. Africa. Cultivated on small scale in Ethiopia for fibre production. Wild or weedy types were introduced into India. It grows wild there and as companion weed of E. coracana*. Probably one of the parents

of E. africana*, the putative parent of E. coracana.

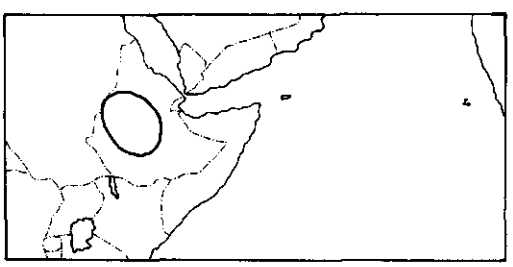


Eleusine indica (Phillips, 1972)

ERAGROSTIS CURVULA (Schrad.) Nees. Weeping loving grass, Boer love grass. 2n=20, 40, 50, 60, 30-70. S. Africa. Used to stabilize sand.

ERAGROSTIS SUPERBA Peyr. 2n=40. E. Africa. Cultivated there.

ERAGROSTIS TEF (Zuccagni) Trotter (syn. E. abessinica Link, Poa abyssinica Jacq.). Tef. 2n=40. Ethiopia and Eritrea. Cultivated there as a cereal and elsewhere for forage crop.



Eragrostis tef (Portères, 1950)

HYPARRHENIA RUFA (Nees) Stapf. (syn. Andropogon rufus Kunth). Yaragua 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=36. Africa. Cultivated as a fodder plant.

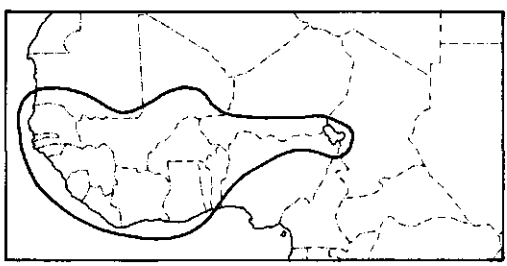
OREOBAMBOS BUCHWALDII K. Shum. 2n= The mountains of trop. Africa.

ORYZA BRACHYANTHA A. Chev. & Roehr. 2n=24, genome formula FF. W. and C. Africa.

ORYZA BREVILIGULATA vide O. perennis*

ORYZA EICHINGERI Peter. 2n=24, genome formula CC, 48, genome formula BBCC. Africa. It has the same genomes as the Asian O. minuta*. It belongs to the 'officinalis' group. As the name O. eichingeri was also used for a tetraploid species, now included in O. punctata*. Gopalakrishnan and Sampath (1966) suggested to rename this species as O. schweinfurthiana.

ORYZA GLABERRIMA Steud. African rice. 2n=24, genome formula A^gA^g. Senegal to Ubangui-Chari. Primary centre: Central Niger delta. Secondary centres: Senegambia and Guinea. It is generally believed that the cultivated African rice developed from the wild O. longistaminata A. Chev. & Roehr. This wild rice is still collected as food. It is thought to derive from the African race of O. perennis*.

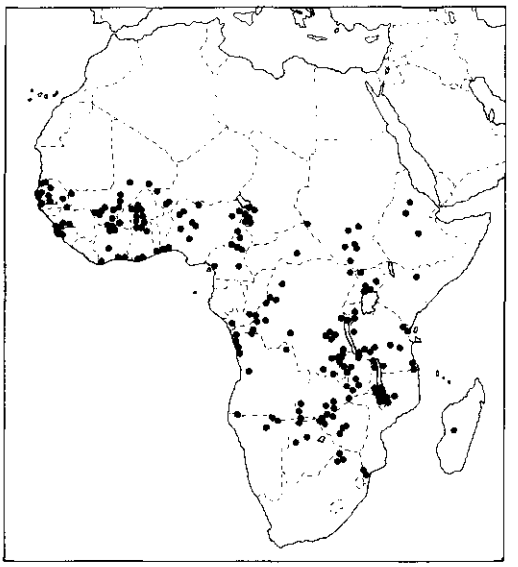


Oryza glaberrima (Portères, 1950)

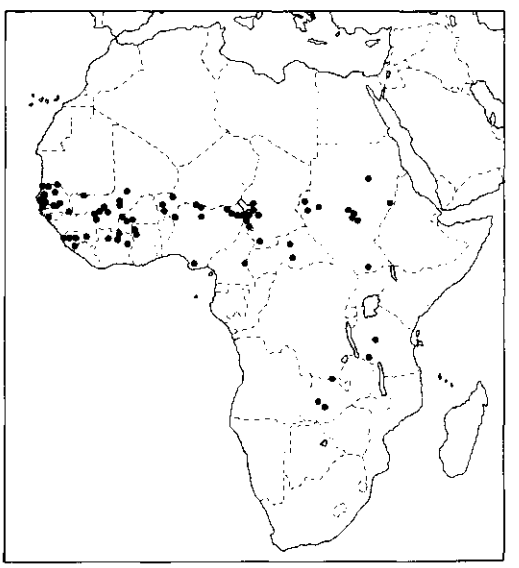
However Nayar (1973) showed that O. glaberrima derives from an old introduction of rice, O. sativa*. O. sativa has reached Egypt from the Indian subcontinent in 4th Century BC. It is not known whether rice spread to West Africa, but during the Arab conquest of N. Africa in the 7th Century rice was distributed. At that time it may have been taken to the Sudan zone. Depending on the introduced material, isolation and selection O. glaberrima evoluated.

O. barthii A. Chev., 2n=24 is according to Nayar (1973) a hybrid product of Asiatic O. sativa* introduced in the 16th Century and later. O. stapfii Roshev. is included in O. barthii.

ORYZA LONGISTAMINATA, see O. glaberrima and O. perennis.

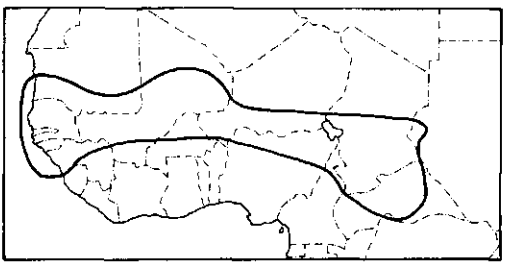


Oryza longistaminata (Harlan, 1973)



Oryza barthii (Harlan, 1973)

ORYZA PERENNIS Moench. 2n=24. genome formula AA. The distribution of O. perennis is discussed on p. 65. The African race includes O. longistaminata A. Chev. & Roehr (syn. O. breviligulata A. Chev. & Roehr). It does not hybridize with O. glaberrima* and O. sativa*. Grains are collected for food.



Oryza perennis African race (Porteres, 1950)

ORYZA PUNCTATA Kotschychev ex Steud. 2n=24, genome formula CC, 48, genome formula BBCC. Africa. The tetraploid has also been described O. eichingeri but this name is used for a different species.

OXYTENANTHERA ABYSSINICA Munro (syn. Bambusa abyssinica Rich.). Woody bamboograss. 2n=c. 60. Trop. Africa. Cultivated for its stems which are used for boats and rafts, as well as for paper making.

PANICUM COLORATUM L. Small buffalo grass. 2n=18, 36 (54).. S. Africa. A good fodder grass. Closely allied to P. maximum*.

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.

PANICUM SUMATRENSE Roth ex Roem. & Schult. (syn. P. miliare Lamk.). Little millet. India and Ceylon. P. psilopodium Trin. (2n=54) might be its ancestor species (Mansfeld, 1959). It is possible that 36 chromosome cytotypes occur.

PASPALUM SCROBICULATUM*

PENNISETUM ANCHYLOCHAETE Stapf & Hubbard. 2n= . Africa. Cultivated as a cereal in N. Nigeria (Mansfeld, 1959).

PENNISETUM CLANDESTINUM Hochst. ex Chiov. Kikuyu grass. 2n=36. Trop. Africa. A perennial grass cultivated for pasture and hay.

PENNISETUM ECHINURUS (K. Schum.) Stapf & Hubbard. 2n=14. Africa. Cultivated in Angola and E. Africa.

PENNISETUM GIBBOSUM Stapf & Hubbard. 2n= . Africa. Cultivated in N. Nigeria.

PENNISETUM LEONIS Stapf & Hubbard. 2n=14. Africa. Cultivated in Sierra Leone.

PENNISETUM MAIWA Stapf & Hubbard. 2n= Africa. Cultivated in N. Nigeria. It has a small head.

PENNISETUM MALACOCHAETE Stapf & Hubbard. 2n= . Africa. Cultivated in Tanzania.

PENNISETUM NIGRITARUM (Schlechtend.) Durand & Schinz. 2n= . Africa. Cultivated as a cereal in W. Africa.

PENNISETUM NILOTICUM Stapf & Hubbard. 2n= . Africa. Cultivated in Egypt.

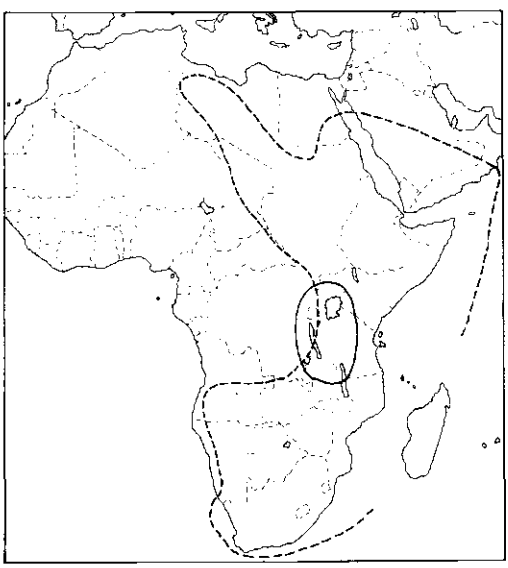
PENNISETUM PERSPECIOSUM Stapf & Hubbard. 2n= . Africa. Cultivated in Sudan.

PENNISETUM PURPUREUM Schum. Napier grass, Elephant grass. 2n=28, genome formula $A^1A^1B^1B^1$. From Senegambia to the Red Sea. A perennial pasture grass. Hybrids between cultivated and wild types and with P. typhoides* often occur resulting in gene exchange and a high variability.

PENNISETUM PYCNOSTACHYUM (Steudel) Stapf & Hubbard. 2n=14. Africa. Cultivated as a cereal in W. Africa (Mansfeld, 1959). It has brittle spines which deter birds.

PENNISETUM ROBUSTUM Stapf & Hubbard. 2n= . Africa. Cultivated there.

PENNISETUM SPICATUM (L.) Roem. & Schult. Pearl millet, African millet. 2n=14. Africa. Cultivated as a cereal in C. Africa and elsewhere.



Pennisetum spicatum (——) and P. typhoides (---) (Portères, 1950)

PENNISETUM TYPHOIDES (Burm.f.) L.C. Rich. (syn. P. spicatum L.). Bulrush millet, Pearl millet. 2n=14, genome formula AA. Probably Africa. Cultivated there for its grain. Spread to Arabia, India and elsewhere. Nigerian plants are characterized by yellow endosperm. Hybrids between cultivated forms, with wild plants and with P. purpureum* result in gene exchange and a high variability especially in Ethiopia and Sudan.

Bono (1973) included all cultivated Pennisetum species in one species. This species is divided on morphological grounds into two groups and four subgroups: cultivated from 1a Mauritania, Mali and Ivory Coast, 1b, Haute-Volta, 2a. Niger and 2b. Senegal. The cultivars from other countries in W. Africa were not included in the study.

PENNISETUM UNISETUM (Nees) Benth. Natal grass, Drakenberg silky grass. 2n= . N. and E. Africa. Cultivated there as a forage grass.

PENNISETUM VULPINUM Stapf & Hubbard. 2n= . Africa. Cultivated in Sudan.

SACCHARUM SPONTANEUM L. Wild sugar cane. 2n=104-128. From India (p. 66) 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*.

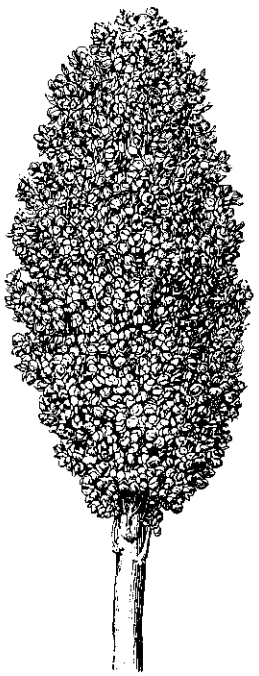
SECALE AFRICANUM Stapf. 2n=14. Eastern part of the Karoo plateau, S. Africa. Whether this species is a Pleistocene immigrant to S. Africa or a derivative of a relatively recent introduction of seeds of S. montanum from Spain or Italy as a contaminant of wheat and barley is not known (Khush, 1960). It 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 GLAUCA Beauv. (syn. Pennisetum glaucum (L.) R. Br.). Pearl millet, Cat-tail millet. 2n=(18), 36, (72). Africa. Cultivated in warm countries as cattle food.

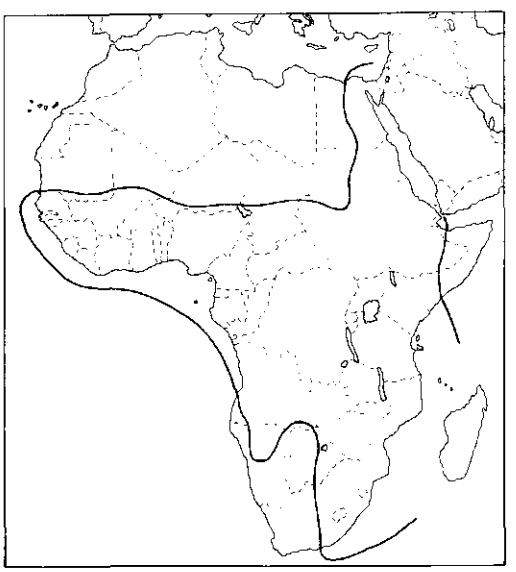
SETARIA SPHACELATA (Schum.) Stapf & Hubbard. Golden timothy grass. 2n=18, 36, 54. Africa. Cultivated in Africa, Australia and elsewhere. Some cultivars have a high oxalic acid content which may result in the death of cattle.

SORGHUM BICOLOR (L.) Moench. Sorghum. 2n=20. The genus Sorghum is widespread in Africa, the Americas, Asia, Mediterranean Europe and Australia. All cultivated sorghums belong to the section Sorghum (formerly Eusorghum) which is restricted to the Old World.

It is thought that cultivation of sorghum started in one place and spread with the weed sorghums to the other areas (Doggett, 1970). It is still possible that cultivated sorghum spread from one centre throughout Africa and in each new site introgressed with the local wild Eusorghum(s) or



Sorghum bicolor



Sorghum bicolor (de Wet et al., 1972)

that domestication of sorghum started independently in several places as is believed by Portères (1962) and de Wet and Huckabay (1967). They suggested that cultivated sorghums in West Africa are derived from S. arundinaceum, the Kaffir corn from S. verticilliflorum (Steud.) Stapf which occurs from Eritrea to SE. Africa and cultivated sorghums of Eritrea and Ethiopia from S. aethiopicum (Hack.) Rupr. ex Stapf and so each has its centre of domestication. Two sorghum types are typical for China and the Far East (p. 33).
S. bicolor groups many former species, but as the cultivated sorghums hybridize easily it is not correct to put all the different types on a species level. The same holds good for the wild Eusorghums which are interfertile with each other and with the cultivated ones. They are grouped in S. arundinaceum (Desv.) Stapf. Dogget (1965) suggested that man selected sorghum for his special needs. This resulted in different types: arundinaceum type in W. Africa, aethiopicum type in Sudan and verticilliflorum type in E. Africa. As the cultivated sorghums easily cross with wild and weedy types there is an interchange of genes between them. This results in a big variation of this species.

A simplified classification of sorghum was presented by Harlan and de Wet (1972).

TRICHOLAENA ROSEA Nees (syn. Rhynchelytrum repens (Willd.) Hubbard. Natal grass, Wire grass, Ruby grass. 2n= . Trop. and SE. Africa. Cultivated as a forage grass and as an ornamental.

TRITICUM AESTIVUM (L.) Thell. ssp. vulgare (Vill.) MK. (syn. T. vulgare Vill.). Bread wheat, Common wheat. 2n=42, genome formula AABBDD. The bread wheats in Africa are especially cultivated in the Sahara oases and Sudan zone. In the oases special types developed, sometimes called T. vulgare ssp. oasicolum Duc. Other speltoid types have been referred to as T. spelta var. saharense, while also inflatum and sphaerococcoid forms (T. sphaerococcum) have been found. Perhaps the Sahara oases could be a secondary centre of ssp. vulgare.

Spelt wheats may have been introduced by the Romans. It is remarkable that an African spelt carries an Rf tim. gene like some of the European spelts (Zeven, 1971).

TRITICUM TURGIDUM (L.) Thell. Cultivated tetraploid wheats. 2n=28, genome formula AABB. Tetraploid cultivated wheats were introduced into Ethiopia. A secondary centre of T. turgidum* ssp dicoccum, ssp. turgidum conv. turgidum conv. durum and conv. polonicum arose here. Typical Ethiopian types have been classified as abyssinicum.

Leppik (1968) showed that Ethiopia is also the primary centre of wheat stem rust (Puccinia graminis Pers.).

ZEA MAYS L. Maize. 2n=20. Secondary centres in W. Africa, S. Africa, E. Africa (Somalia, Kenya and Ethiopia) (Brandolini, 1970). Domesticated in C. America (p. 166).

An example of the diversity of maize is given by Plarre (1972) for the Karamoja district in Uganda.

Labiatae

ACOLANTHUS PUBESCENS Benth. 2n=36. Trop. Africa. Cultivated as a salad.

COLEUS DAZO Chev. (syn. C. floribundus var. longiper Robyns. Plectranthus esculentus N.E. Br.). Dazo, Kaffir potato. 2n=24. Africa. Cultivated there.

COLEUS EDULIS Vatke (syn. C. tuberosus Richard.). 2n= . E. Africa. Cultivated in Ethiopia (Cufodontis, 1957).

COLEUS FORSKOHLII (Poir.) Briquet. (syn. C. barbatus Benth., Ocimum asperum Roth.) Kaffir potato. 2n=28. E. Africa and India. Cultivated in some parts of India (Uphof, 1968).

COLEUS LANGOUASSENSIS Chev. 2n= Africa. Cultivated there.

COLEUS ROTUNDIFOLIUS Chev. & Perrot. (syn. Plectranthus rotundifolius Spreng.) Hausa potato. 2n= . Trop. Africa and Asia. Cultivated for its tubers.

HYPTIS SPICIGERA Lam. 2n=32. Trop. Africa. Cultivated there for its oily seeds.

OCIMUM KILIMANDSCHARICUM Guerke. 2n=76. Africa. Cultivated during World War II for the preparation of camphor.

ORTHOSIPHON RUBICUNDUS Benth. (syn. Plectranthus tuberosus Roxb.). 2n=28. Trop. Africa. Cultivated for its tubers.

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. 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 RUGOSUS (Willd.) DC. (syn. A. violaceus (Forsk.) Schindler). 2n=16. Trop. Africa. Used as a cover crop and fodder crop.

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).

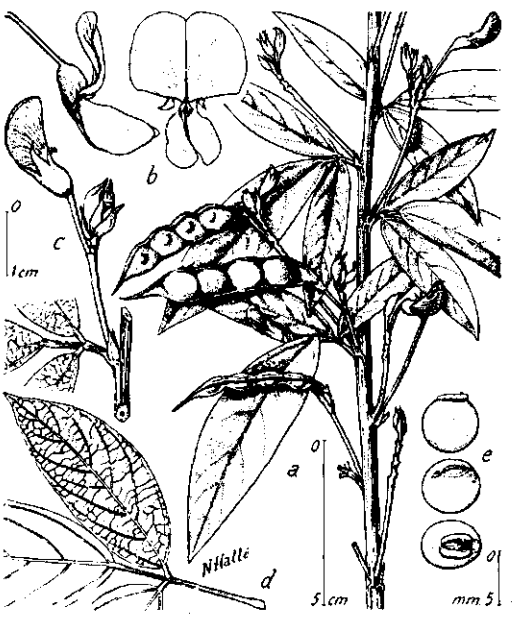
ARACHIS HYPOGAEA L. Groundnut, Peanut. 2n=40. S. America (p. 151). Introduced into Africa where it is cultivated widely. Bunting (1955, 1958) has described numerous varieties for trop. Africa, which points to a secondary centre in this region.

ASPALATHUS CONTAMINATUS (Thunb.) Druce. Rooibostee, Rooibos tea bush. 2n= . S. Africa. There are two forms; the prostate one is found on the Cape Penisula 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 Hochst. 2n=16. E. Africa. Cultivated for horse fodder.

BAPHIA NITIDA Lodd. Cam wood. 2n=44. W. Africa. Cultivated formerly as a source of red dye. Now it is only cultivated as an ornamental.

CAJANUS CAJAN (L.) Mill Sp. (syn. C. indicus Spreng.) Pigeon pea. 2n=22, 44, 66. Probably Africa. Wild and naturalized plants have been found there. Spread to India where a secondary centre arose (p. 67).



Cajanus cajan

CANAVALIA REGALIS Dunn. 2n=22. Probably an old African domesticant 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, Tenevelly senna. 2n=(26), 28. Somaliland 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).

CROTALARIA CANNABINA Schweinf. 2n= Sudan. A fibre crop.

CROTALARIA GOREENSIS Guill. & Pur. Gambia pea. 2n=16, (32). Trop. Africa. Cultivated in Queensland, Australia for green manure.

CROTALARIA INTERMEDIA Kotschy. 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. retzii A. Hitchc. 2n=16. Trop. Africa. A green manure cultivated in (sub)tropical countries. Wild in India and elsewhere.

CROTALARIA USARAMOENSIS Baker f. (syn. C. zanzibarica Benth.). 2n=(14), 16, (20). E. Africa. A cover crop and green manure.

CYAMOPSIS SENEGALENSIS Guill. & Perr. 2n=14. The semi-arid savannah zone south of the Sahara from Senegal to Saudi Arabia. An annual herb. Probably the parental species of C. tetragonoloba* (Hymowitz, 1973).

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. 67). Cultivated in S. India (p. 67).

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).

ERYTHRINA SENEGALENSIS DC. Coral flower. 2n=42. W. Africa. Used as a hedge plant, as an ornamental and for medicinal purposes.

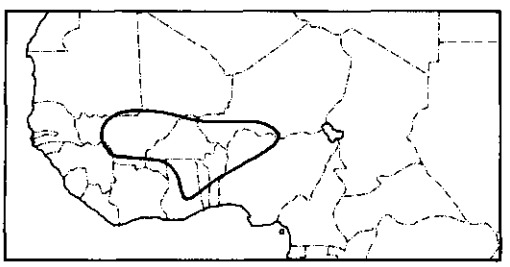
GLYCINE WIGHTII Verdc. Rhodesian kudzu vine. 2n=22, 44. Africa. A perennial soya bean. Some forms are also found in SE. Asia. The cultivars are derived from the African stock.

INDIGOFERA ARRECTA Hochst. Natal indigo. 2n=16. E. Africa. Cultivated formerly as a dye crop, and at present as a green manure.

INDIGOFERA ENDECAPHYLLA Jacq. 2n=32, 36. Africa and Asia. Cultivated as a fodder crop usually in pastures.

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.

KERSTINGIELLA GEOCARPA Harms. Geocarpa bean, Geocarpa groundnut, Kersting's groundnut. 2n=20, 22. Wild (var. tisserantii (Pellegrin) Hepper in Cameroons and possibly in adjacent regions. Cultivated in W. Africa. The chromosome number was established from this wild material. The cultivated types, var. geocarpa Hepper had 2n=22.



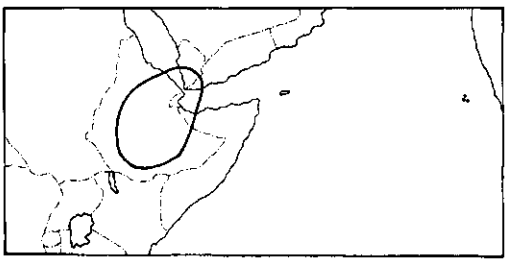
Kerstingiella geocarpa (Portères, 1950)

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 Republic 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 coloured. From Kenya the cultivated ssp. bengalensis (Jacq.) Verdc. (syn. Dolichos bengalensis Jacq.) is reported (Verdcourt, 1970).

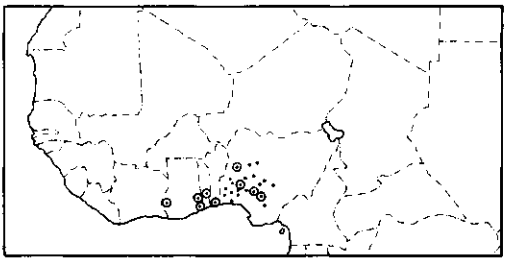
LOTONONIS BAINESII Baker. Miles lotononis. 2n=36. N. Transvaal, S. Africa and Rhodesia. A perennial cultivated in Australia.

PHYSOSTIGMA VENENOSUM Balf. Calabar bean, Ordeal bean. 2n= . W. Africa. Cultivated for its beans which are used as an ordeal poison.

PISUM SATIVUM ssp. abyssinicum (A. Braun.) Alef. (syn. P. abyssinicum Braun). 2n=14. Ethiopia and Yemen. Rarely found wild.



Pisum sativum spp. abyssinicum (Govorov, 1937)



Vigna sinensis (Harlan, 1973)

PSOPHOCARPUS PALUSTRIS Desv. (syn. P. longepedunculatus Hassk.). 2n=20, 22. Probably trop. Africa. Cultivated for its fruits. A perennial herb.

SPHENOSTYLIS SCHWEINFURTHII Harms. Yam bean. 2n= . Trop. Africa. A woody plant. Cultivated for its seeds and tubers.

SPHENOSTYLIS STENOCARPA Harms. 2n=18. Trop. Africa. Cultivated for its seeds.

STYLOSANTHUS FRUTICOSA (Retz.) Alston (syn. S. mucronata Willd.). Wild lucerne. 2n= Trop. Africa and SE. Asia. Cultivated as a fodder crop in Brazil and Australia.

STYLOSANTHUS HUMILIS H. B. et K. Townsville lucerne, Townsville style. 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 and used to stupefy fish. Cultivated as a green manure and cover 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), were 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 (Paris, 1965) (p. 87).

VOANDZEIA SUBTERRANEA Thouars. Bambara groundnut, Congo coober. 2n=22. Wild in W. Africa. Distributed throughout Africa and later to America and Asia. Hepper (1963) described the wild type as var. spontanea (Harms) Hepper and the cultivated ones as var. subterranea Hepper.

Linaceae

LINUM USITATISSIMUM L. Flax. 2n=30, (32). For possible origin see p. 87. 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= . A shrub from trop. Asia and Africa with several uses.

Malvaceae

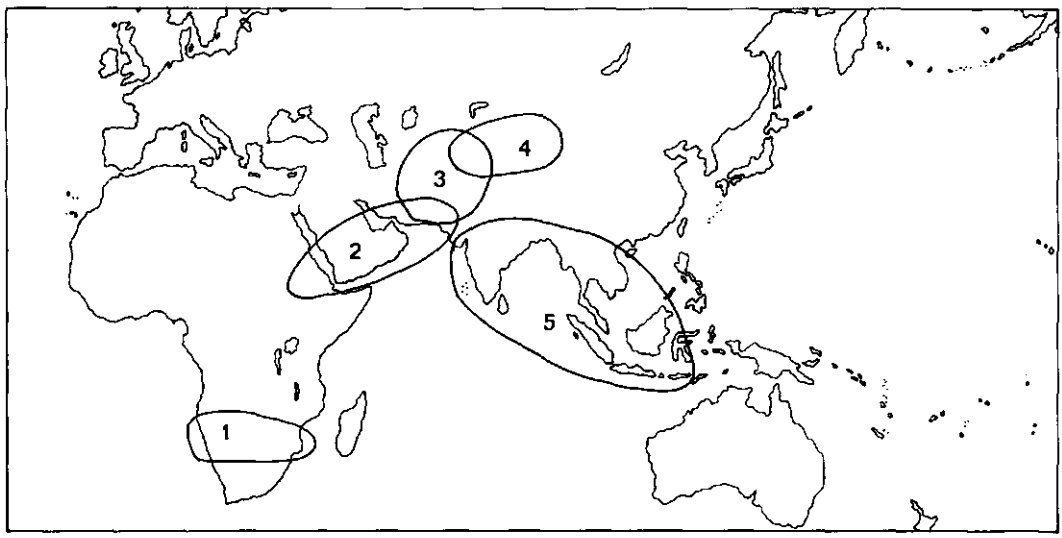
GOSSYPIUM ANOMALUM Wawr. & Peyr. 2n=26, genome formula B_1B_1. Along the southern fringe of the Sahara, in SW. Africa and Angola. It can be crossed with G. herbaceum* and G. arboreum*.

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 Chowhury and Buth (1970, 1971) thought that it is native to Africa (p. 121, p. 153). They found material dated about 3 000 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. Probably the form cultivated by the people of Meroë, an ancient Nubian kingdom, dated about 500 BC.

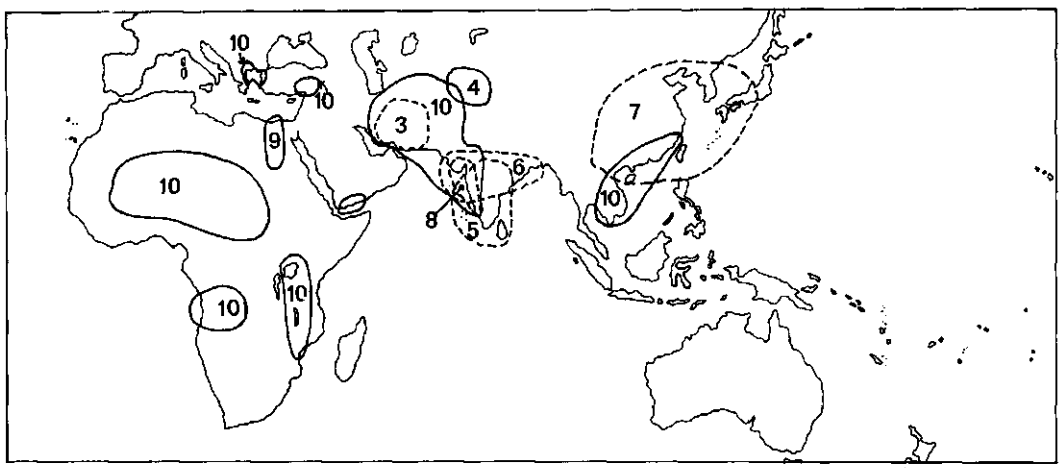
GOSSYPIUM BARBADENSE L. Egyptian cotton. 2n=52, genome formula $(AADD)_2$. Peru (p. 153). Spread to Africa in historical time. A perennial type from S. Nigeria made a 'Green Revolution' of cotton growing in the Nile delta possible after 1820. This lead to introduction of other cottons. Only Sea Islands was successful. Vigorous 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 bushveld across a belt from Mozambique to Angola and SW. Africa. Hutchinson (1971) suggested a likely centre of domestication in southern Arabia and Baluchistan. Furthermore, 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 at about 2 400 BC. However, fragments of textile and a string found at this site and dated 2 500-1 700 BC have been identified as G. arboreum*. Hutchinson (1962) suggested that cotton must have been brought from the present Rhodesian area by early traders to the north. It is most likely that the earliest domesticants were selected between this area and Ethiopia or Arabia. From this variety the primitive cultivated race acerifolium which was formerly found in Ethiopia, S. Arabia and Belutchistan, was selected.

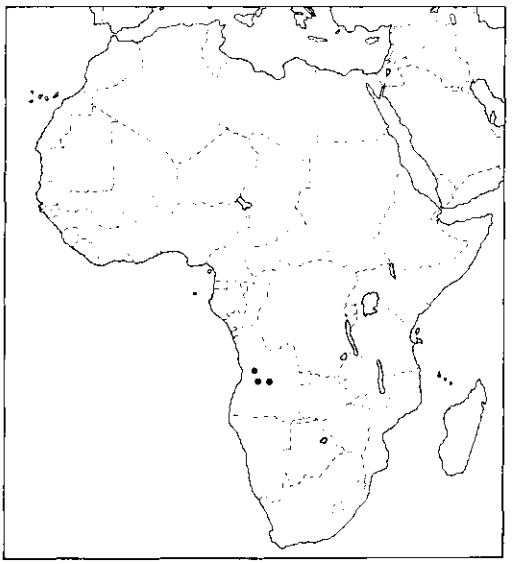
Chowdhury and Buth (1970, 1971) found cotton seed and hairs in Egyptian Nubia with an age of about 2 500 BC. They suggested that because no textile was found cotton was used as sheep fodder.



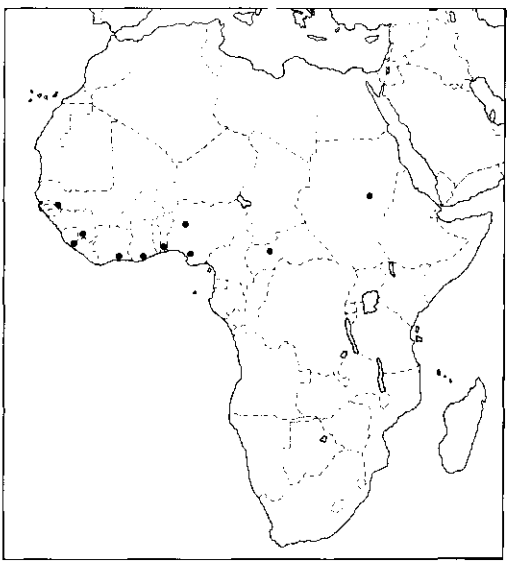
Distribution of the Old World cottons in the 13th Century: Gossypium herbaceum var. africanum (1), G. herbaceum var. acerifolium (2), G. herbaceum var. persicum (3), G. herbaceum var. kuljianum (4) and G. arboreum var. indicum (5) (Hutchinson, 1962)



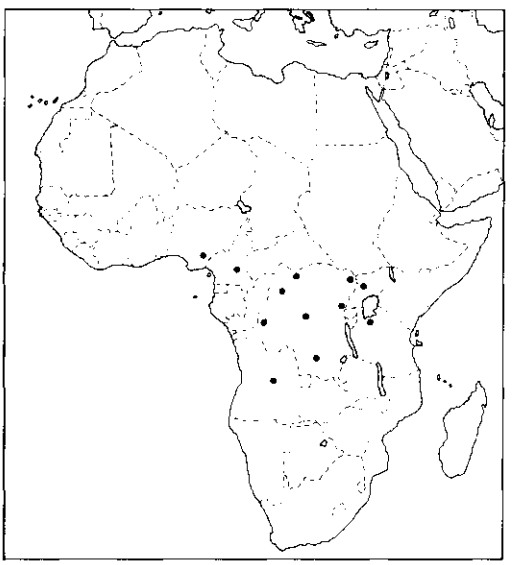
Distribution of annual cottons in the Old World in 1960: Gossypium herbaceum var. persicum (3), G. herbaceum var. kuljianum (4), G. arboreum var. indicum (5), G. arboreum var. bengalense (6), G. arboreum var. sinense (7), G. herbaceum var. wightianum (8), G. barbarense Egyptians (9), G. hirsutum uplands and Cambodias (10) (Hutchinson, 1962)



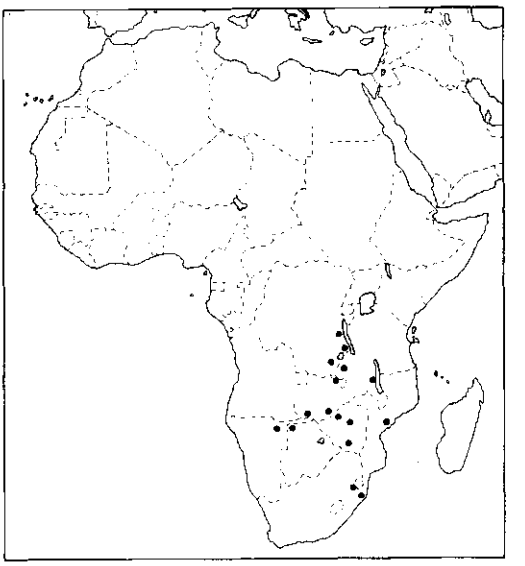
Hibiscus acetosella (Menzel & Wilson, 1969)



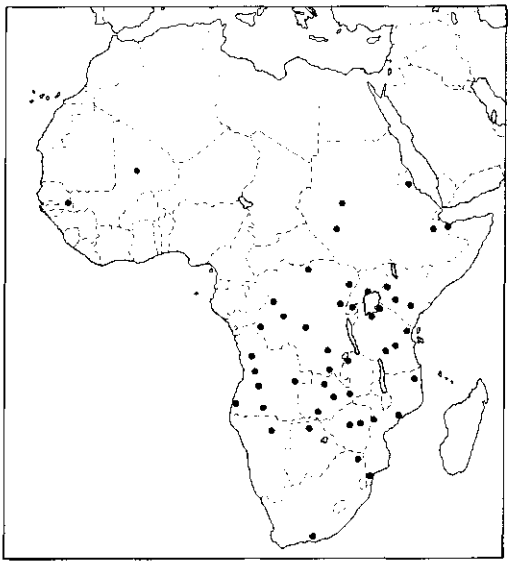
Hibiscus asper (Menzel & Wilson, 1969)



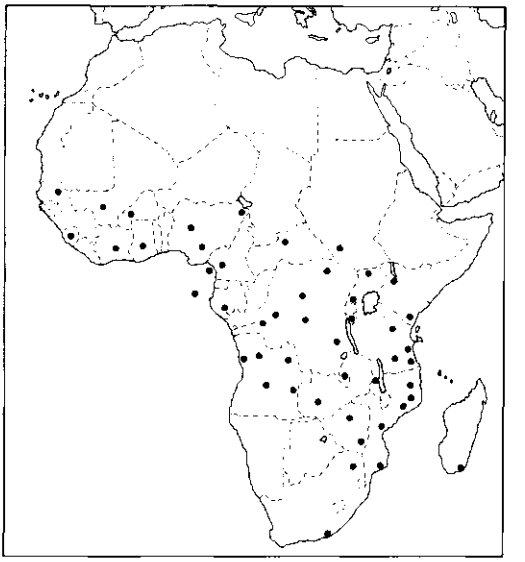
Hibiscus noldeae (Menzel & Wilson, 1969)



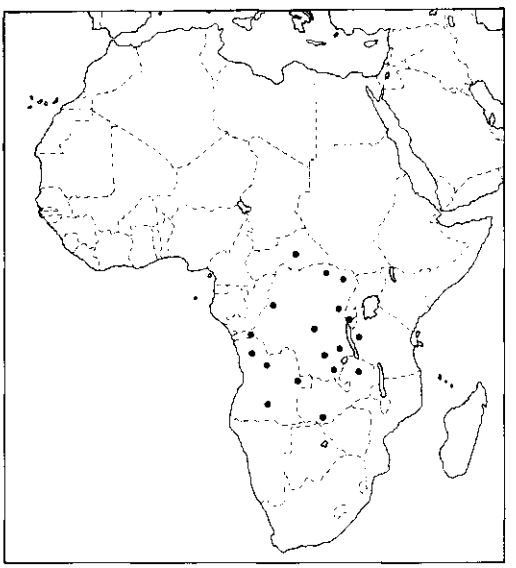
Hibiscus meeusei (Menzel & Wilson, 1969)



Hibiscus cannabinus (Menzel & Wilson, 1969)



Hibiscus surattensis (Menzel & Wilson, 1969)



Hibiscus mechowii (Menzel & Wilson, 1969)

This ancient Nubian cotton is related to G. herbaceum var. africanum and G. arboreum race soudanensis*.

From the race acerifolium race persicum* and race kuljianum* and also G. arboreum race indicum* are derived.

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*.

At present 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 LONGICALYX Hutch. & Lee. 2n=26, genome 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, Somaliland and Kenya. A variable species.

GOSSYPIUM TRIPHYLLUM Hochr. 2n=26, genome formula B_2B_2. The desert regions 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, Zaire, Rhodesia 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 homologue to the A genome of H. asper*. H. surattensis* is the B-genome donor (Wilson & Menzel, 1964; Menzel & Martin, 1970). This species grows in western trop. Africa. The closely related H. radiatus* comes from Asia.

H. noldeae Baker f. appears to be 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=26), 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. 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, Zaire 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*.

Melastomataceae

SAKERSIA LAURENTIA Cogn. 2n= . Zaire. Cultivated there for its leaves (Terra, 1967).

Menispermaceae

CISSAMPELOS OWARIENSIS Beauv. Velvet leaf. 2n= . W. Africa. Cultivated there as a medicinal crop in coastal regions (Dalziel, 1937).

JATEORHIZA PALMATA (Lam.) Miers. (syn. J. miersii Oliv.). 2n= . Trop. Africa. Cultivated as a medicinal crop.

Moraceae

CHLOROPHORA EXCELSA (Welw.) Benth. Iroko. 2n= . Africa. Cultivated there for its timber.

FICUS TILIAEFOLIA Bak. Voara. 2n= . Madagascar. Cultivated there for its fibre.

Moringaceae

MORINGA PEREGRINA (Forsk.) Fiori. 2n= Egypt and Somaliland. 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, Abessinian banana. 2n=18. Ethiopia, the mountains of Kordofan and the lower part of the montane forest belt of Ruwenzori. 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 on higher altitudes than the wild plant itself grows. Several cultivated types are recognized. It is suggested that there are about forty different ensete types. The back of the leaf of the Koba type is red to purple coloured. 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.

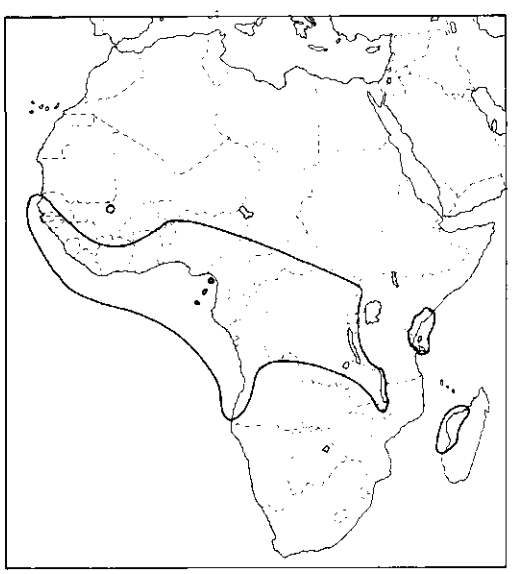
MUSA cultivars of the AAA group. Banana. 2n=33. Primary centre in the Malayan region (p. 52). Secondary centre in the uplands of E. Africa. There it has been cultivated for a long time.

MUSA cultivars of the AAB group - Plantains subgroup. French plantain, Horn plantain. 2n=33. India (p. 68). Secondary centre in E. Africa.

Palmae

BORASSUS FLABELLIFER L. Lontar, Palmyra palm. 2n=36. India and Malayan 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 in Africa are covered by semi-wild palms. In Africa the oil palm was only in a few areas domesticated prior to 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.



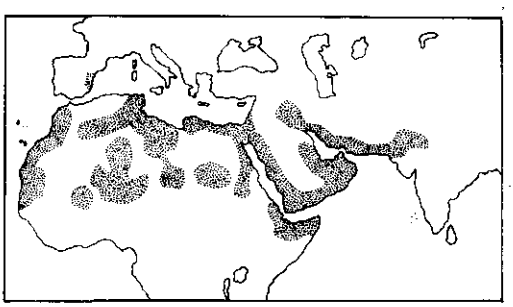
Elaeis guineensis (Zeven, 1967)

PHOENIX ATLANTICA Chev. False date. 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 species easily hybridize. This may have resulted in an increased variability. Perhaps all mentioned Phoenix* species should be included in one species.



Phoenix dactylifera (Oudejans, 1969)

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 properties and therefore cultivated and cared for. In SE. Nigeria it was observed that pedlars sold germinated fruits from the Imo river banks to farmers up to 100 km away.

Pandanaceae

PANDANUS UTILIS Bory. 2n= . 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 oily seeds.

SESAMUM ALATUM Thonn. Tacoutta. 2n=26. Trop. Africa or India (p. 69). Occasionally cul- zone.

SESAMUM INDICUM L. (syn. S. orientalis L.). Oriental sesame, Beni seed. 2n=26, (52, 58). Unknown wild. Secondary centre: in India (p. 69) and in China/Japan (p. 35). 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 and 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 seeds.

Perioplocaceae

CRYPTOSTEGIA GRANDIFLORA Br. 2n=24. Trop. Africa or India (p. 000). Occasionally cultivated for its Palay rubber and often as an ornamental.

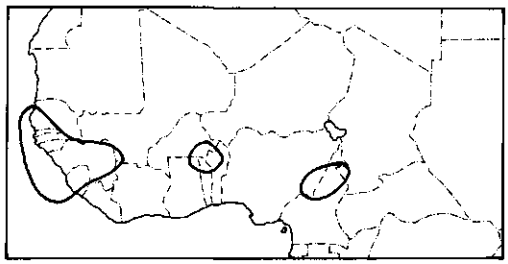
Piperaceae

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 West African culture. However, more evidence is needed. Cultivated in W. Africa for its fibre and seed.



Polygala butyracea (Portères, 1950)

Polygonaceae

RUMEX ABYSSINICUS Jacq. Spanish rhubarb dock. 2n= . Ethiopia. Cultivated in the Zaire basin.

Portulacaceae

TALINUM CUNEIFOLIUM (Vahl) Willd. 2n= . Africa and Arabia. Cultivated in E. Africa as a vegetable.

TALINUM PORTULACIFOLIUM (Forsk.) Aschers. 2n= . Trop. Africa and Asia. Cultivated in Africa as a vegetable.

TALINUM TRIANGULARE Willd. 2n=48, 72. Probably C. and/or S. America or Trop. Africa. Cultivated in Brazil (p. 156), 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

Rubiaceae

COFFEA ARABICA L. Arabica coffee. 2n=22, 44, (66, 88). Primary centre: SW. Ethiopia (Meyer, 1969). Secondary centre: Yemen (p. 90). 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).

COFFEA CANEPHORA Pierre ex Froehner (syn. C. robusta Linden). Robusta coffee. 2n=22, 44. Africa, western to central (sub)tropical regions, from Guinea and Liberia to Sudan and Uganda.

The greatest diversity has been described for Zaire.

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 synonymes.

'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). The Zaire basin. It resembles C. arabica*. Possibly a form of C. canephora*. 'Congusta' coffee is a hybrid product of C. congensis and C. canephora.

COFFEA EUGENIOIDES S. Moore. 2n=22. Wild in the Lake Kivu area of Zaire, W. Uganda and W. Tanzania. Cultivated there. It resembles a slender form of C. arabica*.

COFFEA LIBERICA Bull. 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., syn. 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. Buchu. 2n= . SW. and S. Africa. Cultivated on a small scale in the Chanwilliam 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 has been naturalized.

Sapotaceae

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 West 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 growing hedges.

SOLANUM AETHIOPICUM L. 2n=24. Trop. Africa. This non-tuberous plant is cultivated for its leaves and fruits.

SOLANUM ANOMALUM Thonn. Children's tomato. 2n= . Trop. Africa. This non-tuberous plant is sometimes cultivated.

SOLANUM BURBANKII Bitter. Wonderberry. Msoba. 2n= 6x=72. Probably derived from the southern African msoba (Heiser, 1969). It is apparently not a hybrid of S. sarachoides (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 southern Africa. Cultivated for its fruits and leaves.

SOLANUM INCANUM L. 2n=24. Africa. Occasionally cultivated.

SOLANUM MACROCARPON L. 2n=36. Mascarene Islands. Cultivated for its leaves. The cultivar is described as var. calvum Bitter. Its triploidy may point to a hybrid origin.

SOLANUM NIGRUM L. Black nightshade. 2n=24, (36, 40, 48), 72, (96, 144). Native region is unknown. At present a cosmopolite non-tuberous weed which is cultivated.

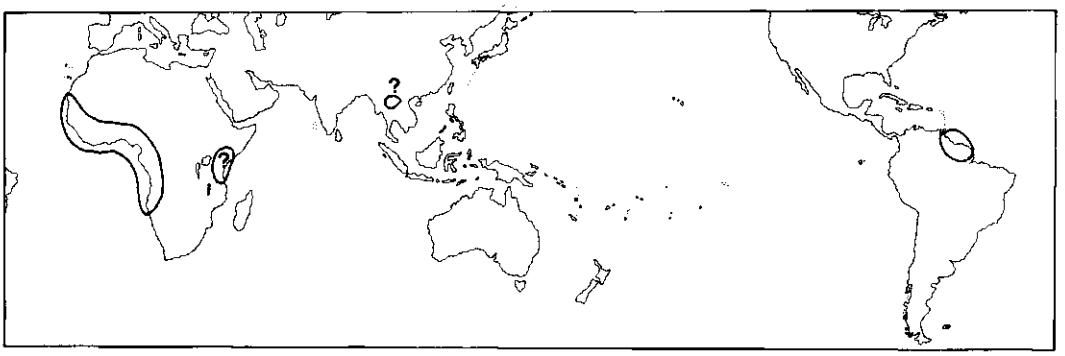
SOLANUM NODIFLORUM Jacq. 2n=24, 72. The Sahara and Nigeria. Cultivated for its leaves. May have run wild elsewhere.

SOLANUM OLIVARE Paill. 2n= . Cultivated in Ivory Coast, Dahomey 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 Zaire and Angola, to the West Indies and elsewhere. Cultivated esp. in W. Nigeria, but is second in importance to C. nitida*.



Aframomum melegueta (van Harten, 1970)

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 Dahomey, 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). Spread in W. Africa and 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 Zaire. 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 Mauritiania. 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. Cultivated sometimes as a vegetable e.g. near Timbuktu, Africa (Uphof, 1968).

Verbenaceae

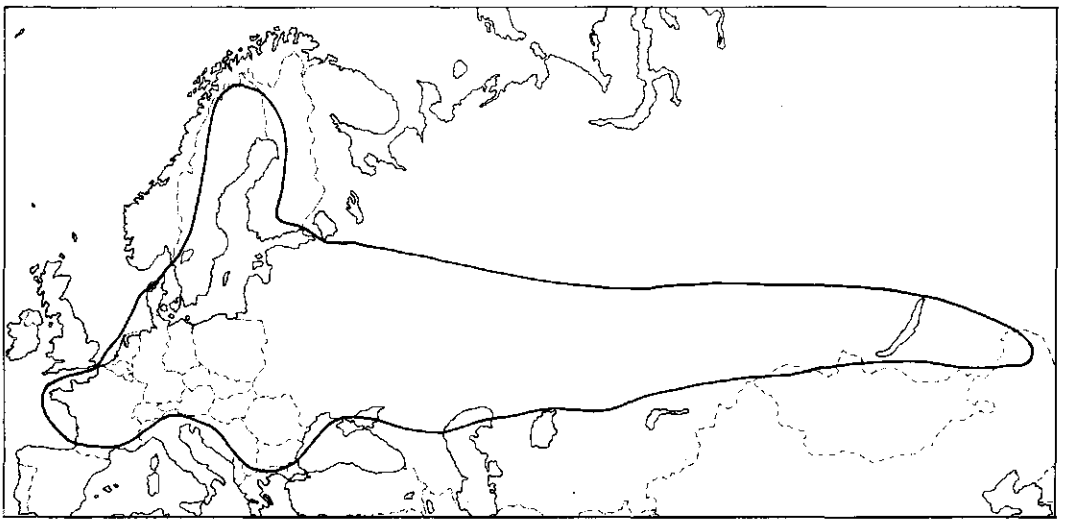
LIPPIA ADOENSIS Hochst. Gambian tea bush. 2n= . Zaire. A potherb cultivated there. In W. Africa it is used as a tea substitute.

VITEX CIENKOWSKII Kotschy & Peye. 2n=32. Trop. Africa. A tree planted on compounds or semi-cultivated for its fruits.

Zingiberaceae

AFRAMOMUM MELEGUETA (Rosc.) K. Schum. Melegueta pepper. 2n= . West 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 historical known 'Grains of paradise', giving its name to the West African Pepper Coast, Grain Coast or Malagueta Coast.

9 European Siberian Centre



The European-Siberian Centre was not indicated by Vavilov. Darlington (1956) was the first to refer to Europe as a region of origin of crop plants. Zhukovsky (1968, 1970) recognized it as a megacentre of diversity of a relatively small importance.

Agriculture reached this region from Centre 6 and arrived at about 4 000 BC. in NW. Europe.

Important crops have been developed in this region: fruit trees, grasses, Brassica sp., Cannabinus sativus, Cichorium sp., Digitaria sanguinalis, Fragaria sp., Lactuca sativa, Humulus lupulus, Medicago sp., Ribes sp., Rubus sp., Trifolium sp., etc.

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, Caucasus to Iran and N. Africa. Cultivated in S. France and around Nürnberg, Germany for its bulbs (Kuckuck, 1962). Some cultivation also in Kashmir (p. 62) and Iran (p. 77).

ALLIUM SCORODOPRASUM L. Giant garlic, Sand leek. 2n=16. C. and S. Europe and Asia Minor. Cultivated in USSR (Kuckuck, 1962).

Araceae

ACORUS CALAMUS L. Sweet flag, Sweet root, Calamus. 2n=18, 24, 36, (44, 48). 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. Cultivated formerly as a medicinal herb in most of Europe. From this cultivation it has naturalized.

Asclepiadaceae

CYNANCHUM VINCETOXICUM (L.). Pers. Swallows wort. 2n=22. Europe to Himalaya and Altai, and in N. Africa. A perennial herb cultivated formerly in gardens as a medicinal plant.

Berberidaceae

BERBERIS VULGARIS L. European barberry. 2n=28. Most of Europe and Caucasus. Difficult to assess its territory because it was planted formerly for its edible berries and is now 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 extirpated on a large scale.

Boraginaceae

LITHOSPERMUM OFFICINALE L. Gromwell. 2n=28. Spp. officinale throughout Europe, W. Asia, Caucasia and Iran. Cultivated formerly in Bohemia for preparing Bohemian or Croatian tea. Spp. erythrorhizon is cultivated in China and Japan (p. 28).

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 (C. ruderalis Janisch) 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 2 500 BC. Cultivated for its fibre and for its seeds, for food or as a source of hemp seed oil. The Indian type (p. 63) is cultivated as a source of narcotics. Special cultivar groups have been developed for different purposes.

HUMULUS LUPULUS L. Hop. 2n=20. Wild plants (var. lupulus) in Europe. Hop is especially cultivated in Europe and N. America. There are two cultivated types: convar. europaeus Mandy with divided leaves and convar. cordifolius (Miq.) Maxim. (syn. H. cordifolius Miq.) with entire heart-shaped leaves cultivated in E. Asia.

Caryophyllaceae

SAPONARIA OFFICINALIS L. Soapwort, Soaproot. 2n=28. Europe and Asia. Cultivated occasionally in Germany (Mansfield, 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

ARTIPLEX HORTENSIS L. Mountain spinach, Garden orach. 2n=18. Wild in temperate Europe and Asia. Cultivated formerly in Europe as a vegetable.

BETA VULGARIS L. var. rapa. Fodder beet. 2n=18. Distribution of the the wild type is given on p. 92. Developed probably in the Netherlands and perhaps from types introduced from Spain. Secondary centre in Centre 5 (p. 71). Spread to Germany and elsewhere. It may have played a role in the development of sugarbeet, var. saccharifera (syn. var. altissima). The sugarbeet probably developed in Silecia, Poland from hybridization of an old garden form and fodder beet. The variety "Weisser schlesicher Zückerrübe" is the parent of all sugarbeet varieties.

CHENOPODIUM ALBUM L. Goosefoot, Fat hen, Lamb's quarters. 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. A Paleotemperate native. Cultivated formerly as a potherb.

CHENOPODIUM FOLIOSUM Aschers. 2n=18. Europe and the Orient. Cultivated formerly as a vegetable (Uphof, 1968).

Compositeae

ANTHEMIS NOBILIS L. Noble chamomile. 2n=18. S. and W. Europe. Cultivated as a medicinal plant.

ANTHEMIS TINCTORIA L. Dyer's chamomile, Golden chamomile. 2n=18. Europe and W. Asia. Cultivated as a dye plant.

ARCTIUM LAPPA L. (syn. Lappa arctium Gaertn.). Great but, Great burdock, Cockle bur. 2n=32, 36. Europe and Asia. Cultivated in Europe as a medicinal plant, and also in China and Japan (p. 29).

ARTEMISIA ABROTANUM L. Southern wood. 2n=18. S. Europe and temp. Asia. Cultivated as a medicinal crop.

ARTEMISIA ABSINTHIUM L. Absinthe. 2n=18. Europe, S. Siberia, Kashmir and Mediterranean region. Cultivated in S. Europe, N. Africa and the 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.

CARUM CARVI L. (syn. Apium carvi Crantz). Caraway. 2n=20, 22. Europe and W. Asia. Cultivated in temperate regions and in N. India and Sudan (see C. roxburghianum*, C. copticum*).

CICHORIUM ENDIVIA L. Endive. Escarolle. 2n=18. S. Europe to India. Primary centre in the Mediterranean region.

CICHORIUM INTYBUS L. Chicory, Succory, Brussel Witloof. 2n=18. European Siberia, N. Africa and the Near East to Iran, Belutchistan 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 Brussel witloof, was first developed around Brussels, Belgium.

HELIANTHUS ANNUUS L. Sunflower. 2n=34. Wild in N. America (p. 173). Secondary centre in USSR. Domesticated and cultivated in N. America. Large-headed forms introduced in Europe.

LACTUCA QUERCINA L. 2n=18. Europe, esp. in Germany, France to USSR and the Balkan. 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., the prickle 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 4 500 BC.; a long-leaved form was depicted on 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, celtuce forms a single, thickened straight stem of 90 cm or more which is eaten as salad when young.

MATRICARIA CHAMOMILLA L. Chamomille, German chamomille. 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 Anthemis nobilis*.

TARAXACUM HYBERNUM Steven. Krim sagiz. 2n=32, 40. Italy, Balkan, Asia Minor, Syria and Crimea. Cultivated in USSR as a rubber crop.

TARAXACUM OFFICINALIS Weber. Dandelion, Lions-tooth, 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 mole-hills are collected as dandelion salad.

Crassulaceae

SEDUM REFLEXUM L. Jenny stone crop. 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.). Horse radish. 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 for its culinary purposes 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. Moderate Europe, Asia and N. Africa. Spread throughout the world. Cultivated as a potherb.

BRASSICA CAMPESTRIS L. Turnip group. 2n=20, genome formula AA. The wild form spp. sylvestris (L.) Jancken grows as a weed and ruderal in most of Europe, moderate Asia and N. Africa. The various oily, spp. oleifera (Metzg.) Sinsk. (oil seed turnip) and fodder, spp. rapifera (Metzg.) Sinsk. ("stubble turnip", Dutch turnip) cultivars have been developed independently.
There are three main groups: the Asian (p. 29), the Mediterranean and the West European.
The development of the turnip rape var. oleifera (Metzg.) Sinsk. possibly took place 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. Wild unknown. Primary gene centre in the Mediterranean region (p. 94). 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 consumed as a vegetable.

BRASSICA NIGRA (L.) Koch. Black mustard. 2n=16, genome formula BB. Europe, especially in C. and S. parts. Cultivated since ancient times. Seeds are pressed for black mustard-seed oil. 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. 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=32, (48, 64). W. Asia and S. Europe and Great Britain. Cultivated. The tips of the leafy stems are eaten as salad. It is also cooked as a vegetable. In New Zealand it is a serious river-weed. The almost sterile hybrid plants (2n=45) of watercress and its relative N. microphyllum (Boenn.) Rchb. (2n=64) are also cultivated for salad (Purseglove, 1968). It is vegetatively propagated.

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 Britain and N. Africa. Cultivated formerly as a medicinal crop. Spp. cretica is found in the Aegian 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 Libia.

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. Cultivated in the USSR.

AGROPYRON CRISTATUM L. Gaertn. Crested wheatgrass. 2n=14, 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). Wheat grass. 2n=(28), 42, genome formula $B_2B_2E_1E_1E_2E_2$. S. and C. Europe to Iran and Caucasia.

AGROPYRON REPENS (L.) Beauv. Quackgrass. 2n=28, 42, (56). Temperate Eurasia. Cultivated. A tedious pestweed.

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.). Beach grass. 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. 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). Tepper (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. odoratum	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 oat grass. 2n=40. Europe. A valuable pasture grass.

ARRHENATHERUM TUBEROSUM Druce (syn. Avena tuberosa Gilib., Arrhenatherum avenaceum Beauv.). Onion couch grass. 2n=28. In neolithic times possibly cultivated for its tubers.

AVENA SEPTENTRIONALIS 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 it 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), 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 synonym as two species.

BROMUS INERMIS Leyss. Awnless brome, Smooth brome, Hungarian brome. 2n=(28, 42, 49), 56, (54-58). N., C. and SE. Europe, Caucasia, temperate Asia to China. Cultivation started at various places in Europe. Introduced to N. America.

CYNOSURUS CRISTATUS L. Crested dogtail, Dog's tail grass. 2n=14. Primary centre in C. and W. Europe, Caucasia and Asia Minor.

DACTYLIS GLOMERATA L. 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 variability 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. 65). 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.

FESTUCA PRATENSIS Huds. (syn. F. elatior L.). Fescue grass, Meadow fescue, English bluegrass. 2n=14, (28, 42, 70). Europe, Caucasia, Iran, the Ural 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.). Artificial amphiploids have been bred.

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).

GLYCERIA FLUITANS R. Br. Mannagrass. 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.

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 Westerwold, NE. Netherlands.

LOLIUM PERENNE L. Perennial ryegrass. 2n=14. Not known where and when it was domesticated, but probably in Europe. However, the parent plants may have come from the Mediterranean region or 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, Herd's grass. 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. Reed grass. 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 blue grass. 2n=28, (42). Arctic zone of Europe, Asia and N. America. Various varieties have been developed in Europe.

POA PRATENSIS L. Blue grass, Kentucky blue grass, Bird grass. 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. 176) 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*.

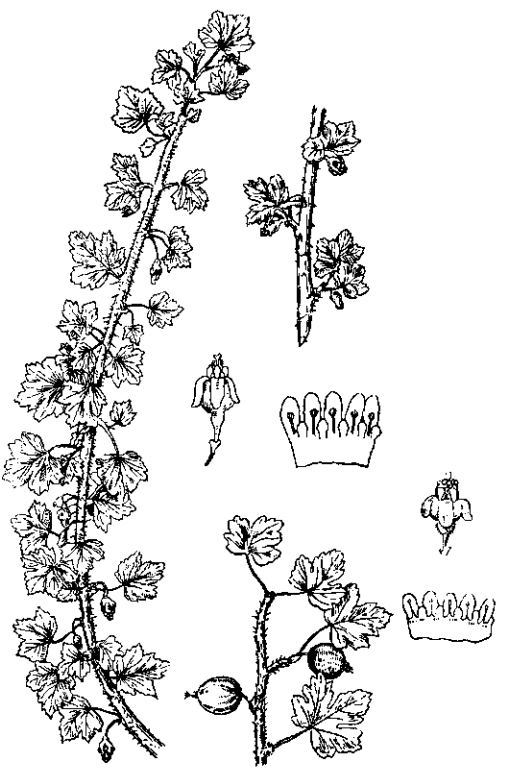
SPARTINA TOWNSENDII H. et J. Grooves. Cord grass. 2n=(62, 120, 122, 124), 126. Originated in W. Europe after introduction of the American S. alterniflora Lois. (2n=70) and amphiploidization of this species with the European S. maritima (Curt.) Fern. (2n=56). Cultivated for soil reclamation and as a stabilizer.

TRISETUM FLAVESCENS (L.) Beauv. (syn. T. pratense Bers.). Yellow cat grass, Golden oat grass. 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. compactum Host.). Club wheat. 2n=42, genome formula AABBDD. The club wheats 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. 117). 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 $\underline{Rf}_{tim}$-gene (Zeven, 1971).

ZEA MAYS L. Maize, 2n=20, Secondary centres in S. Europe and the Mediterranean region (p. 117) in the European corn belt and the Atlantic and Continental maize growing regions (Brandolini, 1970). Domesticated in C. America (p. 166). 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).



Ribes acicularis

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. Related 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 Nasonia 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).

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 blackcurrant. They have breeding value.
Cultivars of var. sibiricum E. Wolf. of this species and R. ussuriense* are sources of resistance to the blackcurrant gall mite, Phytoptus ribis Nal.

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-redcurrant (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 redcurrant.

RIBES SPICATUM Robson. 2n=16. NE. Europe. Sometimes cultivated.

Juglandaceae

JUGLANS REGIA L. Walnut. Persian walnut, English walnut. 2n=32, 36. Primary centre of diversity in Centre 5 (p. 72). 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, Wooly 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 $RRS^{C}S^{C}$. 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. Nm. alopecuroides (syn. M. alopecuroides Hull, M. velutina Lej.) was formerly much cultivated. 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 marjoram. 2n=30, 32. Europe, Siberia, Himalaya, Asia Minor and Iran. Cultivated as a medicinal plant.

Leguminosae

ANTHYLLIS VULNERARIA L. Kidney vetch, Spring vetch, Lady's fingers, Wound-wort, Amer, Tare. 2n=12. Temperate 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.

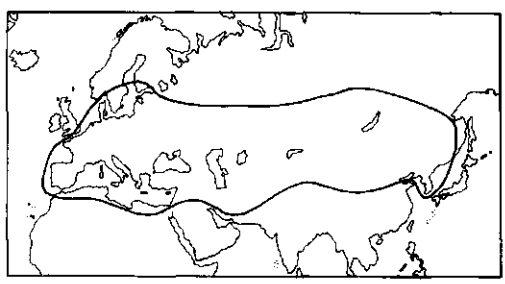
LATHYRUS TUBEROSUS L. Groundnut peavine, Earth chestnut. 2n=14. Europe and W. Asia. Cultivated for its tubers. In the 16th Century its flowers were distilled for perfumes (Uphof, 1968).

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 Somaroo & 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. Europe (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 DENTICULATA Willd. 2n=16. China. Used as a vegetable. Related to M. sativa*.

MEDICAGO FALCATA (L.) Doell. Yellow lucerne. 2n=16, 32. From W. Europe to E. China and E. of USSR, including the Mediterranean region. Primary centre in USSR. There are two Siberian subspecies described: spp. ruthenica (L.) Ledeb. (syn. M. ruthenica Trautv.) and spp. platycarpos (L.) Ledeb. (syn. M. platycarpa Trautv.).



Medicago falcata (Fischer, 1938)

The hybrid described as M. medica Pers. originates where the area of M. sativa and M. falcata overlap. In the same area M. hemicycla Grossh. (2n=16, 32) is found. It may have a hybrid origin (Lesin & Lesin, 1964). M. falcata and M. sativa* are closely related. Their karyotypes are similar (Gillies, 1970). Spp. falcata (L.) Arcangeli (syn. M. borealis Grossh.) (2n=16, 32) is a wild perennial type growing in meadows of the non-chernozem zone of European USSR and W. Siberia. It is early maturing requiring a long-day period. It has a good practical value.
M. romanica Prodon (2n=16) is a Russian Southern Steppe type. Other species as M. tenderiensis Opperm. and M. glandulosa David. (2n=32) are variants of M. falcata.
Wild diploid forms do not readily cross with cultivated tetraploid types, hence these types may not have introgressed (Lesin & Lesin, 1964).

M. glomerata* resembles hybrids of M. falcata x M. prostrata Jacq. (2n=16, 32) and M. falcata x M. sativa*.

MEDICAGO GLOMERATA Balbis. 2n=16. Probably the Maritime Alps. It resembles hybrids of M. falcata* x M. prostrata Jacq. (2n=16, 32) and M. falcata x M. sativa*. It easily crosses with the last-mentioned species being a source of disease resistance.
Most individuals are not winterhardy.

MEDICAGO LUPULINA L. Hop clover, Black medic. 2n=16, genome formula SS, 32, (64). Europe, N. Africa and temp. Asia. Cultivated since 1659 in England and since 1785 in France. Cultivated now in the Old and New World as a green fodder, hay crop and green manure.
Var. lupulina has been described as M. willdenowii Boenningh and M. stipularis Wallr. and var. cupaniana Urb. as M. cupaniana Guss. and M. leiocarpa Guss. (Mansfeld, 1959).

MEDICAGO SATIVA L. Lucerne. Blue alfalfa. 2n=(16, genome formula SS), 32, (48, genome formula SSSSSS, 64). Transcaucasia (p. 86). 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. 2n=28. Temp. Europe, SW. Asia to Altai and Transbajkal. 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. Temperate 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 centre 9. It was probably first cultivated in the Netherlands, in the beginning of the 16th Century. 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 rosette. 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.

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. 102) and in the Netherlands. Very variable.
Brewbaker and Keim (1953) suggest that T. nigrescens Viv., Ball clover (2n=16) is one of the parents. Chen and Gibson (1971) 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 region to Sicilia. It includes T. savianum Guss. of Sicilia and Calabria, Italy. It is probably an autotetraploid.

TRIFOLIUM RESUPINATUM L. (syn. T. suaveolens Willd.). Persian clover. 2n=(14), 16. The Mediterranean region 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. 87). Secondary centre in Hungary.

Liliaceae

ASPARAGUS OFFICINALIS L. Garden asparagus. 2n=20. Primary centre probably in the salt-steppes of E. Europe (Chittenden, 1951). 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. 87. Helbaek (1956) 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 fibre 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.

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. Common purslane, Pursley. 2n=(45), 54. Europe. Cultivated as a vegetable (spp. sativa (Haw.) Celak.), but is often found as a weed (spp. oleracea). Now spread over a large part of the world.

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, Caucasus and China (p. 36). 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.

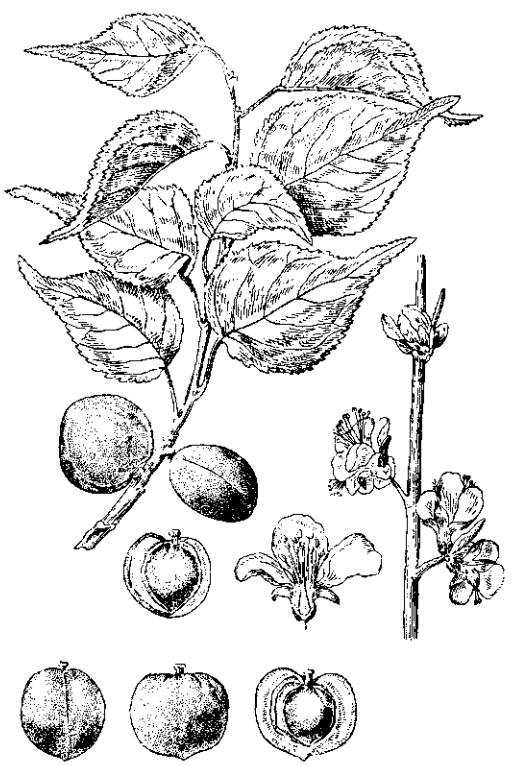
AMYGDALUS PERSICA L. Peach. 2n=16. Primary centre in China (p. 36). Secondary centre in Moldavia, USSR.

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.

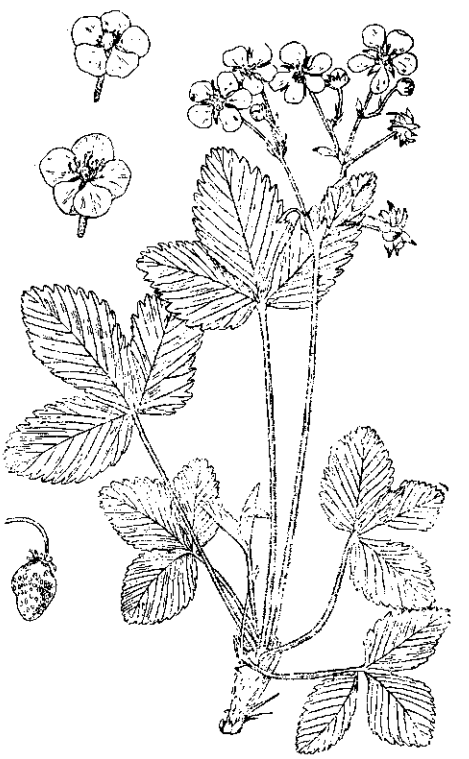
ARMENIACA SIBIRICA Pers. (syn. Prunus sibirica L., P. armeniaca var. sibirica K. Koch.). Siberian apricot. 2n=16. Intern Mongolia to the Sowjet Far East and Lake Baikal. This species has the largest distribution of all apricot species (Zylka, 1970). It is very cold resistant.

FRAGARIA X ANANASSA Duch. (syn. F. grandiflora Ehrh.). Pineapple strawberry. 2n=56. Arose spontaneously in W. Europe (possibly in Bretagne, France) after hybridization of F. virginiana* from N. America and F. chiloensis* from N. and S. America and Hawaii. 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.



Armerica sibirica



Fragaria moschata

FRAGARIA VESCA L. Wild strawberry, Alpine strawberry. 2n=14, genome formula AA. Europe and Asia. According to Darrow (1955) the var. semperflorens Duch. is the parent form of the cultivated strawberry. Its domestication occurred in the north of the Italian Alps.

FRAGARIA VIRIDIS Duch. Polunitsa. 2n=14. European part of centre 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 baccata

MALUS PRUNIFOLIA (Willd.) Borkh. (syn. Pyrus prunifolia (Willd.). Chinese crab apple. 2n=34, (51, 68). Wild and cultivated in the extreme eastern sector of Centre 9. Primary centre China.

MALUS PUMILA Mill. (syn. Pyrus malus L.) Apple. 2n=34, 51, 68. The Balkans and SW. USSR (p. 75), eastwards through Transcaucasia, Iran, Turkestan, and northward 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 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. 90). The population Vladimirskaya vishnia with large dark-claret fruits that are very palatable and aromatic, originated in Centre 9, extending westward and southward to the Rhine and Balkans.

PRUNUS DOMESTICA L. Garden plum, Domestic plum. 2n=48, genome formula CCSSSS or CdCd SSS_1S_1 or $CdCdD_1D_1D_2D_2$. For origin see p. 90. 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 the Bashkir Republic. 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.

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. caucasia*. 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. 2n=56. Europe and N. Asia used in breeding with R. idaeus*. Easily domesticated (Larson, 1969).

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. xanthocarpus Bur. & French 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.

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.

RUBUS SAXATILIS L. Stoneberry. 2n=28. 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 (Larson, 1969).

SANGUISORBA MINOR Scop. 2n=28, (54, 56). Europe and temp. Asia. Sometimes cultivated to flavour soup or for salads (Mansfeld, 1959).

SANGUISORBA OFFICINALIS L. Great burnet, Garden burnet. 2n=28, (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. Large-fruited forms are found in forests in Crimea (p. 89).

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. 75) 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. cinerа x S. viminalis. S. helix L. is a hybrid of S. purpurea* x S. viminalis.

Sambucaceae

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. 105) 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. 171). 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 introductions, 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.

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. 76). 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, 1962).

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 COLLINA Wallr. 2n=28. Europe. Formerly cultivated in Germany.

VALERIANA EXALTATA Mikan.f. ex Pohl. 2n=14, (28). Europe. Cultivated in Germany. This species might be included in V. officinalis*.

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=14, 28, (56). Europe and temperate Asia. In Germany and Poland the three ploidy levels are found. In Poland these ploidy types do not hybridize, but in Germany hybrids are often found. In the Netherlands, Belgium, France and Great Britain diploids are not observed, while in USSR octaploids are not seen. These ploidy types and hybrids have led to many synonyms (Schrantz, 1961).

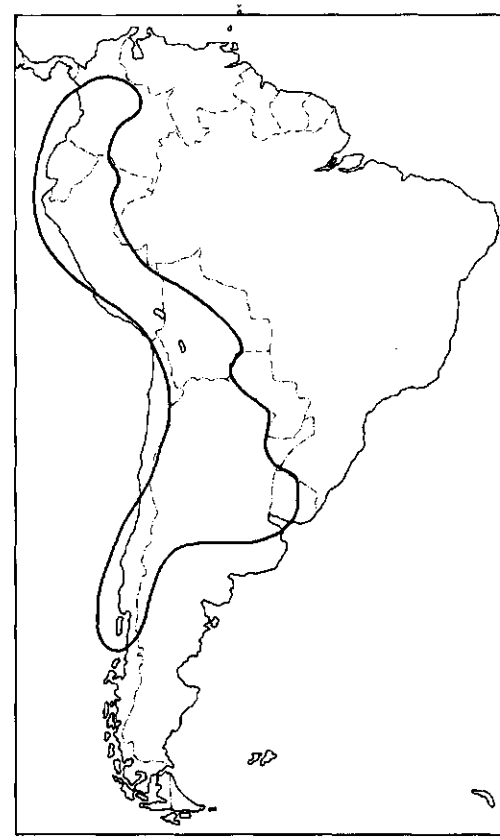
VALERIANA PROCUMBENS Wallr. 2n=56. Spain, Great Britain, France and Germany. Cultivated in Germany. This species might be included in V. officinalis*.

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.

10 South American Centre



The South American Centre was first restricted to the Andes and described by Vavilov (1949/50) as the Andean Centre of Origin. Vavilov divided it in two areas, 1. Peru, Ecuador and Bolivia, and 2. a small one on the island of Chiloe, Chile. Darlington & Janaki Ammal (1945) added the zone between the coast of E. Venezuela and Guyana-Surinam-Cayenne and that of S. Brazil-Paraguay calling it the Brazil-Paraguay Centre of Origin. Zhukovsky (1968) created the megacentre of S. America, while Harlan (1971) described a large part of S. America as a noncentre C2 South American noncentre.

Agriculture was introduced from C. America before 6 000 BC because remains of domesticated Phaseolus vulgaris found in the Guitarrero Cave in Peru have been dated about 6 000 BC. (Kaplan et al., 1973).

A number of tuberous crops (Oxalis tuberosa, Solanum, Ullucus tuberosus) was domesticated in this centre. For tuberous Solanum triploid upto hexaploid species were developed. Other examples are fruit trees, Amaranthus sp., Ananas comosus, Arachis hypogaea, Capsicum sp., Cinchona ledgeriana, Cucurbita maxima, Gossypium sp., Hevea sp., Lupinus sp., Lycopersicon sp., Manihot esculenta, Nicotiana sp., Phaseolus sp., Solanum sp., Theobroma cacao etc. Only one cereal Bromus mango was developed in this region.

A secondary centre of diversity arose for Zea mays.

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 GIGANTEA Venth. Piteira, Piteira gigante. 2n=(18), 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. 145).

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 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 peper tree, Brazil pepper tree. 2n=28, 30. Mexico to Chile and up to 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.

Annonaceae

ANNONA CHERIMOIA 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. Antemoya 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.

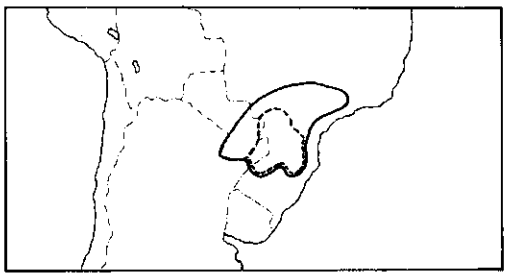
Apocynaceae

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 W. 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 BELOPHYLLUM (Willd.) Kunth. 2n= . Cultivated for its roots in Venezuela.

XANTHOSOMA BRASILIENSE (Desf.). Engl. Yautia, Belembe, Calalou. 2n= . Cultivated from S. Brazil to the West Indies and Panama. The leaves are cooked and eaten.

XANTHOSOMA CARACU C. Koch & Bouché. Caracu. 2n= . Cultivated throughout the American tropics for its corms and young leaves.

XANTHOSOMA JACQUINII Schott. Yautia Palma. 2n= . Cultivated in trop. America.

XANTHOSOMA MAFAFFA Schott. Mafaffa, Rascadera, Tartago, Yautia. 2n= . Probably from S. Brazil. Cultivated now in several areas of Brazil.

XANTHOSOMA SAGITTIFOLIUM (L.) Schott. Yellow yautia. 2n=24, 26. S. America. There it was cultivated for its roots and leaves. Now much cultivated throughout the tropics. Some cultivars have been developed for their starchy corms, others for their leaves.

XANTHOSOMA VIOLACEUM Schott. Primrose Malanga, India Kale. 2n=24, 26. S. America. Roots and leaves are eaten.

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 Caldas. Ulluca. 2n=24, 36. Unknown wild. A very ancient crop cultivated in C. Andes. The starchy tubers are curved in shape. It is very frost-resistant.

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. of S. 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=), A. erectifolius 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 Parguazo 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. Argentine and Brazil. There its primary centre is found. Cultivated on a large scale on Polynesian and Melanesian islands.

Cactaceae

PERESKIA ACULEATA Mill. Barbados cherry, Sweet Mary, West Indian goose-berry, Lemon vine. 2n=22. Trop. America. Cultivated for its fruits.

TRICHOCEREUS PACHANOI Britton & Rose. 2n= . Andean parts of Ecuador and Peru. Apparently widely cultivated throughout the C. Andes (Schultes and Hofmann, 1973).

Cannaceae

CANNA EDULIS Ker. Achira, Queensland arrowroot. 2n=18, (27). Probably NW. of S. America. Spread to Mexico, C. America, West Indies and the northern of S. America. At present achira is cultivated in W. 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. 2 400 BC. It could not be established whether they had been collected or cultivated.

Mukherjee and Khoshoo (1971) suggested that the triploid (2n=3x=27) is probably an intervarietal hybrid involving rather genetically related varieties.

It is highly 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= . Equador. 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= . Equador. 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 Equador.

Caryocaraceae

CARYOCAR NUCIFERUM L. 2n= . Brazil and Guiana. A tall tree cultivated in the W. Indies for its edible Suari nuts.

Chenopodiaceae

CHENOPODIUM PALLIDICAULE Aellen. Cañihua. 2n=36. Andes. Cultivated on the Altiplano of Peru and Bolivia as a marginal grain crop (Dale, 1970).

CHENOPODIUM QUINOA Willd. Quinoa. 2n=36. Cultivated in the Andes as a grain crop. Cultivation is on the decline. Closely related to Ch. nuttalliae*.

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, W. Indies and also India. Cultivated as a vegetable or salad.

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.

Convolvulaceae

IPOMOEA TILIACEA (Willd.) Choisy (syn. I. fastigiata (Roxb.) Sweet). 2n=30, 60. S. America and the West Indies. It has been claimed that it was already cultivated in West Indies in pre-Inca times (Uphof, 1968). It has been named as one of the parents of I. batatas*.

MERREMIA MACROCARPA (L.) Roberty. 2n= . Brazil and W. Indies. Cultivated for its medicinal tubers.

MERREMIA TUBEROSA (L.) Rendle (syn. Ipomoea tuberosa L., Convolvulus sinuata Ort.). 2n=30. Brazil, W. 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.

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. 64). Whitaker (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.

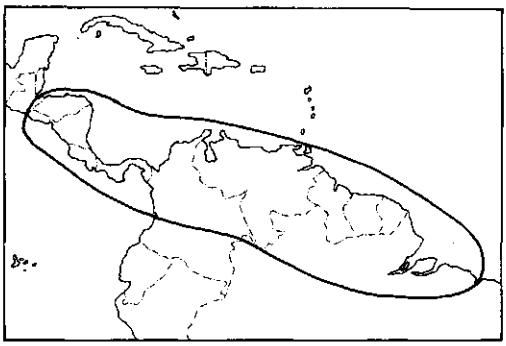
The wild C. ecuadorensis Cutler & Whitaker (2n=40) is closely related to this species and C. andreana (Cutler & Whitaker, 1969).

SICANA ODORIFERA (Vell.) Naud. Casa banana, Curaba. 2n= . Peru, Brazil to Mexico and W. Indies. This vine is cultivated in trop. America.

Dioscoreaceae

DIOSCOREA PIPERIFOLIA Humb. & Bonpl. 2n= . Brazil. Cultivated there.

DIOSCOREA TRIFIDA L. Cush-cush yam, Yampi. 2n=54, 72, 81. S. America. Cultivated throughout the Caribbean area.



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.

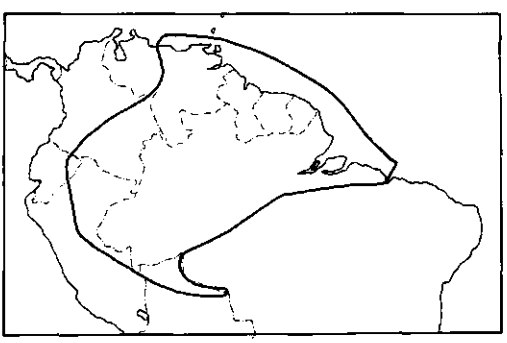
Some taxonomists include E. novogratense*, E. truxillense Rusby and E. bolivianum Burck in this species.

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. 46). Cultivated now in Malaya, Indonesia, Ceylon and in some other countries. In Africa rubber has been cultivated as a farmer's crop and as a plantation crop. A farmer's plot often consists of a few trees. Bouharmont (1960) suggested that H. brasiliensis originated by amphiploidization of two yet unknown diploid species.



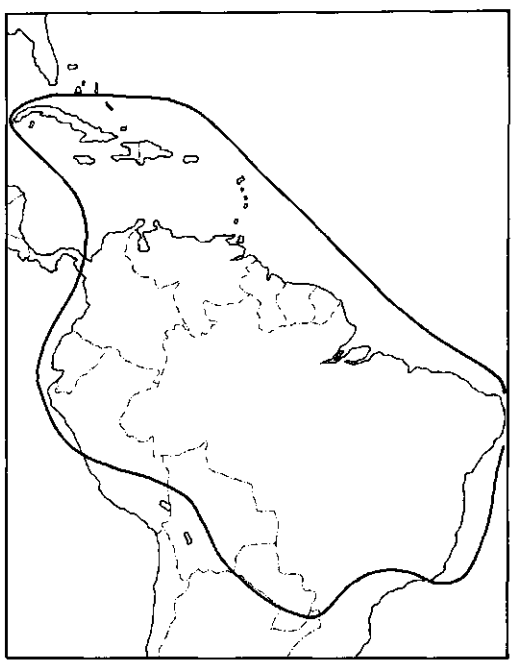
Hevea brasiliensis (Dijkman, 1951)

JATROPHA CURCAS L. French purging nut, Physic nut. 2n=22. Mexico and Bermudas up to Chile and Paraguay. Cultivated in these and other tropical countries for its curcas oil. In Brazil it is planted as a living fence.

JATROPHA MULTIFIDA L. Chicaquil, Tortora, Yuca cimarrona. 2n=22. Trop. America up to Mexico and West Indies. A shrub cultivated there as a medicinal crop and elsewhere as an ornamental.

JATROPHA URENS L. Pendo tree. 2n= . Trop. America. This tree is cultivated in the Philippines for its leaves which are used as a vegetable (Terra, 1967).

MANIHOT ESCULENTA Crantz. Cassava, Manioc, Manihot, Yuca. 2n=36. Cassava is an imported food crop troughout the tropics. Secondary gene centres almost certainly exist in Africa (p. 111) and Indonesia (p. 46). Cassava can be divided into sweet cassava and bitter cassava (M. esculenta Crantz, 2n=36, M. utilissima Pohl., 2n=36). The sweet cassava was probably first domesticated in Meso-America (p. 165), from where it spread to S. America. Bitter cassava was domesticated in northern S. America (Renvoize, 1972). In Brazil the diversity increased through intra-species crosses and by hybridization with wild Manihot species. The weedy M. saxicola Lanj.



Manihot esculenta (Harris, 1972)

(2n=), M. melanobasis Muell. -Arg. and other weedy species may derive from the cultigen (Roger, 1963). The first species is found in NE. of S. America. M. glaziovii* is a source of resistance to cassava mosaic disease and drought.

MANIHOT GLAZIOVII Muell. -Arg. Ceara rubber. 2n=36. Brazil. Attempts were made to establish plantings for rubber production in Asia and Africa, but the cultivation was abandoned in favour of para rubber (Purseglove, 1968).

OMPHALEA MEGACARPA Hemsl. 2n= . S. America, especially Brazil and also West Indies. A shrub cultivated for its seeds.

PLUKENETIA VOLUBILIS L. (syn. P. peruviana Muell. - Arg.). 2n= . N. of S. America and W. Indies. A vegetable and a fodder crop.

SAPIUM JENMANI Hemsl. 2n= . Guiana. Cultivated there.

Gramineae

BRASILOCALAMUS PUBESCENS (Doell) Nakai. 2n= . Brazil. Related to the Asiatic Bambusa.

BROMUS MANGO Desv. 2n= . Chile. Before this country was discovered and European cereals were introduced this species was cultivated. Its cultivation has disappeared now.

BROMUS UNIOLOIDES H. B. K. (syn. B. catharticus Vahl., B. schraderi Kunth). Rescue grass, Schrader's brome. 2n=28, 42, 56. S. of USA, S. America, Australia and Europe. It probably developed in S. America particularly Argentina. In the Andean region it (syn. B. haenkeanus (Presl) Kunth) (2n=42) grows wild.

BROMUS WILLDENOWII Kunth (syn. B. unioloides (Willd.) Respail, Festuca unioloides Willd.). Common rescue grass. 2n=28, 42. A plant from S. America cultivated as a fodder grass.

CHUSQUEA ANDINA Phil. 2n= . Chile, where it reaches the snow bounderies. NB. The genus Chusquea Kunth includes over 70 species native to S. America, Mexico and E. India. It is typical for the Andes, where the species form dense thickets. Many of them are very ornamental and many be very valuable for introduction to the humid subtropical areas of USSR and elsewhere because they are very hardy.

CHUSQUEA CULEON E. Desv. ex C. Gray. 2n= . Chile.

CHUSQUEA DEPAUPERATA Pilg. 2n= . Peru, up to 3 400 m.

CHUSQUEA ULIGINOSA Phil. 2n= . Chile.

CORTADERIA ARGENTEA Stapf (syn. Gynerium argenteum Nees). Pampas grass. 2n=70. S. America. A grass cultivated as a source of pulp.

ERIOCHLOA POLYSTACHYA H. B. K. Carib grass. 2n= . West Indies, Brazil to Ecuador. A grass cultivated as a forage grass in SE. of USA.

GUADUA ANGUSTIFOLIA H. B. K. 2n= . Columbia and Ecuador up to 1 500 m and in humid areas it forms thickets. Cultivated in Puerto Rico, Guatemala, Ecuador, Haiti, Honduras, Peru, USA and elsewhere. The stems may grow 18 - 30 m long. It is the most valuable species in the Western Hemisphere. The wood is strong and easy to work with. Its stems are used for buildings. N. B. the genus Guadua contains 35 species. They are native to Mexico and S. America. Several species are cultivated in and beyond the natural area. This genus is near to the Asiatic genus Bambusa.

GYNERIUM SAGITTATUM (Aubl.). P. Beauv. Indian arrowleaf. 2n= . Cultivated in Venezuela for its shafts which are used for making long arrows.

ORYZA ALTA Swallen. 2n=48, genome formula CCDD. C. and S. America.

ORYZA GRANDIGLUMIS Desv. 2n=48, genome formula CCDD. C. and S. America. Closely related to O. alta*. Gopalakrishman & Sampath (1966) suggested that O. grandiglumis derives from O. alta.

ORYZA LATIFOLIA Desv. 2n=48, genome formula CCDD. C. and S. America.

PASPALUM DILATATUM Poir. Dallis grass. 2n=(30), 40, 50, (60). Probably Chaco savanna. The common type has 2n=50 and the genome formula AABBC. It probably originated from a cross of an unreduced gamete (AABB) and C genome donor species. The dilatatum type pauciciliatum has 2n=40, genome formula AA_1BC_1. Type uruguaiana (2n=60) genome formula AAA_1A_2BB and type torres (2n=60) (univalents). These types are all apomictic. The only sexual type is 'yellow anther' (2n=40), genome formula AABB. Introduced now into other countries. In Japan sexual and apomictic types occur. They are triploids, 2n=3x=30. P. juergensii Hack. (2n=20) or a closely related type might be the donor parent of the A or B genome (Burson & Bennett, 1972).

PASPALUM NOTATUM Fluegge. Pensacola Bahia grass. 2n=20, (30), 40. It is not clear whether Pensacola Bahia grass originated in Florida or that it came from interior of S. America (Burton, 1967), where a wide variation of types on the Berduc Island of Rio Parana, Uruguay was found. Widespread in S. USA. There it was first found in Pensacola, Florida.

PASPALUM PLICATULUM Michaux. 2n=20, 40, (60). S. America. Cultivated in Australia.

SORGHUM ALMUM Parodi. Black sorgo, Columbus grass. 2n=40. Argentine where this forage crop probably originated from a cross of S. hale-

pense* and a variety of S. bicolor*. It has a lower sugar content than S. halepense.

TRIPSACUM AUSTRALE Cutler & Anderson. 2n= . S. America, extending from Venezuela to Paraguay. Also found in NC. Peru.

Tripsacum australe (Hernandez, 1973)

TRIPSACUM DACTYLOIDES (L.) L. 2n=36, 72. Described on p. 165. It has a rather thick rachis and may have been the source of this characteristic of some primitive S. American maize cultivars (Zea mays, p. 150) like Cabuya and Sabanero (Galinat, 1969).

ZEA MAYS L. Maize. Corn. 2n=20. Maize derives from teosinte, Z. mexicana*, which grows wild in C. America (p. 167). From here it spread south and north. After its introduction into S. America, its development there became agriculturally more advanced than in its area of domestication. This might be a result of the absence of its wild and weedy relatives. A secondary centre in S. America. These S. American primitive maize varieties were taken to C. America. In Mexico they were described as Pre-Columbian Exotic races (p. 166). In the 19th Century a secondary centre of diversity arose here when cultivars from the Amazonian and Paraguayan lowlands mixed with 'coastal tropical' flint from the West Indies and with flint cultivars from the southern slopes of Bolivia (Brandolini, 1970).

Primitive Races - all belonging to the popcorn type - have been found in Columbia, Equador, Bolivia, Peru and Chile. In Colombia the Primitive Races are called Pollo and Pira. Pollo might be related to the Peruvian Confite Morocho. Collections of Pollo made at Medellin, at an altitude considerably lower than their normal habitat, segregate plants which in their general aspects are almost identical to maizoid teosinte in Mexico. Such plants at the silking stage can easily be mistaken for teosinte (Roberts et al., 1957). It is thought that the cause might be a virus inducing profuse branching. Pira might have also occurred in Venezuela and Bolivia. It is related to the Peruvian Confite Morocho and Confite Puntiagudo.

At a later stage less primitive and developed races originated in S. America. In the coastal eastern S. America the race 'Coastal Tropical Flint' was cultivated. This race was also found in the West Indies, it was probably introduced from the continent. However, it is possible that in both areas a similar race developed from identical parents (Hatheway, 1957).

Owing to the high variation of maize in S. America this region is considered as a secondary centre of diversity. For instance, Grobman et al. (1956) concluded that Peru appears the home of pericarps colour genes. In the dept. Ancash all three alleles of the A locus and all 7 of the P locus are found. From S. America maize was returned to C. America and Mexico and was taken to N. America and the Old World.

Guttiferae

MAMMEA AMERICANA L. Mammey apple. Mamey. 2n= . Trop. America and West Indies. Cultivated there for its edible fruits and for its scented flowers which are used to prepare the liquor Eau de Créole.

RHEEDIA ACUMINATA (Ruiz & Pav.) Planch. & Triana. 2n= . Colombia up to Peru. Cultivated as a compound tree in NW. of S. America.

Juglandaceae

JUGLANS HONOREI Dode. Ecuador walnut. 2n= . Rootstock of J. regia*.

Lauraceae

NECTANDRA CINNAMOMOIDES Nees. 2n= . Equatorial Andes. A tree cultivated in Ecuador as a spice plant.

PERSEA LEIOGYNA Blake. 2n= . Probably trop. America. A fruit tree.

Lecythidaceae

BERTHOLLETIA EXSELSA Humb. & Bonpl. Brazil nut, Para nut, 2n=34. The Amazon forests. The kernels and oil are eaten. The oil/kernel ratio is quite high: 60-70%.

LECYTHIS ZABUCAJO Aubl. Sapucaia nut, Paradise nut, Monkey pot. 2n= . The forests of Guianas and Brazil. Not much cultivated.

Leguminosae

ACACIA CAVENIA Bert. Cavenia acacia, Espino cavan. 2n=26, 52. S. America. A small tree cultivated as a source of perfume. Related to A. farnesiana*.

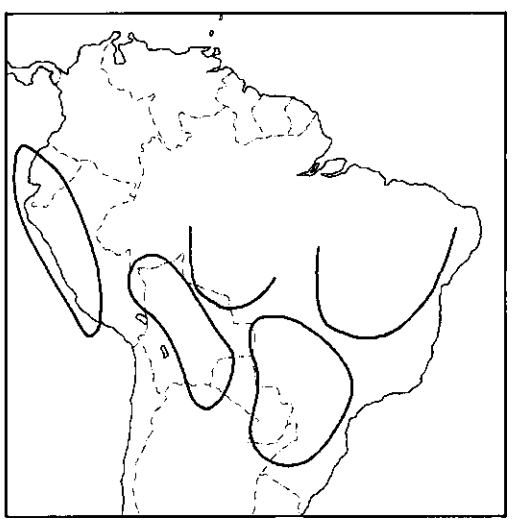
ACACIA FARNESIANA (L.) Willd. Sweet acacia. 2n=52, (104). Probably trop. America (Purseglove, 1968). This shrub is cultivated esp. as an ornamental and for its perfumery, where it has run wild in the tropics. In S. France the very fragrant Cassie Flowers are the source of Cassie Ancienne.

AESCHYNOMENE AMERICANA L. (syn. A. glandulosa Poir.). 2n= . Trop. America. Used in Indonesia and elsewhere as a green manure, soil cover and as a forage crop.

ALBIZIA CARBONARIA. 2n= . Colombia and C. America. Cultivated in Puerto Rico (Whyte et al., 1953).

ARACHIS GLABRATA Benth. Arb peanut. 2n=40. Brazil, Argentina and Bolivia. Perennial used for pastures and hay (Prine, 1964).

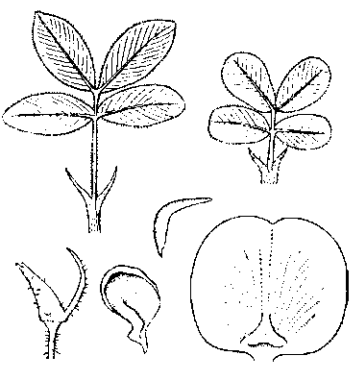
ARACHIS HYPOGAEA L. Groundnut, Peanut. 2n=40, genome formula $A^hA^hB^hB^h$. S. America. Primary gene centre in Argentine and Bolivia. Secondary centres in Nigeria, Senegal and Congo (p. 118). Probably domesticated in the Gran Chaco area. As it is a tetraploid and no wild groundnut



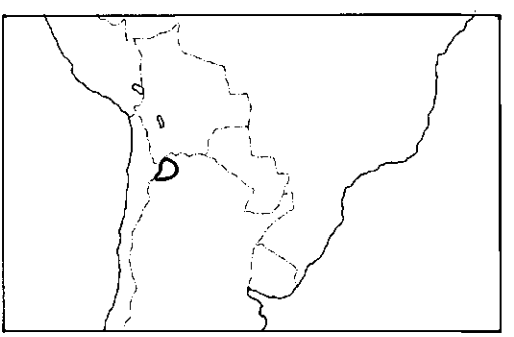
Gene centres of Arachis hypogaea (Krapovickasy, 1972)

has been found, an amphiploidization of one or two wild diploid species is suggested, or the groundnut may be a cultigen of a wild tetraploid species that has arisen in this way. This could be A. monticola Krapov. & Rig. This species (2n=40) grows wild in the mountains of the Jujuy Province, NW. Argentina. It crosses easily with the groundnut. It can be used to improve disease resistance etc. of the groundnut. A. villosa Benth. (2n=20) has the genome formula A^vA^v (Raman, 1973).

Krapovickas (1969) pointed to five S. American centres of diversity: 1. the Guarami region, the basins of the Paraguay and Parana rivers, which is the centre of variation for the ssp. fastigiata Waldron var. vulgaris Harz., the Spanish type, 2. The region of Goias and Minas Geraes where ssp. fastigiata var. fastigiata, 3. The region of Rondonia and NW. Mato Grosso. This region is not yet fully studied. It includes ssp. hypogaea var. hypogaea (syn. A. africana Lour., A. nambyquarae Hoehne), the Brazilian or Virginia type, and the distantly related cultivated A. villosulicarpa*, 4. The region of the eastern foothills of the Andes in Bolivia, which contains a great variability of var. hypogaea. Some introgression may occur with var. fastigiata resulting in the forms Overo, Pintado and Cruceño, and 5. Peru, which is the centre of variability of ssp. hypogaea var. hirsuta Kohler (syn. A. asiatica Lour.).



Arachis monticola



Arachis monticola (Zhukovsky, 1971)

ARACHIS VILLOSULICARPA Hoehne. 2n=20. Cultivated by the Indians of Juruena and Diamantino of the Mato Grosso in Brazil. Perennial and not closely related to A. hypogaea* (Krapovickas, 1969).

CANAVALIA ENSIFORMIS (L.) DC. Jack bean, Horse bean, 2n=22. S. America. Secondary cen-

tre in India. Sauer and Kaplan (1969) mentioned C. boliviana Piper (2n=), C. brasiliensis Mart. ex Benth. (2n=), C. dictyota Piper (2n=), C. maritima (Aubl.) Thou. (2n=) and C. piperi Killip & MacBride (2n=22), as possible ancestors. An ancient legume, now cultivated in the tropics as a green manure or fodder crop.

CANAVALIA PLAGIOSPERMA Piper. 2n=22. Probably trop S. America. Possible ancestor of the Andean C. piperi Killip & MacBride (2n=22) (Sauer, 1964). One of the earliest cultivated crops in S. America, but not cultivated at present. It resembles C. ensiformis*.

CENTROSEMA PLUMIERI (Turp.) Benth. 2n=20. Trop. America. This cover crop and green manure has been distributed throughout the tropics.

CENTROSEMA PUBESCENS Benth. 2n=20. Trop. America. This cover crop and green manure is distributed throughout the tropics.

CROTALARIA ANAGYROIDES H. B. K. 2n=16. Trop. America and West Indies. Cultivated as a cover crop, green manure and fodder.

DESMODIUM CINEREUM DC. Trebold. 2n= . S. America. Cultivated for green manure and as a vegetable (Terra, 1967).

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 Guianas and the 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. of S. 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 GLAUCA (L.) Benth. Jumpy bean. 2n=(36), 104. Trop. America. Used as a shade tree and as green manure. Selections have been made with a low mimosine content.

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-CUNNINGAHAMII-CRUCKSHANKSII species group. 2n=48. Andes region between Bolivia and Venezuela. This group of species, also named L. mutabilis Sweet 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 San 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 northwestern Argentine Andes. Probably extended through Bolivia, Peru, Ecuador up to Hondu-

ras (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 Argentine. 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. 168). A small-seeded subspecies (ssp. microsperma, Sieva or Small Lima) originated by natural selection. It spread to the Antilles Islands.

PHASEOLUS VULGARIS L. Common bean. 2n=22. For origin see p. 168. The earliest remains of cultivated common beans have been found in the Guitarrero Cava in Peru. It dates from about 6 000 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 JULIFLORA DC. Mesquite. 2n=28, 52, 56. Trop. America. A small tree cultivated for various purposes (Mansfeld, 1959).

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. Guiana. Used as a food plant for livestock and as a soil conservator.

VICIA GRAMINEA Smith. 2n=14. Argentine and Chile. Occasionally cultivated for its seeds as a source of anti-N-lecitin (Nijenhuis et al., 1961). 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. S. America. Cultivated there and elsewhere for its fruits. It also makes a good hedge, like M. coccigera L. (Purseglove, 1968).

Malvaceae

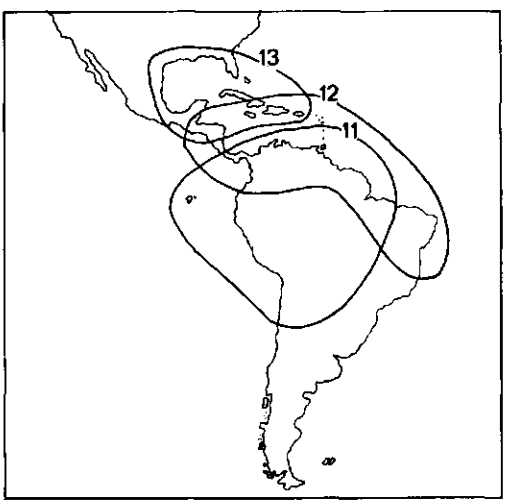
ABUTILON OXYCARPUM F. Von Muell. 2n=14. S. America and Australia. Cultivated for its fibres.

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 at Huaca Prieta, Peru which was dated 2 400 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. Argentine. 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 lenth 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. 73, 120) (Harlan, 1970). The Atlantic assemblages include the kidney cottons (seeds

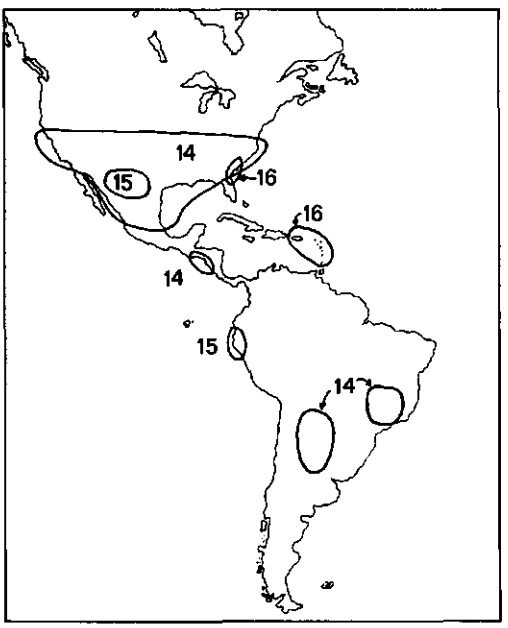


Distribution of the New World cottons in the 13th century: Gossypium barbadense (11), G. hirsutum var. marie-galante (12) and G. hirsutum punctatum (13) (Hutchinson, 1962)

fused in a kidney-shaped cross). They have a wide distribution in northern S. America and the islands of C. America. They have been taken to Africa, India, Ceylon, Indonesia and elsewhere.

Secondary centres in Egypt (p. 120) and in Turkmenia - Tadzhikistan - S. Uzbekistan, USSR (p. 73).

On the Sea Islands of S. Caroline, USA the Sea Island cottons developed after cottons from Bahamas or Jamaica (p. 177) 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)

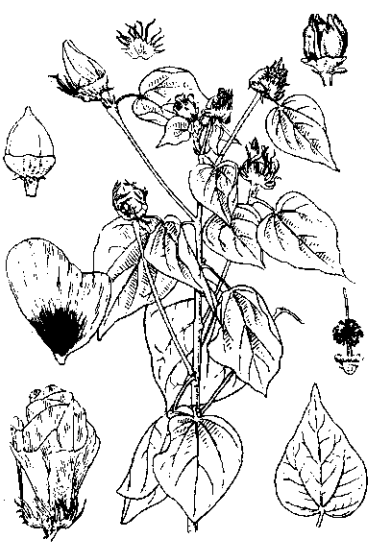
GOSSYPIUM CAICOENSE. 2n=52, genome formula AADD. This tetraploid species was discovered in NE. Brazil in 1967.

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 A genome. It is not known when this amphiploidization took place, but material collected from Tehuacan Valley in Mexico and dated 3 500-2 300 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. 169). 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.

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. 169). 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 Anderson. 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 Gidego islands (p. 124).

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. 2n=52, genome formula $(AADD)_1$. Hawaii. A fuzzy-seeded but

not linted 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 Ceulon 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.) Lindl. Sweet corn root. 2n= . The W. Indies. A tuber crop cultivated there and in S. America.

MARANTA ARUNDINACEA L. Arrowroot, Bermuda arrowroot. 2n=18, 48. N. S. America and the Lesser Antilles. Cultivated in the tropics for its rhizomes containing starch.

Musaceae

MUSA cultivars of the AAB group - Plantain subgroup. French Plantain, Horn Plantain. 2n=33. India (p. 69). Secondary centre: trop. America.

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. 58). Secondary centres: Brazil, Argentine and the Mediterranean region (p. 104).

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. Argentine. 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

COROZO OLEIFERA (H.B.K.) Bailey. (syn. Elaeis melanococca Gaertn.). 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 Gayana. A palm cultivated on compounds for its oily fruits.

Passifloraceae

PASSIFLORA ALATA Dryand. Maracuja. 2n= . Peru and Brazil. A woody vine cultivated in Brazil for its fruits.

PASSIFLORA ANTIQUIENSIS Karst. (syn. P. vanvolxemii (Lem.) Triana & Planch.). 2n= . Banana passion fruit. Colombia. A woody vine cultivated e.g. in New Zealand for its fruits.

PASSIFLORA CEARENSIS Barb. 2n= . Brazil. There it is also cultivated for its fruits.

PASSIFLORA EDULIS Sims. Passion fruit. 2n=18. S. Brazil. Widely distributed throughout the tropics and subtropics. The fruits are especially used for juice preparation.

PASSIFLORA FOETIDA L. 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, Jamaica honeysuckle, Belle apple, Pomme de liane. 2n=18. Thickets and forest fringes in the West Indies and NE. S. America. Cultivated for its fruits in the 17th Century. Spread throughout the tropics (Purseglove, 1968).

PASSIFLORA LIGULARIS Juss. Sweet granadilla. 2n=18. Trop. America. Its sweet fruits are much used in the mountainous regions of Mexico and C. America (Purseglove, 1968).

PASSIFLORA MALIFORMIS L. Curuba. 2n= Trop. America. A vine cultivated for its fruits.

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 PSILANTHA (Sodiro) Killip. Gullan. 2n= . Ecuador. 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.

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. Temperate 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, Ambato strawberry. 2n=56, genome formula AAA' A'BBBB. The Pacific coastal region of N. and S. America and Hawaii. 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 Ceylon 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

MELICOCCUS 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. of S. 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

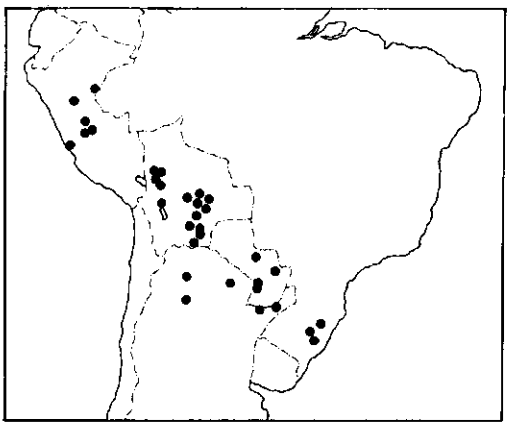
QUASSIA AMARA L. Surinam quassis, Bitter wood. 2n= . N. of S. America. Cultivated for its wood which is used medicinally, and also as an ornamental tree.

Solanaceae

CAPSICUM BACCATUM H.B.K. (syn. C. angulosum Miller). Pepper. 2n=24. The wild type is var. 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. Columbia, 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 PUBESCENS Ruiz & Pav. 2n=24. Unknown wild. Cultivated in the highlands of S. America.



Capsicum baccatum var. baccatum (Eshbaugh, 1970)

Capsicum baccatum var. pendulum (Eshbaugh, 1970)

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 CHILENSE Dun. 2n= . The coastal strip of Peru and northern Chile. A wild tomato often found growing together with L. peruvianum. However they do not cross. This species is characterized as a source for resistance to all tomato diseases except Phytophthora.

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 Galápagos Islands. The greatest variability 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 and probably of other areas in the New 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. The Galápagos tomato, ssp. minor Rick (syn. L. minutum Rick, L. cheesmanii Riley var. minor (Hook.) Mill., 2n=24) grows wild on the coasts of the Galápagos Islands. They are characterized by a very dense pubescence, compound, yellow-green leaves, yellow or orange fruit (B-carotene synthesis), a calyx which expands after fertilization and seeds with a deep dormancy. The plants are very resistant to drought. They are eaten by the Galápagos tortoises and seeds become germinative after passing through the digestive tracts of these tortoises (Rick & Bowman, 1961).

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^bGe^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 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: Chile, Peru and Ecuador. This red fruited species is cultivated and occurs as a weed. It crosses easily with L. esculentum*, of which it may be a subspecies. It is a source of tolerance to tomato mosaic virus.

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. Goodspeed (1954) showed that tobacco originated by amphiploidization of two wild diploid species N. sylvestris Speg. & Comes (2n=24, genome formula S'S') and probably N. otophora Grisebach (2n=24, genome formula T'T'). This may have happened in NW. Argentina where the wild parents are found. Clausen (1932), however, suggested that tobacco is a natural amphiploid of N. sylvestris and N. tomentosiformis Goodsp. (2n=24). This is supported by isozymic evidence (Sheen, 1972). The occasionally found wild tobacco plants are escapes of cultivation.

Interspecific crosses have been made to introduce male sterilizing cytoplasms 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=24. Cultivated in N. Bolivia (dept. La Paz) and S. Peru. Similar to S. stenotomum* that might be its parent species after hybridization with S. x juzepczukii* and other species. 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. Rich in tomatine alkaloid which is poisonous to the Colorado beetle.

Introgression between this species and S. microdontum exists in Argentine 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, 1962).

SOLANUM x CHAUCHA Juz. & Buk. (syn. S. tuberosum group chaucha). 2n=36. This species is a hybrid of S. tuberosum* ssp. andigena and S. stenotomum* or S. phureja*, but Bukasov (1970) suggested that it was a triploid derivative of S. phureja*. The hybridization may have occurred several times and because of the variability of the parents this species is very polymorphic. Cultivated from C. Peru to N. Bolivia. It has a rather low yield.

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. C. Argentina, Paraguay, Uruguay and S. Brazil. A source of resistance to potato canker and Colorado beetle.

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* x S. tuberosum group andigena. It reproduces itself vegetatively, although it is moderately fertile. It crosses readily with S. tuberosum. Less frost resistant than its parent S. x juzepczukii (Hawkes, 1962).

SOLANUM GONIOCALYX Juz. & Buk. 2n=24. This potato is cultivated in C. Peru (dept. Junin). It is a northern derivative of S. 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 caretinoids. They have an excellent flavour.

SOLANUM HUMECTOPHILUM Ochoa. 2n= Peru. With white-hyaline tubers of 8-12 mm length.

SOLANUM x JUZEPCZUKII Buk. 2n=36. The high Andes of Bolivia and Peru. Cultivated there for a considerable period of time. Probably a sterile hybrid of S. acaule* x S. stenotomum* or S. phureja*.

S. x juzepczukii may have been formed more than once, with different varieties of its parents in each case. This may have resulted in its wide morphological variation. However, its sterility has prevented its use as a source of frost resistance (Hawkes, 1962).

SOLANUM MURICATUM Ait. Pepino morado. 2n=24. Unknown wild. Probably domesticated in the Andes. Cultivated in C. America 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 Huánreco region, Peru. A tetraploid species of the Tuberosum group. (Ochoa, 1970).

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 Juz. & Buk. (syn. S. tuberosum group Phureja). Criollo potato. 2n=24, genome formula A_1A_1. Cultivated in the most lowlands of Venezuela, Columbia, Ecuador, Peru and N. Bolivia. The tubers are the largest among all diploid species. The rest period is very short (1-13 days). It matures early. It is a selection for short tuber dormancy of S. stenotomum*.

SOLANUM QUITOENSE Lam. Naranjillo, Lulo. 2n=24. Unknown wild. Cultivated for its fruits in Colombia and Ecuador. Var. septentrionale R. E. Schultes & Cuatrecasan is spineless (Heiser, 1971).

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 SPARSIPILUM Bitt. 2n=24. Peru and Bolivia. A weedy species. Probably a clonal mixture of diploid hybrids of S. stenotomum* and S. 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

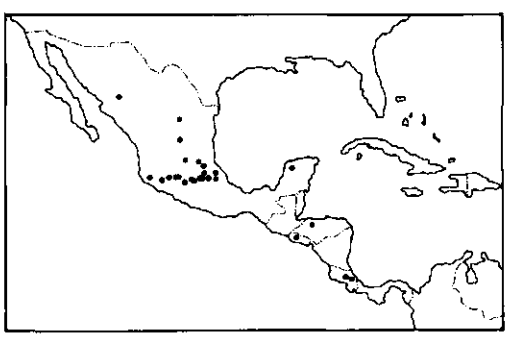
species may form a bridge for a gene flow from S. brevicaule s.l. and S. tuberosum* and vice versa (Ugent, 1970a).

SOLANUM STENOTOMUM Juz. & Buk. (syn. S. tuberosum group Stenotomum). 2n=24. Cultivated at very high altitudes from Peru to N. Bolivia. It may derive from S. brevicaule. It is the parent species of S. tuberosum ssp. andigena*, S. x chaucha*, S. phureja* and S. juzepczukii*. Some forms are frost resistant. The yield and quality is good.

SOLANUM TOPIRO Humbolt & Bonpland ex Dunal. Jibara, Uvilla, Cocona. 2n= . 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.

Artificial intervarietal hybrids have been made. It has been suggested that in nature such hybrids also occur (Heiser, 1971).

SOLANUM TUBEROSUM L. Potato. 2n=48. There are two geographical regions where the largest number of the wild and cultivated potatoes grow:



Solanum tuberosum group Andigena (Ugent, 1968)

1. C. Mexico (p. 171, 172) and 2. Andes of C. Peru, Bolivia and NW. Argentine. The greatest number of tuberous Solanum species is found in Peru where the potato was probably first domesticated.

There are two subspecies of S. tuberosum: 1. ssp. andigena (syn. S. tuberosum group Andigena, S. andigena Juz. & Buk.) and 2. ssp. tuberosum (syn. S. tuberosum group Tuberosum). Ssp. andigena is found in the Andes of Venezuela, Columbia, Ecuador, Peru, Bolivia and NW. Argentine. It was domesticated in the C. Andes. Ssp. tuberosum occurred formerly in the coastal regions of SC. Chile (Island of Chiloé and adjacent mainland). They derive from ssp. andigena introductions (Brücher, 1971). Sykin (1971) suggested an independent origin of ssp. tuberosum in S. Chile. In Europe and N. America ssp. tuberosum was also selected from ssp. andigena (Hawkes, 1958). Simmonds (1968) has 'repeated' this evolution.

The distinction between these subspecies is that ssp. tuberosum has less dissected leaves with wider leaflets, generally arched and set at a wider angle to the stem. The tubers are formed under long days, or under short days in the tropics only at lower altitudes.

The parent species of ssp. andigena is probably S. stenotomum* and S. x chaucha*, a diploid and triploid cultivated species, respectively. It is interesting to note that in the Canary Islands cultivar Negra has been cultivated. It is a triploid (2n=36) (Zubeldia L. et al., 1955). Sañudo (1970) suggested that it is a hybrid of S. stenotomum and ssp. andigena. Zubeldia L. et al. (1955) believed that it was introduced from Peru in the early part of 17th Century together with 4x material.
Run wild potatoes grow in the Kilimandjaro mountains, in Lesotho and Botswana. They probably derive from cultivars introduced from Europe. Brücher (1966) described 30 types.

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 semi-domesticated. 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 Guianas (Cheesman, 1944; Toxopeus, 1969).

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 W. 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.

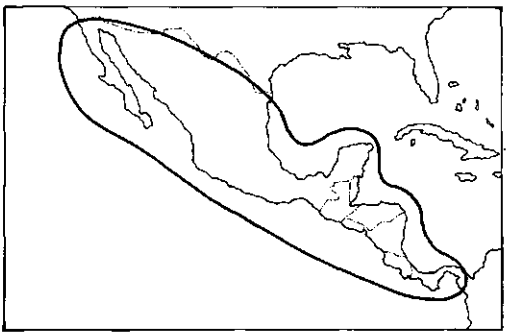
Umbelliferae

ARRACIA XANTHORHIZA Bancr. (syn. A. esculenta DC.). Arracacha, Apio arracacia. 2n= . The Andean region of S. America. Cultivated in Bolivia, Peru, Colombia and Venezuela.

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 Centre



The Central American and Mexican Centre has been described by Vavilov as the Central American and South Mexican Centre of Origin. Darlington and Janaki Ammal (1945) only named Mexico as a centre of origin, while Darlington (1956) added C. America to Mexico. In this centre agriculture developed in the 7th millenium BC. and therefore Harlan (1971) called it a centre C1 Mesoamerican centre.

Old sites of farming have been discovered at Tamaulipas and in the Tehuacán Valley, S. Puebla, Mexico. To the earliest plant remains belong Amaranthus sp., Avocado persica, Capsicum annuum, Cucurbita pepo, C. mixta, Gossypium hirsutum and Lagenaria siceraria.

Only 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. 2n=60, 120, (180, 240 and aneuploids). Probably from Mexico. Cultivated in Mexico, Europe, Africa and N. America as an ornamental, foliage plant, a hedge plant and for pulp.

AGAVE ATROVIRENS Karw. (syn. A. latissima Jacobi). 2n=150, 180. Mexico. Cultivated there.

AGAVE CANTALA (Haw.). Roxb. 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 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. 108). Cultivated in many countries.

AGAVE FUNKIANA Koch. & Bouché. Jaumave, Loguguilla. 2n= Mexico. Cultivated there.

AGAVE LETONAE F.W. Taylor. Letona, Salvador henequen. El Salvador. Cultivated there for centuries.

AGAVE SISALANA Perr. (syn. A. rigida Mill.). Sisal agave. 2n=(c. 138, 147, 149), 150. Mexico and C. America. Primary centre in Yucatan, Mexico. Introduced to Florida and from here to most sisal-growing countries.

AGAVE TEQUILANA Weber. Meczal, Chino Azul. 2n= . Mexico. Cultivated there.

FURCRAEA GIGANTEA*

HESPEROYUCCA FUNIFERA (Koch.) Trel. (syn. Yucca funifera Koch.). 2n= . Mexico. Cultivated for its leaves which are a source of fibre.

POLIANTHES TUBEROSA L. 2n=(50), 60. Tuberose. Very likely from Mexico (Dressler, 1953). Unknown wild. It has probably a long history of domesticated ornamental because of its great variability. Spread to other countries where it is used for perfumery and other purposes. It may derive from P. gracilis Link. (Mansfeld, 1959).

YUCCA ELEPHANTIPES Regel. 2n= . Probably Veracruz, Mexico (Dressler, 1953). Cultivated for hedges especially in C. America, where it was apparantly introduced. The flowers are used as a vegetable.

Alstroemeriaceae

BROMAREA EDULIS (Tuss.) Herb, 2n= Mexico to S. America. Apparently very variable. Probably the species of Bromarea cultivated by the Mexicans for the edible, tuberous roots, and as an ornamental (Dressler, 1953).

Amaranthaceae

AMARANTHUS CRUENTUS L. 2n=32, 34. Cultivated in Guatemala and other parts of C. America as a grain crop. It evidently derives from A. hybridus* (Sauer, 1969).

AMARANTHUS HYBRIDUS L. Slim amaranth. 2n=32. C. America. Cultivated in India and neighbouring regions as a grain crop and as an ornamental. Derived from A. cruentus* (Sauer, 1969). Hybridization with other Amaranthus species and with species of the genus Acnida has been observed (Sauer, 1950).

AMARANTHUS HYPOCHONDRIACUS L. (syn. A. leucocarpus S. Wats.). Huauhtli. 2n=32. A main crop in the Colombian times. Still cultivated in Mexico and Guatemala, and also in Asia (India, Iran?). An ornamental in Europe and N. America. Most of the Mexican populations are pale-seeded, as are those of Asia although there are more black-seeded forms than found in Mexico. The plants cultivated as ornamentals in Europe and N. America are invariably black-seeded (Sauer, 1950). It is evidently derived from A. powellii S. Wats. (2n=34) (Sauer, 1969). It is also morphologically close to A. hybridus*.

Anacardiaceae

ANACARDIUM OCCIDENTALE*

CYRTOCARPA PROCERA H. B. K. Chupandilla. 2n= . Tehuacán Valley of Mexico. A small fruit tree. Archeological seed-remains date from about 6 500 BC. (Smith, 1968).

SCHINUS MOLLE*

SPONDIAS PURPUREA*

Annonaceae

ANNONA DIVERSIFOLIA Safford. Itama. 2n= S. Mexico, Guatemala, El Salvador and other countries of C. America. Cultivated there and in Florida.

ANNONA MONTANA Macf. Mountain soursop. 2n=16. The West Indies. Cultivated.

ANNONA MURICATA L. Soursop, Guanabana, Corossol. 2n=14, (16). Gene centre the Antilles. A small tree cultivated from C. America to the coastal valleys in Peru and elsewhere in the tropics. It develops the biggest fruits of all Annona species. Some fruits may weigh 2 kg.

ANNONA PURPUREA Moc. & Sessé. Soncoya. 2n= . S. Mexico and C. America. Cultivated there.

ANNONA RETICULATA L. Bullock's heart, Common custard apple, Corazon. 2n=14, (16). Gene centre lies in the Antilles. Spread to trop. America and later to other tropical countries.

ANNONA SCLERODERMA Safford. Posh té. 2n= . C. America especially from S. Mexico to Guatemala. Cultivated.

ANNONA SQUAMOSA L. Sweetsop, Sugar apple, Custard apple. 2n=14, (16). Gene centre in the Antilles. Spread to trop. America. Later it was brought to other tropical countries. Atemoya is a hybrid product with A. cherimoia*.

CYMBOPETALUM PENDULIFLORUM Baill. 2n= . Mexico and Guatemala. A shrub cultivated for its vanilla-scented petals.

Araceae

MONSTERA DELICIOSA Liebm. (syn. Philodendron pertusum Kunth). Ceriman. 2n= . Mexico and Guatemala. A liane cultivated for its fruits.

XANTHOSOMA ROBUSTUM Schott. Pixi, Capota, Quequesque, Marac, Quiscamote. 2n=26. S. Mexico and C. America. There often cultivated as an ornamental. The huge leaves are used as umbrellas, and the roots as food. Roots and leaves are also used medicinally and as a stimulant.

Basellaceae

BOUSSINGAULTIA CORDIFOLIA*

Bignoniaceae

CRESCENTIA CUJETE L. Calabash tree, Calabazo, Cujete. 2n=40. Trop. America. Cultivated in the tropics. The thin shell of the fruits is used for containers. In Guatemala three varieties are recognized. It should not be confused with Lagenaria siceraria*.

PARMENTIERA CEREIFERA Seem. Candle tree. 2n= . C. America. Cultivated in the West Indies and other tropical regions for its fruits.

PARMENTIERA EDULIS DC. Cuachilota, Food candle tree. 2n=40. C. America. Cultivated there and in Mexico for its fruits.

Bombacaceae

CEIBA PENTANDRA Gaertn. Kapok tree, Silk cotton tree. 2n=72, 80, 88. Toxopeus (1950) believed that the kapok tree originated in an area which was later divided by the Atlantic Ocean. So this species is native both to America and Africa (p. 108). He based hin conclusion mainly on the great variability of this plant and on the high frequency of dominant inherited characteristics in these two continents. However, Bakhuizen van den Brink (1933) and Chevalier (1949) thought that seeds may have come from America in prehistoric times and that later introduction increased the variability.

Its chromosome number suggest a polyploid

origin and if this supposition is correct the kapok tree can only have arisen in that area where its parents occur. As all other Ceiba species are restricted to America this would also indicate an American origin.

The variety found in America and Africa is C. pentandra var. caribaea (DC) Bakh.

Bromeliaceae

BROMELIA PINGUIN L. Pegwe. 2n=96. W. Indies, C. America and Venezuela. A perennial herb cultivated as a living hedge. The fruits are edible.

Cactaceae

HYLOCEREUS UNDATUS (Haw.) Britt. & Rose. 2n=22. Mexico. Cultivated there and in C. America for its edible fruits.

NOPALEA COCHENILLIFERA (L.) Salm-Dyck. Nopal. 2n=22. Probably S. Mexico. Cultivated in trop. America.

NOPALEA DEJECTA Salm-Dyck. 2n= . Mexico. Cultivated for its fruits.

OPUNTIA FICUS-INDICA (L.) Miller. Indian fig, Nopal. 2n=22, 88. C. America. Cultivated in the tropics and subtropics for its fruits.

OPUNTIA MEGACANTHA Salm-Dyck (syn. O. castillae Griffith). Tuna, Nopal. 2n= . Mexico. Cultivated there for its fruits.

SELENICEREUS GRANDIFLORUS (L.) Britt. & Rose. (syn. Cereus grandiflorus Mill.). 2n=22. Mexico. Cultivated as a source of drug.

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 Saff. 2n=36. Cultivated as a vegetable and a grain crop in C. Mexico. Closely related to Ch. quinoa*.

Compositae

DAHLIA VARIABILIS Desf. (syn. D. rosea Cav.). Dahlia. 2n=64. Mexico. A tuberous plant introduced as a food crop into Europe but it is now commonly cultivated 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 SC. 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.) Lam. Sweet potato. 2n=90, genome formula BBBBBB. Unknown wild. Probably derived from I. trifida (H.B.K.) Don. (2n=90, genome formula BBBBBB), which grows wild in Mexico. Related to I. littoralis Blume (2n=60, genome formula BBBB) which is probably a tetraploid of I. leucantha Jacq. (2n=30, genome formula BB). Both species also grow wild in Mexico (Nishiyama, 1963, 1971). Purseglove (1968) suggested that I. trifida might be a weed derived from the cultigen. It may also derive together with the cultigen from a common parent. Yen (1963) proposed I. tiliacea* as the parental species. Genome formula is as yet unknown (Nishiyama, 1971). This species has its greatest variation in S. America.

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 Hayne (syn. Exogonium purga (Wender.) Benth.). Jalap. 2n=24-28. E. Mexico. Cultivated in that country, the West Indies and later India for its medicinal tubers.

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 Bailey in C. America and S. Mexico. It appears that it was widely distributed in N. Mexico and SW. USA in pre-Columbian 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 (1962) suggested it to be a derivative of C. lundelliana*.

CUCURBITA PEPO L. Marrow, Pumpkin. 2n=(24, 28), 40, (40-42, 44-46). Whitaker (1962) suggested that this 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 off-spring of C. pepo or may have been involved in the latter's formation. Whitaker and 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= . 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. Chayota edulis Jacq.). Chayote, Guisquil, Christophine. 2n=24. Mexico and C. America. It was common among the Aztecs prior to the Conquest. Spread now throughout the tropics.

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.

Euphorbiaceae

JATROPHA ACONITIFOLIA Mill. (syn. Chidoscolus chayamansa McVaugh.). 2n= . A shrub. Cultivated in the Yucatan area, Mexico. Young shoots and leaves are eaten as a potherb. During domestication, forms with fewer stinging hairs were selected for (Dressler, 1953).

MANIHOT ESCULENTA Crantz. Cassava, Manioc, Manihot, Yuca. 2n=36. Unknown wild. There are two geographical centres: in W. and S. Mexico, and C. America, parts of Guatemala and in NE. Brazil (Rogers, 1963). He suggested that cassava could have arisen in both these centres, because there is no reason to exclude root domestication in the Mexican seed type agriculture. Cassava can be divided into sweet cassava (M. dulcis, 2n=36, syn. M. palmata Muell.-Arg., 2n=36) and bitter cassava (M. esculenta Crantz, 2n=36, M. utilissima Pohl, 2n=36). The difference is the content and place of HCN in the tuber. Renvoize (1972) stated that sweet cassava was probably first domesticated in Meso-America. The sweet types may have derived from the wild population. From Meso-America it was taken to S. America. In northern S. America the bitter cassava would have been domesticated (p. 148). (Renvoize, 1972). In Brazil the diversity increased through intra-species crosses and by hybridization with wild Manihot species (p. 148).

Gramineae

AXONOPUS COMPRESSUS (Swartz) Beauv. Carpet grass. 2n=40, 50, 60. C. America and the W. 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. 65. In America var. cubensis (O. cubensis Ekman), the American race (2n=24, genome formula AA) of this species developed. Gopalakrishnan and Sampat (1966) suggested that O. perennis entered America as a weed of O. sativa in post-Columbian times.

PANICUM SONORUM Beal. Sauwi. 2n= . This little-known cereal is cultivated in Mexico. One of the few cereals domesticated in the New World (Dressler, 1953).

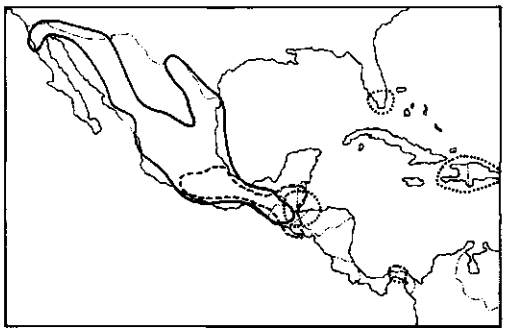
PANICUM VIRGATUM L. Switch grass. 2n=36, 72 and aneuploids. N. and C. America. Cultivated for cattle food.

TRIPSACUM DACTYLOIDES (L.) L. 2n=36, 72 and aneuploids. Observed in USA, C. America, the West Indies and S. America. It has the largest distribution of all Tripsacum species. It is cross-compatible with Zea mays* (Randolph, 1970). The genus Tripsacum is related to the genus Zea. It is believed that it played a role in the evolutionary history of cultivated maize (Zea mays) (Randolph, 1970).

TRIPSACUM LANCEOLATUM Rupr. ex Fourn. 2n=72. Arizona (USA), Mexico and C. America. Hybrids possible between T. pilosus* and this species have been described as T. lemmoni Vasey (Randolph, 1970).

TRIPSACUM LATIFOLIUM Hitchc. 2n=36, 72. Guatemala, Honduras, Belize and the West Indies. Cultivated for forage. Typical 4x forms are found in W. Mexico.

TRIPSACUM LAXUM Nash. 2n=(54), 72. Mexico, the West Indies, C. and S. America. Only cultivated or has escapes from cultivation. Sterile and



Tripsacum latifolium (. . .), T. lanceolatum (——) and T. laxum (---) (Randolph, 1970)

hence propagated vetatively for forage. Some variation is observed which suggests some production of viable seed (Randolph, 1970). Spontaneous mutations might be another source, perhaps, the only one, of this variation.

TRIPSACUM MAIZAR Hernández & Randolph. 2n=36, (72). SW. Mexico. A typical 2x and 4x forms occur elsewhere in Mexico and Guatemala. Probably one of the parents of the allotetraploid Tripsacum species (Randolph, 1970).

TRIPSACUM PILOSUM Scribn. & Merr. 2n=72. Mexico and C. America.

TRIPSACUM ZOPILOTENSE Hernández & Randolph. 2n= . SW. Mexico. Probably one of the parents of the allotetraploid Tripsacum species. This region is near to the centre of diversity of the genus Tripsacum which is in S. Mexico and neighbouring Guatemala (Randolph, 1970).

ZEA MAYS L. 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.G. 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. - would 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 3 600 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 2 200 BC. Early tripsacoid maize dates from 2 300-1 500 BC. MacNeish (1964) supposed that about 5 000 BC wild maize i.e. teosinte was cultivated.

From C. America maize reached S. America where its development became more advanced (p. 150). 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, Oloton 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. 176).

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 relict 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 associated 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 1 000 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 inflorescence 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 (de Wet, pers. comm. 1971).

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 Eastern 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 - indentata 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. 99), Asia (p. 48) and Africa (p. 85). where secondary centres of diversity developed.

At present flint maize, flint corn - indurata Sturt. - is quite common in C. America.

Derivatives of Z. mays x Z. mexicana[2] are used for fodder. These are called maisinte (Prasad & Chaudhuri, 1968).

ZEA MEXICANA (Schrad.) Kuntze (syn. Euchlaena mexicana Schrad.). Teosinte. 2n=20. SW. Chihuahua, Mexico to S. Honduras. MacNeish (1964) suggested that about 5 000 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 of maize to teosinte is very small (see p. 166). 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.

Zea mexicana (Wilkes, 1967)

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 1 000 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. 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. cyanea Lindl. (2n= .) of C. Mexico.

Lauraceae

PERSEA AMERICANA Miller. Avocado. 2n=24. 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 anise-scented 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).

PERSEA SCHIEDEANA Nees. Coyo avocado. 2n= . From Guatemala to Mexico. Cultivated on a small scale - chiefly near Orizaba in Mexico for its 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 beggarweed. 2n=22. C. America, Florida, West Indies and northern S. America. A perennial herb used as a green manure and forage crop.

DESMODIUM UNCINATUM*

ENTEROLOBIUM CYCLOCARPUM (Jacq.) Griseb. 2n=26. Mexico, C. America, N. of S. 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. Leucaena. 2n= . C. America. Spread to the Caribbean islands, the Philippines, SE. Asia and elsewhere. Used as a shade tree, for cattle food and to control soil erosion.

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. C. 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.

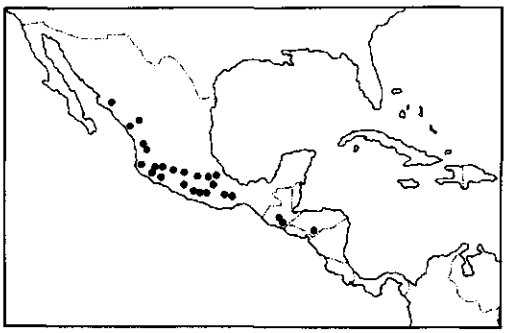
PHASEOLUS ACUTIFOLIUS Gray. var. latifolius Freeman. Tepary bean. 2n=22. Mexico, Texas and Arizona. A very polymorphic species especially characterized by its drought-resistance. The cultivated variety is var. latifolius.

PHASEOLUS COCCINEUS L. Scarlet Runner, Runner bean. 2n=22. Mexico and Guatemala. Domesticated there. 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.

PHASEOLUS LUNATUS L. Sieve 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. 153).

PHASEOLUS RETUSUS Benth. Metcalf bean. 2n= . Texas, Arizona and New Mexico, USA. Occasionally cultivated.

PHASEOLUS VULGARIS L. Common bean. 2n=22. Kaplan (1965) suggested a multiple domestication within C. America from a widespread and polymorphus species. Willey (1962) suggested that this domestication may have taken place between 5 000 and 3 000 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. arborigineus Burkart which occurs wild in Peru. It is quite possible that when Ph. vulgaris reached Peru it introgressed with Ph. arborigineus. Similarly in other areas introgression of related wild material may have taken place. Recently Gentry (1969) pointed out that a wild type of Ph. vulgaris is growing in C. America. From



Phaseolus vulgaris (Gentry, 1969)

this wild type the cultivated forms derive.

Ph. arborigineus was reduced by Burkart and 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). Secondary centres in Eurasia (p. 34).

PITHECELLOBIUM DULCE Benth. Manila tamarind. 2n=26. Mexico to N. of S. 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 patterns of G. klotzschianum* (Cherry et al.,1970).

GOSSYPIUM HARKNESSII Brandagee. 2n=26, genome formula $D_{2-2}D_{2-2}$. The islands and coasts of Gulf of California.

GOSSYPIUM HIRSUTUM L. Upland cotton. 2n=52, genome formula $(AADD)_1$. The current theory is that this species originated in C. America. Harland (1970) suggested that its centre of origin is in S. America (p. 154), while C. America is an important secondary centre of diversity. Upland cotton is cultivated in USA, in Africa except for the Nile Delta (p. 154), in C. Asia, India (Cambodia type, p. 51), 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 Anderson var. davidsonii (Kelloggs) Saunders. 2n=26, genome formula $D_{3-D}D_{3-D}$. Shores of the Gulf of California and the Revilla Gidego islands. Related to the plants of this species found on the Galapagos Islands (p. 154).

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 (Moc. & Sess. ex DC.) Skovsted. (syn. Ingenhouzia triloba Moc. & Sess. ex DC.). 2n=26. C. Mexico (Fryxell & Parks, 1967).

Moraceae

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. 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= . 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=(28-31), 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. of S. 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 UTILIS Oerst. 2n= . C. America. A palm cultivated there.

Papaveraceae

ARGEMONE MEXICANA L. Mexican prickly poppy. 2n=28. SW. of USA and Mexico. Cultivated in Mali. Seeds are used to prepare oil. Also an ornamental.

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. of 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.

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 (see above).

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.

CHRYSOPHYLLUM 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.

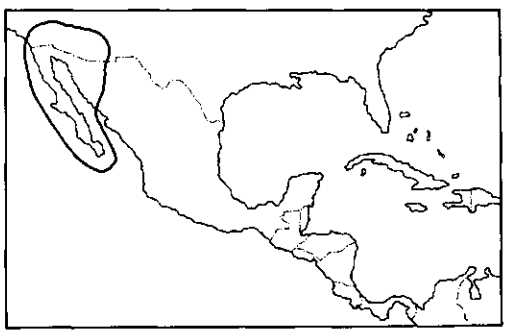
MANILKARA ACHRAS (Mill.) Fosbérg (syn. Achras zapota L., M. zapotilla (Jacq.) Gilly). Sapodilla, Chiku. 2n=26. Mexico and C. America. Cultivated now in the tropics for its fruits and gum (chickle) for chewing-gum production.

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 CALIFORNICA Nutt. Jojoba, Pignut, Goatnut. 2n= . California and adjacent Mexico. A preliminary domestication was done in California. The product is a liquid wax, jojoba oil.



Simmondsia californica (Gentry, 1958)

Solanaceae

CAPSICUM ANNUUM L. Bell pepper, Cayenne pepper, Mexican chili. 2n=24. Wild variety in Southern USA, West Indies, Mexico, C. America and Colombia. Primary centre in Mexico. Secondary centre centres in Europe (p. 142) and Asia (p. 70). Originally the cultivars were limited to C. America. The wild bird pepper (C. annuum var. minimum) is the most probable ancestor of the cultivated varieties (var. annuum). It is a very polymorphic species.

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. multiinterruptum Bitt., S. abbottianum Juz., S. liriunianum Card. & Hawkes, S. ochoae Vargas, S. multidissectum 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 Cuerrero 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 NC. 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 2 000 and 3 500 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 piñon 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 $A_1A_1A_4A_4BB$. WC. Mexico. The A_1 genome may have come from S. verrucosum*.

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. EC. Mexico, Honduras, Costa Rica and adjacent Panama.

SOLANUM PAPITA Rydb. 2n= . Similar to S. fendleri*.

SOLANUM PINNATISECTUM Dun. 2n=24. NC. 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.

SOLANUM POLYTRICHON Rydb. 2n=48, genome formula A_4A_4BB. NW. to NC. 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 of resistance to Phytophthora and potato aphid.

SOLANUM x SAMBUCINUM Rydb. 2n=24. In maize fields in NC. Mexico. A natural hybrid of S. cardiophyllum ssp. ehrenbergii* (2n=24) and S. pinnatisectum* (2n=24) (Hawkes, 1966).

SOLANUM x SEMIDEMISSUM Juz. 2n=60. Clones of this 5x plant in roadside thickets in Mexico. A source of Phytophthora and frost resistance. It is thought that it is a hybrid of S. demissum x S. tuberosum, the reciprocal of the cross yielding S. x edinense. It is sterile (Ugent, 1967). This may block introgression of S. demissum into the potato.

SOLANUM STOLONIFERUM Schlechtd. & Bouché. 2n=48, genome formula A_4A_4BB. N. Mexico. A source of resistance to Y virus, A virus, Phytophthora, Pseudomonas and the potato aphid, Macrosiphum euphorbiae Thomas. One of the parents of S. x vallis-mexici*. One genome is the same as that of S. acaule*.

SOLANUM x VALLIS-MEXICI Juz. 2n=36, genome formula A_1A_4B, 60, $A_1A_4A_4B$, 72, $A_1A_1A_4A_4BB$. The Valley of Mexico. A natural hybrid of S. stoloniferum* and diploid S. verrucosum*. Amphiploids have also been found. Seed collected from 5x plants produced aneuploid plants resembling either S. stoloniferum* or S. demissum*. Plants of the first group had 2n=47-55, while those of the second group had 2n=61-69. Intercrossing between the hybrid, the aneuploids and the species could account in part, for the extensive polymorphism found in S. stoloniferum and S. demissum populations (Marks & Montelongo-Escobedo, 1970).

SOLANUM VERRUCOSUM Schlechtd. 2n=24, genome formula A_1A_1, (36, 48, 72). NE., C. and S. Mexico. Also cultivated there. The tubers have a good flavour (Abdalla & Hermsen, 1973). A source of resistance to Phytophthora infestans, virus X, virus Y, and several insects. The diploid forms a link between the Demissa and the Tuberosa series of S. America. It is similar to the Colombian S. andreanum*.

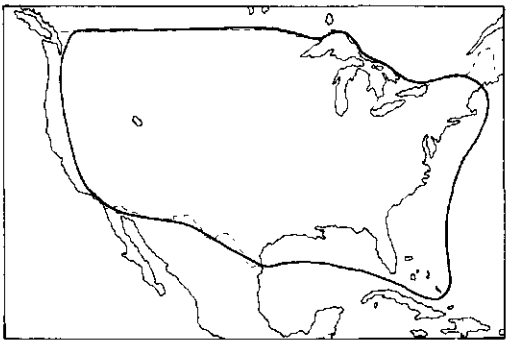
SOLANUM WOODSONII Corr. 2n= . Dry specimens came from Costa Rica, Panama and Venezuela. No living material has been collected yet.

Sterculiaceae

THEOBROMA BICOLOR H. & B. Nicaraguan cacao. 2n=20. From Mexico to Brazil. Cultivated outside its natural range for the edible pulp round the seeds. The seeds themselves are used like those of Th. cacao* (Purseglove, 1968).

THEOBROMA PANTAGONA Bern. Cacao lagarto. 2n= . Costa Rica to Panama. Cultivated there.

12 North American Centre



Darlington & Janaki Ammal (1945) established the USA Centre of Origin. Zhukovsky (1968) enlarged this area to the southern half of N. America. Agriculture must have been introduced from Centre 11 in the third millenium BC., although there are indications that chenopods and amaranths were deliberately cultivated (Haury, 1962). However, they may have belonged to the ruderal flora the seeds being collected as food. To the earliest introduced crops belong Zea mays.

A few but important crops have been domesticated in this centre: Fragaria virginiana, Helianthus sp., Prunus sp., Rubus sp., Vaccinium sp., Vitis sp. etc.

Aceraceae

ACER SACCHARUM Marsh. Sugar maple, Rock maple. 2n=26. E. of N. America. The sap is a source of maple sugar and maple syrup. Also cultivated. Mansfeld (1959) suggested that A. saccharinum L. is a synonym, but this species has 2n=52.

Amaranthaceae

AMARANTHUS HYBRIDUS*

AMARANTHUS POWELLII see A. leucarpus*

AMARANTHUS SPINOSUS*

Araceae

ACORUS CALAMUS*

Araliaceae

PANAX QUINQUEFOLIA L. American ginseng. 2n= . E. part of N. America. Cultivated for its roots, which are used as a stimulant.

Asclepiadaceae

ASCLEPIAS SYRIACA L. (syn. A. cornuti Decne). 2n=(20), 22, (24). E. of N. America. Run wild in cultivated ground and dry grassland (Tutin et al., 1972). Cultivated formerly in Europe for fibre and as a food-plant for bees.

Campanulaceae

LOBELIA INFLATA L. Indian tobacco. 2n=14, (16). N. America. Cultivated there as a medicinal plant. It has attracted attention again recently because it has been discovered to be a source of the lobeline used in anti-smoking preparations.

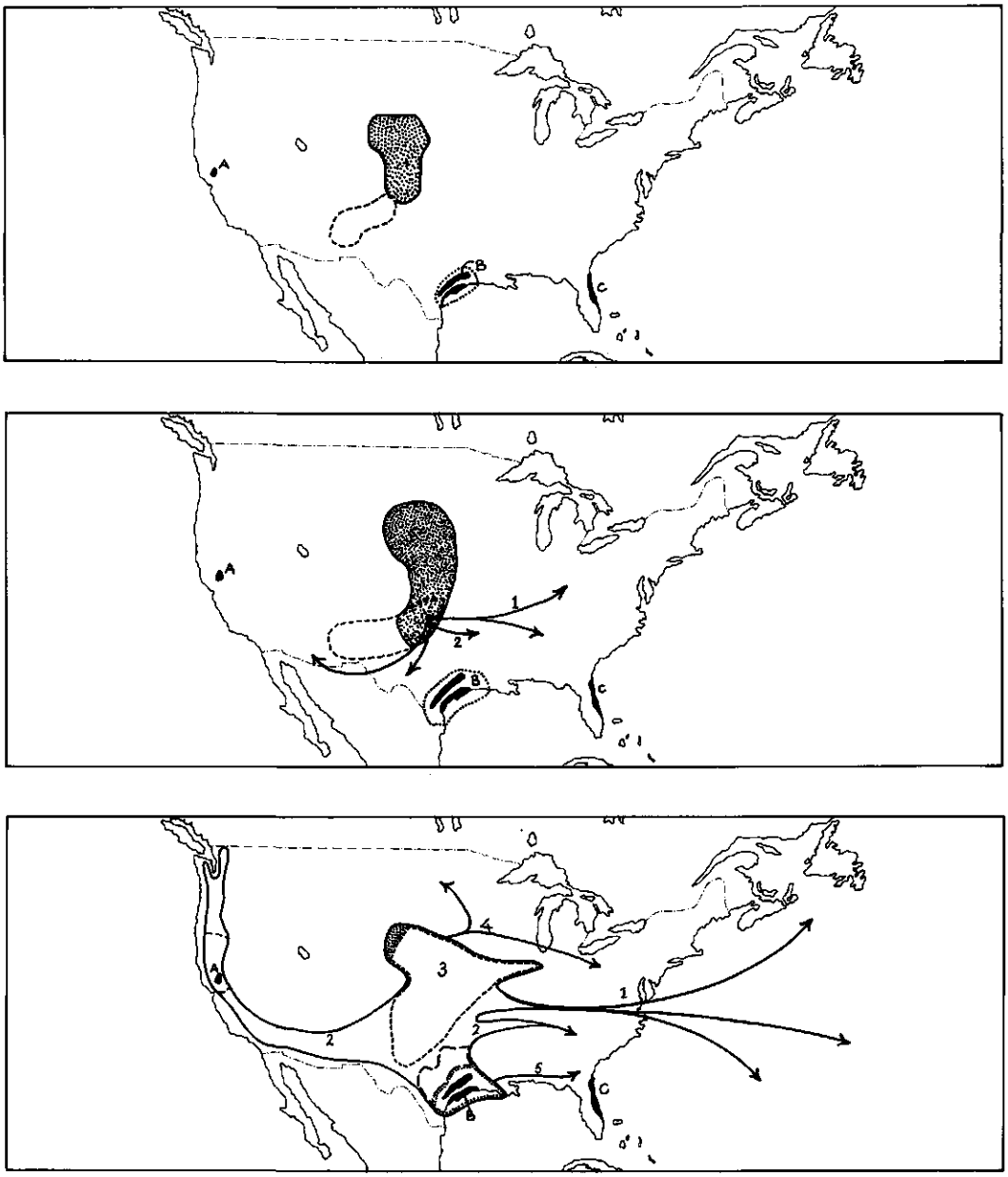
Chenopodiaceae

ATRIPLEX CANESCENS (Pursh.) Nutt. American shad scale, Hoary saltbush, Wing scale, Fourwing saltbush. 2n= . W. of N. 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.

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 variability has increased. An important species is H. bolanderi A. Gray (2n=34) of C. and N. California. 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 sun-



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)

flower, found in the settlements in the Midwest. It possibly derives from ssp. lenticularis. Var. macrocarpus (DC.) Ckll is probably the parental from of the cultivated types. It grows in NE. of 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).

H. x laetiflorus Pers. (2n=102), a wild perennial species of USA is probably a hybrid of H. subrhomboideus Rydb. (2n=102) and H. tuberosus. The first parent is also native to USA (Clevenger and Heiser, 1963).

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.

Cupressaceae

JUNIPERUS VIRGINIANA L. Eastern red cedar. 2n= . E. N. America. Much variation is due to introgressive hybridization with other Juniperus species (Hemmerly, 1970).

Ebenaceae

DIOSPYROS VIRGINIANA L. Common persimmon. 2n= . E. of N. America. Cultivated for its fruits. Also used as a rootstock of D. kaki*.

Elaeocarpaceae

MUNTINGIA CALABURA L. Panama berry, Capulin, 2n= . Widely cultivated for its sweet, edible fruits.

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 Ashe, V. simulatum and V. australe Small, Southeastern highbush blueberry.

Fruits of wild plants are still picked, as are those of other wild species like V. myrtillus L., (European) blueberry, Whortleberry, Billberry (2n=24).

VACCINIUM MACROCARPON Ait. Cranberry. 2n=24, genome formula MaMa. NE. N. America. Cultivars selected and cultivated in N. America and on Terschelling, the Netherlands. Related to the N. American wild V. oxycoccos L. (2n=48) genome formula $Mi^{o}Mi^{o}Ma^{o}Ma^{o}$. The Mi^{o} genome is related to Mi of V. microcarpum (Turcz.) Hook. (2n=24) (Ahokas, 1971).

Euphorbiaceae

ALEURITES FORDII Hemsl. Tung oil tree, 2n=22. SC. China (p. 31). Secondary gene centre probably in the large planting.

Fagaceae

CASTANEA DENTATA (Marsh.) Borkh. American chestnut. 2n=24. E. of N. America. A tree cultivated for its edible sweet nuts.

CASTANEA PUMILA (L.) Mill. Common chinquapin. 2n= . N. America (from Pennsylvania to Florida and Texas). A tree cultivated for its nuts.

Gramineae

AGROPYRON PAUCIFLORUM (Schweinitz) Hitchc. (syn. A. trachycaulum (Link.) Malte). Slender wheatgrass, Bald wheatgrass, Western ryegrass. 2n=28. N. America. A forage crop.

AGROPYRON SMITHII Rydb. Western wheatgrass. 2n=28. N. America. Used to control erosion and as a forage crop.

AGROPYRON SPICATUM (Pursh) Scribn. & Smith. Bluebunch wheatgrass. 2n=14, genome formula SS, 28. N. America. Cultivated as a forage crop. Var. inerme is Beardless bluebunch wheatgrass. A. latiglume (Scribn. & Smith) Rydb., (2n=28), A. scribneri Vasey (2n=28), A. trachycaulum (Link.) Malte ex H. F. Lewis (2n=28) and Sitanion hystrix (Nutt.) J. C. Smith (2n=28) also possess a pair of S genomes.

AGROSTIS GIGANTEA*

AGROSTIS TENUIS*

BOUTELOUA CURTIPENDULA (Michx.) Torr. Side-oats grama. 2n=20-103. N. America. An important pasture grass.

BOUTELOUA ERIOPODA Torr. Black grama, Grama grass. 2n=20, 21, 28. SW. of USA and N. Mexico. Used as a pasture grass.

BOUTELOUA FILIFORMIS (Fourn.) Griff. Grama grass. 2n=14, 20, 21, 22, 46, W. of USA and N. Mexico. A pasture grass.

BOUTELOUA GRACILIS (H. B. K.) Lag ex Steud.

Blue grama. 2n=20-84. N. America, ranging from Canada to Mexico.

BROMUS MARGINATUS Nees. Mountain brome. 2n=28, 42, 56, 70. N. America. Cultivated in Australia, E. Africa and N. America.

DESCHAMPSIA INSIGNIS Pierre (syn. D. caespitosa (L.) Beauv.). Tufted hairgrass, Tussock grass. 2n=(24, 25), 26, (27), 28, (49). W. of N. America. Cultivated for hay and pasture. Putman & Klein (1971) suggested that from this species D. elongata (Hook.) Munro (2n=26) and D. holciformis Presl (2n=26) have been derived From D. elongata comes the annual D. danthonioides (Trin.) Munro. These four species are found in N. America and Europe.

DIGITARIA ADSCENDENS (H.B.K.) Henrard. 2n=54. N. America. A weedy grass sometimes included in D. sanguinalis*, but Gould (1963) classified 2n=6x=54 plants as D. adscendens and 2n=4x=36 plants as D. sanguinalis. These species are closely related.

ELYMUS CANADENSIS L. Canada wild-rye. 2n=28, (42). N. America. A grass used as pasture and hay crops.

PANICUM VIRGATUM*

PASPALUM DISTICHUM L. 2n=40, (48), 60. N. and S. America. Used in the USA as a soil stabilizer.

POA COMPRESSA L. Canada blue grass, Wire grass. 2n=(14), 42, 56 and aneuploids. Europe to the Urals and Caucasia, and in N. America. Selection work was done particularly in N. America.

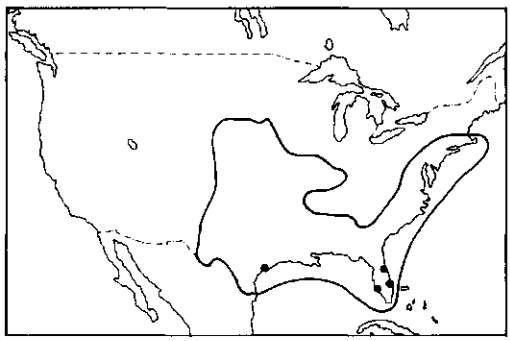
POA NEMORALIS L. Wood meadows grass. 2n=28, 42, 56, c. 70 and aneuploids. Europe, N. Africa, temperate Asia, N. America. Cultivated in N. America.

POA PRATENSIS L. Blue grass, Kentucky blue grass, Bird grass. 2n=38-147. For origin see p. 134. Europe, Asia, N. Africa and northern N. America. Various varieties have been developed in Europe, Canada and elsewhere. Natural hybrids with P. ampla Merr. have been found in W. N. America.

PUCCINELLIA NUTTALLIANA (Schult.) Hitchc. Nuttal alkali grass, Meadowgrass. 2n=42, 56. N. America. Cultivated as a forage grass especially on alkaline soils.

STIPA VIRIDULA Trin. Green needle grass. 2n=82. N. America. This perennial bunch grass has been adapted to the N. Great Plains for rangeland.

TRIPSACUM DACTYLOIDES (L.) L. 2n=36, 72. See p. 165. Tetraploid types of Florida, USA have a thick rachis which apparently developed as an adaptation to dispersal by floating (Galinat, 1969).



Tripsacum dactyloides (——) and T. floridanum (• •) (Randolph, 1970)

TRIPSACUM FLORIDANUM Porter ex Vasey. 2n=36. S. Florida and Texas, USA. Cross compatible with Zea mays*.

UNIOLA PANICULATA L. Sea cats. 2n=40. S. of N. America. A dune stabilizer.

ZEA MAYS L. Maize, Corn. 2n=20. Secondary centres in N. America. Domesticated in C. America (p. 165). There local races and those introduced from the Mexican lowlands and the West Indies, hybridized (Brandolini, 1970). Dent maize, dent corn - indentata Sturt. - is common here.

ZIZANIA AQUATICA L. Indian rice, Wild rice, Tuscarora rice. 2n=30. S. Canada and USA in the area of the Great Lakes. Seeds are collected. Not cultivated.

Grossulariaceae

RIBES CYNOSBATI L. American wild gooseberry, Frickle gooseberry. 2n=16. E. N. America. Cultivated there. Its characteristic mildew resistance is useful in breeding European gooseberry cultivars (p. 135).

RIBES ODORATUM Wendland. Buffalo currant. 2n=16. N. America. Types with large fruits are cultivated.

Hydrastidaceae

HYDRASTIS CANADENSIS L. Golden seal, Orange root. 2n=26. E. of N. America. Cultivated there as a medicinal crop and as an ornamental.

Hydrophyllaceae

PHACELIA TANACETIFOLIA Benth. Valley vervenia. 2n=(18), 22. California, USA. Cultivated as a crop for honey bees.

Juglandaceae

CARYA ILLINOINENSIS (Wangenh.) K. Koch. (syn. Carya pecan Engler & Graebn.). Pecan. 2n=32. N. America. A tree cultivated for its nuts. One of the parents of C. x lecontei Little, bitter pecan (2n=). The other parent is probably C. aquatica (Michx.f.) Nutt., water hickory (2n=32).

CARYA OVATA (Mill.) K. Koch (syn. C. alba Nutt.). Shagbark hickory, Shellbark hickory. 2n= . N. America. Cultivated also as an ornamental.

JUGLANS HINDSII Jepson. C. Californian black walnut. 2n= . C. California, USA. Cultivated as rootstock of J. regia*.

JUGLANS NIGRA L. Black walnut. 2n=32. Most of the eastern half of the USA and southern Ontario between Lake Huron and Lake Ontario. Pure, natural stands are rare and usually small, it generally occurs as individual trees scattered through the forest. This walnut is mainly selected for its fruits, but also some selections have been made for distinctive foliage and for wood (Funk, 1969).

Labiatae

MENTHA CANADENSIS L. (syn. M. arvensis L.). American wild mint. 2n=54, 96. N. America. Occasionally cultivated.

Leguminosae

AMPHICARPAEA MONOICA (L.) Ell. (syn. Falcata comosa (L.) Kuntze). Hog pea, Ground peanut. 2n=20. E. and S. of USA. Formerly cultivated for its seeds.

APIOS TUBEROSA Moench. (syn. A. americana Medik., Glycine apios L.). Potato bean, Ground nut. 2n= . E. N. America, Florida and Texas. Cultivated for its edible tubers and as an ornamental or as a curiosity.

GLEDITSIA TRIACANTHOS L. Honey locust, Sweet bean. 2n=28. C. and E. N. America. This tree is cultivated in hedges and as an ornamental.

LUPINUS PERENNIS L. 2n=48, 96. E. N. America. Cultivated as an ornamental, fodder crop and green manure.

LUPINUS POLYPHYLLUS Lindl. 2n=48. Pacific N. America. Cultivated as an ornamental, fodder crop and green manure.

ROBINIA HISPIDA L. 2n=30. SE. of N. America. Cultivated as an ornamental and in hedges.

ROBINIA PSEUDACACIA L. Locust, Black locust. 2n=20, c. 20, 22. C. and E. N. 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. part of N. 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. part of N. America. See further C. leichtlinii*.

Malvaceae

GOSSYPIUM BARBADENSE L. Sea Islands cotton. 2n=52, genome formula $(AADD)_2$. Peru (p. 153). 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).

Martynaceae

PROBOSCIDEA LOUSIANICA (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. 2n= . N. America. Used for hedges and as an ornamental.

Passifloraceae

PASSIFLORA INCARNATA L. May-Pop, Apricot-Vine. 2n=18, 36. E. N. America, Florida and Texas. It was cultivated by Indians in Virginia.

Phytolaccaceae

PHYTOLACCA AMERICANA L. 2n=36. USA. It has run wild in S. Europe. Cultivated as a dye plant (berries) and ornamental.

Rosaceae

AMYGDALUS PERSICA L. Peach. 2n=16. Primary centre: China (p. 36). Secondary centre: California, USA.

FRAGARIA CHILOENSIS*

FRAGARIA VIRGINIANA Duch. Virginian strawberry. 2n=56. N. America, especially in the eastern part. Cultivated. One of the parents of F. 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. of 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, Rum cherry. 2n=32. N. America from Ontario and N. 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. of N. America. Micurin selected Vinogradnaja from this species (Zylka, 1971b).

RUBUS ACAULIS Michx. 2n=14. The Canadian counter part of R. arcticus (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. N. 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 lead 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. 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 lead 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 Kamtchatka. 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* (Larson, 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. of the 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. US states Arizona, New Mexico and Colorado, and in Mexico near the Arizona boundary.

Valerianaceae

VALERIANA EDULIS Nutt. 2n= . N. America. This perennial herb is cultivated for its roots.

Vitadaceae

VITIS BERLANDIERI Planch. 2n=38. SE. of 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. of 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. of USA. It can be crossed with V. vinifera* to introduce resistance to fungal diseases.

VITIS LABRUSCA L. Fox grape. 2n=38. E. N. America. It appears to have run wild in Georgia, USSR (p. 90). 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. 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. Var. scuppernong is cultivated in S. part of USA. Hybrids of this species and V. vinifera* are completely resistant to Phylloxera, Erysiphe and Oidium

VITIS RUPESTRIS Scheele. 2n= . SW. of USA. Used as a rootstock. It can be crossed with V. vinifera* to introduce resistance to phylloxera, Viteus vitifolii Shimer.

Species with a not identified centre

Some species could not be listed in one of the gene centres. 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.

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, Ambarelia, Hog plum.* 2n= . Cultivated for its fruits. Mansfeld (1959) reported the presence of var. cythera 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).

Cucurbitaceae

MOMORDICA BALSAMINA L. Balsam apple. 2n=22. Tropics of the Old World. 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.

Gramineae

CENCHRUS CILIARIS L. (syn. Pennisetum cenchroides Rich.). Buffel grass. 2n= mainly 36. The tropics and subtropics. Cultivated in Australia.

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, Rhodesia and Zaire, 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 GANGETICUM DC. 2n= . Trop. Asia and Australia. Cultivated as a fodder plant and green manure.

INDIGOFERA HIRSUTA L. 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.

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, 1969).

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After the page number the centre of diversity is given between brackets.