TOWNS AND VILLAGES

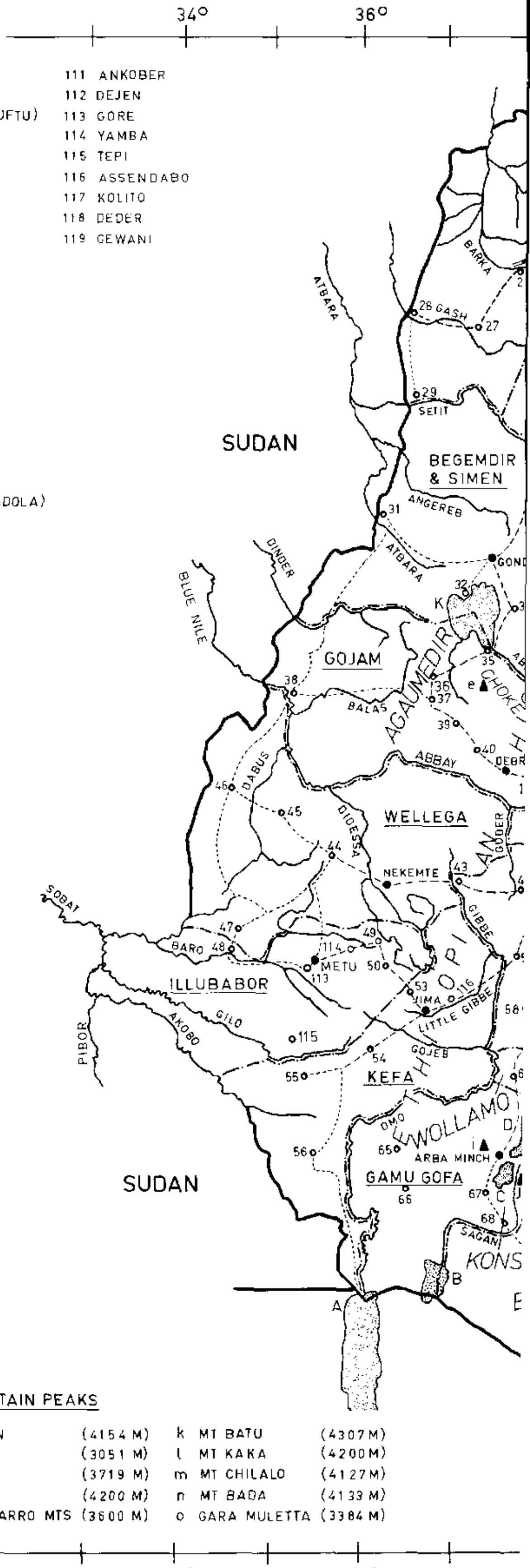
1 DEBRE BIRHAN
2 DEBRE SINA
3 KARA KORE
4 KOMBOLCHA
5 BATI
6 TENDAHO
7 SERDO
8 ASSAB
9 WOLDYA
10 KOBO
11 ALAMATA
12 LALIBELA
13 SOKOTA
14 MAICHEW
15 ENDA MEDHANE ALEM
16 ABIY ADI
17 AXUM
18 ADUA
19 ADIGRAT
20 SENAFE
21 ADI KAYEH
22 ADI UGRI
23 DEKEMHARE
24 MASSAWA
25 KEREN
26 AGORDAT
27 BARENTU
28 TESENEY
29 OM HAJER
30 DEBAREK
31 METEMA
32 GORGORA
33 ADDIS ZEMEN
34 DEBRE TABOR
35 BAHAR DAR
36 DANGLA
37 INJIBARA
38 GUBA
39 BURE
40 DEMBECHA
41 FICHE
42 AGERE HIWET (AMBO)
43 BAKO (SHOA)
44 GIMBI
45 MENDI
46 ASOSA
47 DEMBI DOLO
48 GAMBELA
49 BEDELLE
50 DEMBI
51 GHION (WOLLISO)
52 WELKITE
53 AGARO
54 BONGA
55 MIZAN TEFERI
56 MAJI
57 BUTAJIRA
58 HOSAINA
59 DEBRE ZEIT (BISHUFTU)
60 MOJO
61 MAKI
62 ADAMI TULU
63 SHASHAMANE
64 SODDO
65 BULKI
66 BAKO
67 GIDOLE
68 GIARSO
69 YABELO
70 BURJI
71 AGERE MARIAM
72 FISHA GENET
73 YIRGA CHAFFE
74 DILA
75 WONDO
76 YIRGA ALEM
77 AGERE SELAM
78 KEBRE MENGIST (ADOLA)
79 NEGELLI
80 MEGA
81 MOYALE
82 DOLO
83 EL KERE
84 GINIR
85 ADABA
86 DODOLA
87 BEKOJI
88 TICHO
89 NAZRET (ADAMA)
90 METAHARA
91 AWASH
92 MIESO
93 ASBE TEFERI
94 BEDESSA
95 GELEMSO
96 HIRNA
97 KOBBO
98 DIRE DAWA
99 ALEMAYA
100 FIK
101 IMI
102 JIJIGA
103 DEGEH BUR
104 AWARE
105 WERDER
106 GELADI
107 SHILALO
108 KEBRE DEHAR
109 KELAFO
110 FERFER
111 ANKOBER
112 DEJEN
113 GORE
114 YAMBA
115 TEPI
116 ASSENDABO
117 KOLITO
118 DEDER
119 GEWANI

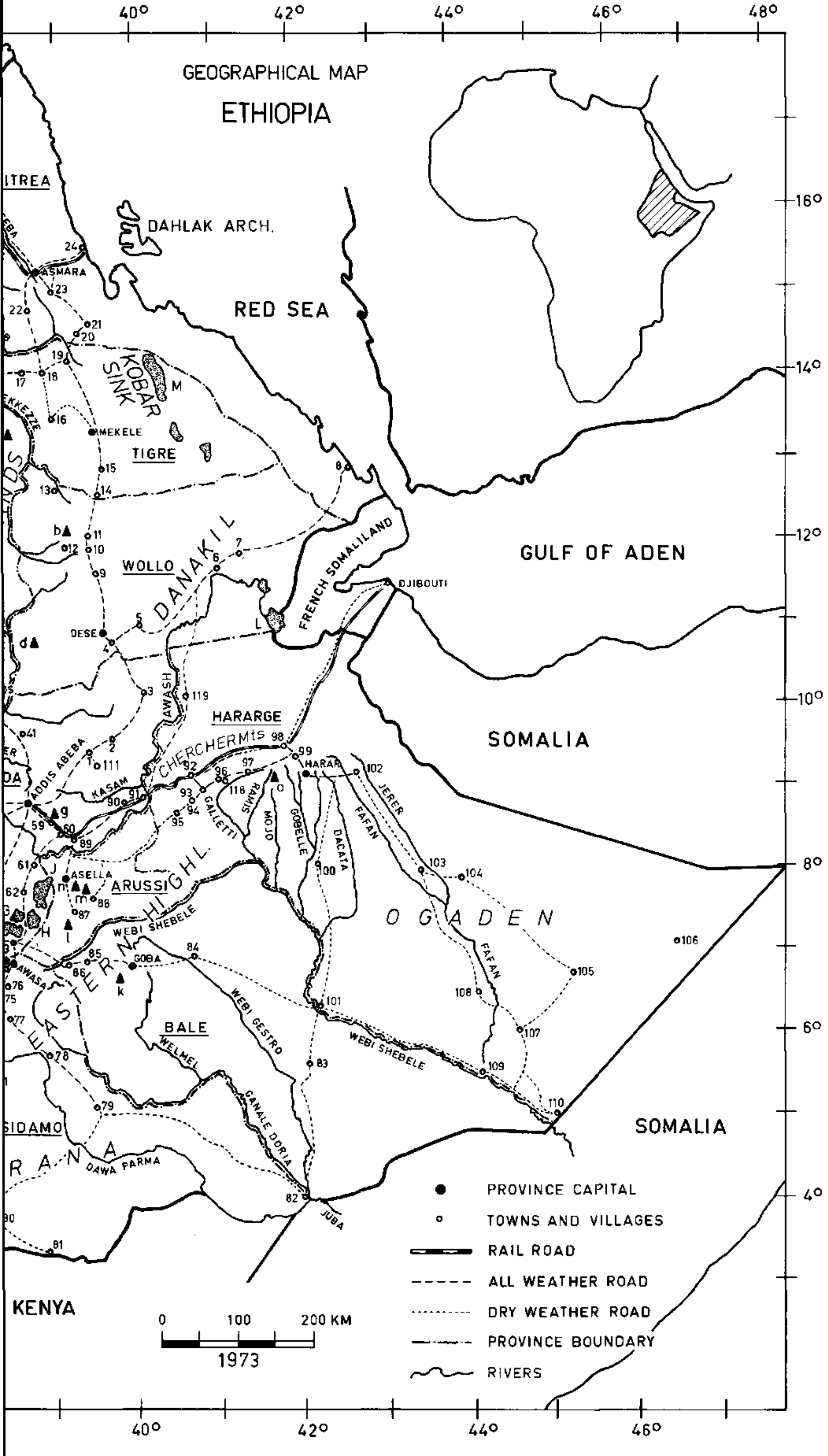
LAKES

A LAKE RUDOLF
B LAKE CHEW BAHIR
C LAKE CHAMO (RUSPOLI)
D LAKE ABAYA (MARGHERITA)
E LAKE AWASA
F LAKE SHALA
G LAKE ABAYITA
H LAKE LANGANO
J LAKE ZIWAI
K LAKE TANA
L LAKE ABBE
M LAKE ASALE

MOUNTAIN PEAKS

a	RAS DASHAN	(4620 M)
b	MT ABUNA YOSEF	(4194 M)
c	MT GUNA	(4281 M)
d	AMBA FARIT	(3978 M)
e	MT AMEDAMIT	(3619 M)
f	RAS BIRHAN	(4154 M)
g	MT YERER	(3051 M)
h	MT GURAGE	(3719 M)
i	MT TOLA	(4200 M)
j	PEAK IN AMARRO MTS	(3600 M)
k	MT BATU	(4307 M)
l	MT KAKA	(4200 M)
m	MT CHILALO	(4127 M)
n	MT BADA	(4133 M)
o	GARA MULETTA	(3384 M)




GEOGRAPHICAL MAP
ETHIOPIA
RED SEA
GULF OF ADEN
SOMALIA
SOMALIA
KENYA
DAHLAK ARCH.
KOBAR SINK
TIGRE
WOLLO
DANAKIL
FRENCH SOMALILAND
DJIBOUTI
HARARGE
CHERCHER Mts
ARUSSI
EASTERN HIGHL.
BALE
SIDAMO
OGADEN
ASMARA
MEKELE
DESE
ADDIS ABEBA
HARAR
ASELLA
GOBA
AWASA
AWASH
KASAM
WEBI SHEBELE
WEBI GESTRO
GANALE DORIA
WELMEL
DAWA PARMA
JUBA
FAFAN
JERER
DACATA
GOBELLE
MOJO
RAMIS
GALLETTI
PROVINCE CAPITAL
TOWNS AND VILLAGES
RAIL ROAD
ALL WEATHER ROAD
DRY WEATHER ROAD
PROVINCE BOUNDARY
RIVERS
0
100
200 KM
1973

Spices, condiments and medicinal plants in Ethiopia, their taxonomy and agricultural significance

P. C. M. Jansen

Laboratory of Plant Taxonomy and Plant Geography,
Agricultural University, Wageningen

Spices, condiments and medicinal plants in Ethiopia, their taxonomy and agricultural significance

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The author graduated on 10 June 1981 as Doctor in de Landbouwwetenschappen at the Agricultural University, Wageningen, the Netherlands, on a thesis with the same title and contents.

Abstract

Jansen, P. C. M., 1981. Spices, condiments and medicinal plants in Ethiopia, their taxonomy and agricultural significance. Agric. Res. Rep. (Versl. landbouwk. Onderz.) 906, ISBN 90-220-0767-7, (xii) + 327 p., 28 figs, 39 photographs, 10 tables, 468 refs, glossary of pharmacological, medical, veterinary terms, indexes of common and scientific plant names. Also: Doctoral thesis, Wageningen.

The book is the third in a series of publications on useful plants of Ethiopia. It describes 12 spices and condiments and 13 medicinal plants, both from a taxonomic and an agricultural viewpoint.

The extensive botanical description of each taxon is accompanied by a full-page drawing, relevant photographs, lists of synonyms, literature and names, and details on taxonomic problems, geographic distribution, ecology, husbandry, uses and chemical composition.

Numerous other spices, condiments and medicinal plants of Ethiopia that are not treated in detail are listed separately.

Date of publication 15 April 1981

Cover plate: *Hagenia abyssinica* (Bruce) J. F. Gmelin

Samenvatting

Dit is het derde boek in een serie publikaties over nuttige planten van Ethiopië. (Peulvruchten van Ethiopië en Landbouwsystemen van Ethiopië, geschreven door E. Westphal, zijn de eerste twee publikaties.)

Van maart 1975 tot juli 1977 werd door mij veldwerk verricht in Ethiopië (verbonden aan de landbouwfaculteit van de Addis Ababa Universiteit te Alemaya, met financiële steun van NUFFIC en DTH).

Talrijke planten uit geheel Ethiopië werden verzameld en bestudeerd (en zijn nu geconserveerd in diverse herbaria, o.a. te Wageningen en te Alemaya, Ethiopië) en gegevens over het gebruik van de planten werden zorgvuldig genoteerd. Zaadmonsters, voornamelijk verzameld op markten (ook door eerdere projectmedewerkers van het NUFFIC-LHW-2-project), werden uitgezaaid in Ethiopië en in Wageningen en alle belangrijke stadia (kiemplant, bloem, vrucht, zaad) werden bestudeerd en verzameld.

Van maart 1978 tot oktober 1979 kon ik via een WOTRO-beurs mijn gegevens uitwerken op het Laboratorium voor plantensystematiek en -geografie van de Landbouwhogeschool te Wageningen.

In deze studie komen 12 specerijen en 13 medicinale planten uitvoerig aan de orde. Elke soort wordt op de volgende wijze behandeld:
- verklaring van de wetenschappelijke naam;
- auteur, oorspronkelijke publikatie en typificatie van de soort;
- opsomming van synoniemen (niet volledig);
- lijst van chronologisch gerangschikte literatuur, met korte indicatie van de aard der inhoud;
- lokale namen en andere niet-wetenschappelijke namen in de Engelse, Franse en Duitse taal;
- geografische verspreiding van de soort in Ethiopië en elders;
- uitgebreide beschrijving van de soort, gebaseerd op herbariummateriaal van Ethiopische planten;
- een of twee oorspronkelijke botanische tekeningen ter verduidelijking van de beschrijving en meestal een of meer foto's van de plant of van plantedelen;
- taxonomische opmerkingen; verklaring van de typificatie; aanduiding van de variabiliteit van de soort in Ethiopië;
- bespreking van taxonomische literatuur betreffende de soort; cultivars worden niet onderscheiden;
- ecologische en botanische bijzonderheden van de soort (o.a. hoogte boven zeeniveau van de vindplaatsen, bloeibijzonderheden);
- de teelt van de soort (als deze verbouwd wordt, iets over de wijze waarop,

zaai-, bloei- en oogstdata, ziekten en plagen van het gewas);
– gebruik van de soort (bij of als voedsel, als medicijn en andere gebruiken);
– chemische samenstelling van de soort (gegevens uitsluitend ontleend aan de literatuur).

Na het voorwoord en de introductie (hoofdstuk 1), waarin de gevolgde werkwijzen uiteengezet worden, komen in hoofdstuk 2 de specerijen en condimenten aan de orde. Geïmporteerde specerijen worden genoemd en de betekenis van de inheemse specerijen voor de typisch Ethiopische maaltijden en dranken wordt aangeduid. De volgende 12 specerijen worden uitgebreid behandeld:

1. *Aframomum corrorima* (Braun) Jansen (nieuwe combinatie)
2. *Anethum foeniculum* L. (syn.: *Foeniculum vulgare* Mill.)
3. *Anethum graveolens* L.
4. *Capsicum annuum* L. (syn.: *Capsicum frutescens* L.)
5. *Coriandrum sativum* L.
6. *Cuminum cyminum* L.
7. *Nigella sativa* L.
8. *Ocimum basilicum* L.
9. *Rhamnus prinoides* L'Hér.
10. *Ruta chalepensis* L.
11. *Trachyspermum ammi* (L.) Sprague ex Turrill
12. *Zingiber officinale* Rosc.

In de inleiding van hoofdstuk 3 wordt de betekenis van de medicinale planten in Ethiopië kort besproken. Daarna worden de volgende 13 soorten uitgebreid behandeld:

1. *Adhatoda schimperiana* (Hochst.) Nees
2. *Brucea antidysenterica* J. F. Miller
3. *Calpurnia aurea* (Ait.) Benth.
4. *Catha edulis* (Vahl) Endl.
5. *Cordia africana* Lam.
6. *Croton macrostachyus* Hochst.
7. *Embelia schimperi* Vatke
8. *Hagenia abyssinica* (Bruce) J. F. Gmelin
9. *Juniperus procera* Hochst.
10. *Lepidium sativum* L.
11. *Myrsine africana* L.
12. *Phytolacca dodecandra* L'Hér.
13. *Tamarindus indica* L.

Hoofdstuk 4 geeft een opsomming van ruim 300 Ethiopische plantesoorten welke eveneens als specerij of als medicijn gebruikt worden. Van elke soort worden enkele lokale namen vermeld en het gebruik kort aangeduid.

Het boek besluit met een algemene literatuurlijst, een verklarende lijst van gebruikte farmacologische, medische en veterinaire termen, een index op niet-wetenschappelijke plantenamen en een index op wetenschappelijke plantenamen.

Contents

Preface

This book is the third volume of a series on useful plants of Ethiopia, and deals with spices, condiments and medicinal plants.

The first volume of this series dealt with the pulses (Westphal, 1974) and the second one with the agricultural systems (Westphal, 1975).

The author of this book was in Ethiopia from March 1975 to July 1977, attached to the College of Agriculture at Alemaya of the Addis Ababa University. He was a cooperator in a technical cooperation project between the Addis Ababa University and the Agricultural University at Wageningen. Numerous collection trips were made, notably in the southern part of Ethiopia. The political circumstances did not allow travel in the north. Relevant plants of the cultivated and wild flora of Ethiopia were collected (in total ca 7000 specimens) and information about use and agricultural aspects were carefully noted and observed. Numerous seed samples (mainly collected on markets by the author and by previous collectors in the project) were sown in Ethiopia and at Wageningen in order to study and conserve the different growth stages of the plants.

From January 1974 to April 1977, the work was sponsored by the Netherlands University Foundation for International Cooperation (NUFFIC); from April 1977 to April 1978 by the International Technical Assistance Department of the Netherlands Ministry of Foreign Affairs (DTH); from April 1978 to October 1979 by the Netherlands Foundation for the Advancement of Tropical Research (WOTRO). All this time, the Laboratory of Plant Taxonomy and Plant Geography (headed by Professor Dr H. C. D. de Wit), the Department of Tropical Crop Science (Professor Dr Ir J. D. Ferwerda) of the Agricultural University at Wageningen, and the Plant Science Department of the College of Agriculture at Alemaya (headed by Dr Dejene Makonnen) of the Addis Ababa University in Ethiopia, provided all possible facilities and assistance. The present book appears as a joint publication of those three institutions.

The financial support of the Stichting (Trust) 'Landbouw Export Bureau 1916/1918' to publish this book is gratefully acknowledged.

1 Introduction

From 1965 to 1977, ca 30 000 herbarium specimens (dried or preserved in spirits) of Ethiopian plants were collected from all over Ethiopia by staff of the Laboratory of Plant Taxonomy and Plant Geography of the Agricultural University at Wageningen.

In 1967, E. Westphal started a project to survey useful plants of Ethiopia. His collections and those of his successors showed that Ethiopia was remarkably rich in useful plants. He particularly studied the Ethiopian pulses (Westphal, 1974) and the agricultural systems in Ethiopia (Westphal, 1975). My study concentrated on spices, condiments and medicinal plants of Ethiopia.

This book is based on the herbarium material to which I contributed about 7000 specimens in the years 1975–1977, on observations in the field and on literature.

The method of working and the arrangement of the text are similar to those in Westphal's book on pulses. To obtain a complete collection of all stages of growth of the spices and condiments, seed samples, collected mainly from markets from all over Ethiopia, were sown. The growing plants were studied and all relevant stages were collected and stored in the WAG herbarium (for the codes of herbaria see p. 5). A duplicate set of all specimens is stored in the ACD herbarium. At Wageningen, the samples were mainly grown in a greenhouse (a few in the open air) and in Ethiopia all samples were grown at Alemaya (alt. ca 2000 m) and a selected group at Melkassa (alt. ca 1500 m, garden of the Institute of Agricultural Research near Nazareth). So, plants from the same seed were grown in three habitats and it was hoped that the plants would show their variability.

By careful observations, comparisons and measurements of all material thus obtained, a detailed description could be made of each species.

It would perhaps have been better if more widely different localities in Ethiopia (e.g. between 0–1000 m alt., and 2500–3000 m alt.) had been compared. The limited time available for the project, and problems of distance and manpower (cultivation and collection are time-consuming) made this impractical.

The medicinal plants (except *Lepidium sativum*) were not grown. Their descriptions are based on material and observations from plants growing in the wild only. Especially in Hararge province, the author gathered much information on medicinal plants. All oral information obtained was based on and documented by specimens of plants collected on the spot. The students Jemal Omar and Yeshie Haile often assisted me with this work.

An excellent general introduction to agriculture in Ethiopia was prepared by Westphal in 1975 in the second volume of this series. That publication is also a rich source of data on the geography, climate, soils, natural vegetation, ethnic groups and languages, markets, food and nutrition. It is unnecessary to repeat those data in this book.

In this book, 12 spices and condiments (Chapter 2) and 13 medicinal plants (Chapter 3) are described in detail; Chapter 4 lists numerous other spices and medicinal plants used in Ethiopia.

Each species is treated as follows:

- An etymological explanation of the scientific name of the plant (mainly based on Backer, 1936);
- The author of the species and the original publication;
- The type specimen of the species;
- A list of synonyms. It should be noted that those lists are usually far from complete and are based mainly on literature. It was beyond the scope of this work to investigate the correctness of all synonyms cited in the literature;
- A chronological list of literature about the species. Pure taxonomic literature already indicated with the synonyms, is not always repeated in this list. The references are usually abbreviated. A full citation can be found at the end of the book under Bibliography. The main aspect of each publication is indicated (e.g. tax., agric., chem.) but such indications hardly ever indicate all information in the source;
- Local names. In the literature, they are spelt in various ways. I tried to give all variants but not all spellings. The main source for the local names (besides my own information) is Cufodontis, 1953–1972. The language or area in which the names are used is given in parentheses (e.g. Amarinia, Gallinia, Tigrinia);
- Trade names are given only in English, French and German;
- The geographic distribution of the species in Ethiopia and elsewhere;
- A detailed description of the species, accompanied by one or two original botanical drawings and sometimes photographs;
- Taxonomic notes. The typification is explained; literature on the taxonomy of the species is reviewed; the variability of the Ethiopian material is indicated; material on which the description is based is cited; other examined material, not usually used for description, is cited separately. The variability of the species was often considerable but cultivars were not circumscribed. In my opinion, cultivars can only be distinguished if it is proved by experiments that the designated cultivar breeds true in all important characteristics. As no data were available on numerous agricultural aspects (e.g. disease resistance, yield, water requirements) and on the behaviour of the plants after more than one generation of cultivation, the ultimate naming and distinction ought to be postponed until such data become available. The present work is intended as a base for such research on cultivars;
- Ecology. The altitudinal range and various botanical data are given;
- Husbandry, if the species is cultivated;
- Uses. The information was usually subdivided into culinary uses (spices mainly), medicinal uses (spices and medicinal plants), and miscellaneous uses (e.g. the usefulness of the wood);
- Chemical composition, taken from the literature.

For botanical terms, the following works were consulted: B. D. Jackson, A glossary of botanic terms. 4th ed. 1971; G. H. M. Lawrence, Taxonomy of vascular plants. App. Illustrated glossary of taxonomical terms. 1963; W. T. Stearn, Botanical Latin. 2nd ed. 1973.

In the heading 'literature' the following abbreviations are used in parentheses: tax. = taxonomy; agric. = agriculture; bot. = botany; chem. = chemistry; phytop. = phytopathology.

For cited specimens, collector's names are abbreviated as follows: WP = E. Westphal & J. M. C. Westphal-Stevels; SL = C. J. P. Seegeler; Bos = J. J. Bos; PJ = P. C. M. Jansen.

If no herbarium is cited, the specimens are present both at the herbarium of the Laboratory of Plant Taxonomy and Plant Geography at Wageningen (WAG) and at the herbarium of the College of Agriculture at Alemaya, Ethiopia (ACD). For other herbaria, the codes of 'Index Herbariorum' are used:

B	Berlin, Germany: Botanisches Museum.
BM	London, Great Britain: British Museum (Natural History).
ETH	Addis Ababa, Ethiopia: National Herbarium.
FI	Firenze, Italy: Herbarium Universitatis Florentinae, Istituto Botanico.
FT	Firenze, Italy: Erbario Tropicale di Firenze.
G	Genève, Switzerland: Conservatoire et Jardin botaniques.
G-DC	Genève, Herbier De Candolle, see G.
HBG	Hamburg, Federal Republic of Germany, BRD: Institut für Allgemeine Botanik.
K	Kew, Great Britain: The Herbarium and Library.
KR	Karlsruhe, Federal Republic of Germany, BRD: Landessammlungen für Naturkunde.
L	Leiden, Netherlands: Rijksherbarium.
LINN	London, Great Britain: The Linnean Society of London.
LZ	Leipzig, German Democratic Republic, DDR: Sektion Biowissenschaften der Karl-Marx-Universität, Bereich Taxonomie/Ökologie.
P	Paris, France: Muséum National d'Histoire Naturelle, Laboratoire de Phanérogamie.
P-JU	Paris: Herbier Jussieu, see P.
TUB	Tübingen, German Democratic Republic, DDR: Institut für Biologie I, Lehrbereich spezielle Botanik.

The following signs and abbreviations need explanation:

dates	day–month–year
!	(after a specimen or herbarium) seen by the author
al.	alii: others
alt.	altitude
Code	International Code of Botanical Nomenclature (1978)
comb. nov.	combinatio nova: new combination of name and epithet
c.s.	cum suis: with collaborators
e.g.	exempli gratia: for example
f.	(after a personal noun) filius: son; (before an epithet) forma: form
f	(after a collection number) female

fl(s)	flower(s)
fr(s)	fruit(s)
holo.	holotype
herb.	herbarium
IAR	Institute of Agricultural Research, Ethiopia
JECAMA	Imperial Ethiopian College of Agricultural and Mechanical Arts (old name for College of Agriculture, Alemaya)
lecto.	lectotype
m	male
nom. cons.	nomen conservandum: name conserved in International Code of Botanical Nomenclature
nom. nud.	nomen nudum: name unaccompanied by a description or reference to a published description
nom. rej.	nomen rejiciendum: rejected name
pers. comm.	personal communication
prop.	proposita: proposed
prov.	province
s.l.	sensu lato: in a broad sense
s.n.	sine numero: without a number
s.s.	sensu stricto: in a narrow sense
sp.	species
spp.	species (pl.)
ssp.	subspecies
t. (tab.)	tabula: plate
var.	variety

2 Spices and condiments in Ethiopia

The words 'spices' and 'condiments' are used here to denote plants or plant products that are used to flavour foods or beverages before, during or after their preparation. Culinary herbs are included.

The literature generally admits that the distinction between spices, condiments, and culinary herbs is not clear. Some authors prefer to restrict the term spice to those culinary plants (or their products) that are of tropical origin. Usually 'condiment' is considered to comprise also flavourings of non-vegetable origin (for instance salt).

Redgrove (1933) preferred to use the word 'condiment' to denote a spice or other seasoning used in a particular manner, i.e. added to food after it has been served at table. The term 'culinary herb' is sometimes restricted to plants from outside the tropics.

For convenience the term 'spice' is used here in its widest sense.

Under spices, most people understand plants or their products like the following:
- cardamon (*Elettaria cardamomum* Maton) ('hell': Amarinia; 'Hindu's korarima': Gallinia);
- cinnamon (*Cinnamomum zeylanicum* Breyn) ('karafa, karafu': Amarinia, Gallinia);
- clove (*Syzygium aromaticum* L.) ('krinfud': Amarinia);
- nutmeg and mace (*Myristica fragrans* Houtt.) ('gaws': Amarinia);
- black pepper (*Piper nigrum* L.) ('kundo berbere': Amarinia);
- Indian long pepper (*Piper longum* L.) ('timiz': Amarinia);
- turmeric (*Curcuma longa* L.) ('urd, ird': Amarinia; 'hard': Gallinia).

Although all 'classical' spices are used in Ethiopia, they are not grown there but imported, mainly from India. Recently there has been some cultivation of turmeric.

The following spices, grown in Ethiopia, are dealt with in detail in this book:
(1) *Aframomum corrorima* (Braun) Jansen, *Zingiberaceae,* 'korarima' (Amarinia); part used: seed;
(2) *Anethum foeniculum* L., *Umbelliferae,* 'insilal' (Amarinia); part used: fruit;
(3) *Anethum graveolens* L., *Umbelliferae*, 'insilal' (Amarinia); part used : fruit;
(4) *Capsicum annuum* L., *Solanaceae,* 'berbere, mitmita' (Amarinia); part used: fruit;
(5) *Coriandrum sativum* L., *Umbelliferae,* 'dembilal' (Amarinia); part used: fruit;
(6) *Cuminum cyminum* L., *Umbelliferae,* 'ensilal' (Amarinia); part used: fruit;
(7) *Nigella sativa* L., *Ranunculaceae,* 'tukur azmut' (Amarinia); part used: seed;
(8) *Ocimum basilicum* L., *Labiatae,* 'basobila' (Amarinia); part used: aerial parts;
(9) *Rhamnus prinoides* L'Hér., *Rhamnaceae,* 'gesho' (Amarinia); part used: aerial parts;

(10) *Ruta chalepensis* L., *Rutaceae*, 'tenadam' (Amarinia); part used: mostly fruit;
(11) *Trachyspermum ammi* (L.) Sprague ex Turrill, *Umbelliferae*, 'netch-azmut' (Amarinia); part used: fruit;
(12) *Zingiber officinale* Rosc., *Zingiberaceae*, 'zingibel' (Amarinia); part used: rhizome.

The spice *Trigonella foenum-graecum* L. ('abish': Amarinia) has been described by Westphal (1974, p. 199–205). The spices *Brassica nigra* (L.) Koch ('senafitch': Amarinia), and *Sesamum indicum* L. ('salid': Amarinia) will be treated by Seegeler in the forthcoming book on Ethiopian oil-plants in this series.

Many other spices of minor significance used and grown in Ethiopia (and not treated here in detail) are listed in Chapter 4.

In terms of cultivated area and production, only *Brassica, Capsicum, Rhamnus, Trigonella* and *Sesamum* have agricultural significance in Ethiopia. Hardly any export of spices exists. *Capsicum* is most important in Ethiopia. The others are grown mainly as garden crops, although some of them are cultivated as a field crop as well in some areas (e.g. *Nigella, Trachyspermum, Coriandrum, Zingiber*).

Aframomum corrorima is a spice only known from Ethiopia. It certainly deserves more attention, as its seeds have a milder, sweeter flavour than those of the better known West African species *Aframomum melegueta*.

The use and cultivation of the spices *Nigella sativa* and *Trachyspermum ammi* is also typical of Ethiopia, although they are cultivated and used elsewhere too.

Rhamnus prinoides is also a noteworthy Ethiopian plant. It is used to flavour local alcoholic beverages (just as hops are used elsewhere to flavour beer).

The other spices are well known all over the world.

Vavilov (1951) considered Ethiopia as a primary gene centre (centre of origin) for *Rhamnus prinoides* and as a secondary centre (centre of diversity) for *Coriandrum sativum, Nigella sativa* and *Trachyspermum ammi.* Although I certainly observed a wide variability in those species, this study does not confirm Vavilov's statements.

Of the spices dealt with, *Aframomum* and *Zingiber* fall within the 'ensat-planting complex' and 'shifting cultivation complex' (as distinguished by Westphal, 1975). All the other treated spices fall within the 'seed farming complex' and the 'ensat planting complex'.

Four of the twelve spices dealt with grow also in the wild in Ethiopia: *Aframomum, Anethum foeniculum, Ocimum* and *Rhamnus.*

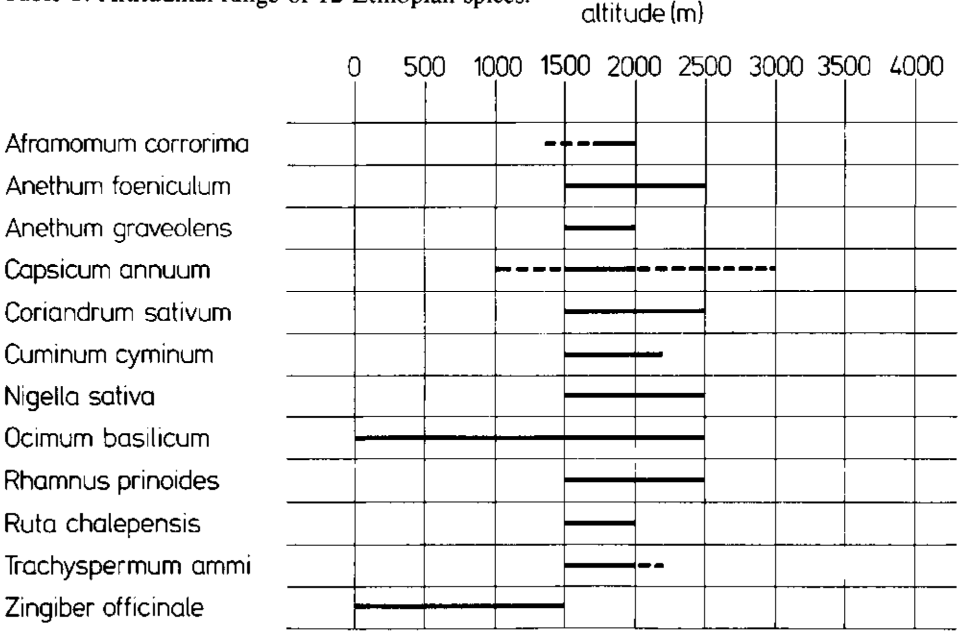
The observed altitudinal ranges of growth of the spices are given in Table 1.

For Ethiopians, the significance of spices can hardly be overestimated. Spices are needed every day in the preparation of the main dish. The main dish consists of 'enjera' (bread) and 'wot' (spiced sauce).

'Enjera' is a kind of unleavened bread made of grain. The best 'enjera' is made of 'tef', *Eragrostis tef* (Zucc.) Trotter. As 'tef' is rather expensive, however, 'enjera' of inferior quality is often prepared from maize, sorghum, barley, wheat or from mixtures of grains. It is a kind of pancake, ca 0.5 m diam., ca 0.5 cm thick, baked in large earthenware or iron pans over open fire, grey, spongy, sour in taste. It is usually eaten cold, torn into pieces, dipped in the 'wot'.

The major use of spices in Ethiopia is in the preparation of 'wot'. 'Wot' is a thick,

Table 1. Altitudinal range of 12 Ethiopian spices.



usually highly spiced sauce. Many kinds of 'wot' exist; almost every woman has her own recipe. The more sorts of spice added to the 'wot', the more it is appreciated (certainly, social status is involved in this appreciation too). Two groups of 'wot' can be distinguished. One group with *Capsicum* pepper ('berbere') as the main spice ('kai-wot' = red 'wot', pungent) and a group without *Capsicum* pepper ('alicha wot' = non pungent 'wot'). Both kinds are either based on meat ('siga wot' = beef 'wot', 'doro wot' = chicken 'wot'), or on pulses ('misir wot' = lentil 'wot', 'kik wot' or 'shiro wot' = pea or bean 'wot'). The use of meat is forbidden by religion (Ethiopian Orthodox Church) on days of fasting (up to 220 per year!). As meat is rather expensive, most people are obliged to prepare 'wots' based on pulses. Onions (shallots), garlic and butter or vegetable oil are the main ingredients of every 'wot'. Besides spices, 'wot' may contain vegetables, eggs and many other edible ingredients.

The major spice used in the preparation of Ethiopian alcoholic beverages is *Rhamnus prinoides.* Some well know Ethiopian drinks are:

– 'Talla'. A turbid frothing sour kind of beer, prepared from water, malt, flour and *Rhamnus prinoides* (leaves and woody parts). It is the most common alcoholic drink, prepared in almost every house, from any grain available. The volume fraction of alcohol is ca 7%.

– 'Tedj'. An almost clear orange aromatic slightly sour honey drink, prepared from water, honey and *Rhamnus prinoides* (only woody parts). It is the 'beer' of rich Ethiopians, who can afford to buy expensive honey. Poor people drink it only on feast days. An inferior quality 'tedj' is produced by replacing up to three quarters of the honey by sugar. The volume fraction of alcohol is again ca 7%.

Photograph 1. Women selling spices and medicinal plants at Harar market.

– 'Areke' or 'katikala'. A kind of gin, prepared from water, malt, flour and spices (leaves of *Rhamnus prinoides, Anethum foeniculum,* and other spices according to taste). It is also prepared by distillation of 'talla' or 'tedj' or fermented 'enjera'. 'Areke' prepared from flour of *Eleusine coracan* (L.) Asch. & Graebn. ('chitta areke') is appreciated most.

Spices are also used as medicines and to flavour bread, cakes, butter and raw meat.

In Ethiopia, spices are sold by women on the markets. Usually those women sell only spices, or spices and medicinal plants. The spices are sold separately or in various mixtures. Almost every village has a small daily market ('sauce market') as well as its normal busy market day(s). There people can buy for their daily needs. Usually all markets are remarkably well supplied with indigenous and imported spices in all seasons of the year.

2.1 Aframomum corrorima (Braun) Jansen (comb. nov.) Fig. 1

'*Aframomum*': composed from Africa and *Amomum. Amomum* perhaps derived from the Arabic 'hamma' which means: 'hot, warm', probably hinting at the pungency of the seeds. '*corrorima*': the local Ethiopian Gallinia name for this species, more often spelt 'korarima'.

Jansen, P. C. M., Spices, condiments and medicinal plants in Ethiopia: p. 10 (1981).
Type: from Ethiopia: 'Kommt durch den Handel nur von Gallaländern'. Two fruits collected by W. Schimper, s.n., without date and locality (P, in fruit collection, Box F511, lecto.!).

Synonyms

Amomum corrorima Braun, Flora, Bd 31(6): p. 95–96 (1848), (basionym).
Amomum korarima Pereira, Mat. Med. ed. 3, 2(1): p. 1136–1137 (1850), (lectotype: Beke s.n., BM).
Aframomum korarima (Pereira) K. Schum. ex Engler, Pflanzenw. Afr. 2: p. 386 (1908), (lectotype: Beke s.n., BM).

Literature

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1975: Lock & Hall, Taxonomic studies in the genus *Aframomum*, Boissiera 24: p. 225–231. (tax.)
1976: Lock, Notes on some East African species of *Aframomum*, Kew Bull. 31: p. 263–271. (tax.)
1977: Lock et al., The cultivation of Melegueta pepper in Ghana, Econ. Bot. 31: p. 321–330. (agric.)
1978: Lock, Notes on the genus *Aframomum* 1. The species related to *A. polyanthum* (K. Schum.) K. Schum., Bull. Jard. Bot. Nat. Belg. 48: p. 129–134. (tax.)
1978: Lock, Notes on the genus *Aframomum* 2. The Ethiopian species, Bull. Jard. Bot. Nat. Belg. 48: p. 387–391. (tax.)

Local names: korarima, kurarima, kwererima, kewreriam (Amarinia); corrorima, korarima, oghio (Gallinia); orsha (Ghimira); ofio, otiyo (Kaffinia); heil, habhal-habashi (Arabic).
Trade names: korarima cardamom, false cardamom, Guragi spice (English); korarima, cardamome d'Ethiopie, poivre d'Ethiopie (French); Korarima, Abyssinischen Kardamon (German).

Geographic distribution

Korarima is known only from Ethiopia, where it grows in the forests of the provinces of Kefa, Sidamo, Illubabor and Wollega (Cufodontis, 1972; Herb. FT, K, WAG). One specimen (J. G. Meyers 10612, present at K!), collected in Khor Aba, Aloma Plateau, Sudan (7-3-1939) and identified as korarima by J. M. Lock, might prove that korarima has a wider distribution but more evidence is needed. It is the only known specimen not collected in Ethiopia. The statement in Kew Bulletin (1894, p. 400) that the species is indigenous to the whole mountainous region of Eastern Africa has never been confirmed by botanical collections.

Cultivation of the plants has been reported not only from around the centres where the plant grows in the wild, but also from around Lake Tana (Baldrati, 1950), Eritrea (Baccarini, 1909) and Gelemso. The statement of Baccarini (1909) that the korarima cultivated in Eritrea originated in the Arabian Peninsula is probably not true, unless it was korarima first exported by Ethiopia.

Description

A perennial aromatic (especially the crushed leaves) herb, usually with strong fibrous subterranean scaly rhizomes and with leafy stems ca 1–2 m high.

Rhizomes subterete, up to 1 cm diam., brown to red-brown, smooth (in dried specimens usually wrinkled), glabrous; scales brown, thin, subovate, up to 6 × 4 cm, with prominent parallel veins outside, usually slightly puberulous near the apex and with white scarious ciliate margins, deciduous, the scars visible as lighter coloured rings. Roots borne on the rhizomes, often perforating the scales, subterete, up to 4 mm diam., whitish to light-brown, fibrous.

Stems unbranched, subterete, up to 1 cm diam., mainly formed by the leaf-sheaths; base usually thickened, up to 3 cm diam.

Leaves distichous, ca 1–8 cm apart; sheaths covering each other, yellow-green, with prominent parallel darker-green veins and scarious, usually ciliate margins; ligule deeply bilobed, thin, ciliate, base ca 0.5 × 1.5 cm, lobes acute, up to 3 cm long; petiole subterete in outline, deeply grooved above, usually thicker at base, ca 4–10 mm long, light-green, glabrous; blade glossy dark-green above, lighter green, sometimes a bit reddish, with yellowish midrib beneath, elliptic to oblong, ca 10–30 × 2.5–6 cm, leathery, usually obliquely obtuse at base, cuspidate at apex, entire, glabrous, with a prominent midrib below (rather deeply wrinkled in dried specimens); lateral nerves fine, pinnately arranged, parallel, making a very sharp angle with the midrib, 4–9 in 5 mm above and 12–16 in 5 mm below.

Inflorescence a ca 5-flowered, short-stalked head, arising from the rootstock near the base of the leafy stem, sometimes situated at the end of a rhizomatous runner; peduncle up to 7 cm long, usually slightly curved, completely covered by imbricate, brown to purplish-brown, glabrous to scarcely puberulous, ca ovate, up to ca 2.5 × 1.5 cm scales, with scarious, glabrous to ciliate margins and with prominent veins, the apex sometimes slightly notched; head covered with imbricate, brown to purplish-brown, ovate to ca square, up to 4.5 × 4.5 cm bracts, with scarious, ciliate margins and prominent veins and sometimes a double-notched apex; each flower surrounded by a scarious, suboblong, ciliate, bidentate bract, up to 6 × 2 cm.

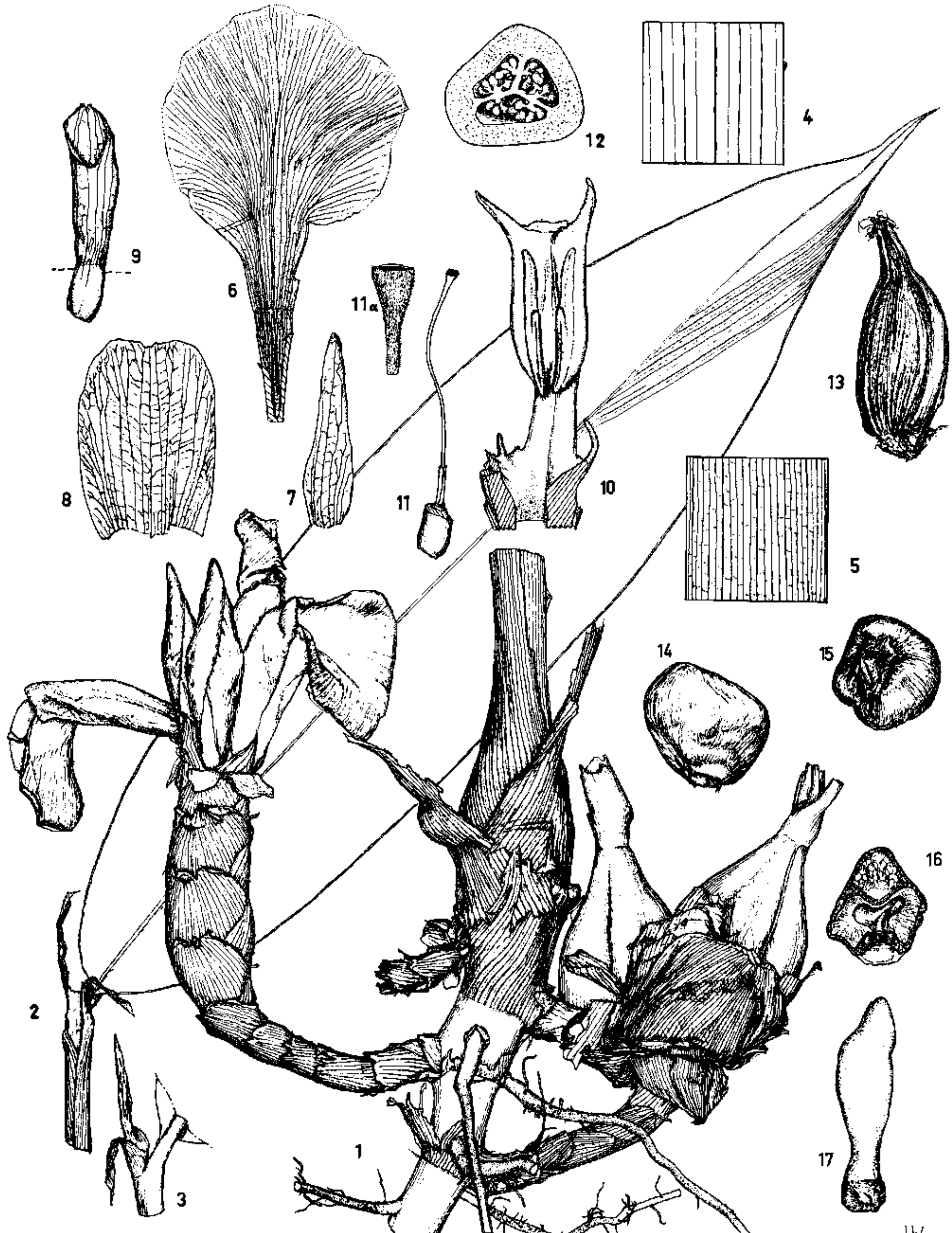

Fig. 1. *Aframomum corrorima* (Braun) Jansen. – 1. habit rhizome with flowers and fruits ($\frac{2}{3}\times$); 2. leaf ($\frac{2}{3}\times$); 3. ligule ($\frac{2}{3}\times$); 4. venation upperside leaf ($2\times$); 5. venation underside leaf ($2\times$); 6. labellum ($\frac{2}{3}\times$); 7. lateral corolla lobe ($\frac{2}{3}\times$); 8. dorsal corolla lobe ($\frac{2}{3}\times$); 9. calyx ($\frac{2}{3}\times$); 10. anther ($2\times$); 11. pistil ($\frac{2}{3}\times$); 11a. stigma ($3\times$); 12. cross-section ovary ($4\times$); 13. dried fruit ($\frac{2}{3}\times$); 14. seed ($4\times$); 15. dried seed ($4\times$); 16. seed, section through hilum ($4\times$); 17. embryo ($20\times$). – 1–5. PJ 5544 (spirit mat.); 6. PJ 5544 + WP 5536 (spirit mat.);7–11. WP 5536 (spirit mat.) 11a–12. PJ 5544 (spirit mat.); 13. PJ 5910; 14. PJ 2206 (spirit mat.); 15. WP 135; 16–17. PJ 2206 (spirit mat.).

Calyx spathaceous, up to 4.5 cm long and 1 cm diam., split in front over ca 1–2 cm from the apex, scarcely puberulous, with acute, sometimes notched, ciliate apex.

Corolla tubular, 3-lobed at apex, the connation of the 3 petals in the tube visible as 3 furrows; tube up to 3.5–4.5 cm long, white to pale-violet, glabrous outside, inside glabrous except for the densely woolly upper 2 cm; lateral lobes ovate-oblong, up to 4 × 2 cm, with acute or shallowly (0.5 mm deep) bidentate apex, glabrous, entire, white to pale-violet; dorsal lobe ovate-oblong, up to 4 × 3 cm, glabrous, entire, white to pale-violet, with a rather blunt, single-notched or double-notched apex.

Androecium: labellum obovate in outline, with a half-tubular fleshy claw of up to 3 × 1.5 cm and a subovate to orbicular, thin, slightly notched, glabrous, up to 3 × 3.5 cm lobe; base of claw puberulous inside, lobe pale-violet but yellow at throat inside; fertile stamen 1, with a fleshy, slightly rounded, glabrous to puberulous filament of ca 6 × 5 mm; connectivum fleshy, with a ventral central groove, ca 12 × 5 mm, glabrous to puberulous, whitish to pale-violet, at apex with two lateral, fleshy, acute, glabrous to puberulous horns of ca 4 × 1 mm and a central small entire or slightly notched ciliate protruding part of ca 1 × 2.5 mm; thecae 2, narrowly ellipsoid, ca 11 × 1 mm, yellow, dehiscing by a longitudinal slit from base up to about the middle, their proximal lateral sides densely puberulous; between the base of filament and labellum, usually a triangular fleshy staminodium of ca 1 × 1 mm (but the length may vary from 1 to 11 mm) is present at each side, with usually a puberulous base.

Gynoecium: ovary inferior, subcylindrical, up to 13 × 7 × 4 mm, glabrous, 3-locular with numerous, subglobose white ovules (a bit brown at top); placentas situated in the middle of each lamina; ovary wall fleshy, green, brown-red speckled on transverse section (in specimens conserved in spirit), with a rather long sterile upper part; style thin, terete, ca 0.5 mm diam., up to 5 cm long, glabrous to densely puberulous in the upper half, at top widening into a funnel-shaped ciliate stigma, ca 2 mm wide; in bud, the stigma is situated above the thecae; at anthesis, it lies against or slightly below the base of the thecae; top of ovary provided with usually 2 (sometimes many) lobed fleshy glabrous outgrowths (perhaps nectaries), which are ca oblong, with rounded apex, unequal in length, up to 21 × 1 mm, partly clasping the style.

Fruit indehiscent, fleshy, subconical, up to ca 6 cm long and 3.5 cm diam., shiny-green when immature, turning bright-red at maturity, usually showing 3 longitudinal furrows (the 3 carpels), sometimes more furrows are present; dried fruits (as often sold on markets) flask-shaped, ca 3–6 cm long and 1.5–3 cm diam., with a beak ca 1–2 cm long, brown to grey-brown, with a tough, strong fibrous wall, usually showing irregular ribs and furrows due to shrinkage; fruit with 3 clusters of ca 45–65 seeds each.

Seeds subglobose in outline, usually somewhat angular, ca 2–5 mm diam., with a glossy, light to dark-brown, glabrous, finely lined testa and a circular, whitish hilum; aril thin, a bit fleshy, finely lined, completely covering the seed, becoming papery after drying; section of the seed through the hilum shows that the seed-coat is partly strongly thickened (mainly opposite the hilum) dividing the space within in two distinct parts; the thickened, pale-brown, somewhat spongy part of the seed-coat may constitute a varying fraction of the seed volume (up to 0.75), and shrinks considerably on drying, giving the seeds a wrinkled appearance on top; the other part is filled with an irregularly shaped, very white mass of perisperm; within this mass, more or less in the centre, a small, subovoid, dirty-white mass of endosperm can be observed; the embryo is small, ca 1.5×0.5 mm, erect, straight or slightly curved; its cotyledon is embedded in the endosperm; its reversedly funnel-shaped radicle is situated near the hilum; the seeds have a strong spicy smell and taste.

Notes:

(1) The embryo remains standing upright if put on its radicle.
(2) Flowers of specimens conserved in spirit may show red-brown excretions on different parts, especially on the throat of the corolla and the upper part of the style.
(3) Dry fruits, sold on Ethiopian markets, often show a hole through the upper part. (Fruits are dried in the sun, hanging on a rope).

Taxonomic notes

(1) The identity of korarima has been a mystery to botanists for a long time. Its fruits, however, were known by 'Cordus, Matthiolus, Geoffrey, Smith and Geiger' as '*Cardamomum majus*' or as '*Cardamomum maximum* Matthioli'. They realized that these fruits were different from the fruits known as Melegueta pepper (Pereira, 1850). In 1775, Forskal stated that their Arabic name was 'habhal-habashi' (Flückiger & Hanbury, 1874). In 1847, Pereira published an article on the 'cardamoms of Abyssinia' and he considered the fruits of korarima as identical with those of *Amomum angustifolium* Sonnerat. In 1850 Pereira preferred to give the korarima fruits a distinct (provisional) name *(Amomum korarima)*, as he had some doubts about his earlier statement of their identity. (The year of Pereira's *Amomum korarima* publication is often erroneously cited as 1842).

Schumann (1904, p. 32) stated that korarima belongs to the genus *Aframomum*, but he did not publish the new combination: *Aframomum korarima*. This was done for the first time by Engler (1908) and thus the author citation should be *A. korarima* (Pereira) K. Schum. ex Engler.

In 1939 (Meyers 10612, K) and later from 1957, complete specimens of korarima were collected and so korarima became better known. Until 1939, only the fruit was available to botanists. In 1963, Siegenthaler provided a coloured drawing of fruits and flowers and a black-and-white drawing of an anther and pistil. In 1978, Lock gave a complete description of the species and designated as lectotype a fruit in BM, labelled 'korarima of Abyssinia, Dr Beke'.

(2) Although Pereira's *Amomum korarima* (1850) has always been considered as the oldest name for this taxon, A. Braun already named it in 1848. Braun reported that he had received Ethiopian fruits from W. Ph. Schimper, who had received them from his relative W. Schimper, at that time living in Ethiopia: '... in jüngster Zeit hat der kühne und ausdauernde Reisende [W. Schimper], der unterdessen zum abyssinischen Statthalter der Provinz Antitcha geworden und seine Residenz in Amba Sea aufgeschlagen hat, weitere Materialien zur Kenntniss der abyssinischen Cultur- und Arnzei-pflanzen, mit vielen handschriftlichen Bemerkungen begleitet, an seinen Verwandten in Strassburg, den Bryologen W. Ph. Schimper, gesendet, welcher die

Güte hatte, die gesendeten Exemplare und Samen mit mir zu theilen. . . .'. On p. 95–96 as No 35, Braun (1848) published '*Amomum? Corrorima*', with the following notes and description: 'Kommt durch den Handel aus den Gallaländern und wird als Gewürz benützt. Preis in Godscham 2000 Stück zu 1 Thaler, in Massauah 500–1000 Stück zu 1 Thaler. Die von Schimper unter dem Namen Corrorima gesendeten Früchte gleichen am meisten dem *Cardamomum javanicum* des Handels, sind aber fast doppelt so gross; von dem *Cardamomum longum* sind sie durch grössere Dicke sehr verschieden. Sie sind 3-fächerig und enthalten zahlreiche, in häutige Hüllen eingeschlossene Samen, welche an Grösse, Gestalt und Farbe fast ganz mit den Paradieskörnern übereinstimmen, jedoch von weniger brennendem, angenehmer gewürzhaftem Geschmacke sind.' Although Braun was not certain whether this taxon belonged to the genus *Amomum*, the name *Amomum corrorima* is a validly and effectively published name, and has priority over Pereira's name of 1850. Here I publish the new combination *Aframomum corrorima* (Braun) Jansen, as the korarima certainly belongs in the genus *Aframomum*. I cannot locate the original herbarium material of Braun. Most probably it went to Berlin, where it is no longer.

Neither was it to be found in the following herbaria: Giessen, HBG, KR, LZ, TUB, K. At Berlin, one box with 3 korarima fruits (!) is present with the labels: 734, *Amomum korarima* Abyssinia and (written by Loesener): 'species incertae sedis sogenanntes *Amomum korarima* Pereira?'. It is not likely that these fruits are from Braun's collection, otherwise the Schimper name 'corrorima' would have been used. At Paris, however, one box (No F511) contains 2 fruits of korarima and a label, written by W. Schimper himself: 'corrorima. Kommt durch den Handel nur von den Gallaländern. Frucht als Gewürze. Früchte in Godscham 2000 – 1 Thaler, in Massauah 500–1000 – 1 Thaler'. As this text is exactly the same as Braun reports, this specimen may be considered an isotype of the specimens Schimper sent to W. Ph. Schimper and, for lack of Braun's specimens, I designate these two fruits at P as the lectotype of the species. The box also contains some loose brown korarima seeds and black *Nigella sativa* seeds, which may indicate that Schimper bought the fruits on a market in Ethiopia, where spice samples are often mixed intentionally or unintentionally with other things (*Nigella sativa* seeds are used as a spice in Ethiopia; see p. 76). The box bears the name: *Amomum angustifolium*, for purposes of labelling.

(3) In the same habitats as *A. corrorima*, another *Aframomum* can be found in Ethiopia: *A. zambesiacum* (Baker) K. Schum. subsp. *puberulum* Lock. This species is known in Kefa Province as 'sheti-ofjo' (monkey's korarima) and is not used by the people. The people distinguish this species from the real korarima by the smell of the leaves: the leaves of the real korarima are more aromatic. Other clear distinguishing characteristics of this species are: the leaves are pubescent on the margins and on the midrib below; inflorescences have 25–50 flowers; bracts of the peduncle are densely appressed-puberulous over their whole external surface (Lock, 1978).

The species *A. polyanthum* (K. Schum.) K. Schum. and *A. sanguineum* (K. Schum.) K. Schum., though listed by Cufodontis (1972), have not been collected in Ethiopia as far as is known (Lock, pers. commun., 1979).

(4) The description is based on the following specimens:

Hararge Alemaya market: WP 31 (dry frs), PJ 5910 (dry frs); Dire Dawa market: WP 135 (dry frs), Bos 8356 (dry frs), PJ 1035 (dry frs); Harar market: WP 68 (dry frs), Bos 8044 (dry frs, also in spirit).

Kefa 20 Km NW of Bonga, near Buba, alt. 1800 m, 17-8-1965: W. de Wilde c.s. 7788 (fl, frs); Bonga, around catholic mission station, alt. 1800 m, 17-2-1968: WP 3328 (fl, frs in spirit); 8 Km on road Bonga-Wush-Wush, alt. 1800 m, 18-2-1968: WP 3342 (fl, frs, also in spirit); 11.5 Km on road Bonga-Wush-Wush, alt. 1930 m, 5-7-1968: WP 5536 (fl, frs, also in spirit); 8 Km on Bonga-Jimma road, alt. 1700 m, 6-7-1969; J. J. F. E. de Wilde 5375 (frs); 8 Km on Bonga-Jimma road, alt. 1700 m, 30-8-1974: Bos 8431 (frs); Bonga, around catholic mission station, alt. 1740 m, 20-7-1975: PJ 2151 (frs), alt. 1750 m, 21-7-1975: PJ 2198 (frs); Around Bonga, alt. 1850 m, 24-3-1976: PJ 5544 (fl, frs in spirit), 15 Km on road Bonga-Jimma, alt. 1900 m, 26-3-1976: PJ 5620 (frs); Agaro market: SL 108 (seeds); Bonga market: WP 5537 (seeds), PJ 2206 (frs, also in spirit), PJ 2207 (dry frs); Jimma market: Bos 8630 (dry frs, also in spirit).

Shoa Shashemene market: WP 1727 (frs, also in spirit).

Wollega Ghimbi market: PJ 1183 (dry frs), PJ 1188 (dry frs).

The following specimens originating from Ethiopia, were seen: Addis Ababa, 1937: P. G. Piovano 18(frs, FT); Bonga, 7° 15'N × 36° 13'E, alt. 1700 m, 7-1-1973: I. Friis, Getachew Aweke, F. Rasmussen, K. Vollesen 2133 (frs, K); Bonga, 7°15'N × 36°11'E, alt. 1800 m, 29-4-1967: E. F. Gilbert 302 (fl, K); Bonga, 7°15'N × 36°15'E, alt. 1800 m, 15-11-1960: H. F. Mooney 8657 (K); W. de Wilde c.s. 7788 (K); Bonga, 7-5-1937: Ufosso 194 (FT); Bonga, April 1937: P. G. Ciravegna s.n. (frs, FT); Ghimbie, 9°11'N × 35°50'E, alt. 2000 m, 4-2-1962: F. G. Meyer 8152 (K); Gondar, 30-10-1909: E. Chiovenda 3303 (frs, FT); Kachissy, 21-10-1935: E. Taschdjian 151 (frs, FT); Kaikala forest, 12 km N of Bonga, 7°19'N × 36°12'E: F. G. Meyer 7873 (K); Mezan Tefari, 6°58'N × 35°25'E, alt. 1350 m, 29-7-1962: H. F. Mooney 9187 (FT,K); Box with fruits s.n. *(Amomum korarima* Pereira, Elem. Mat. Med. p. 1136, fig. 245–247, BM); Box with 2 fruits, F 511, with label in Schimper's handwriting, s.n., Corrorima etc. (P, lectotype); R. Corradi 10515 (fr, FT); Khor Aba, Aloma plateau, Sudan, 7-3-1939: J. G. Meyers 10612 (fl, K).

Ecology

In Ethiopia, korarima grows naturally at (1350–) 1700–2000 m altitude on slighty shaded, more or less open places in forests. These areas have an annual rainfall of ca 1300 mm to more than 2000 mm, of which 50–60% falls in 'summer' (June–August) and 15–20% in 'spring' (March–May); there is no real dry season. The annual average temperature is ca 20°C (Westphal, 1975). Noteworthy is that in Ethiopia korarima grows in almost the same habitats as coffee in the wild.

The plants flower from January to September (some perhaps also in the remaining months). The fruits are mature ca 2–3 months after flowering. The main flowering period in Kefa Province is June–July with fruits in September–October (Pajella, 1938; Siegenthaler, 1963; Herb. WAG).

The position of the stigma in the flower, below or against the base of the anther thecas, hints at self-pollination of korarima, but there is no experimental or observational evidence. The presence of rather large nectaries at the top of the ovary make insect visits rather probable. In many other *Aframomum* species, the stigma is situated at the top of the anther-thecas and cross-pollination caused by insects is the normal process, although the plants are self-fertile too. Most probably the flowers are open for only one day (Lock et al., 1977).

Natural dispersal of the seeds is certainly increased by animals (monkeys), which eat the pulp around the seeds.

Husbandry

Korarima can be propagated by seeds but is probably easier and quicker to plant from rhizome parts. No information is available about its cultivation methods in Ethiopia. In Kefa Province the fruits are mainly harvested from plants growing in the wild. Perhaps people influence the wild population by rough propagation. As the desired products of korarima are the seeds, only mature red fruits should be gathered; they should be carefully dried. The fruits are usually pierced near the top

Photograph 2. *Aframomum corrorima* in forest near Bonga.

and strung on strips of banana fibre or other ropes and hung to dry in the sun (Siegenthaler, 1963). As the drying is usually badly done, and the fruits are often mixed with immature ones, the dried product is of poor quality. So there is no export to Europe nor the United States. Some is exported to markets of Sudan, Egypt, Arabia, Iran and India (Baldrati, 1950).

The dried fruits are sold on almost every Ethiopian market and are quite expensive, relative to other spices (ca 5–10 birr-cts per fruit). In the production areas, fresh fruits are sold too, rarely only seeds.

If the cultivation method is comparable to the West African *Aframomum melegueta*, the plants are sown in the rainy season, in the shade of other crops and transplanted the next rainy season to a more even spacing. The plants start producing 3 years after sowing and may produce during the next 4 years. The yield (without fertilizers) can be ca 500 kg of dried fruits per ha (Lock et al., 1977).

Stewart & Dagnatchew (1967) observed a rust, *Puccinia aframomi* Hansford, on korarima plants in Kefa Province.

Uses

1. Culinary uses

Korarima seeds (dried, sometimes fresh) are used in Ethiopia to flavour all kinds of 'wot', for which they are ground and usually mixed with other spices. Another widespread use of the seeds in Ethiopia is as a flavouring to coffee (sometimes also to tea). Sometimes they are used to flavour a special kind of bread (Asrat, 1962). In Kefa Province butter is flavoured with korarima (Pajella, 1938). Compared to other Aframomums *(A. melegueta),* the seeds of korarima have a less peppery pungent taste; they have a milder, sweeter flavour (Flückiger & Hanbury, 1874; Engler, 1895). The arilloid flesh around the seeds is edible too (Engler, 1895).

2. Medicinal uses

In Ethiopia the seeds of korarima are used as a tonic, as a carminative and as a purgative (Ferrara, 1957; Lemordant, 1960).

3. Miscellaneous uses

Sometimes strings of fruits are used as an ornament or, by the Arabs, as rosaries (Flückiger & Hanbury, 1874). The fruits were once used as money in Ethiopia (Berger, 1964).

Chemical composition

The seeds of korarima contain ca 1-2% of an essential oil (Ferrara, 1957; Berger, 1964). The oil has a typical odour and is sometimes called 'nutmeg-cardamom' (Berger, 1964). Lawrence (1970) steam-distilled dried comminuted fruits for 8 hours and obtained about 3.5% of pale yellow volatile oil with a flat cineolic odour, in which he found the following compounds:

α-pinene	3.2%	1,8-cineol	35.1%
camphene	0.2%	γ-terpinene	2.6%
β-pinene	6.8%	P-cymene	3.9%
sabinene	6.7%	terpinolene	0.4%
myrcene	0.4%	terpinen-4-ol	5.4%
α-phellandrene	0.3%	α-terpineol	3.4%
α-terpinene	0.9%	geraniol	4.8%
limonene	13.5%		

2.2 Anethum foeniculum L. — Fig. 2

'*Anethum*': from the Greek '*anethon*', a plant name of Aristophanes; probably derived from the Greek 'aëmi', which means 'I breathe', because of the strong odour of these plants. '*foeniculum*': diminutive of the Latin 'foenum' = 'hay'; so, '*foeniculum*' means small hay, fine hay, because the dry leaves are hay-like.

Linnaeus, Sp. Pl. ed. 1: p. 263 (1753).
Type: 'Habitat in Narbonae, Aremoriae, Maderae rupibus cretaceis'. Specimen in Hort. Cliff. herbarium (BM) with on the sheet the inscription: '*Anethum foeniculum dulce* CB. P.' (lecto.!).

Synonyms

Foeniculum vulgare Mill., Gard. Dict. ed. 8, 1, alphabet. (1768).
Foeniculum capillaceum Gilib., Fl. lithuan. 2: p. 40 (1782).
Foeniculum officinale All., Fl. Pedem. 2: p. 25 (1785).
Foeniculum foeniculum Karsten, Fl. Deutschl. 2: p. 462 (1895).
Anethum rupestre Salisb., Prodr.: p. 168 (1796).
Ligusticum foeniculum Crantz, Class. Umbell. Emend.: p. 82 (1767).
Meum foeniculum Spreng. in: Schult., Syst. veg. 6: p. 433 (1820).
Ozodia foeniculacea Wight & Arn., Prodr.: p. 375 (1834).
Selinum foeniculum E. H. L. Krause in: Sturm, Fl. Deutschl., ed. 2, 12: p. 115 (1904).

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1768: Miller, Gard. Dict., ed. 8, 1: *F. vulgare.* (tax.)
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1859: Lenz, Botanik der alten Griechen und Römer: p. 561–562. (use)
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1962: Karsten et al., Lehrbuch der Pharmakognosie, ed. 9: p. 502–505. (use)
1962: Watt & Breyer-Brandwijk, Medicinal & poisonous plants S. & E. Afr., ed. 2: p. 1038. (use)
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1963: Sundararaj et al., Preliminary observations on fennel with special reference to floral biology, Madras Agric. J. 50: p. 235–238. (bot.)
1964: Ramanujam, Extent of randomness of cross-pollination in some umbelliferous spices of India, Indian J. Genet. 24: p. 62–67. (bot.)
1968: Tutin, *Umbelliferae,* in: Flora Europaea 2: p. 341. (tax.)
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1976–
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1978: Cannon, *Umbelliferae,* in: Flora Zambesiaca 4: p. 605–607. (tax.)
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Local names: insilal, ensilal, kamun (Amarinia); kamuni, kamona (Gallinia); ensellal, silan (Tigrinia).
Trade names: fennel, finkel, spingel (English); fenouil, aneth doux, aneth fenouil (French); Fenchel (German).

Note 1. Seed samples, offered for sale on Ethiopian markets under the local names are almost always mixtures of seeds of *Anethum foeniculum, Anethum graveolens* and *Cuminum cyminum.*
Note 2. *Nigella sativa* is sometimes called 'fennel-flower' in the literature.

Geographic distribution

In all probability, *Anethum foeniculum* originates from Southern Europe and the Mediterranean area. It is now worldwide, being cultivated and used since ancient times. Cultivation is reported from Algeria, Austria, Bulgaria, Czechoslovakia, China, Egypt, Ethiopia, France, Germany, Great Britain, Greece, India, Indonesia, Iran, Italy, Japan, Crete, Malta, Rumania, Spain, the Netherlands, the United States and the Soviet Union (Rolet, 1918; Thellung, 1925; Rosengarten, 1969).

In Ethiopia, it is a common plant of the highland flora in all provinces and it is occasionally cultivated too (Cufodontis, 1959; Herb. WAG, FT).

Description

An erect perennial herb, up to 2 m high, with a strong light-brown to yellowish taproot, up to 2.5 cm diam. with many laterals; green parts often glaucous, making the plant look blue-green; all parts glabrous, sweet-smelling, especially after crushing.

Stem terete to subterete, up to 2.5 cm diam. at base, sulcate, profusely branched at all heights, blue-green with light-green ribs, yellowish at nodes, internodes often becoming hollow when older.

Leaves alternate, decompound, sheathed; sheath forming an open cylinder, at base embracing the stem, 2–15 cm long, with white scarious margins, whitish inside, sulcate and yellow-green outside; rest of petiole subterete, sulcate, 0–10 cm longer than the sheathing part; blade triangular in outline, up to 30 × 50 cm, the upper ones usually much smaller, bi- to hexa-pinnately divided into filiform, acute, blue-green lobes 1–14 cm long; primary pinnae odd-numbered, 3–19.

Inflorescence: a compound umbel, up to 20 cm diam. but usually smaller; peduncle terete to subterete, finely sulcate, light-green to blue-green, 3.5–15(–24) cm long; bracts and bracteoles absent; primary rays terete to subterete, finely sulcate, 5–30(–33) per umbel, (0.2–)0.5–7(–12.5) cm long, unequal in length, the longest situated at the outside of the umbel, blue-green; secondary rays terete, finely sulcate, (2–)10–30(–45) per umbellet, 0.5–9(–11) mm long, unequal in length, the shortest in the centre, light-green to blue-green; (seldom one of the primary rays starts lower than the common point, or one of the secondary rays continues to form an umbellet of the second order); all flowers bisexual and actinomorphic, often some central ones remaining rudimentary, protandrous (usually the styles and stigmas developing fully after shedding of corolla and stamens).

Calyx: vestigial, often visible at the top of the ovary as a slightly protruding adnate ring, seldom with some small teeth, light-green.

Corolla: petals 5, distinct, subovate in outline, up to 1.5 × 1 mm, top strongly inflexed, with a thin membranous outgrowth on the ventral side of the midrib from base to nearly the top, glabrous, yellow, margin entire, usually notched at apex.

Androecium: stamens 5, distinct, alternating with the petals; filaments conical, tapering from the fleshy base towards the filiform apex, up to 1.5 mm long, yellow, inflexed in bud; anthers dorsifixed, 2-celled, ovate, ca 0.5 × 0.5 mm, yellow, dehiscing by longitudinal slits.

Gynoecium: pistil 1, ovary inferior, subterete, ca 1–5 × 1–1.5 mm usually with 8, slightly protruding, narrow longitudinal subparallel ribs, bilocular with 1 pendulous ovule per locule, light-green, crowned by a white, persistent, conical, fleshy stylopodium of ca 0.5–1 × 1–1.5 mm; styles 2, persistent, fleshy, ca 0.5 mm long, spreading, white, with a small, slightly thickened, spherical, finely papillate, white or light-green apical stigma.

Fruit: usually an ovoid-oblong erect, but sometimes slightly curved, schizocarp, 3–8.5 × 2–2.5 mm, light-green to yellow-brown or grey-brown, splitting at maturity

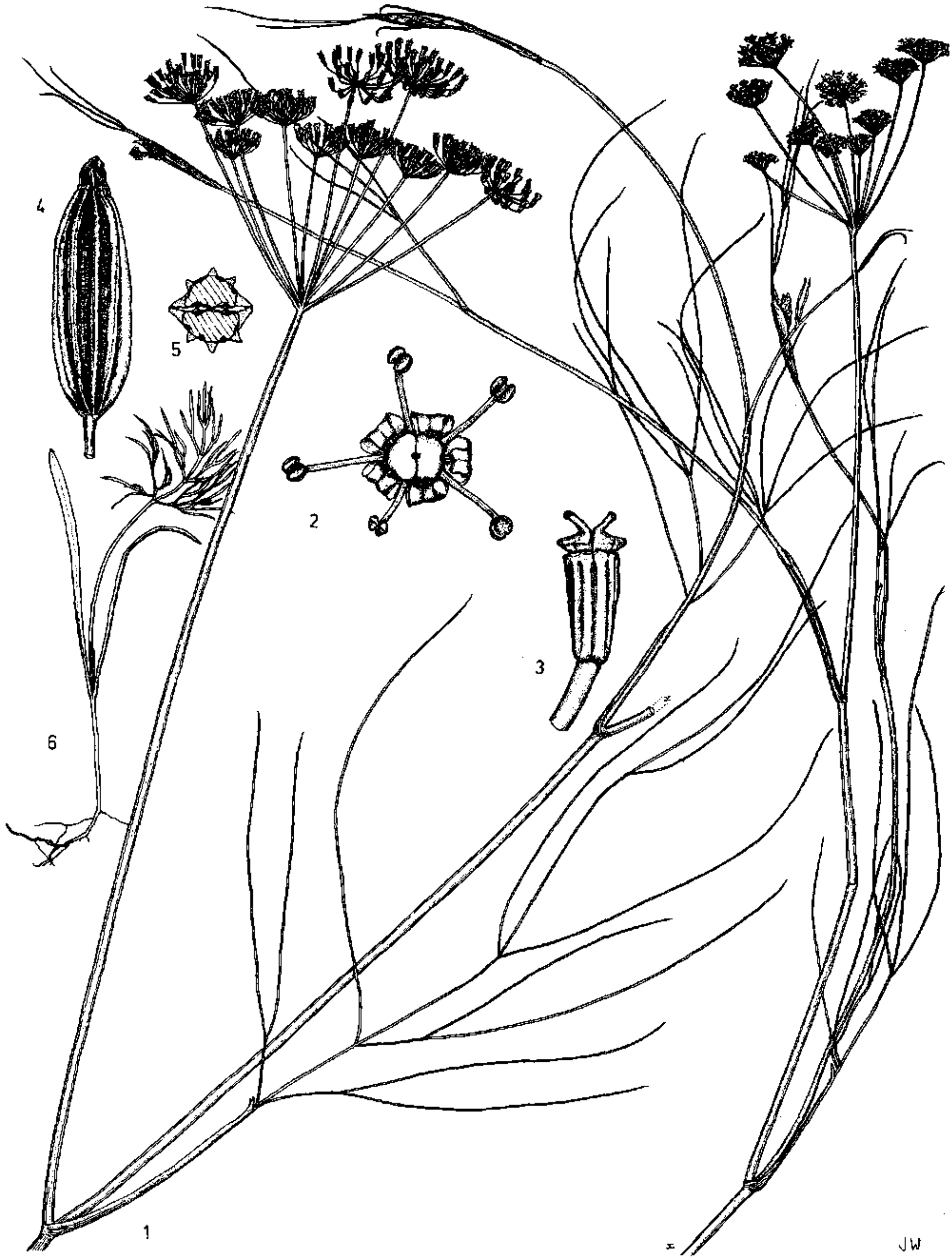


Fig. 2. *Anethum foeniculum* L. – 1. habit of plant part ($\frac{2}{3}\times$); 2. male flowering stage of flower ($6\times$); 3. female flowering stage of flower ($6\times$); 4. fruit ($6\times$); 5. cross-section fruit ($6\times$); 6. seedling ($\frac{2}{3}\times$). – 1. PJ 603; 2. WP 7388 (spirit mat.); 3. WP 7352 (spirit mat.); 4–5. PJ 881; 6. PJ 131 (spirit mat.).

into 2 mericarps fixed at the top to an erect, white, thin carpophore, which is split to the base; mericarps flat or slightly concave at the commissural side, convex at the dorsal side, usually with five longitudinal, subparallel, prominent ridges, triangular in transverse section, yellow to grey-brown, alternating with usually dark-brown or grey, not protruding oil-containing stripes (vittae); the two commissural ridges are usually flatter and wider than the other ones; the commissural side usually showing two dark-brown, longitudinal vittae.

Seed: testa adnate to the pericarp; embryo situated in the apical part of the mericarp, usually straight, up to 2 × 0.2 mm, white, with conical radicle and two small cotyledons; endosperm copious, greyish, fatty.

Seedling: germination epigeal; taproot about same length as the aerial parts, yellow-brown, with many finer side-roots; hypocotyl terete, 2–25 mm long, brownish or purplish; cotyledons opposite, linear, attenuating towards slightly sheathing base, ca 20–60 × 1–2 mm, light-green, entire; next leaf decompound, petiole 3–10 cm long, sheath 0.5–2 cm long with white scarious margins, blade triangular in outline, up to 4.5–5.5 cm, usually divided into 5 or 7 pinnae, each divided into filiform to sublinear lobes 1–16 mm long.

Taxonomic notes

(1) Although Linnaeus (1753) named this taxon '*Anethum foeniculum*', fennel is now currently known as '*Foeniculum vulgare* Mill.'. The genus '*Foeniculum*' was described by Miller (Gard. Dict. Abr. ed. 4, 1754). Miller (1768) named this Linnaean species '*Foeniculum vulgare*' and justified separation of the genus '*Foeniculum*' from the genus '*Anethum*' as follows: '... as the seeds of fennel are oblong, thick and channelled, and those of dill [*Anethum graveolens*] flat and bordered, it is much better to keep them separate, than to join them in the same genus....' Miller accepted dill as a species in *Anethum*. The fruits of fennel and dill are different indeed, but hardly any other morphological difference can be detected between the two species. Even the fruit character is not always distinctive, as some intermediate fruit-forms exist. In my opinion, two species, that are so closely related (they cross easily), belong in the same genus, and their differences are better expressed at a specific than at a generic level. Although the name '*Foeniculum vulgare*' was generally adopted since Miller, we should return to Linnaeus's opinion, expressed in the name: '*Anethum foeniculum*'. If *A. foeniculum* and *A. graveolens* are to be kept in different genera, the genus conception becomes so narrow that it would justify, often on better grounds than in this case, the creation of numerous new genera in almost all plant families.

(2) In Sp. Pl., Linnaeus (1753) described the species '*Anethum foeniculum*' as: '*Anethum* fructibus ovatis' and he referred to three of his own earlier works, to Roy. lugdb. 116, and to three 'names' of Bauh. pin. 147. The first Linnaean reference is to Hort. Cliff. (1738) where he had described the species as: '*Anethum* fructo ovato'. Obviously, Linnaeus's opinion of the species had not changed between 1738 and 1753 and so the type-specimen should preferably be chosen from the Hort. Cliff. herbarium. In this herbarium (p. 106, No 2, BM), 5 specimens are present under '*Anethum* fructo ovato'. Only one of the five specimens is accompanied by six loose

mature mericarps (half-fruits). The other specimens mainly bear flowers, sometimes with a few very young fruits. As that specimen bears also two leaves, one flowering umbel and one (young) fruiting umbel, it is the most complete specimen and the only one showing the character of the description.

In the LINN herbarium, four specimens are present under *'Anethum foeniculum'* (No 371.4–371.7), but all of them without mature fruits. In the van Royen herbarium (L), only a sterile specimen is present.

I designate as lectotype of the species *'Anethum foeniculum'* the specimen in the Hort. Cliff. herbarium (BM), p. 106, with on the sheet the inscription: *'Anethum foeniculum dulce* CB. P.'

(3) In the literature, there is great diversity of opinion about the number of species, subspecies, varieties and forms of *Foeniculum*.

Miller (1768) distinguished three *Foeniculum* species: (1) *F. vulgare:* 'fennel with decompounded leaves, whose small leaves are shorter and end in many points, and a shorter seed'; (2) *F. dulce:* 'fennel with decompounded leaves, whose small leaves are very long and a longer seed'; (3) *F. azoricum:* 'dwarf fennel with a fleshy stalk, recurved seeds and an annual root'.

Thellung (1925) distinguished only one species (*F. vulgare* Mill.), with two subspecies: (1) *piperitum* (Ucria) Coutinho: perennial, 0.5–2 m high, leaf-lobes shorter than 20 mm, leaf-sheaths 1–3 cm long, primary rays 4–12, fruit not sweet, dry places, Mediterranean region; (2) *capillaceum* (Gilib.) Holmboe: short living, leaf-lobes 20–50 mm, leaf-sheaths 2–5 cm long, primary rays 12–25, Mediterranean area. Thellung stated that many transitional forms between the two subspecies existed. In practice his division is pretty useless.

Tutin (1968) distinguished two subspecies of *F. vulgare* Mill.: (1) *piperitum* (Ucria) Coutinho; (2) *vulgare:* biennial, leaf-lobes usually more than 10 mm long, terminal umbel not overtopped by lateral ones, primary rays 12–25, fruit sweet-tasting.

Hedge & Lamond (1972), Shishkin (1973) and Cannon (1978) do not make any subdivision of *F. vulgare,* nor do they distinguish more than one *Foeniculum* species (*F. vulgare* Mill.).

(4) For Ethiopia, Cufodontis (1959) distinguished two *Foeniculum* species: *F. piperitum* (Ucria) Presl and *F. vulgare* Mill. The material I studied certainly belongs to one (perennial) species: *Anethum foeniculum* L. It does not make any sense to subdivide this species. The variability observed in Ethiopia is, in my opinion, due to environmental circumstances only. Specimens originating from the same plant, but collected in the dry season may differ considerably from specimens collected in the rainy season.

The numerous, more or less constant different 'forms' of *Anethum foeniculum* could be preferably described and studied at cultivar level, rather than at subspecific or varietal level. It may be noted that the taxonomical entity 'subspecies' should be used in subdividing a species only, when morphological characters are combined with geographical or ecological separation and is not appropriate to accommodate the variability caused by human interference within a cultivated species.

(5) Plants grown at Wageningen were more etiolated and less robust than those grown from the same seed samples of *A. foeniculum* in Ethiopia.

(6) The description is based on the following specimens:

Begemdir	Debarek market: WP 4971; Gondar market: WP 4999.
Hararge	Alemaya, College of Agriculture, cultivated: PJ 1402–1407, PJ 1820, PJ 1827–1828, PJ 4382–4385, PJ 5131, PJ 5217–5218, PJ 5901–5902, PJ 7023; Alemaya in field: Bos 7483, Bos 7902–7903, Bos 7897, Bos 8083; Alemaya, road to Kombolcha, 2 km from College gate: WP 415, WP 519; 60 km SW of Alemaya: W. de Wilde 9819; Asbe Tefari: F. G. Meyer 8735; Assebot market: SL 702; Bati, in field: PJ 1760; Dire Dawa market: WP 110, WP 114, Bos 8371, Bos 8385, PJ 1044, PJ 5931; Gursum market: PJ 4465; Harar market: WP 81, WP 4038B; Jijiga market: SL 360; Lange market: SL 280; Mieso market: WP 1438, WP 3515; Moulu market: SL 453.
Kefa	Jimma market: WP 3275–3276, WP 3278, WP 3280B.
Shoa	Ambo, in garden: PJ 1214–1215; Debre Zeit in garden: WP 1965; Nazareth, cultivated: PJ 2424–2425, PJ 4829–4830.
Sidamo	41 km from Soddo on road to Shashamane, in garden: WP 2874.
Wollega	Nekemt market: PJ 1194.
Wollo	Bati market: SL 1032
Grown at Wageningen	WP 5869–5870, WP 6006–6008, WP 6020–6021, WP 6146–6147, WP 7344, WP 7347–7352, WP 7363, WP 7387–7388, WP 8654, WP 8660–8661, PJ 130–134, PJ 596–597, PJ 603, PJ 654–655, PJ 758–760, PJ 834–839, PJ 878–881.

The following specimens, originating from Ethiopia, were seen (all in FT herbarium): I. Baldrati 506; A. Bellini 182; A. de Benedictus 298; L. Buscalioni 631, 1642; E. Chiovenda 2252; R Corradi 2626, 2627; A. Fiori 1456; G. Giordana 807; Massa 785; F. G. Meyer 8735; G. Negri 705; A. Pappi 86, 99, 604, 5086, 5769; R. Pichi-Sermolli 693, 694, 695; F. G. Piovano 492; P. Rovesti s.n. (26-12-1931); G. Schweinfurth & D. Riva 1855; L. Senni 975; A. Terracciano & A. Pappi 535, 912, 2015, 2208.

Ecology

In Europe, fennel is said to be best suited for cultivation in areas where grapes can be grown: on light sunny well-manured and well-drained limy soils (Thellung, 1925; Redgrove, 1933). For Italy, Gorini (1977) reported that the optimum monthly average temperature to grow fennel is 15–18°C and the minimum temperature is 7°C. He stated that plants thrive best with long days and warmth during early stages of growth.

In India, fennel is grown at altitudes up to 2000 m (Sundararaj et al., 1963).

In Ethiopia fennel is a common perennial weed of the highlands, growing at altitudes of 1500–2500 m (Herb. WAG). The Ethiopian plants are resistant to light frosts and to long dry periods.

According to Ramanujam et al. (1964), 80–90% cross-pollination occurs in fennel, although Sundararaj et al. (1963) reported that 100% self-pollination and fertilization may occur, if cross-pollination is prevented. As the flowers of *A. foeniculum* are protandrous, cross-pollination seems natural.

Husbandry

Fennel is easily propagated by seed. According to Redgrove (1933), the plant can be propagated too by dividing its (mainly underground) parts. The plant will grow almost anywhere, but it does best on well-manured well-drained light sunny limy soils (Redgrove, 1933). The seeds are usually sown in drills, 40–80 cm apart. Within the rows the seedlings are thinned to 20–40 cm apart. Per ha, up to 10 kg seed is required (Rolet, 1918). Fennel seed keeps its viability for ca 3–4 years under normal circumstances. Germination is usually ca 60–70% (Gorini, 1977). The seed germinates in about two weeks. According to Gorini (1977), the germination time is prolonged by low temperatures (at 7°C 25 days; at 25°C 8–15 days). The plants will flower ca 3–4 months after sowing and the fruits can be harvested ca 5–7 months after sowing. Gorini (1977) advised dressing with nitrogen, phosphorus and potassium in the ratio N:P:K = 1.7:1:1.

As the fruits of fennel do not mature at the same time, harvest is spread over several weeks. The first harvested umbels usually give the best fruits and the best quality oil. The fruits should be dried carefully in the shade. If dried in the sun, essential oil is lost. The total yield may be 1000–2000 kg of fruits per ha, but in the first two years, the yield usually is considerably less. The plants are usually destroyed after three or four years, as a degeneration seems to result after some time in smaller fruits (Thellung, 1925; Rosengarten, 1969). Several cultivars, however, are grown as an annual crop. Anahosur et al. (1972) observed a lot of fungi internally and externally on fennel seed, causing necrosis of the leaves, and rotting of seeds and seedlings. Sulphur effectively controlled all of them. Several other fungal diseases of fennel have been reported:

- Black spot, caused by *Phoma foeniculacea* Sacc. (also present in Ethiopia).
- False mildew, caused by *Plasmopara nivea* Schroet.
- Early dying of the plant, caused by *Sclerotinia libertiana* Fuckel.
- Root-rot caused by *Rhizoctonia violacea* Tul.

The caterpillars *Mamestra persicariae* L. and *Depressaria* sp. are reported as pests of fennel. In India, severe attacks of aphids and losses up to 40% caused by larvae of the chalcid fly *Systole albipennis* Walk. eating the seed-embryo have been observed (Rolet, 1918; Thellung, 1925; Redgrove, 1933; Gupta, 1962; Stewart & Dagnatchew, 1967).

In Ethiopia, fennel is hardly cultivated, as the plant grows abundantly in the wild. When found as a weed, some plants may be left on the fields or they may be cultivated around houses for direct use. Plants cultivated in Alemaya, took ca 10 months before they were harvestable. Once the plants were well established, they continued flowering and fruiting throughout the year, with an optimum after the first rains of a new season. A severe attack of an unidentified fungal disease was observed in the cultivated plants, though the plants growing in the wild usually looked remarkably healthy.

Uses

1. Culinary uses

Since ancient times, fennel has been used as a spice because of its pleasant smell and taste (Lenz, 1859). The fruits are used, for instance, to flavour bread, cheese, meat, soups, sweet pickles, fish, liqueurs and confectionary. The essential oil of the fruits is used as an adaptable flavouring agent in manufacturing, for instance of soaps, perfumes, liqueurs and other alcoholic beverages, sauces, cough drops, licorice sweets and cakes (Redgrove, 1933; Rosengarten, 1969; and many other sources).

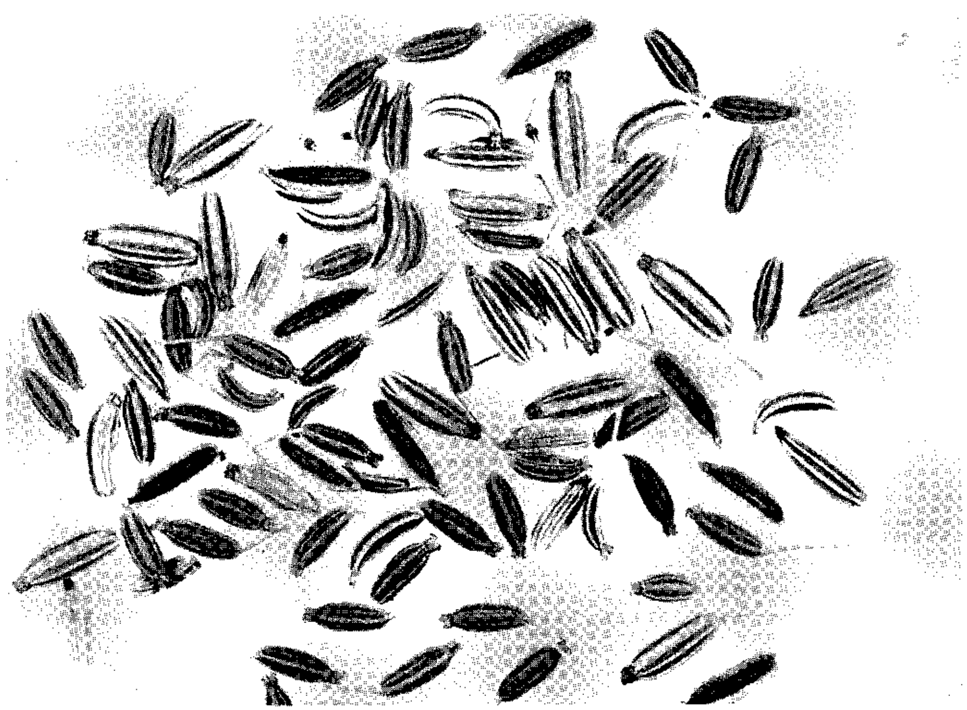
The fresh leaves are used to flavour fish sauces and to garnish fish; fennel is often called 'the fish herb'.

In France, the young tender stems of a sweet cultivar of fennel are eaten raw as a salad (Rosengarten, 1969). In many European countries the large petiole-sheaths of a fennel cultivar are cooked as a vegetable (Rosengarten, 1969; and many other sources).

In Ethiopia the ground fruits of fennel are a constituent of some 'wot' sauces. Perhaps more important is its use, together with young stems and leaves, in the preparation of alcoholic beverages like 'katikala', 'areke' and 'tedj', to which it gives a typical flavour (Asrat, 1962; Telehun, 1962; Amare, 1976).

2. *Medicinal uses*

In many countries the fruit and oil of fennel are still officinal. The recorded medicinal uses of fennel in the literature have such a wide range that it may be considered as a panacea. Fennel seems to be effective as a spasmolyticum, a carminativum, as an expectorans and as a lactogogum (Garnier et al., 1961; Karsten,



Photograph 3. *Anethum foeniculum*, mericarps (3×), PJ 879.

1962). A watery oil-solution is used externally as eye-bath and as a gargle (Karsten et al., 1962).

In southern Europe, the root is used as a diuretic, the herb as a poultice for mammary inflammation, and as a remedy for jaundice and menstrual troubles (Watt & Breyer-Brandwijk, 1962). A decoction of the fruits is used as a sleeping draught for small children (Thellung, 1925).

In South Africa a tincture of the fruits is used against diarrhoea, cramp and stomach ache (Watt & Breyer-Brandwijk, 1962). High doses of the oil may be dangerous. They can cause hallucinations, epilepsy, and extreme stimulation (Garnier et al., 1961).

In Ethiopia a decoction of the roots mixed with the beverage 'talla' is used against gonorrhoea (Siegenthaler, 1963; Amare, 1976). Local doctors use the roots on the umbilical cord of newborn babies. The leaves are boiled in coffee and tea or chewed as a diuretic against gonorrhoea and as a laxative against stomach ache (Kloos, 1976, 1976/1977). The fruits are used as a diuretic and as a medicine against headache, stomach ache and coughs. In some areas of Ethiopia fennel-leaves are spread on the floor on festal days for their pleasant fragrance.

Chemical composition

According to Thellung (1925) fennel fruits contain water 10–13%, crude protein 16%, fats 9–12%, sugar 5%, invert sugar (not starch) 14%, nitrogen-free extract 19%, fibre 14%, essential oil 2–6% and ash 8–10%. The essential oil is extracted by steam-distillation mainly from the fruits. It is colourless or light-yellow, clear, aromatic, bitter at first, later sweet of taste. The most important components are anethol (50–70%) and D-fenchone (10–20%). D-fenchone causes the bitter taste (Thellung, 1925; Mensier, 1957). Rolet (1918) stated that before distillation the fruits should be soaked in water for 15 hours. The semi-drying essential oil may be used to obtain lauric acid, used in detergents and to obtain adipic acid, used in nylon, lubricants and plasticizers (Cobley & Steele, 1976). Redgrove (1933) recorded that the quality and the content of essential oil of the fruit depended on the origin of the fennel. French sweet fennel fruits contained ca 2.5% essential oil of fine flavour. Russian and Galician fruits contained ca 4–6% of an inferior flavoured oil and Indian fruits were deficient of essential oil. According to Redgrove (1933), the dried distilled fruits contain ca 14–22% protein and 12–18% fat and may be used as cattle feed. Gleisberg & Hartrott (1953) proved that the content of essential oil in the fruits did not rise with storage of the fruits for some months after harvest, as had been generally believed. They observed a higher oil content in immature fruits than in mature ones. According to Mensier (1957) the fatty oil of fennel fruits is composed of palmitic acid (4%), petroselinic acid (60%), oleic acid (22%) and linoleic acid (14%).

2.3 Anethum graveolens L. — Fig. 3

'Anethum': from the Greek *'anethon'*, a plant name of Aristophanes; probably derived from the Greek 'aëmi', which means 'I breathe', because of the strong odour of these plants.
'graveolens': derived from the Latin 'grave' (gravis, graviter) = 'heavy, strong', and from the Latin 'olens' (olere) = 'to smell', so strongly smelling.

Linnaeus, Sp. Pl., ed. 1: p. 263 (1753).
Type: 'Habitat inter Lusitaniae & Hispaniae segetes'. '*Anethum* fructibus compressis' (specimen LINN 371.1, lecto.!).

Synonyms

Anethum arvense Salisb., Prodr.: p. 168 (1796).
Anethum sowa Roxb. ex Flem., As. Res. 11: p. 156 (1810).
Angelica graveolens Steudel, Nom., ed. 2(2): p. 555 (1841).
Ferula graveolens Sprengel, Neue Schr. Halle 2: p. 14 (1813).
Pastinaca anethum Sprengel, in: Schult., Syst. 6: p. 587 (1820).
Pastinaca graveolens Bernh., Syst. Verz. Erf.: p. 171 (1800).
Peucedanum anethum Baill., Trait. bot. méd.: p. 1045 (1884).
Peucedanum graveolens (L.) Benth. & Hook. f., Gen. Pl. 1: p. 919 (1877).
Peucadenum sowa Kurz, Journ. As. Soc. Beng. 46, 2: p. 116 (1877).
Selinum anethum Roth, Tent. Fl. Germ. 1: p. 134 (1827).

Literature

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1847: Richard, Tent. fl. Abyss. 1: p. 329. (tax.)
1866: Alefeld, Landwirthschaftliche Flora: p. 158–159. (tax.)
1867: Schweinfurth, Beitrag zur Flora Aethiopiens: p. 84. (tax.)
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1874: Flückiger & Hanbury, Pharmacographia: p. 291–293. (use)
1874: Roxburgh, Flora indica (repr. ed. 1832): p. 272–273. (tax.)
1879: Clarke, in: Flora of British India 2: p. 709. (tax.)
1895: Engler, Pflanzenw. Ost-Afrikas & Nachbargebiete, B., Nutzpflanzen: p. 279. (use)
1897: Drude, *Umbelliferae,* in: Engler & Prantl, Die nat. Pflanzenfam., ed. 1, B. 3, 8: p. 208–209. (tax.)
1925: Thellung, *Umbelliferae,* in: Hegi, Illustr. Fl. Mittel-Eur., ed. 1, B. 5, 2: p. 1290–1295. (tax. + use)
1933: Redgrove, Spices and condiments: p. 211–216. (agric.)
1946: Baldrati, Piante officinali dell'Africa orientale, Centro Studi Colon. 32: p. 19. (use)
1957: Mensier, Dictionnaire des huiles végétales, Encycl. Biol. 52: p. 39–40. (chem.)
1959: Cufodontis, Enumeratio, Bull. Jard. Bot. État Brux. 29(3), suppl.: p. 648. (tax.)
1961: Garnier, Ressources médicinales de la flore française, 2: p. 857–859. (use + chem.)
1963: Siegenthaler, Useful plants of Ethiopia, Exp. Stn. Bull. 14: p. 12. (use)
1968: Tutin, *Umbelliferae,* in: Flora Europaea 2: p. 341–342. (tax.)
1969: Rosengarten, The book of spices: p. 232–237. (use)
1969: Parry, Spices, 1: p. 189–190; 2: 116–119. (use)
1970: Szujko-Lacza, External and internal morphology of *A. graveolens,* Acta Bot. Acad. Sci. Hung. 16(1/2): p. 213–240. (bot.)
1972: Hedge & Lamond, *Umbelliferae,* in: Flora of Turkey, 4: p. 377. (tax.)
1974: Gessner & Orzechowski, Gift- und Arzneipflanzen von Mitteleuropa, ed. 3: p. 295. (use)
1976: Gorini, Ortaggi da foglia: 2.4 Aneto, Informatore di Ortoflorofrutticoltura 17(7): p. 3–5. (agric.)
1976–
1977: Kloos, Preliminary studies of Medicinal plants and plant products in markets of central Ethiopia, Ethnomedicine, B. 4, 1/2: p. 85–86. (use)
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1978: Cannon, *Umbelliferae,* in: Flora Zambesiaca, 4: p. 607–609. (tax.)

Local names: ensilal, insilal, selan, shelan, (Amarinia); kamun, kamuni (Gallinia); sandan-shoa, salanbeta, shilan (Tigrinia).
Trade names: dill (English); aneth, aneth odorant, fenouil puant, fenouil bâtard (French); Dill, Gemeiner Dill, Dillfenchel, Teufelsdill, Gurkenkraut (German).

Note. Seed samples offered for sale on Ethiopian markets under the local names are almost always mixtures of seeds of *Anethum foeniculum, Anethum graveolens,* and *Cuminum cyminum.*

Geographic distribution

A. graveolens is probably indigenous to the Mediterranean region and South-East Asia (Thellung, 1925). It is now cultivated all over the world, often as a culinary herb in gardens. It was reported to be a troublesome weed in Paraguay (Thellung, 1925).

In Ethiopia, the fruits are for sale on almost every market and small scale cultivation is widespread in all provinces. According to Baldrati (1946), the plant grows in the wild in Ethiopia too. If so, it is certainly less common than *Anethum foeniculum* L. and I never collected it from the wild.

Description

An erect annual herb, ca 30–150 cm high, with a light-brown to yellowish taproot, up to 12 mm diam., with many sideroots; green parts often glaucous, making the plant sometimes look blue-green; all parts glabrous, strong smelling (not sweet), especially after crushing.

Stem terete to subterete, ca 2–12 mm diam., branched at all heights, sulcate, with fine, whitish to yellowish lines alternating with broader dark-green lines; blue-green to dark-green, lighter-green at nodes, internodes often hollow.

Leaves alternate, decompound, sheathed; sheath forming an open cone, embracing the stem at base, ca 1–3(–5) cm long, with white, scarious margins, up to 1 mm broad, whitish inside, sulcate and yellow-green outside; petiole otherwise (sub) terete, sulcate, equalling to exceeding (by up to 13 cm) the sheath; lower leaves usually rather long petiolate, higher ones with the blades often sessile on sheath or almost so; blades triangular or ovate in outline, up to 30 × 50 cm, usually much smaller, pinnately divided into ca 2–6 pairs or whorls (in this case usually 3 or 4 pinnae) of primary pinnae and one top-pinna; each pinna again 2–4 times pinnately divided into linear or filiform, acute, blue-green or dark-green lobes of ca 1–60 × 0.1–1 mm; lobes of the lower leaves usually broader and shorter than those of the higher ones.

Inflorescence a compound umbel, ca 4–16 cm diam.; peduncle stem-like, ca 4–30 cm long; bracts and bracteoles usually absent; primary rays terete to subterete, finely sulcate, ca 5–35 per umbel and ca (1–)2–7(–10) cm long, unequal in length, the longest at the outside of the umbel, blue-green to medium-green; secondary rays terete, finely sulcate, ca 3–35 per umbellet, ca (1–)5–10(–15) mm long, unequal in length, the shortest near the centre of the umbellet, blue-green or medium-green (rarely a secondary ray is branched and bears 2–4 flowers on top); all flowers bisexual and actinomorphic, often some central ones remaining rudimentary, protandrous (usually the styles and stigmas becoming fully developed after shedding the corolla and stamens).

Calyx vestigial, sometimes 5 very small light or dark-green teeth at the top of and adnate to the ovary.

Corolla: petals 5, distinct, subovate in outline, ca 0.5–1.5 × 0.75–1 mm, top strongly inflexed, glabrous, yellow, with a thin membranous outgrowth on the ventral side of the midrib from base to nearly the top, margin entire, usually notched at apex.

Androecium: stamens 5, distinct, alternating with the petals; filaments conical, the fleshy base tapering towards the filiform apex, ca 1.5 mm long, yellow, inflexed in bud; anthers dorsifixed, 2-celled, ovate, ca 0.5 × 0.5 mm, yellow, dehiscing by longitudinal slits.

Gynoecium: pistil 1; inferior ovary conical, ca 1–2 × 0.5–1.5 mm, usually with 8 protruding, rather broad, longitudinal, subparallel ribs, bilocular with 1 pendulous ovule per locule, light-green, crowned by a white, persistent, conical, fleshy stylopodium of ca 0.5 × 1 mm; styles 2, persistent, fleshy, ca 0.5 mm long, spreading, white, with a small, slightly thickened spherical, finely papillate, white or light green, apical stigma.

Fruit usually an erect, lens-shaped schizocarp, (2.5–)3.5–5(–6) × 2–3(–4) mm, light or dark brown with a whitish to pale-brown margin, splitting at maturity into 2 one-seeded mericarps, which are attached by their top to an erect, whitish, thin carpophore; the carpophore splits down to the base; mericarps flat or slightly concave at the commissural side, slightly convex at the dorsal side, usually with three longitudinal, subparallel, prominent ridges with a whitish to pale-brown sharp apex and two flat, wing-like, whitish to pale-brown commissural ridges, up to 0.5 mm wide; on the commissural side usually two dark-brown, slightly protruding, longitudinal vittae are present; on the dorsal side, usually between each two ridges, one vitta is present; the fruits are crowned by the remaining stylopodium and styles.

Seed: testa adnate to the pericarp; embryo at apex of mericarp, usually straight, ca 1 × 0.3 mm, white, with conical radicle and two small cotyledons; endosperm copious, grey, fatty.

Seedling: germination epigeal; taproot thin, whitish, with many fine side-roots; hypocotyl terete, ca 5–25 mm long, light-green or more often red-brown; cotyledons opposite, linear, attenuating petiole-like towards slightly sheathing base, ca 15–50 × 1–2 mm, light-green, entire; next leaf decompound, triangular in outline, sheathing part of petiole 3–10 mm long with white scarious margins, non-sheathing part of petiole 2–2.5 cm long; blade 1–2.5 × 1–3 cm in outline, usually divided into three or five pinnae, each divided into filiform to sublinear lobes, 1–18 mm long.

Taxonomic notes

(1) Linnaeus described dill as '*Anethum* fructibus compressis' in Sp. Pl. (1753), and referred to Hort. Cliff. 106, Hort. Ups. 66, Mat. med. 146, Roy. lugdb. 116 and to *Anethum hortense* Bauh. pin. 147. He did not change his opinion about this species between 1738 and 1753, describing dill as '*Anethum* fructo compresso' in Hort. Cliff.

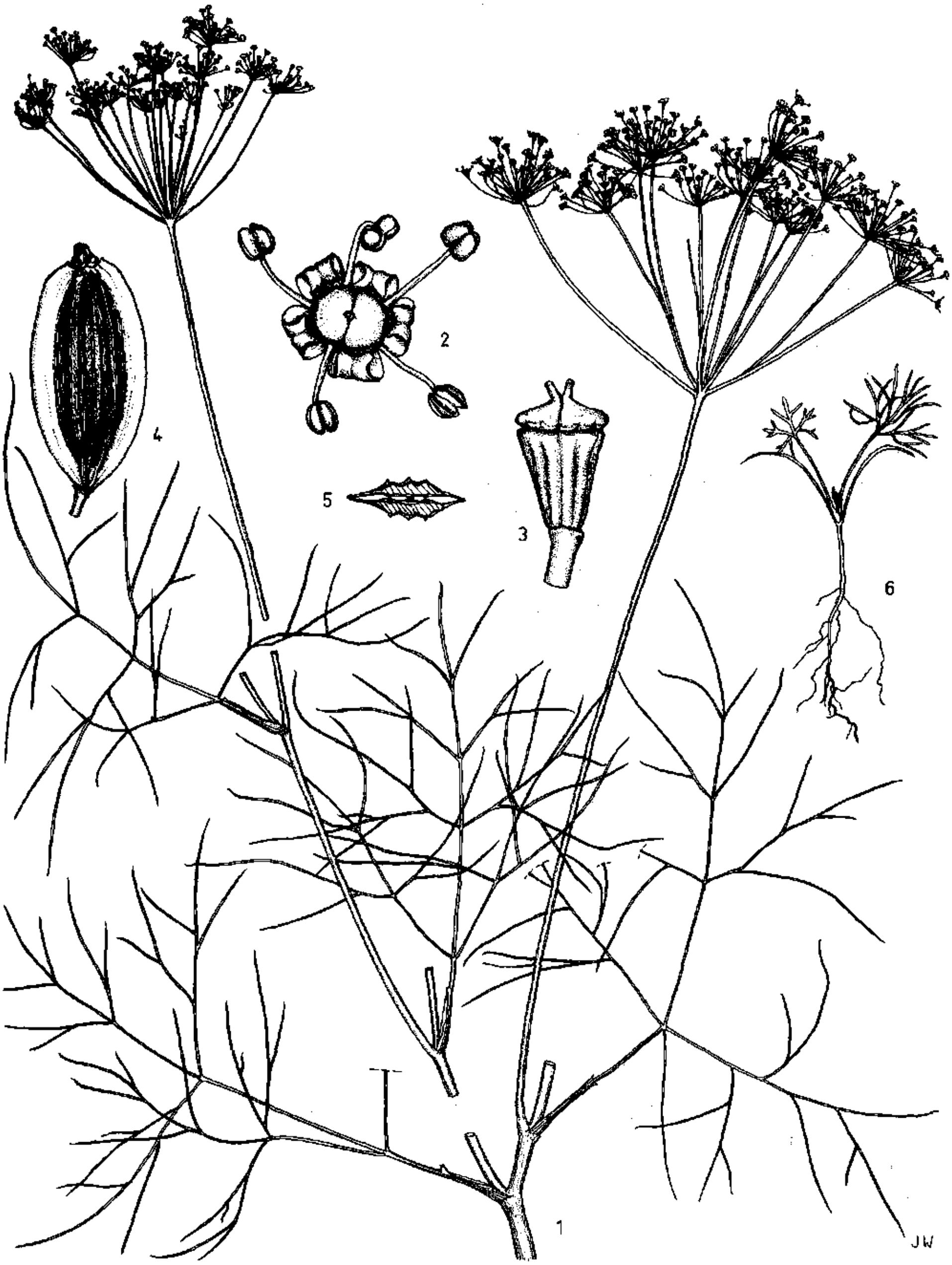


Fig. 3. *Anethum graveolens* L. – 1. habit of plant part ($\frac{2}{3}\times$); 2. flower at male flowering stage ($8\times$); 3. flower at female flowering stage ($8\times$); 4. fruit ($6\times$); 5. cross-section of fruit ($6\times$); 6. seedling ($\frac{2}{3}\times$). – 1. PJ 658; 2. PJ 2935 (spirit mat.);3. PJ 2936 (spirit mat.); 4–5. PJ 4507; 6. PJ 136 (spirit mat.).

(p. 106). So the type specimen of the species should preferably be chosen from the Hort. Cliff. herbarium (BM). In that herbarium three specimens are present under '*Anethum* fructo compresso', but none of them expresses well the character of the protologue. The specimen present in the van Royen herbarium (L) only bears flowers. The one loose fruit, present on the same sheet (van Royen) might be a later addition. In LINN three specimens are present under *A. graveolens*. Of these three specimens I designate as lectotype specimen LINN 371.1, as it clearly shows the character of the protologue and as the sheet bears the inscription: '1 *graveolens*', which corresponds with the order in Sp. Pl.

(2) Thellung (1925) distinguished three forms of *A. graveolens:*
(a) f. *minus* (Gouan) Moris 1843 (ca 30 cm high, leaves small with short and stiff lobes, primary rays (4–)6–10, fruit 3–3.5 × 1.5–2 mm with narrow wings);
(b) f. *submarginatum* Lej. et Court. 1836 (fruits as f. *minus* but other parts stronger, leaf lobes longer and not so stiff);
(c) f. *hortorum* Alef. 1866 (the largest, cultivated form, leaf lobes long, not stiff, many primary rays, fruits up to 5 × 4 mm with wide wings).

In the Ethiopian material those forms cannot be distinguished. Although Thellung adopted 3 forms, he stated at the same time that these three forms were not essentially different.

Tutin (1968), Hedge & Lamond (1972) and Cannon (1978), authors dealing with dill in three recent floras, do not subdivide the species.

(3) For easy distinction between *A. graveolens* and *A. foeniculum,* the following characters of *A. graveolens* are useful:
- All parts smell and taste bitter, slightly pungent
- The fruits are lens-shaped and narrowly winged
- On average the secondary rays of the umbel are longer than in *A. foeniculum*

(In Ethiopia, *A. graveolens* rarely grows in the wild).

(4) Only one obvious difference was observed between plants raised at Wageningen and in Ethiopia: the number of primary rays varied from 5 to 22 in the Wageningen material and from 5 to 35 in the Ethiopian material.

(5) The description is based on the following specimens:

Begemdir	Debarek market: WP 4971.
Gojam	Dedjen market:SL 778.
Hararge	Alemaya, cultivated at College of Agriculture: PJ 1816–1819, PJ 1821, PJ 2782–2783, PJ 2801–2803, PJ 2809, PJ 2935–2937, PJ 4026–4031, PJ 4072–4073, PJ 4332–4335, PJ 4506–4507; Dire Dawa market: PJ 1037, PJ 1041; Mieso market: WP 3516.
Illubabor	Gambella market: PJ 5108.
Kefa	Jimma market: WP 3275–3276, WP 3278, WP 3280, SL 137.
Shoa	Nazareth, cultivated in garden IAR: PJ 2420–2423, PJ 3588, PJ 3590–3593, PJ 4709, PJ 4711–4712.
Wollega	Bekedjana market: SL 1572; Ghimbi market: PJ 1181, PJ 1185–1187; Nekemt market: WP 3388.
Grown at Wageningen	WP 7347–7352, WP 7360–7362, WP 7365–7366, PJ 135–137, PJ 144, PJ 306–307, PJ 310, PJ 402–403, PJ 593–595, PJ 658, PJ 743–746, PJ 755–757, J. van Veldhuizen 13.

The following specimens, originating from Ethiopia, were seen (all in FT herbarium): I. Baldrati 597; P. Benedetto 201; A. de Benedictus 310; I. Bisi 106; G. Negri 1374; A. Pappi 3, 115, 149, 163, 260, 2411, 6557; Schimperi iter Abyssinicum no. 379 (22-12-1837).

Ecology

Dill grows successfully in Ethiopia at altitudes of ca 1500–2000 m.

In Hungary, dill has a taproot 5–18 cm long, 3–10 mm diam. with side-roots up to 10–12 cm long and 1–1.5 mm in diam., suggesting that it can be grown as a rainfed crop only in the rainy season (Szujko-Lacza, 1970).

According to Thellung (1925), the flowers are odoriferous but poorly nectariferous. Yet the flowers are well visited by bees and flies. As the flowers are strongly protandrous, cross-pollination and -fertilization seem normal.

Husbandry

Dill is easily grown from seed. According to Thellung (1925), the plant does not demand much of the soil or manuring. Redgrove (1933), however, stated that dill tends to exhaust the soil. In India dill is preferably grown on sandy loams to which farmyard manure has been added (Joshi, 1961). Thellung (1925) recorded that dill is often intercropped between, for instance, onions, parsley or carrots. In Ethiopia, dill is also normally grown as an intercrop. If cultivated as a field crop, ca 7 kg/ha of seed is required. It is usually sown with rows ca 70 cm apart and with ca 15–30 cm between plants in the rows. As the plant produces a taproot, sowing in a nursery and subsequent transplanting is not recommended (Rosengarten, 1969). Germination takes about 15–20 days. At low temperatures, germination takes longer.

The seed remains viable for ca 2–3 years and germination is ca 75% (Gorini, 1976). The optimum monthly average temperature for growing dill in Italy is ca 16–18°C (Gorini, 1976), the minimum temperature for growth ca 7°C. Dill cannot withstand wet conditions (Thellung, 1925).

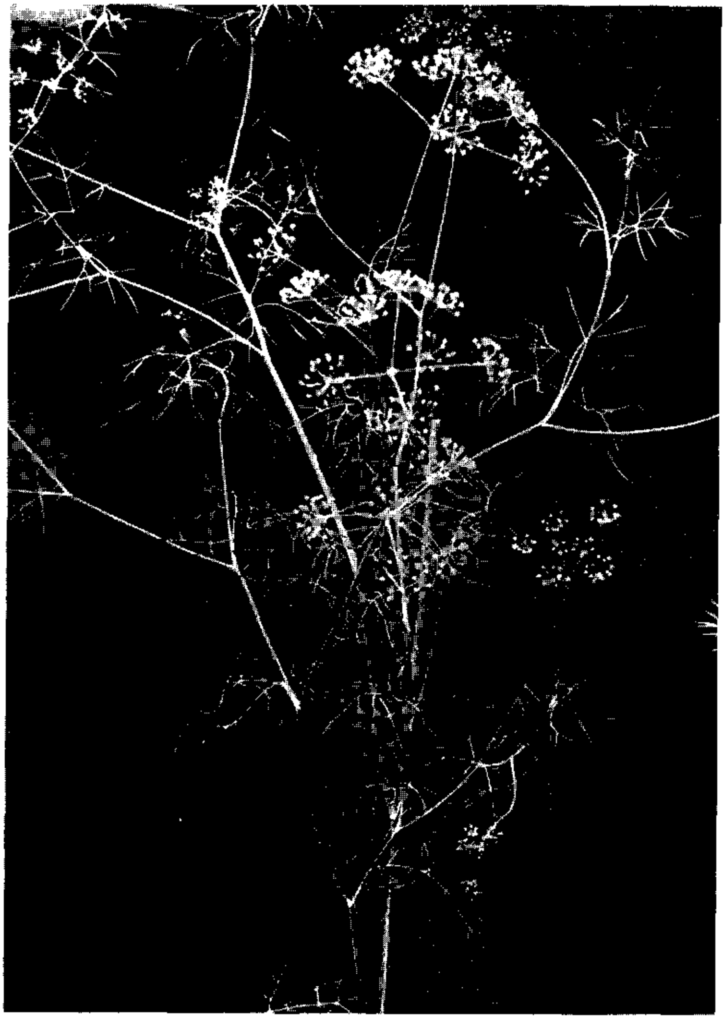
If the highest quality dill is required, either for dill-weed or for essential oil, the plants should be cut before they flower. If the fruits (dill-seed) are required, the plants usually are harvested moist with dew to prevent excessive dropping. As the fruits do not mature all at once, some maturing after harvest must be allowed (preferably in the shade), after which the plants are threshed. Yield of fruits is ca 500–700 kg/ha (Rosengarten, 1969).

In Ethiopia, where dill is mainly grown for its fruits, full germination was observed ca one month after sowing, flowering after ca 2–3 months, and harvest was possible after ca 5–6 months.

According to Thellung (1925), the following diseases of dill are common:

- A leaf spot caused by *Ascochyta anethicola* Sacc.
- A stem spot caused by *Phoma anethi* Sacc. This disease was also observed on dill in Ethiopia (Shoa Prov.) by Stewart & Dagnatchew (1967).
- A rust caused by *Puccinia petroselini* Lindr.

As pests, Thellung (1925) reported plant-lice and caterpillars without specification. In India, the larva of the chalcid fly *Systole albipennis* Walk. feeds upon embryos or



Photograph 4. *Anethum graveolens,* flowering plant, PJ 306.

endosperm of umbelliferous seeds. In dill, it may cause a loss of ca 25% of the seeds (Gupta, 1962).

In Ethiopia, no serious diseases or pests were observed on dill in 1975–1977.

Uses

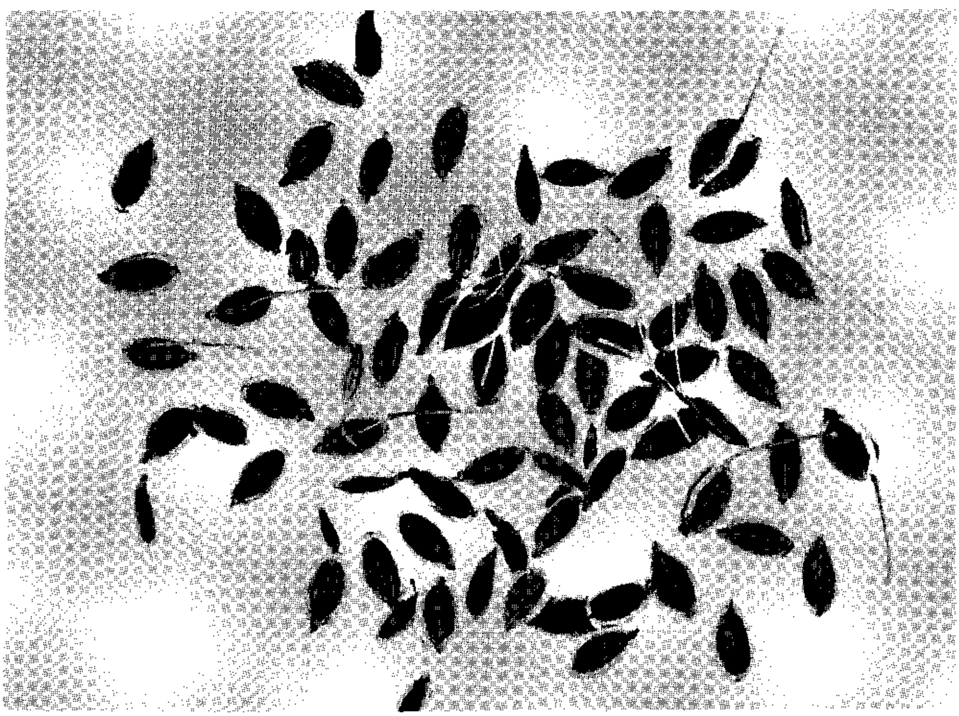
1. Culinary uses

Dill has been used as a herb since ancient times. The green parts and the fruits have a pleasant aromatic odour but are a bit bitter and pungent in taste. Finely chopped fresh or dry leaves are used as a culinary herb, for instance in soups, salads, boiled potatoes and sauces. The fruits are used to flavour pickled cucumbers, onions, vinegar, pastries, sauces and sauerkraut. In parts of Germany and Scandinavia the fruits are sometimes added to bread. In India the fruits are an ingredient of curry powder (Thellung, 1925; Redgrove, 1933; Rosengarten, 1969). Dill salt is a concentrated aromatic powder, obtained by extraction of the fruits with alcohol and subsequent drying of the extract. The extracted fruits may be roasted at ca 200°C and again extracted with hot water. The resulting brown-black extract is used in the preparation of jam and liquors. The roasted fruits were sometimes used as a coffee substitute. The essential oil of dill is used in manufacturing liquor and oil-extracted fruits are used as cattle fodder (Thellung, 1925).

In Ethiopia, the dried fruits and flowers are a flavouring agent in several kinds of 'wot'. According to Asrat (1962) and Telahun (1962), all tender parts of the plants (also the fruits) are used as a flavouring agent in the preparation of 'katikala', a local alcoholic beverage.

2. *Medicinal uses*

Dill was known as a medicinal plant in past centuries, but is now almost unused in medicine. The fruits were said to cure hiccoughs, to soothe stomach aches, to mask bad breath and to cure haemorroids. To ease digestion, dill water is recommended, made by distilling one part of the spice with 20 parts of water. A mixture of a quarter



Photograph 5. *Anethum graveolens*, mericarps (3×), PJ 745.

litre of white wine with 10 g of a decoction of dill fruits is said to relieve insomnia (Redgrove, 1933; Garnier et al., 1961; Rosengarten, 1969). The oil of dill is strongly antiseptic (Thellung, 1925). According to Mensier (1957), the essential oil of dill is used against colics. In India, the fruits are especially recommended for pregnant women (Joshi, 1961). Rosengarten (1969) reported that dill's pleasant flavouring is reputed to be beneficial for diabetic patients and for persons on a low-salt diet.

In Ethiopia, the medicinal use of dill is similar to that of fennel.

Chemical composition

According to Garnier et al. (1961) the dry fruits of dill contain water 8%, fatty oil 15–20%, crude protein 18%, pectin 6%, fibre 30% and essential oil 3–4%. The essential oil is pale yellow or colourless when freshly distilled and the taste of it is like the spice. Its chief constituents are D-limonene (up to 70%) and D-carvone (at least 30%). The essential oil may be obtained from the fruits alone (dill-seed oil) or from the whole plant (dill-weed oil). The dill-seed has a high D-carvone content, which varies with geographical origin, the cultivar and the maturity rate of the seed (USA 50–60%, Europe 37–60%). The dill-weed oil has a D-carvone content ranging from 12 to 42.5%. The total essential oil content varies also: for the seed 2.1% in India to 5.6% in Russia; for the weed 0.16% in India, 1.5% in Russia (Embong et al., 1977).

The leaves contain ca 60 mg ascorbic acid per 100 g (vit. C). The oil-extracted fruits, used as cattle fodder, contain ca 15–18% fat and ca 15% protein (Redgrove, 1933).

2.4 Capsicum annuum L. **Figs. 4, 5**

'Capsicum': perhaps derived from Latin 'capsa' (box, case), referring to the almost dry box-like mature fruits; another explanation is that it is a latinization of the Greek 'capsicon', derived from 'kaptein' = 'to bite', referring to the pungency of the fruits.
'annuum': derived from Latin 'annus' (year): annual.

Linnaeus, Sp. Pl. ed. 1: p. 188 (1753).
Type: 'Habitat in America meridionali'. *'Capsicum* caule herbaceo' (specimen s.n. in van Royen herb. at L, herb. No 908244400, lecto.!).

Synonyms

C. frutescens L., Sp. Pl. ed. 1: p. 189 (1753).
C. abyssinicum Rich., Tent. flor. Abyss. 2: p. 96–97 (1851).
C. annuum L. var. *acuminatum* Fingerh., Monogr. Gen. Caps.: p. 13(c), t. 2(c) (1832).
C. annuum L. var. *cordiforme* (Mill.) Sendtner, Fl. Bras. 10: p. 148 (1846).
C. annuum L. var. *oblongo-conicum* (Dunal) Cuf., Bull. Jard. Bot. État Brux. 33(3), suppl.: p. 860 (1963).
For more synonyms see Irish, 1898.

Literature

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1851: Richard, Tent. fl. Abyss. 2: p. 96–97. (tax.)

1852: Dunal, *Capsicum,* in: DC, Prodr. 13, 1: p. 411–429. (tax.)
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Local names: berbere, schirba, mitmita, karya (Amarinia); afrindschi (Agau); filfil-ghedut (Somali); ademedda (Gambella).
Trade names: chilli, bird pepper, Cayenne pepper, red pepper, Capsicum-pepper (English); piment, piment enragé, piment z'oiseau (French); Spanischer Pfeffer, Roter Pfeffer, Beissbeere (German).

Geographic distribution

Although *Capsicum* peppers are now grown in every country of the world where they will grow, they probably originated from Central and South America. It is known that Columbus introduced *Capsicum* fruits from the New World to Spain towards the end of the 15th Century and that the plant spread rapidly over the whole world in the 16th Century. The Spaniards and the Portuguese were in fact searching for the true pepper *(Piper nigrum* L.), and understood that *Capsicum* pepper was a valuable spice. It is even more pungent than the true pepper and rather easy to grow (Purseglove, 1968). It is astonishing how this spice became an almost indispensable dietary ingredient for many people in the tropics (e.g. Africa, India, Indonesia).

In Ethiopia too, *Capsicum* is ubiquitous. The fruits can be found on almost every market and the plant is cultivated in every province. It is the most important spice of the country. According to Alkämper (1972) ca 2.5% (230 000 ha) of Ethiopian arable land is cropped with *Capsicum* every year. The main centres of cultivation are Ghion, Bako and Harar (Alkämper, 1972; Herb. WAG).

Description

A perennial, erect herb, often cultivated as an annual, sometimes suffruticose, 0.5–1.5 m high, with a strong brown taproot and many brownish sideroots.

Stem: irregularly angular to subterete, up 1 cm diam., often woody at base, much branched, sparsely to densely tomentose (rarely glabrous), especially near branchings, green to brown-green, often with purplish spots near nodes.

Leaves alternate, simple, upper ones often almost opposite; petiole angular to subterete, up to 10 cm long, usually tomentose, rarely glabrous, light-green; blade ovate, up to 10(–16) × 5(–8) cm, acuminate at apex, usually attenuate at base, subglabrous to tomentose, usually tomentose on veins and near vein-axils, especially so on the veins beneath, light to dark-green, always paler-green beneath, margin sub-entire, serrulate to papillate or ciliate.

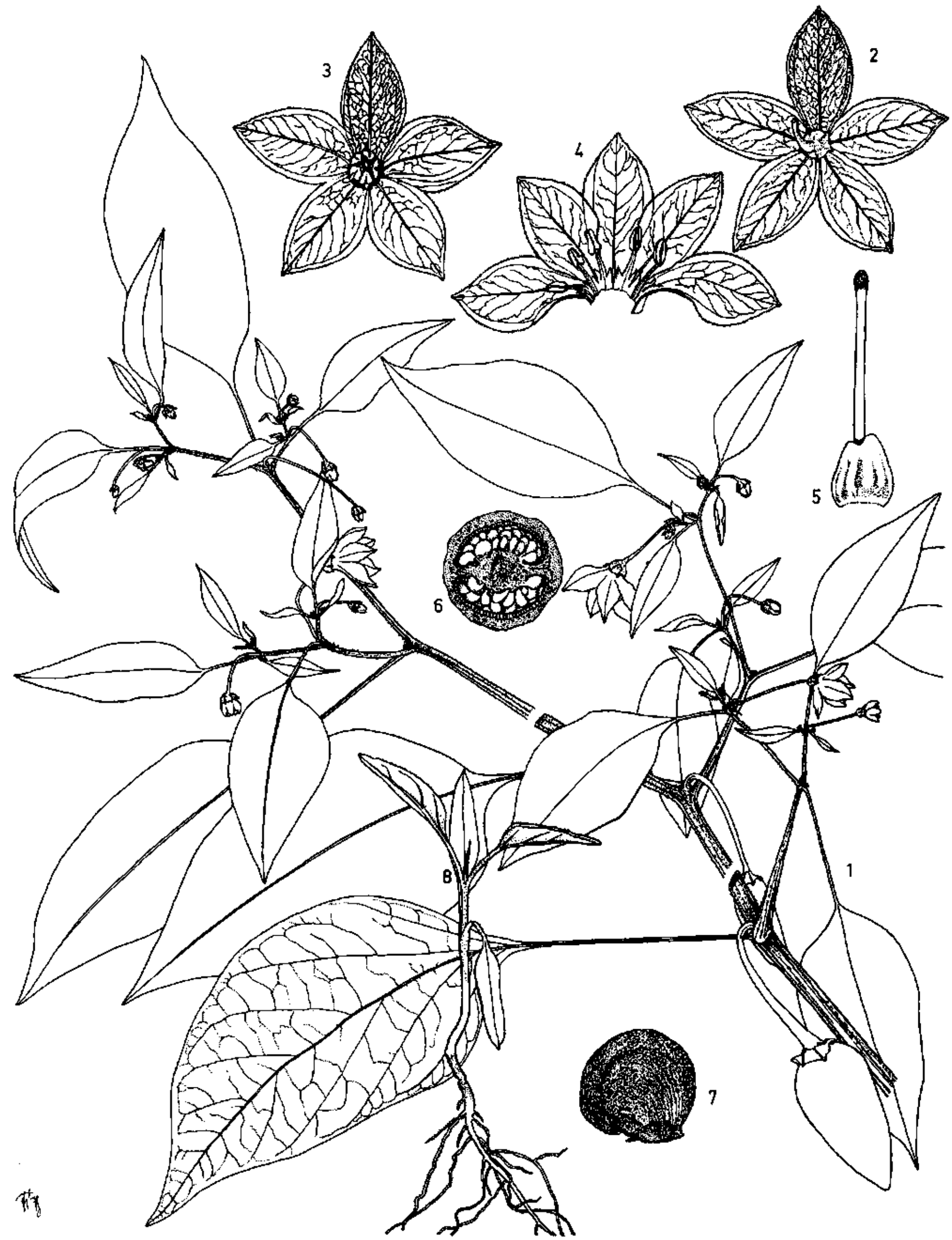

Fig. 4. *Capsicum annuum* L. – 1. habit plant part with flowers and fruits ($\frac{2}{3}\times$); 2. underside flower (2×); 3. upperside flower (2×); 4. opened corolla with stamens (2×); 5. pistil (4×); 6. cross-section ovary (8×); 7. seed (4×); 8. seedling ($\frac{2}{3}\times$). – 1. PJ 869; 2–6. PJ 841 (spirit mat.); 7. PJ 916; 8. PJ 240 (spirit mat.).

Inflorescence: flowers terminal or apparently axillary, solitary or sometimes in groups of 2–5, usually 5-merous, rarely 6–7-merous; pedicel irregularly ribbed, up to 3 cm long in flower, up to 8 cm long in fruit, slightly widening at apex, glabrous to slightly tomentose, light-green, pendulous or (sub)erect.

Calyx cup-shaped, 1–5 mm long, 2–6 mm in diam., persistent and enlarging in fruit, usually with 5 conspicuous, usually slightly thickened teeth up to 1 mm long, or truncate, glabrous to sparsely tomentose, light-green.

Corolla campanulate to rotate, tube 3–7 mm long, the 5 lobes ovate, 3–10 × 3–8 mm, acuminate, glabrous, margin serrulately papillate or ciliate, white, dingy white, yellow-white or greenish-white.

Androecium: stamens 5; basal part of filaments adnate to corolla tube and 1–3 mm long, widened, usually ending in two lateral teeth up to 1 mm long; free filament part filiform, 2.5–6 mm long, glabrous, white or purplish; anthers 2.5–4 × 1–2 mm, dark-green to blackish, dehiscing by two lateral longitudinal slits.

Gynoecium: ovary conical, 2–5.5 mm long, 1–4 mm diam., glabrous, dark-green, sometimes finely spotted with dark red-brown, 2(–3)-locular, placentation axile; style filiform, 2.5–5.5 mm long, white or purplish; stigma capitate, light-green to yellow.

Fruit a non-pulpy berry, very variable in size and shape, always more or less conical, 1–19 cm long, 0.5–4.5 cm diam.; apex acuminate or blunt, base rounded or obtuse, persistent calyx sometimes surrounding base of fruit; immature fruits light- to dark-green, turning yellow-orange and finally light to dark, often bright red when mature; near the apex the fruit is usually 1-locular.

Seed orbicular, flattened near the hilum, 3–4.5 mm diam., ca 1 mm thick, slightly rugose, yellow; embryo white, strongly curved, embedded in copious grey endosperm.

Seedling: germination epigeal; taproot and side-roots whitish; hypocotyl 11–20 mm long, glabrous to slightly tomentose, green or purplish-green; cotyledons opposite, with a petiole 2–10(–14) mm long and an ovate-acuminate to triangular blade, 1–3 cm long, 2–6 mm wide, glabrous, usually light-green; epicotyl 2–14 mm long, usually sparsely tomentose, green to purplish-green.

Taxonomic notes

(1) In 1753, Linnaeus described two *Capsicum* species: *C. annuum* ('caule herbaceo', 'habitat in America meridionali', annual) and *C. frutescens* ('caule fruticoso', 'habitat in India', perennial). The only difference between the two species indicated by Linnaeus is the herbaceous (annual) versus the woody (perennial) character. In 1762, in the second edition of Sp. Pl., Linnaeus added another distinguishing characteristic: *C. annuum* ('caule herbaceo, pedunculis solitariis') and *C. frutescens* ('caule fruticoso, pedunculis geminis'), and he remarked that the fruits of both species showed an unusual variation. On the basis of these differences *(C. annuum,* annual, single pedicels; *C. frutescens,* perennial, paired pedicels), it is impossible to distinguish with certainty between the two species. Many authors have observed that *C. annuum* L. can also become woody and behave like a perennial, and may sometimes even have paired pedicels. Moreover, *C. frutescens* may have single

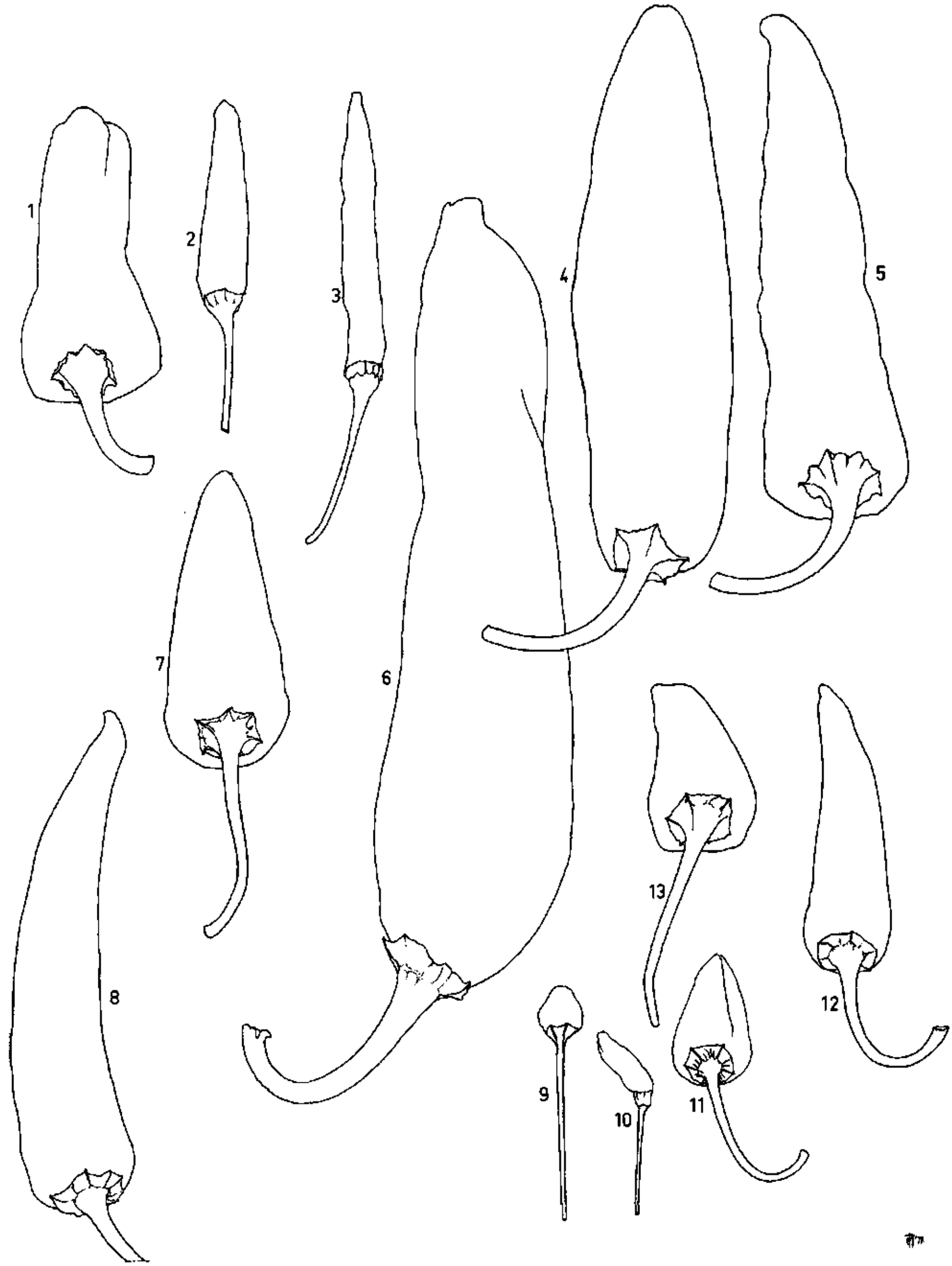

Fig. 5. *Capsicum annuum* L. – 1–13. different shapes of mature fruits ($\frac{2}{3}\times$). – 1. PJ 916; 2. PJ 933; 3. PJ 987; 4. PJ 4398; 5. PJ 4532; 6. PJ 4534; 7. PJ 960; 8. PJ 4401; 9. PJ 1000; 10. PJ 904; 11. PJ 977; 12. PJ 966; 13. PJ 1001.

pedicels. In 1891, Kuntze joined the two species and considered the taxon *C. frutescens* L. as a variety of *C. annuum* L. In 1923 Bailey (as cited by Heiser & Pickersgill, 1969) preferred the name *C. frutescens* L. for the united taxa and considered *C. annuum* L. as a synonym of *C. frutescens.* Bailey's choice, however, conflicted with the Rules of the Botanical Code, so Kuntze's choice had to be followed.

Most current authors again distinguish the two Linnaean 'species', probably partly through the recent research of Smith & Heiser (1951). In their view, *C. annuum* L. has single pedicels (rarely paired), white, dingy-white or rarely purplish corollas, and *C. frutescens* L. has 1–6 pedicels at one node (one pedicel per node only in adverse growing conditions) and waxy, greenish-white corollas. Crosses between the two 'species' resulted in non-viable seed when *C. annuum* was used as the mother, and only a few viable seeds when *C. frutescens* was used as the mother parent. Although the differences between the two taxa as defined by Smith & Heiser (1951) seem to be clear, their 'key' frequently does not work for many specimens from Ethiopia, as combinations of characteristics of the two taxa occur often. Therefore I do not make the distinction for the plants originating from Ethiopia and consider all Ethiopian cultivated *Capsicum* taxa as belonging to one species: *Capsicum annuum* L.

(2) *C. annuum* L. has been typified by D'Arcy & Eshbaugh (Baileya 19: p. 98, 1974). They designated as the lectotype Herb. Hort. Cliff. 59 (BM). On the same page, however, they stated: 'The lectotype designated above is a specimen in flower and fruit with the numeral '1' and the word '*annuum*' written at the bottom of the sheet. This specimen is reproduced on microfiche IDC LINN 141: II. 3'. But, IDC LINN 141: II. 3 is a plant of the Linnaean herbarium, specimen LINN 249.1, and not the plant of the Hort. Cliff. herbarium. D'Arcy & Eshbaugh thus designated two different plant specimens as the lectotype of *C. annuum.* As it is not clear which of the two they meant, I reject both choices and designate as lectotype of *C. annuum* L. the specimen in the van Royen herbarium at Leiden (L): van Royen s.n., herbarium number 908244400. This choice seems better founded. Linnaeus first citation in Sp. Pl. under *C. annuum* is 'Roy. lugdb. 426'. In fact, Linnaeus's descriptive phrase of the protologue 'caule herbaceo' is taken directly from A. v. Royen, Florae Leydensis: p. 426, 1740. The lectotype specimen in the van Royen herbarium (L) shows two plant parts: one part with leaves and three fruits, the other part with leaves, flower-buds, flowers and one fruit. The specimens in the Hort. Cliff. and in the LINN herbarium are much less illustrative.

(3) *C. annuum* has long been cultivated and, probably as a result of human selection, many forms of it developed. Many authors tried to order this taxon and, as the variability is most clearly expressed in the fruit shape, most classifications were based on that. We now know that classifications based on fruit shape alone are without much practical value, as the shape of the fruit shows a continuum between the extremes.

Fingerhuth revised the genus *Capsicum* in 1832 and recognized 25 species and 28 botanical varieties. In 1852, Dunal recorded 50 species with many varieties. In 1898, Irish reduced the number of cultivated *Capsicum* species to two: *C. annuum* and *C. frutescens,* and taxa, earlier described as species, were reduced to varieties (cultivars now). Although the classification of Irish is based on the annual-perennial character for the species, and on fruit shape and calyx characters below the species level (and hence difficult to follow now), his names are well known and are still often used. Within *C. frutescens,* he only distinguished one variety: var. *baccatum* (L.) Irish (ovate to almost round fruits). Within *C. annuum,* he distinguished seven varieties. Their most important characters as well as the cultivars belonging to them are given in Table 2.

In 1953, Heiser & Smith published a valuable report on the cultivated *Capsicum* peppers. Within cultivated *Capsicum,* they distinguished four species: (1) *C. pubescens* R. & P.: corolla lobes purple, seed black, leaves rugose, stem and leaves rather densely pubescent; (2) *C. pendulum* Willd.: corolla white with yellow or tan markings on the throat and yellow anthers; (3) *C. frutescens* L.: corolla greenish-white, pedicels paired or several at a node (seldom solitary); (4) *C. annuum* L.: corolla clear white or dingy white, rarely purple, pedicels solitary, seldom paired at a node. In 1957 they added a fifth species: (5) *C. chinense* Jacq.: leaves broad wrinkled, fruits bonnet shaped.

In 1964, Heiser subdivided *C. annuum* into two varieties: var. *annuum* (with the 'cultivated' forms) and var. *minimum* (Miller) Heiser (with the 'spontaneous' forms). In 1968 Eshbaugh showed that the name *C. pendulum* had to be changed into *C. baccatum* L. on nomenclatural grounds and he subdivided *C. baccatum* into two varieties: var. *baccatum* for the 'spontaneous' forms, and var. *pendulum* (Willd.) Eshbaugh for the 'cultivated' forms. These subdivisions of Heiser and Eshbaugh into different varieties for cultivated and spontaneous forms seem rather artificial.

In 1966, Terpo stated that all cultivated *Capsicum* belonged to one species: *C. annuum* L. This taxon he subdivided into ssp. *baccatum* (L.) Terpo and three convarieties: *annuum, longum* and *grossum.* Although he declared that one had to follow the Rules of the Botanical Code, he designated no type specimens for his numerous taxa and gave only vague, undistinctive descriptions for the 59 taxa he created.

In 1974, D'Arcy & Eshbaugh changed the name *C. annuum* L. var. *minimum* (Miller) Heiser into *C. annuum* L. var. *aviculare* (Dierbach) D'Arcy & Eshbaugh for reasons of priority.

(4) The material I studied included no other taxa than *C. annuum* L. (including *C. frutescens* L.). *C. annuum* was not subdivided as this was impossible on the basis of morphology of the plants alone. If other characters like disease resistance, yield, growth period and pungency were also taken into account, the Ethiopian *Capsicum* material would certainly produce some valuable cultivars. For designation of Ethiopian cultivars, however, more research like that of Alkämper (1972), Rouanet (1972) and Bezuneh (1973) is needed, and the eventual results ought to be based on conserved materials in order to achieve reliable results and dependable data.

(5) Differences between plants raised at Wageningen and at Alemaya were negligible.

(6) The description is based on the following specimens:

Arussi	Kofale market: SL 1282; Sire market: SL 142, SL 145.
Bale	Goba market: SL 1218, SL 1222; Goro market: SL 1258–1259.
Begemdir	Gondar market: SL 865, SL 918–919; Infranz market: SL 829.

Table 2. *Capsicum annuum* L. varieties as classified by Irish, 1898.

variety	Conoides	Fasciculatum	Acuminatum	Longum	Grossum	Abbreviatum	Cerasiforme
plant height (cm)	30–75	30–45	45–75	45–75	45–60	30–60	30–60
petiole length (cm)	$1–1\frac{1}{2}$	ca 10	$2–2\frac{1}{2}$	long	$5–7\frac{1}{2}$		$1–2\frac{1}{2}$
leaf-blade size (cm)	$5–7\frac{1}{2} \times \frac{1}{2}–5$	$9\frac{1}{2} \times 3$	$5–9 \times 2\frac{1}{2}–5$	$6–10 \times 4–6\frac{1}{2}$	$7\frac{1}{2}–12\frac{1}{2} \times 5\frac{1}{2}–9$	$5–10 \times 3–7$	$3–9 \times 1–4$
pedicel erect or pendent	e	e	e & p	e & p	e & p	e & p	e & p
corolla colour	green-white	white	dingy white	dingy white	dingy white	dingy white	dingy white
corolla width (cm)	$1–1\frac{1}{2}$	ca 2	1–3	2–3	2–3	2	2–3
fruit size (length, diam.) (cm)	$2–3 \times \frac{1}{2}–1\frac{1}{4}$	$7\frac{1}{2} \times \frac{1}{2}$	$1–11\frac{1}{2} \times \frac{1}{2}–1$	$7\frac{1}{2}–30 \times 2–4\frac{1}{2}$	$7\frac{1}{2}–15 \times 5$	2–5 long	$1\frac{1}{2}–2\frac{1}{2}$ in diam.
pungency	extreme	acrid	extreme	mild to extreme	mild		extreme
fruit form	subconical oblong cylindrical, acuminate or obtuse	cylindro-conical, straight or curved	slender, ± curved	tapering base flat or depressed	large, oblate oblong or truncate, 3–4-lobed	ovate ± rugose	spherical sub-cordate oblate
'cultivars'	Coral Gem Tabasco Orange-Red-Cluster	Red Cluster Yellow Cluster	Chilli Yellow Chili Long Cayenne Long Yellow Cayenne Nepal Chilli	Black Nubian Long Red County Fair Cardinal Long Yellow Elephant's trunk Procopp's giant Ivory Tusk	Emperor Monstrous Sweet Spanish Bell Sweet Mountain Ruby King Brazilian Upright Golden Upright Squash Yellow Squash	Celestial Etna Kaleidoscope Red Wrinkled Princess of Wales	Little Gem Prince of Wales Cherry Yellow Cherry Oxheart Yellow Oxheart

Gemu Gofa	Arba Minch, forest between lake Abaye & lake Chamo: PJ 3824; 31 km from Soddo, on road to Arba Minch: WP 2970; 108 km from Soddo, on road to Arba Minch: WP 3199.
Gojam	Dedjen market: SL 761; Elias market: SL 797–799; Lumane market: SL 735.
Hararge	Alemaya, cultivated at College of Agriculture: PJ 1408–1475, PJ 1808–1814, PJ 2083–2084, PJ 2584–2707, PJ 2812, PJ 2910–2921, PJ 3118–3141, PJ 3437–3444, PJ 4017–4023, PJ 4053–4056, PJ 4076–4212, PJ 4321–4329, PJ 4386–4416, PJ 4529–4566, PJ 4722–4760, PJ 4823, PJ 4833–4842, PJ 5124–5130, PJ 5132, PJ 5219–5220, PJ 5890–5894, PJ 7018–7022; Alemaya, in garden: WP 340B, WP 406, WP 449, WP 459, WP 802; Alemaya market: WP 144, WP 157–158, SL 26, Bos 8064, Bos 8072–8073, Bos 8076; Asbe Tefari market: SL 458–459; Assebot market: SL 703–705; Bedeisa market: SL 672; Bedeno market: SL 311–315; Bisadimo, in garden: WP 980; Chelenko market: SL 240, SL 244, SL 257, SL 266; Deder market: SL 370–372; Dire Dawa market: Bos 8374, Bos 8379–8380, Bos 8382, PJ 1031–1032, PJ 1049–1050; Feddis market: SL 185; Gelemso market: SL 629; Gursum market: PJ 4468–4469; Harar market: WP 108, Bos 8048, Bos 8057, PJ 1554; Jijiga market: SL 359; Karra market: SL 589–592; Kuni market: SL 575; Lange market: SL 279, SL 293–294, SL 299; Moulu market: SL 435–438, SL 457; Waichu market: SL 527–529.
Illubabor	Djemezo market: SL 1439, SL 1450–1451; Gambella, in garden: PJ 5054; Gambella market: PJ 5107, PJ 5110; Metu market: SL 1493–1496.
Kefa	Agaro market: SL 83, SL 88, SL 107; Bonga market: SL 1416, PJ 2200, PJ 2202, PJ 2208; Jimma, Institute of Agricultural Research: PJ 5852; Jimma market: WP 3303–3307.
Shoa	Alelu market: SL 1315; Ambo market: PJ 1218; Bako market: PJ 1209–1210; Bulbulla market: PJ 3901–3902; Kuyera market: SL 1201–1202; Melkassa, cultivated in garden of Institute of Agricultural Research (Nazareth): PJ 2407–2408, PJ 2410–2415, PJ 3573–3575, PJ 3579–3585, PJ 4696–4698, PJ 4702–4708, PJ 4826–4828, PJ 5114–5118; Robi market: SL 1164–1166; Shashemene market: WP 2601–2602, SL 1309–1311.
Sidamo	Adillo market: PJ 3666–3667; Awassa market: SL 1323–1326; Kebre Mengist market: SL 1348; Negele market: SL 1396: Tafari Kele market: WP 4060; Wondo market: WP 2809; Wondo, 12 km on road to Dilla, market: WP 4057.
Wollega	Alem taferi market: SL 1543; Bekedjama market: SL 1573–1576; Defno market: SL 1549–1551; Dembidolo market: SL 1529–1530; Ghimbi market: PJ 1184; Nekemt market: PJ 1205.
Wollo	Bati market: SL 1035–1037, SL 1058; Dessie market: SL 1099–1100; Haik market: SL 1125–1127, SL 1131; Kombolcha market: SL 987–988.
Grown at Wageningen	WP 5999–6000, WP 6104–6106, WP 6110–6113, WP 6117–6118, WP 6490, WP 7151–7153, PJ 183–193, PJ 216–220, PJ 222–236, PJ 239–294, PJ 311–315, PJ 340, PJ 404–505, PJ 730–742, PJ 763–796, PJ 840–877, PJ 883–888, PJ 895–908, PJ 911–936, PJ 938–1013, PJ 1015–1028.

The following specimens, originating from Ethiopia, were seen (all at FT):
I. Baldrati 2454, 2455, 3542; A. Bellini 466; E. Chiovenda 2074; G. Cufodontis 292, 612; A. Fiori 10; R. Guidotti 809, 810; A. Pappi 8543; A. Terracciano & A. Pappi 2823; A. Vatova 1565, 1566, 1744.

Ecology

In general, *Capsicum* is grown in the tropics and subtropics. In temperate climates, it can be cultivated in areas where vines will grow (Zeijlstra, 1949). According to

Purseglove (1968), *Capsicum* is grown in the tropics up to ca 2000 m altitude or higher.

In Ethiopia, it is grown at altitude 1000–2500 m (Alkämper, 1972) but, according to Simoons (1960), even at 3000 m in the Semeyen mountains. At high altitudes, however, the fruits do not ripen well and are difficult to dry. The main areas of cultivation in Ethiopia are at altitude 1500–2000 m. A warm humid period is required during growth, a dry period for the ripening and harvesting.

The optimum temperature range for its growth is 20–25°C (Paul, 1940; Maistre, 1964). The plants withstand much higher temperatures (35°C or more) and then blossom earlier and the fruits ripen quicker. However, high temperatures generally cause a lower fruit setting (Paul, 1940). For optimum fruit setting Paul (1940) reported 15–20°C as being the best temperature. Temperatures below 10°C retard growth and frost kills the plants (Maistre, 1964). So *Capsicum* can be grown in the temperature range (10–)15–25(–35)°C.

According to Paul (1940), *Capsicum* peppers require a moderately short day for fruiting, although only days with more than 15 h light increased the time taken to the flowering stage in his experiments.

Capsicum requires an annual rainfall of ca 600–1250 mm (Maistre, 1964; Purseglove, 1968), preferably with a rainy and a dry season. The moistness of the soil influences the number of fruits formed. Best soils for *Capsicum* growth have a water capacity of 55% (Maistre, 1964). If there is too much rain, fruit sets poorly or rots. Waterlogging of the plants, even for a short time, causes leaf shedding (Maistre, 1964; Purseglove, 1968).

The flowers are open for 2–3 days (Purseglove, 1968). They are both self and cross pollinated. Cross-pollination may vary from 2 to 78%, but is normally ca 14–16% (Paul, 1940; Purseglove, 1968). Rouanet (1969) observed a cross-pollination of 8% in Awassa, Ethiopia. Bees, flies, thrips and ants cause the cross-pollination (Paul, 1940). Under normal circumstances, ca 40–50% of the flowers set fruit (Purseglove, 1968).

Purseglove (1968) reported that light loamy soils, rich in lime, are best suited for *Capsicum* cultivation, but that many soils are suitable if they are well drained. Duke & Terrell (1974) indicated that *Capsicum* can grow on soils with pH 4.5 or more.

Husbandry

C. annuum is propagated by seed. As the seed remains viable for ca 2–3 years without special conservation and as every healthy ripe fruit contains many seeds, seed is always available when needed. Even hybrid F_1 seed can be produced rather cheaply since the discovery of the cytoplasmically inherited male sterility (Purseglove, 1968). Paul (1940) recommended disinfection of the seed to prevent leaf-spot and fruit-diseases. Before sowing, the seed should be soaked overnight in water and then dipped in a copper sulphate solution (12.5 g/l) for 8 min, dried for 30 min and dusted with air-slaked lime. In general, however, one should be careful with disinfection of *Capsicum* seed, as they are more sensitive to disinfectants than many others (Paul, 1940). Paul (1940) reported that seed 6 months old germinated better than fresh seed.

Usually seed is sown in nurseries. The preparation of a good nursery is essential for raising of vigorous seedlings. Compost (ca 10–15 kg/m^2) is recommended. For a nursery of ca 250 m^2, ca 2 kg seed is needed and can then be planted out over 1 ha. The seed is sown at ca 0.5 cm depth and the soil should be protected against sunshine and heavy rainfall (Paul, 1940). In Ethiopia, this is often done by small low sheds above the nursery, covered with straw (Kostlan, 1913). In Ceylon, the soil is covered with straw and palm leaves (Paul, 1940). In temperate climates, seed can be sown under glass to avoid late night-frosts (Irish, 1898).

Germination time depends on the cultivar used, the temperature and the water supply and the viability of the seeds. Paul (1940) reported the influence of the temperature on germination (Table 3).

At Alemaya, germination took 1–2 months (rather low temperatures at night, low rainfall, sown directly in the field). After emergence of the cotyledons (ca 7 days), shade should be removed. After ca 4 weeks, the young plants show first flower buds and then are ready for transplanting. Paul (1940) recommended topping of the young plants to obtain better branching. For good results, the field must first be manured with well-decomposed dung or compost (ca 50 t/ha) (Maistre, 1964). The plants in the field are usually spaced at 60–90 cm apart in all directions or in rows, 90 cm apart, 30 cm within the rows (Purseglove, 1968). The Ethiopian farmer normally transplants in plots ca 1.20 m wide without rows at a planting density of 5–15/m^2. At Bako, the optimum was ca 10 plants per m^2 (50 × 20 cm) (Alkämper, 1972).

Application of fertilizers is recommended, especially when little or no organic manure is applied. Maistre (1964) recommended $(NH_4)_2SO_4$ at 200–250 kg/ha when transplanting and another 350–550 kg/ha during flowering.

In Ethiopia *Capsicum* is usually cultivated on rather small plots (100–1000 m^2), near the farmer's house (Alkämper, 1972). This is done because this culture requires much manual labour and theft can be easier prevented. Moreover, cattle manure can be applied easier, as the cattle are brought near the house at night. Six to eight weeks before the long rainy season, nurseries are laid out and the plants are transplanted as soon as the rain starts. If no dung is available, the Ethiopians prefer fallow land for the *Capsicum* crop (Alkämper, 1972). About the influence of fertilizers on *Capsicum* growth little is known for Ethiopian conditions.

Alkämper (1972) reported that in trials at Awassa a combination of 200 kg N/ha and 44 kg P/ha gave the highest yield; at Bako, 80–120 kg N/ha and 35–52 kg P/ha gave good results, but no larger amounts were tested. The fertilizers were applied

Table 3. Effect of temperature on germination of *Capsicum annuum* (from Paul, 1940). (d = days)

Temp. (°C)	Germination time (d)	Germinated seed (%)
10 – 15	30 – 31	59
15 – 20	19 – 20	72
20 – 30	10 – 11	78
30 – 40	5 – 6	74

before transplanting as urea and calciumphosphate $Ca_3(PO_4)_2$. Alkämper reported almost the same high yield for *Capsicum* grown on arable land manured with dung and 35 kg P/ha, as on arable land only manured with 80 kg N/ha and 35 kg P/ha. In his opinion, it is certainly worthwhile, even for poor farmers, to calculate the profit of even a small amount of fertilizer. In 1970–1971 at Bako, an investment of 100–150 E$/ha for fertilizers, could increase yield of fruits by 1000 kg/ha, worth 600–1000 E$/ha.

Weed control is necessary in *Capsicum,* as badly cleaned fields give lower yields (Alkämper, 1972; and many other authors). About 1.5 month after transplanting, the plants start flowering and continue to flower for ca 3 months (Paul, 1940). One month after flowering starts, picking of green fruits can begin. According to Paul (1940) picking of fully developed but green chillies gives a much higher yield than picking of ripe red fruits only. Apparently when the fruits are picked green, the plant is stimulated to produce more flowers and fruits. Even when only red ripe fruits are required, a first picking of green fruits and afterwards only ripe red fruits gives a higher yield of red fruits than when only red fruits are harvested from the beginning (Paul, 1940). This statement is not confirmed by other authors. The harvest of red fruits can start ca 4–5 months after germination and may continue for some months (picking ca every two weeks). Towards the end of the harvest the fruits generally become much smaller.

At Alemaya and at Wageningen, flowering started 4–5 months after sowing. Harvest of red fruits was possible at Alemaya 6–8 months after sowing, at Wageningen after 7–9 months.

According to Maistre (1964) and Purseglove (1968), the most important diseases of *Capsicum* are:

- Mosaic and leaf-curl viruses, perhaps transmitted by the thrips *Scirtothrips dorsalis* H.
- Fruit rot, caused by *Colletotrichum capsici* (Synd.) Butl. & Bisby
- Anthracnose, caused by *Colletotrichum nigrum* Ell. & Halst.
- Die-Back, caused by *Glomerella piperata,* which is stimulated by wet conditions.

In Ethiopia, Stewart & Dagnatchew (1967) observed the following diseases in *Capsicum:*

- *Ascochyta* sp., on leaves, Shoa Prov.
- *Cercospora capsici* Heald & Wolf, leaf spot, Kefa Prov.
- *Cercospora unamunoi* Castell, velvet leaf spot, common every province
- *Colletotrichum capsici* (Synd.) Butl. & Bisby, fruit rot, Shoa Prov.
- *Leveillula taurica* (Lev.) Arn., powdery mildew, Kefa, Harar, Shoa Prov.
- *Oidiopsis sicula* Scalia, powdery mildew, Eritrea, Shoa Prov.
- *Rhizoctonia solani* Kuehn, root rot, Shoa Prov.

In Ethiopia both green and red fruits are harvested and used. The undried fruits cannot be kept for long. Paul (1940) reported that they could be kept for 40 days at 0°C and 10 days at 21°C. So the normal procedure is to dry the ripe fruits after harvest. This is usually done in the sun and it takes ca 3–15 days. The fruits should be exposed to the sun in thin layers (2–3 fruits thick). If partial after-ripening is also required, this should be done in the shade. If partly green fruits are directly exposed to the sun, white patches appear on the fruits. After-ripening is possible if fruits are stored indoors for ca two days at 20–25°C. Fruits can be artificially dried at temperatures up to 55°C and take ca 2–3 days (Paul, 1940). During drying, the fruits lose up to ca 70% of their weight. Dry fruits can be kept for a very long time (Paul, 1940). Ridley (1912), reported that fresh chillies can be kept in salt water more than a year, without losing colour and pungency.

Yield varies with conditions of growth. In India, rainfed crops yield 250–750 kg/ha; irrigated crops 1500–2500 kg/ha of dried fruits (Purseglove, 1968). In Ethiopia, the average yield is 410 kg/ha (dried). The highest reported yield of dried fruits for Ethiopia is 6400 kg/ha (Zemedu Worku, cited by Alkämper, 1972), which is hardly likely. Other reports claim 3000 kg/ha (Rouanet, cited by Alkämper, 1972). Since 1964, a considerable amount of peppers in Ethiopia is bought by the 'Ethiopian Spice Extraction Share Company, Kalamazoo'. This company extracts the red pigment from the fruits to obtain a natural colouring agent. Since that time, many 'foreign' cultivars have been introduced into Ethiopia. The taste and pungency of the peppers is unimportant for the colour extractors and some of the imported cultivars give higher yields than Ethiopian peppers. For colour extraction, fruits can best be dried in shade, as the sun always bleaches the fruits to some degree. Sun-dried fruits also lose ca 10% more of their weight than shade-dried fruits (Rouanet, cited by Alkämper, 1972).

Uses

1. Culinary uses

There is probably no spice so popular as *Capsicum*, and no spice has become such an indispensable ingredient of the daily food of so many people of the world. *Capsicum* spices are known, offered for sale and used under many different names, often differing in origin, pungency or size of the fruit. Most names are not defined precisely and are used in various meanings. Some of their names and their uses, frequently encountered are:

- Paprika: mild kinds of *Capsicum*, best known from Spain (Spanish pepper) and Hungary. Sometimes a distinction is made between the *Capsicum* of Spain ('pimenton' or 'pimiento') and of Hungary (the real paprika). In general, paprikas are sweet thick-fleshed *Capsicum* cultivars used as a culinary colouring agent, as a flavouring vegetable or as a seasoning in cooking, in cheese, in stuffed olives, in processed meats, in goulash, or eaten raw in salads.
- Cayenne pepper (red pepper): a powder, usually made from moderately pungent *Capsicum* fruits. It is best known as a household seasoning and as a common ingredient of curry powder. It certainly has no connexion with Cayenne in French Guiana. In the West Indies, the dried and ground *Capsicum* is mixed with flour, leavened with yeast, baked hard, powdered and sifted and constitutes the Cayenne pepper there.
- Nepal pepper: one of the most appetizing kinds of Cayenne pepper because of its agreeable flavour.
- Chilli (also written chili or chile): general name for (usually pungent) *Capsicum* peppers.

– Chilli powder: a mixture of ground pungent *Capsicum* fruits and several other flavourings, used in meat (chili con carne), stews, beans, sausages, sauces and as a seasoning in the kitchen.
– Pickled peppers: usually made from small yellow immature fruits of cultivars 'Floral Gem' and Hungarian 'Yellow Wax'.
– Tabasco pepper sauce: pulp of the ripe fruit of cultivar 'Tabasco', extracted by pressure. The sauce is usually pungent.
– Chilitepin (bird pepper): small-fruited *Capsicum* forms.
– Mandram: a West Indian stomachic, prepared by mashing a few fruits of small peppers and mixing them with sliced cucumbers and shallots to which has been added a little lime juice and Madeira wine (Irish, 1898; Redgrove, 1933; Paul, 1940; Heiser & Smith, 1953; Purseglove, 1968; Rosengarten, 1969).

In Ethiopia, *Capsicum* spice is the most important spice of the country. Kostlan (1913) called it the 'National Spice' of Ethiopia and he stated 'Without Spanish pepper one can not imagine a food, almost not even an Ethiopian'. This still holds.

The Ethiopians distinguish three kinds of *Capsicum* spices:
(1) 'Karya', the immature green fruits;
(2) 'Berbere', the bulk of the red mature pungent fruits; the same name is also used to indicate a pungent sauce;
(3) 'Mitmita', the small extremely pungent fruits.

On the markets, 'berbere' fruits are usually graded into classes, according to

Photograph 6. Market hall at Dire Dawa with *Capsicum* fruits in front.

quality. 'Berbere' is the main constituent of most kinds of 'wot'. Three methods of preparation of the 'berbere' fruits are well known:
(1) 'Dilih'. The best quality of dried peppers are cleaned (pedicel and calyx removed) and ground. Mixed with fresh garlic, basil, ginger and rue, it is ground again with or without some water. Then the mixture is dried in the sun. Other ground spices like fenugreek, coriander, Ethiopian caraway, black cumin, cloves, cinnamon, korarima and salt and red onions are mixed, slightly roasted, ground to a fine powder, and then added to the other mixture. Some water is added until a semi-fluid substance is obtained, called 'dilih'. 'Dilih' can be stored for a very long time, it is the sauce of 'wot'.
(2) 'Awazie'. Pedicel, calyx and seeds are removed from the fruits, that are dried, slightly roasted and ground, mixed with garlic and salt, ground again, then left for two days, after which some 'tedj' (fermented honey drink) is added. The resulting fluid, 'awazie' can be stored long and is used to flavour raw meat.
(3) 'Aferinge'. Only the seeds and the placentas of the peppers are dried and mixed with garlic, ginger, korarima, Ethiopian caraway, black pepper, turmeric and salt. The mixture is ground, sieved, dried and ground again to a fine powder, 'aferinge'. It is used to flavour raw meat.

'Mitmita' can be prepared in the same way as 'berbere', but its use is limited, as it is very pungent. As a powder (together with other spices), it is used as 'salt' to flavour all kinds of food. A popular dish is 'kitfo', which is raw meat. It is sprayed with 'mitmita' powder and usually slightly roasted.

The mixtures mentioned may vary in the amount of other spices added. Green peppers are usually used immediately in 'wot' or roasted together with meat (Asrat, 1962; Ketema, 1962; Telahun, 1962).

2. *Medicinal uses*

Pungent *Capsicums* are considered powerful stimulants and carminatives. Preparations of it are applied externally as irritants to produce warmth and redness. If they are too concentrated, however, blistering may result (Redgrove, 1933). The number of reported medicinal uses of *Capsicum* is quite large. It seems to be a panacea. Among uses are the following:

- Against certain throat inflammations (Irish, 1898; Heiser & Smith, 1953);
- Against stomach disorders due to alcohol (Heiser & Smith, 1953);
- Against certain types of diarrhoea (Heiser & Smith, 1953);
- Against freckles (Irish, 1908);
- As an antidote to poisons (Dalziel, 1955);
- Leaves are used as a dressing for wounds and sores (Dalziel, 1955);
- Leaf-sap is squeezed into the eyes against headache (Dalziel, 1955);
- As an insecticide (Dalziel, 1955);
- As a bactericide (Watt & Breyer-Brandwijk, 1962).

According to Stevenel (cited by Watt & Breyer-Brandwijk, 1962), regular intake is beneficial against haemorrhoids, varicose veins, anorexia, liver congestions and vascular conditions.

In Ethiopia, people who eat raw meat believe that *Capsicum* kills dangerous micro-organisms in the meat and the stomach. The hot peppers are used also against amoeba infection and intestinal worms. Externally they are used in ointments as an irritant (Amare, 1976). Lemordant (1971) reported that in Ethiopia *Capsicum* is used against rabies. The liver of the dog that bit is spiced with *Capsicum* pepper and eaten as antidote.

Chemical composition

Maistre (1964) provided data on the composition of dry *Capsicum* fruits (Table 4).

Capsicum fruits may have a rich vitamin C content. Content of vitamin C in fruits of non pungent cultivars is 0.5–2.8 g/kg expressed as ascorbic acid. The vitamin A content is 2000–200 000 IU/kg for pungent cultivars and 1000–12 000 IU/kg for non pungent cultivars (Purseglove, 1968).

The pungent principle of *Capsicum* fruits is capsaicin (or capsicin) ($C_{18}H_{27}NO_3$), a volatile phenolic compound, related to vanillin in structure. It is quite stable, persistent and extremely potent. The pure form can be detected by taste at a dilution of one part per million. Capsaicin is found in the placental tissue of the fruits only. Seeds and ovary wall are not pungent (Heiser & Smith, 1953). The fruits contain ca 0.1–0.2% capsaicin (Maistre, 1964; Purseglove, 1968).

The major pigment in *Capsicum* fruits is the carotenoid capsanthin ($C_{40}H_{58}O_3$) (Purseglove, 1968). The content in paprika is up to 4 g/kg.

The content of carotene in paprika is up to 0.5 g/kg (Redgrove, 1933). According to Agren & Gibson (1968), Ethiopian *Capsicum* has the composition given in Table 5.

Table 4. Composition of dry *Capsicum* fruits (from Maistre, 1964).

	Whole fruit	Pericarp	Seed	Placenta
Content in whole fruit (%)	100	55	36	9
Content in part of fruit (%)				
Crude protein	15.75	13.05	14.92	11.56
Nitrogen-free extract	42.86	51.52	33.88	26.94
Lipid	10.39	4.62	18.40	10.98
Fibre	15.37	15.00	20.74	29.99
Ash	6.02	7.17	4.41	15.50
Essential oil	1.18	0.95	1.91	0.29
Content in ash (g/kg)				
K	458			
Mg	37			
Fe	10			
P	70			
Ca	34			
Cl	36			
S	26			
Na	33			
Si	9			
Cu	0.25 – 1.35			

Table 5. Composition of Ethiopian *Capsicum* (g/kg) according to Agren & Gibson (1968).

	'mitmita' undried	'mitmita' dried	'berbere' undried	'berbere' dried	'berbere' spice mixture
Water	653–734	91	661–858	59–153	41–94
Nitrogen	2–9	–	3–8	13–29	18–31
Protein	3–36	–	12–32	52–116	44–124
Fat	14–52	14	17–36	50–222	114–189
Carbohydrates	189–277	–	126–248	502–720	497–589
Fibre	16–19	–	56–128	197–467	194–267
Ash	17–20	63	12–27	49–187	61–263
Calcium	0.48–0.49	2.76	0.12–0.36	0.71–2.32	1.75–2.82
Phosphorus	0.79–1.75	2.95	0.48–1.10	2.29–4.72	2.81–4.76
Iron	0.028–0.037	0.632	0.023–0.07	0.15–1.18	0.094–0.962
Thiamine	0.0004	0.0005	0.0006–0.0016	0.0006–0.0068	0.085–0.005
Riboflavin	0.0022	0.0076	0.0012–0.0076	0.0028–0.017	0.0015–0.0084
Niacin	0.013	0.048	0.012–0.041	0.062–0.163	0.012–0.092
Tryptophan	–	–	–	0.76	–
Ascorbic acid	0.44	0.45	0.18–1.88	0.08–0.27	0.12–0.81
B-carotene eq.	–	0.506	0–0.0412	0.3798	0.8
'Rubbish' (in samples)	210	40	220–620	10–190	–

2.5 Coriandrum sativum L. **Fig. 6**

'*Coriandrum*': old Latin plant name, derived from the Greek plant name '*koriannon*', which word is related to the Greek word 'koris' = 'bedbug'. This word alludes to the unpleasant bedbug-like smell of the unripe fruits.
'*sativum*': related to Latin 'serere' = 'to sow, to plant, to cultivate'; grammatically the root of 'serere' is 'sat', so the meaning is sown, planted, cultivated.

Linnaeus, Sp. Pl. ed. 1: p. 256 (1753).
Type: '*Coriandrum* fructibus globosis'. 'In hortis Misniae, Daniae &c'. Burser herbarium vol. 8, no 38 (UPS, lecto., microfiche !).

Synonyms

Coriandrum majus Gouan, Hort. Monsp.: p. 145 (1768).
Coriandrum diversifolium Gilib., Fl. lithuan. 2: p. 26 (1782).
Coriandrum globosum Salisb., Prodr.: p. 166 (1796).
Coriandrum melphitense Ten. & Guss., Ind. sem. Horti Neap.: p. 3 (1837).
Selinum coriandrum E. K. L. Krause, in: Sturm, Fl. Deutschl. ed. 2, 12: p. 163 (1904).

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1957: Mensier, Dictionnaire des huiles végétales, Encycl. Biol. 52: p. 185–186. (chem.)
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1961: Garnier et al., Ressources médicinales de la flore française, 2: p. 886–889. (use + chem.)
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1962: Karsten et al., Lehrbuch der Pharmakognosie, ed. 9: 509–512. (use)
1963: Siegenthaler, Useful plants of Ethiopia, Exp. Stn. Bull. 14: p. 8. (use)
1968: Tutin, *Umbelliferae*, in: Flora Europaea: p. 328. (tax.)
1968: Purseglove, Tropical Crops, Dicotyl. 2: p. 650. (agric.)
1969: Rosengarten, The book of spices: p. 216–221. (agric. + use)
1969: Parry, Spices, 1: p. 184–186; 2: p. 108–111. (use)
1972: Hedge & Lamond, *Umbelliferae*, in: Flora of Turkey, 4: p. 330–331. (tax.)
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1976–
1977: Kloos, Preliminary studies of medicinal plants and plant products in markets of central Ethiopia, Ethnomedicine, B. 4, 1/2: p. 83. (use)
1978: Cannon, *Umbelliferae,* in: Flora Zambesiaca, 4: p. 575–576. (tax.)

Local names: dembilal (Amarinia); debo, shucar (Gallinia); tsagha, zagda (Tigrinia).
Trade names: coriander (English); coriandre, persil arabe (French); Koriander, Wanzendill, Schwindelkorn (German).

Geographic distribution

Most probably, *C. sativum* is a native of the Mediterranean region, where it has been grown since ancient times. It is the oldest known spice. Cultivation of coriander is now reported from Argentina, Brazil, Burma, China, Egypt, Ethiopia, France, Great Britain, India, Italy, Libya, Mexico, Morocco, the Netherlands, Paraguay, Peru, Poland, Rumania, Somalia, Spain, USA, USSR, Yugoslavia (Thellung, 1925; Redgrove, 1933; Cufodontis, 1959; Purseglove, 1968; Rosengarten, 1969; Shishkin, 1973).

In Ethiopia coriander can be found on almost every market. Small scale cultivation in gardens is widespread. Cultivation as a crop is reported from Eritrea, Hararge, Shoa, Kefa (in 1880 coriander represented 10% of the whole market trade in the then important trade centre of Bonga), Wollega and Begemdir (Baldrati, 1950; Cufodontis, 1959; Pankhurst, 1964; Centr. Stat. Off., 1970).

Description

An erect, annual, entirely glabrous, profusely branching herb, up to 1.30 m tall, with a well-developed yellow-brown tap-root up to 15 mm diam. with many laterals.

Stem solid, sometimes internodes becoming hollow when older, subterete, up to 15 mm diam., sulcate, with a white bloom, light-green with darker-green ribs, sometimes violet-tinged or with some violet spots.

Leaves alternate, rather variable in shape and size, with a yellow-green, scariously margined sheath, surrounding the supporting stem for half to more than three quarters of its circumference; petiole and rhachis terete to subterete, sulcate, light-green; leaf-blade white-waxy, shiny-green, often with darker-green veins; the first 1–3 leaves above the cotyledons withering early, usually simple, with petiole up to 5 cm long and ovate blade up to 3 × 3 cm, deeply cleft or parted into usually 3 incised-dentate lobes; next leaves decompound, petiole above the sheath 0–15 cm long, blade ovate or elliptic in outline, up to 30 × 15 cm, usually pinnately divided into ca 3–11 leaflets, which are each alike the blade of the simple lower leaves or again pinnately divided into ca 3–7 simple leaf-like lobes; all higher leaves compound, the petiole restricted to the sheathing part only, the blade divided into 3 leaflets directly above the sheath, of which the central one is the largest, each like the leaflets described above or bi- to tri-pinnately divided into sublinear or subfiliform, entire, acute lobes.

hypocotyl ca 1–2.5 cm long, white, red-brown or purplish-brown; cotyledons opposite, oblanceolate, up to 30 × 4 mm, entire, glabrous, light-green.

Taxonomic notes

(1) In Sp. Pl. (1753), Linnaeus described coriander as: '*Coriandrum* fructibus globosis', and referred to Hort. Cliff. 100, Hort. Ups. 63, Mat. med. 135, Roy. lugdb. 109, Sauv. monsp. 260, *Coriandrum majus* Bauh. pin. 158, *Coriandrum*. Cam. epit. 523. He copied the description from Hort. Cliff. 100, so his opinion about this species did not change between 1738 and 1753. In the Hort. Cliff. herbarium (BM) one '*Coriandrum sativum*' specimen is present; it is a fine specimen in flower, but it lacks fruits. The specimen in the LINN herbarium (No 363.1) and the three specimens in the van Royen herbarium (L) are flowering specimens too, without mature fruits. In the Burser herbarium, however, a specimen with flowers and fruits is present. As the descriptive phrase of the protologue is confined to the fruits of coriander, I prefer to designate as lectotype of *Coriandrum sativum* L., the specimen in the Burser herbarium, vol. 8, no 38, which is labelled: '*Coriandrum maius* Bauh. Coriander. In hortis Misniae, Daniae &c.'.

(2) De Candolle (1830) distinguished one variety in *C. sativum:* var. '*microcarpum,* fructibus dimidio ferè minoribus, foliorum laciniis tenuissimis brevibus' ('*microcarpum,* fruits about half as large, leaf lobes very slender and short'). De Candolle was doubtful about the rank of this 'variety'; he placed a question mark before its name and wondered if it should be classed as a separate species.

(3) Thellung (1925) stated that two varieties of coriander could be distinguished on the basis of fruit diameter:
(1) var. *vulgare* Alef. (fruit ca 3–5 mm in diam.);
(2) var. *microcarpum* DC (fruit ca 1.5–3 mm in diam.).

Thellung distinguished also a form of var. *microcarpum* DC: f. *melphitense* (Ten. & Guss.) Thellung (quoted from Melfi, S Italy; this has umbels with only two, poorly fruited umbellets). According to Thellung (1925) the coriander from India and Morocco has large ovate fruits (6–7 mm long, 4 mm wide), and that from the USSR small fruits (1.5–2 mm in diam.); the German and N American coriander fruits have sizes between the large and small forms.

(4) The coriander from Ethiopia is rather uniform. The fruit-size ranges from ca 2.5 to 4.5 mm in diam. and thus would best fit var. *vulgare* Alef. (= var. *sativum).* But as it is possible to select from almost any batch of Ethiopian coriander fruits a set of fruits which fits also var. *microcarpum* DC, the Ethiopian material does not allow distinction of varieties. Cufodontis (1959), Tutin (1968), Hedge & Lamond (1972), Shishkin (1973) and Cannon (1978) did not subdivide the species either.

(5) The Ethiopian coriander material includes a wide range of variability and could be used as basis for several cultivars. Characters like life cycle, disease resistance, stability, yield, colour and content and quality of essential oil would need to be studied during such selection.

In the cultivated coriander at Alemaya, a remarkable difference in growing season was observed. The specimens SL 584, SL 1128, SL 1204, SL 1257, SL 1313 and SL 1392 showed a relatively short life-cycle, SL 1283 a very long one. Plants grown from seed of the same origin at Wageningen and at Alemaya differed only slightly. The Alemaya plants were more robust and more branched and showed on an average two more flowers per umbellet.

(6) Hedge & Lamond (1972) reported *Coriandrum tordylium* (Fenzl) Bornm. as growing in Iran, Lebanon, Syrian desert and Turkey. This species has not been observed in Ethiopia. It may easily be distinguished from *C. sativum* by its fruit, which splits entirely into two mericarps at maturity, while primary ridges and vittae are absent.

The Linnaean *Coriandrum testiculatum* has been transferred to the genus *Bifora*.

(7) The description is based on the following specimens:

Arussi	Kofale market: SL 1283
Bale	Goba market: SL 1221; Goro market: SL 1257
Beğemdir	Gondar market: WP 4988–4989, SL 856, SL 872, SL 917; Infranz market: SL 835.
Eritrea	Adi Caieh market: SL 900.
Gojam	Dedjen market: SL 768, SL 772, SL 774; Elias market: SL 796; Lumane market: SL 731; 5 km E. of Behar Dar, 11°32'N × 37°23' E: J. J. F. E. de Wilde 5788.
Hararge	Alemaya, College of Agriculture, cultivated: PJ 1346–1350, PJ 1362–1401, PJ 1481–1490, PJ 1497, PJ 1593–1594, PJ 1706–1711, PJ 1840–1847, PJ 1904–1913, PJ 2027–2034, PJ 2036–2037, PJ 2042, PJ 2076–2080, PJ 2757–2764, PJ 2831–2864, PJ 3091, PJ 3093–3110, PJ 3348–3355, PJ 3414–3432, PJ 4044–4051, PJ 4061–4068, PJ 4342, PJ 4511–4516, PJ 4791–4793, PJ 4822, PJ 5898–5900, PJ 6454–6456; Alemaya in garden: WP 716, WP 718, WP 1808, WP 2220, WP 3034; Alemaya in field: WP 683, WP 2335, PJ 7126, PJ 7226; Alemaya market: Bos 8070, Bos 8077, PJ 1166, PJ 5906; Asbe Tefari market: SL 6, SL 11; Assebot market: SL 706; Bedeisa market: SL 671; Bedeno market: SL 329; Chelenko market: SL 272; Dire Dawa market: WP 189, Bos 8360, Bos 8387, PJ 1038, PJ 1045; Feddis market: SL 165; Gelemso market: SL 628; Gursum market: PJ 4466; Harar market: WP 83, WP 4038; Harar, 5 km on road to Feddis: PJ 4433; Jijiga market: SL 363; Karra market: SL 584; Kuni market: SL 544; Lange market: SL 290; Moulu market: SL 447; Wotter market: SL 205.
Kefa	Agaro market: SL 94; Bonga market: SL 1413; Jimma market: WP 3274, WP 3290, Tadessa Ebba 544, SL 111, Bos 8626.
Shoa	Addis Ababa, near Univ. Coll.: W. de Wilde 9240; Ambo market: PJ 1221; Bulbulla market: PJ 3904; Debre Libanos, near old 'Portuguese Bridge': W. de Wilde: 8643; Kuyera market: SL 1204; Nazareth, garden IAR: PJ 2400–2405, PJ 3566–3572, PJ 4689–4695, PJ 4825; Shashemene market: SL 1313, SL 1725.
Sidamo	Awassa market: SL 1322; Dilla, 8 km on road to Wondo, in garden: WP 2828; Kebre Mengist market: SL 1347; Negele market: SL 1392.
Tigre	Axum market: SL 937.
Wollega	Dembidolo market: SL 1532; Ghimbi market: PJ 1180, PJ 1191B; Nekemt market: PJ 1195, PJ 1199.
Wollo	Bati market: SL 1034; Dessie market: SL 1095; Haik market: SL 1182; Kombolcha market: SL 991.
Grown at Wageningen	WP 7136–7139, WP 7148–7150, PJ 46–84, PJ 128–129, PJ 139–140, PJ 173–180, PJ 215, PJ 298–305, PJ 327–339, PJ 394–400, PJ 538–543, PJ 555–563, PJ 572, PJ 587–588, PJ 591–592, PJ 598–599, PJ 606–628, PJ 659–684, PJ 696–711, PJ 750–754, PJ 797–799, J. van Veldhuizen 19–22.

The following specimens, originating from Ethiopia, were seen (all in herb. FT): P. Benedetto 162 (July 1938, Wollega-Sajo, Dembidolo); R. Bricchetti 52 (Harar, 1889); W. Burger 2275 (28-10-1962, College of Agriculture, Alemaya); E. Chiovenda 1761 (3-8-1909, Gondar); Massa 813 (4-6-1936, Semhel); H. F. Mooney 9135 (24-7-1962, Addis Ababa); P. Rovesti 44 (12-10-1931, Asmara); L. Senni 1427 (7-9-1937, Milizia forestale, border of river Dsukan, Shoa); Tadessa Ebba 544 (19-8-1967, Jimma market).

Ecology

Coriander can be grown under a wide range of conditions, from temperate to tropical climates, although in the tropical lowland it may fail to set seed (Purseglove, 1968). It thrives best on light, calcareous soils, but the crop will also grow well on loamy and clayey soils with good drainage (Redgrove, 1933; Garnier et al., 1961; TPI report, 1962).

In Ethiopia, cultivation of coriander is limited to the highlands (ca 1500–2500 m), although it can be cultivated in the lowlands if the rainfall is sufficient. According to Baldrati (1950), coriander can be grown in the same areas as wheat, barley, sorghum and teff.

Ramanujam et al. (1964) reported that Indian coriander was only ca 50–56% cross-fertilized, mainly by wind-pollination but sometimes by bees and flies. Because of protandry in coriander, one might expect a higher percentage. According to Chaudhry (1961), the stigma of the coriander flower remains receptive for five days but the pollen remains fertile for 24 hours only. The stamens of a flower emerge one by one (seldom two at once). If a flower opens before nine o'clock in the morning, all stamens emerge the same day. If a flower opens later, all the stamens are exserted only by noon the next day. The anthers dehisce within 2–24 minutes after expansion of the filaments, but if the filament expands late in the afternoon, dehiscence occurs after 1–2.5 hours. The dehiscence itself takes ca 1–6 minutes. Most flowers open in the morning. Hermaphrodite flowers usually open one day earlier than staminate flowers (Mayandi Pillai, 1939).

In India research has been done to investigate the nature of the sex expression of coriander flowers. The ratio of staminate to perfect flowers seemed to be influenced by developmental and environmental factors, but most probably also by genetics (Singh & Ramanujam, 1973).

Husbandry

Coriander is propagated by seed. It is usually sown in rows, at ca 2 cm depth, with plants 15–30 cm apart and 25–75 cm between rows, taking 10–20 kg seeds per ha. In Europe, coriander is sown in early spring. In regions with warmer climate the best sowing time for rainfed crops is at the beginning of the rainy season (Ridley, 1912; Redgrove, 1933; Garnier et al., 1961, TPI report, 1962; Purseglove, 1968).

In Ethiopia, seed is sown at the beginning of the rainy season. Farmers usually grow only small plots, often along fields with cereals or mixed with them, where the density of the cereals is insufficient. In the open field, coriander is sown in rows with plants 30–40 cm apart after thinning and with rows 50 cm apart (Baldrati, 1950).

Photograph 7. *Coriandrum sativum,* detail of photograph 8.

In the Tinnevelley district of India, coriander is cropped in alternation with *Pennisetum typhoides* and with cotton, or intercropped with cotton or *Phaseolus mungo* (Mayandi Pillai, 1939).

Germination time depends on the availability of water. Seed sown at Alemaya (alt. ca 2000 m) in March took ca 2 months to produce normal seedlings; sown at the end of May it took only 1 month. At Wageningen in a greenhouse (good water supply), it took 3 weeks. At Alemaya, full flowering occurred 2.5–4.5 months after sowing; harvest was possible 4–8 months after sowing. At Wageningen, flowering occurred 2–3.5 months after sowing and harvest was possible 3–5 months after sowing. In Europe, maturing takes ca 3.5–4 months (TPI report, 1962); in India 3–3.5 months (Purseglove, 1968).

The moment of harvest of the fruits must be chosen rather precisely. If harvested too early, the fruits are not ripe and have an unpleasant odour. If harvested too late, many of the fruits are lost as they shatter easily. It is recommended to harvest the fruits when they are fully ripe by taking the whole plant early in the morning or late in the evening (when there is dew). They should then be dried for some days in the shade or in the open field, and threshed by light beating of the plants. The harvested fruits should be dried thoroughly and stored dry (Ridley, 1912; Thellung, 1925; Redgrove, 1933; Garnier et al., 1961; TPI report, 1962). Yield varies considerably. Rainfed crops usually produce 400–700 kg/ha, irrigated crops up to 2000 kg/ha. Frosts may reduce the yield very much (Singh et al., 1967).

Photograph 8. *Coriandrum sativum*, flowering plants, PJ 1038.

In Ethiopia, serious losses of fruit were caused by infestation of a fly, most probably the phytophagous chalcid fly *Systole albipennis* Walk. This fly inserts its ovipositor through the fruit wall and lays an egg between the pericarp and the ovule. The larva feeds upon the embryo or the endosperm, and the adult fly bores a hole in the pericarp and escapes (Gupta, 1962).

This pest might be controlled biologically by parasites of the *Systole* larva such as *Tetrastichus* sp. and *Liondontomerus* sp. as well as by insecticides.

Several fungi are reported to cause diseases in coriander. According to Van Harten (1974) some of them are as follows:

- A wilt is caused by *Fusarium oxysporum* f. *coriandri*. It can be controlled with fungicides.
- A mildew is caused by *Erisyphe polygoni*. It can be controlled with sulphur.
- A canker is caused by *Protomyces macrosporus*. Control is possible by burning the infested plants.

After harvest, the fruits can be protected against insect infestation by regular fumigation for six hours with methyl bromide (Rosengarten, 1969).

According to Baldrati (1950) the production of coriander in Ethiopia is not sufficient for national comsumption. Imports, mainly from India by Indian and Arab merchants, who also control the price of the local product, supply the additional needs. Baldrati (1946) stated that the Ethiopian coriander was better in quality than the Indian product. The Indian and Ethiopian crop decreased in importance because of the increasing area cultivated with coriander in the USSR and in countries around the Mediterranean Sea.

Uses

1. Culinary uses

Coriander is mainly grown for its fruits, which have a distinctive fragrant odour and a pleasant mild and sweet, yet slightly pungent taste (Rosengarten, 1969). The dried ground fruits are a major ingredient of curry powder. Since ancient times, whole or ground fruits are used to flavour foods and beverages (particularly gin). Its range of utility as a flavouring agent is wide (pickles, sauces, seasonings and confectionery). The distilled essential oil from the fruits is used, for instance, in perfumes, soaps, candy, cocoa, chocolate, tobacco, meat products, baked foods, canned soups, liqueurs and alcoholic beverages and to mask offensive odours in pharmaceutical preparations (Ridley, 1912; Redgrove, 1933; Cufodontis, 1959; Rosengarten, 1969; Shishkin, 1973). After distillation of the fruits, the remaining presscake is said to be good cattle food, containing much vitamin C (Ridley, 1912; and many others).

Young plants are used as seasonings in chutneys, sauces, curries and soups (Purseglove, 1968). Young stems sometimes serve as a spice (Shishkin, 1973). Leaves are used as a vegetable in India, Somalia and Libya (Engler, 1895; Redgrove, 1933; Baldrati, 1950). In Ethiopia, coriander leaves are added as an aromatic herb to bread, 'wot' and tea (Kloos, 1976/1977).

In Ethiopia coriander fruits have a wide range of daily uses. According to Baldrati (1950) they are indispensable for the preparation of 'berbere', the pungent pepper powder. Washed, polished and ground fruits are a flavouring agent in 'wot', 'injera', cakes and, mixed with Ethiopian caraway seeds, in bread (Kostlan, 1913; Asrat, 1962; Telahun, 1962; Ketema, 1962; Siegenthaler, 1963). In Kefa Province, ground dried fruits, together with chopped green chillies, are added to cheese and eaten as 'wot' which is called 'diko'. The fruits are also added to a porridge made from *Colocasia antiquorum* as a spice (Siegenthaler, 1963).

2. Medicinal uses

Coriander is little mentioned as a medicine. In Ethiopia, fruits of coriander are used against stomach ache. For this purpose, fruits are boiled in water and drunk on an empty stomach (Asrat, 1962; Gelahun, pers. comm., 1976). The leaves are chewed to control colic and stomach ache (Kloos, 1976/1977).

In Europe, the dry fruits are said to have carminative and stomachic properties. Powdered fruits or oil are added to purgative medicines to prevent griping. The oil or fruit powder may be added to unpleasant drugs to mask the taste (Ridley, 1912; Thellung, 1925; Redgrove, 1933; Garnier et al., 1961; Rosengarten, 1969). In folk medicine, the fresh ground fruits are applied externally to ulcers. In addition, they are a component of the 'Karmelitergeist', a liquid used externally against (articular) rheumatism (Gessner & Orzechowski, 1974). According to Garnier et al. (1961) oil of coriander acts like ethyl alcohol. Frequent use may cause dizziness.

Photograph 9. *Coriandrum sativum*, fruits (3×), PJ 702.

In India a coriander decoction is the cheapest and most common household remedy for biliousness.

Chemical composition

According to Thellung (1925), fruits of coriander contain:

moisture	11–12 %
crude protein	11–12 %
essential oil	0.2–0.84%
fatty oil	19.5 %
sugar	0.1–2 %
starch	10.53 %
nitrogen-free extract	11–13 %
cellulose	26–30 %
ash	4.6–5.3 %

The essential oil is isolated from the fruits by steam distillation, after soaking the fruits for 12–16 hours in water (Shishkin, 1973). The oil is colourless or slightly yellow. It has a finer odour than many other commercial essential oils (e.g. from *Cymbopogon citratus)* and can be used as a starting point for the manufacture of many products (Scott, 1950). The essential oil content of the fruits is highest in Russian coriander; lowest in the Indian fruits. It contains ca 60–70% D–linalol (= coriandrol), ca 20% terpenes and traces of geraniol, 1-borneol and some other substances (Karsten et al., 1962).

According to Shishkin (1973) the remaining oilcake contains water 21%, protein 13%, fat 4%, nitrogen-free extract 21%, cellulose 34%, ash 7%. The green plant contains a different essential oil from the fruits. At flowering, the plant contains ca 0.12%, at harvest ca 0.17% of this oil (Garnier et al., 1961).

According to data of Joshi (1961) the content of vitamin A in coriander leaves is 10 000–12 000 IU per 100 g.

The fatty oil contains ca 8% palmitic acid, 53% petroselinic acid, 32% oleic acid and 7% linoleic acid (Mensier, 1957; Garnier et al., 1961).

2.6 Cuminum cyminum L. — Fig. 7

'Cuminum' = *'cyminum'*: the old Roman plant name, derived from the Greek 'kuminon', probably originating from the old-Babylonian 'ka-mu-nu'.

Linnaeus, Sp. Pl. ed. 1: p. 254 (1753); Gen. Pl. ed. 5: p. 121 (1754).
Type: 'Habitat in Aegypto, Aethiopica', LINN specimen 358.1, lecto.!

Synonyms

Cuminum odorum Salisb., Prodr.: p. 165 (1796).
Cuminum officinale Garsault, Fig. Pl. et Anim. d'usage méd. 2: tab. 239 (1764).
Cuminia cyminum J. F. Gmelin, Syst.: p. 484 (1791).
Cuminon longeinvolucratum St. Lager, Ann. Soc. Bot. Lyon 7: p. 65 (1880).
Ligusticum cuminum Crantz, Cl. Umbell. emend.: p. 82 (1767).
Luerssenia cyminum (L.) O. Ktze, Gen. Pl. 1: p. 268 (1891).
Selinum cuminum (L.) E. H. L. Krause, in: Sturm, Fl. Deutschl. 2, ed. 12: p. 91 (1904).

Literature

1830: De Candolle, Prodr. 4: p. 201. (tax.)
1872: Boissier, Flora Orient. 2: p. 1079–1080. (tax.)
1874: Flückiger & Hanbury, Pharmacographia: p. 295–297. (use)
1895: Engler, Pflanzenw. Ost-Afrikas & Nachbargebiete, B, Nutzpflanzen: p. 280. (use)
1897: Drude, *Umbelliferae,* in: Engler & Prantl, Die nat. Pflanzenfam., ed. 1, B. 3, 8: p. 184. (tax.)
1925: Thellung, *Umbelliferae,* in: Hegi, Illustr. Fl. Mittel-Eur., ed. 1, B. 5, 2: p. 1138–1139. (tax. + use)
1927: Wolff, *Cuminum,* in: Das Pflanzenreich, 4, 228: p. 22–24. (tax.)
1933: Redgrove, Spices and condiments: p. 207–211. (use + agric.)
1934: Bois, Les plantes alimentaires chez tous les peuples et à travers les âges, 3, Plantes à épices, à aromates, à condiments: p. 168–169. (use + agric.)
1957: Ferrara, Tecnologia delle spezie, Rivista Agric. subtrop. & trop.: p. 296–298. (use)
1957: Mensier, Dictionnaire des huiles végétales, Encycl. Biol. 52: *Cuminum.* (chem.)
1959: Cufudontis, Enumeratio, Bull. Jard. Bot. État Brux. 29(3) suppl.: p. 642. (tax.)
1961: Garnier et al., Ressources médicinales de la flore française, 2: p. 891–893. (use + chem.)
1961: Joshi, These new spices will pay you well, Indian Fmg. 10(10): p. 27. (agric.)

1968: Agren & Gibson, Food composition table for use in Ethiopia, CNU-ENI report 16: p. 14. (chem.)
1968: Tutin, *Umbelliferae,* in: Flora Europaea 2: p. 351. (tax.)
1969: Rosengarten, The book of spices: p. 224–229. (use + agric.)
1969: Parry, Spices, 1: p. 186–187; 2: 112–115. (use)
1971: Farm Information Unit: Cumin, Min. of Agr., India. (agric.)
1973: Shishkin, *Umbelliferae,* in: Flora of the USSR (Engl. ed.), 16: p. 265–266. (tax.)

Local names: ensilal, kamun (Amarinia); kamun, kamuna, kamum, kamun-bahari, hawaja (Gallinia); kemano (Tigrinia).
Trade names: cumin, cummin (English); cumin, faux anis, faux aneth (French); Kreuzkümmel, Römischer Kümmel (German).

Note: Seed samples offered for sale on Ethiopian markets under the local names are almost always mixtures of seed of *Anethum foeniculum, A. graveolens* and *C. cyminum.*

Geographic distribution

Cuminum cyminum has been cultivated since ancient times. It is difficult to determine where it is truly indigenous. It is probably native to the southern Mediterranean area, to the deserts of Egypt and other Arabian countries, and to Central Asia (Turkestan) (Wolff, 1927).

The plant is cultivated in many countries of the world. It is grown widely in China, India, Indonesia, Iran, Japan, Morocco, southern Russia and Turkey (Rosengarten, 1969).

In Ethiopia, the fruits are offered for sale on almost every market and small-scale cultivation is widespread.

Description

An erect or suberect, small, annual herb, ca 5–40 cm high, with all parts (the fruits excepted) glabrous. The green parts usually covered with a bloom. Taproot thin, light-brown, up to 3 mm in diam.

Stem: ca terete, finely sulcate, up to 3 mm in diam., branching at all heights, grey-green to dark-green, often brownish at base, some furrows becoming whitish when older.

Leaves alternate, petiolate, compound, blue-green; petiole ca terete, finely sulcate, ca 2–25 mm long, sheathing at base with white scarious margins; upper leaves usually with a sheathing part only; blade consisting of three slender filiform leaflets; each leaflet often (especially in the lower leaves) two or three-forked; the lobes filiform, acute, up to 7 cm long.

Inflorescence a compound umbel, up to 3.5 cm in diam.; peduncle ca terete, finely sulcate, up to 7 cm long, grey-green to dark-green; bracts often as many as primary rays, but one or two more or less possible, linear, sheathing at base with white scarious margins, often up to three-forked, ending in aristate lobes, ca 2–35 mm long, blue-green, but often with one or more completely white ones; primary rays 2–10 per umbel, ca terete, finely sulcate, blue-green, unequal in length, 0–18 mm long; bractlets 3–5 per umbellet, linear, up to 25 mm long, sheathing at base with white scarious

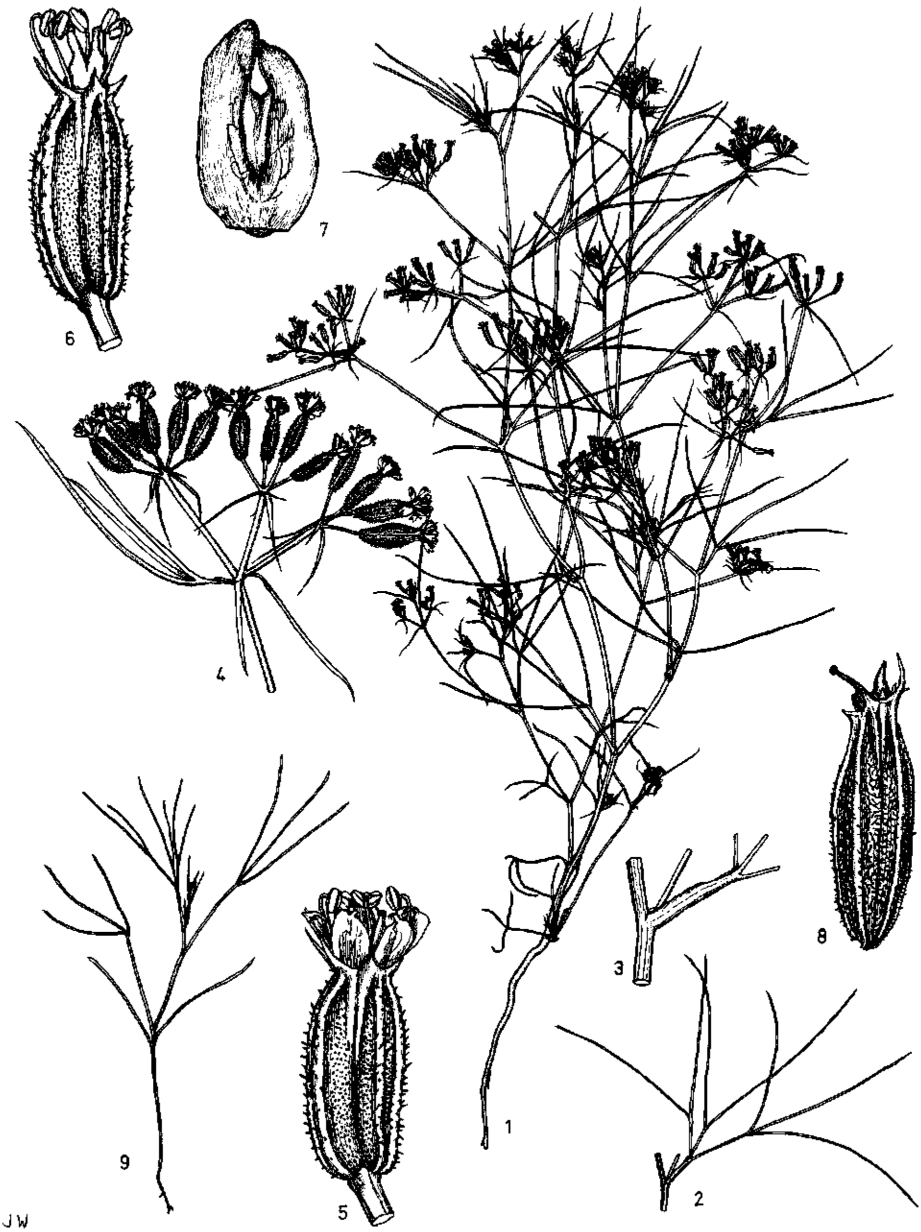


Fig. 7. *Cuminum cyminum* L. – 1. habit ($\frac{2}{3}\times$); 2. leaf ($\frac{2}{3}\times$); 3. leaf base ($2\times$); 4. inflorescence with umbellets, bracts and bracteoles ($2\times$); 5. flower ($8\times$); 6. flower, petals removed ($8\times$); 7. petal, adaxial side ($20\times$); 8. fruit ($6\times$); 9. seedling ($\frac{2}{3}\times$). – 1. **PJ** 657; 2–3. **PJ** 2807; 4. **PJ** 209; 5–7. **PJ** 2807 (spirit mat.); 8. **PJ** 546; 9. **PJ** 145 (spirit mat.).

margins, sometimes two or three-forked, ending in aristate lobes, blue-green or white; secondary rays 3–8 per umbellet, ca terete, finely sulcate, blue-green, unequal in length, 0–6 mm long; often an umbellet may also have one or more rudimentary developed flowers; all flowers hermaphrodite, actinomorphic, protandrous.

Calyx: sepals 5, narrow, triangular, up to 2.5 mm long, with fleshy light-green base and aristate, white apex.

Corolla: petals 5, oblong, up to 1.5 × 1 mm, with strongly inflexed, narrow, blunt apex, usually whitish at base and pinkish ro reddish at top.

Androecium: stamens 5; filaments filiform, up to 1.5 mm long, white; anthers oblong, up to 0.5 × 0.3 mm, yellow, dorsifixed, dehiscing with two longitudinal lateral slits.

Gynoecium: ovary inferior, oblong and laterally flattened, up to 4 × 1.5 × 0.75 mm, scarcely to densely setulose, with 8 pale-green, narrow, longitudinal primary ribs, alternating with 8 wider, light-brown secondary ribs; styles 2, up to 1 mm long, each with a fleshy, conical, persistent whitish stylopodium of ca 0.5 × 0.5 mm and a semiglobose stigma on top of the filiform upper part of the styles.

Fruit: an ovoid oblong, erect or slightly curved schizocarp, tapering towards both ends, laterally flattened, ca 3.5–6.5 × 1–2 × 0.75–1.5 mm, crowned by the persistent, sharp, conical stylopodia and the persistent sepal-bases; primary ribs 8, prominent, scarcely setose, whitish-brown; the two commissural primary ribs often hidden by the prominent neighbouring secondary ribs and only visible near the apex of the fruit; secondary ribs prominent, alternating with and wider than the primary ribs, light- or dark-brown, whitish setose all over, but more densely so centrally, forming a kind of a tertiary rib; the hairs (bristles) break off easily, resulting in subglabrous fruits; usually the fruits do not split at maturity into its two mericarps, although they do so when slightly pressed; carpophore whitish-terete, thin, split almost to the base; the mericarps are strongly concave ventrally, convex dorsally, usually bearing one oil-duct (vitta) below each secondary rib and two vittae at the commissural ventral side.

Seeds: testa adnate to the fruit-wall; embryo white, up to 2 × 0.2 mm, with conical radicle and two small, thin cotyledons, which are embedded in copious grey, fatty endosperm.

Seedling: germination epigeal; taproot thin, whitish; hypocotyl 3–25 mm long, whitish or purplish; cotyledons opposite, up to 15–45 × 0.5 mm, acute, slightly sheathing at base, light-green; epicotyl light-green, up to 2 mm long; petiole of the first non seed-leaf terete, slightly sheathing at base with white scarious margins, thin, finely sulcate, ca 20–30 mm long, light-green; blade consisting of three filiform, light-green, acute lobes; lobes up to 23 mm long.

Taxonomic notes

(1) Linnaeus (1753) did not give a description or diagnosis of *C. cyminum* in Sp. Pl. ed. 1, but he referred to Mat. med. 139, to '*Cuminum* semine longiore' Bauh. pin. 146, and to '*Cuminum sativum*' Cam. epit. 518. In his Gen. Pl. ed. 5: p. 121 (1754) a description of the genus *Cuminum* can be found.

The LINN herbarium contains only one specimen of *C. cyminum:* No 358.1. It is a specimen with leaves, flowers and young fruits, which certainly is in accordance with the generic description. At the top of the sheet '*Cuminum*' is written (not by Linnaeus) and at the base '1 *cyminum*' (by Linnaeus, which corresponds with the number in Sp. Pl.). I designate as lectotype of *Cuminum cyminum* L. specimen LINN 358.1.

(2) In the latest monographic revision of the genus *Cuminum*, Wolff (1927) distinguished three forms of *C. cyminum*. Together with characteristics given by De Candolle (1830), Boissier (1872) and Thellung (1925), these three forms can be described as follows:

f. *setosum* Boiss.
synonyms:
C. hispanicum Mérat ex DC (Wolff, 1927).
C. cyminum var. *hispanicum* (Mérat) Lange (Wolff, 1927).
- Two primary rays per umbel and 3–4 secondary rays per umbellet (DC, 1830; Thellung, 1925).
- Bractlets up to the length of the fruits (Wolff, 1927; Thellung, 1925).
- Secondary ribs of the fruits setose (Boissier, 1872).
- Flowers reddish (DC, 1830; Boissier, 1872; Wolff, 1927).
- Geographic distribution: Turkestan and Spain (Wolff, 1927).

f. *scabridum* DC.
synonyms:
C. aegyptiacum Mérat (Wolff, 1927).
C. cyminum var. *hirtum* Boiss. (Wolff, 1927).
- Three to five primary rays per umbel (Thellung, 1925).
- Bractlets may be longer than the fruits (Thellung, 1925).
- Secondary ribs with ca 2 rows of short scabrid or setulose hairs (Wolff, 1927).
- Geographic distribution: Egypt, Libyan desert, Algeria (Wolff, 1927).

f. *glabratum* DC.
synonyms:
C. cyminum Mérat ex DC (Wolff, 1927).
C. cyminum var. *glabrum* Lange (Wolff, 1927).
- Fruits glabrous or subglabrous (Wolff, 1927).
- Geographic distribution: Algeria, Egypt, Ethiopia, Spain, Turkestan (Wolff, 1927).

Within the Ethiopian material, these three forms cannot be clearly distinguished. Tutin (1968) in Flora Europaea and Shishkin (1973) in Flora of the USSR do not subdivide the species either.

(3) Wolff (1927) described a second species of the genus *Cuminum*: *C. sudanense*, based on a specimen collected by Schweinfurth in Sudan. This species was not observed in Ethiopia. Some differences from *C. cyminum* are:
- The lower leaves are bipinnate with 5–7 pairs of leaflets.
- The umbels have 20–26 primary rays.

(4) Plants of *C. cyminum*, originating from the same seed-source, raised in Ethiopia were more robust than plants raised at Wageningen.

(5) The description is based on the following specimens:

Begemdir	Gondar market: WP 4985.
Eritrea	Addi Caje, alt. 2200 m, 23-7-1902: A. Pappi 3097 (FT).
Hararge	Alemaya, cultivated at the College of Agriculture: PJ 1822–1826, PJ 2804–2808, PJ 3175–3182; Alemaya market: WP 29, PJ 1169; Dire Dawa market: PJ 1041, PJ 1043, PJ 1047, PJ 5944; Mieso market: WP 1439A, WP 3516.
Kefa	Jimma market: WP 3278, WP 3280, SL 113.
Shoa	Nazareth, cultivated at IAR (Melkassa): PJ 2416–2419, PJ 3586–3587.
Sidamo	Yirgalem market: WP 4055.
Tigre	Axum market: WP 4976.
Wollega	Ghimbi market: PJ 1181, PJ 1185.
Wollo	Haik market: SL 40.
Grown at Wageningen	WP 7365–7366, WP 7381, PJ 145, PJ 209, PJ 308–309, PJ 546, PJ 657, PJ 720–721.

Ecology

The natural habitat of the species is near oases in sandy deserts (Shishkin, 1973). However, the plant can withstand neither severe dry heat (Rosengarten, 1969) nor heavy rains (Farm Inf. Unit, 1971).

In Ethiopia the crop can be grown successfully at altitudes ranging from 1500 to 2200 m (Herb. WAG).

In India, ca 33% cross-pollination was observed in cumin (Aiyaduraj, 1966). This percentage is rather low, as the flowers of cumin are protandrous.

Husbandry

Cumin is grown from seed. If it is grown as a rainfed crop, the weather conditions are important. Severe drought or heavy rains can damage the crop considerably. Production figures therefore may show a wide variation. In Iran, for instance, production fluctuates between 8000 and 50 000 tons per year (Rosengarten, 1969). Perhaps the ancients observed cultivation problems too, as Theophrastus said: 'they say that one must curse and abuse it while sowing, if the crop is to be fair and abundant' (Redgrove, 1933).

In India, the crop is mainly grown under irrigation. A rich sandy loamy soil is required, to which 20–30 tons farmyard manure is supplied per hectare. The seed is broadcast on beds of ca 2 × 2.5 m or in rows, ca 25 cm apart, at a rate of ca 20 kg/ha. The best cultivation time is during the dry season. Germination takes about two weeks. Plants flower after ca 1.5 month and the fruits can be harvested at ca 3–3.5 months after sowing. When the plants begin to wither and the fruits turn yellow, it is time to harvest. The plants are uprooted when they are wet with dew and stacked carefully to dry in the sun. Threshing is often done with sticks or by trampling with cattle on a threshing floor. The yield varies from 500 to 1200 kg fruits per ha. (Farm Inf. Unit, 1971; Paulose, undated).

In Ethiopia cultivation of cumin was observed only in small gardens near houses. If irrigation is possible, cultivation in the dry season is recommended. If grown as a rainfed crop, sowing at the beginning of the lesser rains or at the end of the greater rains is advisable. Plants grown at Alemaya (alt. ca 2000 m) took ca 1–1.5 month for full germination, 2–2.5 months to start flowering and harvest was possible ca 3–3.5 months after sowing. The seed (bought on local markets) was contaminated with seed of *Plantago psyllium* L., a troublesome weed in the cultivation of cumin. It closely resembles the cumin plant at first glance. It can be distinguished from it by its opposite leaves and its non-umbelliferous inflorescence.

In Ethiopia, no serious diseases or pests of cumin were observed in 1975–1977.

In India, young plants are attacked by a *Fusarium* wilt, especially on light soils.

Photograph 10. *Cuminum cyminum*, flowering plant, PJ 308.

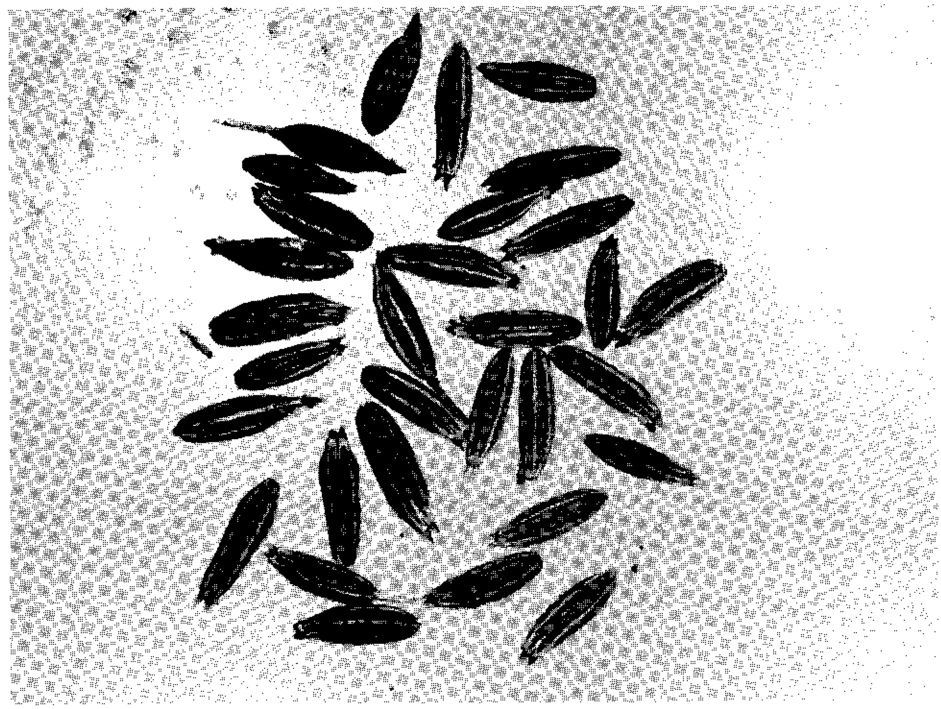
Photograph 11. *Cuminum cyminum*, detail of photograph 10.

This disease can be controlled by a dressing of trace elements to the soil. Powdery mildew can be controlled by dusting with sulphur (ca 15 kg/ha). Leaf-eating caterpillars *(Prodina* sp.) and a seed-embryo eating larva of *Systole albipennis* Walk. (a chalcid fly, causing up to 20% loss of the fruits in India), are the most important pests of cumin in India (Paulose, undated; Aiyaduraj, 1966; Gupta, 1962).

Uses

1. Culinary uses

Cumin seed was highly prized by the ancients as a kitchen spice. Today the seeds



Photograph 12. *Cuminum cyminum,* mericarps (3×), PJ 1169.

are used to flavour soups, rice, meat-dishes, cheese and bread, pickles, sausages, chutney and sauerkraut.

In India the ground seeds are an essential ingredient of curry and chili powder.

The essential oil is used in liqueurs and perfumes (Thellung, 1925; Redgrove, 1933; Ferrara, 1957; Parry, 1969; Rosengarten, 1969).

In Ethiopia the ground seeds are mainly used to flavour different kinds of 'wot' sauce and only small amounts are needed daily.

2. Medicinal uses

The essential oil of cumin has a light anaesthetizing action. The fruits are considered as a good medicine against digestive and intestinal upsets (Garnier et al., 1961; Rosengarten, 1969). Flückiger & Hanbury (1874) reported a considerable use of the fruits as a veterinary medicine.

In Ethiopia, the pounded leaves are applied to the skin against skin disorders (Gelahun, pers. comm., 1976).

Chemical composition

Agren & Gibson (1968) recorded that 100 g edible cumin fruits, originating from Ethiopia, contained:

moisture	6.8 g	calcium	605 mg
nitrogen	2.9 g	phosphorus	570 mg
protein	18.1 g	iron	174.9 mg
fat	40.3 g	thiamin	0.60 mg
carbohydrate total	28.7 g	riboflavin	0.16 mg
fibre	17.0 g	niacin	8.6 mg
ash	6.2 g	ascorbic acid	3 mg
rubbish (in sample)	17 g		

By steam-distillation of the fruits, 2–4% essential oil can be obtained. This oil is colourless at first, but later turns bright yellow. It smells and tastes like the fruits. Its chief components are cuminol (ca 56%, with smell and taste of cumin) and p-cymol (ca 40%, with a lemon resembling odour) (Flückiger & Hanbury, 1874; Thellung, 1925; Rosengarten, 1969).

2.7 Nigella sativa L. **Fig. 8**

'Nigella': diminutive of 'niger' (= 'black'), used like a female substantive *('Nigella'),* meaning 'blackish'; the name hints at the black seeds.
'sativa': derived from Latin 'serere': 'to sow, to plant, to cultivate'; grammatically the root of 'serere' is 'sat', so the meaning is 'sown, planted, cultivated'.

Linnaeus, Sp. Pl. ed. 1: p. 534 (1753).
Type: 'Habitat in Aegypto, Creta'. '*Nigella* petalis subtricuspidatis foliis subpilosis' (specimen LINN 700.4, lecto.!).

Synonyms

Nigella cretica Miller, Gard. Dict. 4 (1768).
Nigella indica Roxb., Journ. bot. 4: p. 203 (1814).
Nigella sativa L. var. *hispidula* Boiss., Ann. Sci. Nat. 16: p. 360 (1841).
Nigella sativa L. var. *brachyloba* Boiss., Fl. Orient. 1: p. 68 (1867).
Nigella arvensis Auct. non L.: Terracciano (1897).

Literature

1824: De Candolle, Prodr. 1: p. 48–50. (tax.)
1867: Boissier, Flora Orient. 1: p. 65–71. (tax.)
1888: Prantl, Beiträge zur Morphologie und Systematik der Ranunculaceen, Bot. Jahrb. 9: p. 244. (tax.)
1891: Prantl, *Ranunculaceae,* in: Engler & Prantl, Die nat. Pflanzenfam., ed. 1, B. 3, 2: p. 57. (tax.)
1895: Engler, Pflanzenw. Ost-Afrikas & Nachbargebiete, B, Nutzpflanzen: p. 280. (use)
1895: Brand, Monographie der Gattung *Nigella*, Helios 13(3): p. 33–34. (tax.)
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1912: Chiovenda, Osservazioni botaniche, agrarie ed industriali, Monog. rapp. col. 24: p. 31. (use)
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1953: Cufodontis, Enumeratio, Bull. Jard. Bot. État Brux. 23(3/4), suppl.: p. 106. (tax.)
1957: Mensier, Dictionnaire des huiles végétales, Encycl. Biol. 52: p. 393–394. (chem.)
1963: Siegenthaler, Useful plants of Ethiopia, Exp. Stn. Bull. 14: p. 19. (use)
1964: Maire, Flore de l'Afrique du Nord, 11: p. 41–42. (tax.)
1965: Davis, *Ranunculaceae,* in: Flora of Turkey, 1: p. 103. (tax.)
1968: Tutin, *Ranunculaceae,* in: Flora Europaea 1: p. 209–210. (tax.)
1970: Krasheninnikov, *Nigella,* in: Flora of the USSR (Engl. ed.), 7: p. 50–57. (tax.)
1971: Agrawala et al., Galactogogue action of *Nigella sativa,* Indian J. Med. Sci. 25(8): p. 535–537. (chem.)
1973: Salama, Sterols in the seed oil of *N. sativa,* Planta Medica, 24: p. 375–377. (chem.)
1974: Damboldt & Zimmermann, *Ranunculaceae,* in: Hegi, Illustr. Fl. Mittel-Eur., ed. 2, B. 3, 3: p. 111–115. (tax. + use)
1976: Amare Getahun, Some common medicinal and poisonous plants used in Ethiopian folk medicine: p. 47. (use)
1977: Lang, Vergleichend morphologische und entwicklungsgeschichtliche Untersuchungen am Gynöcium einiger *Nigella* Arten, Bot. Jahrb. Syst. 98, 3: p. 289–335. (bot.)

Local names: tukur azmut, tikur azmud, asmut (Amarinia); habasudu, abosuda, nugi guracha, gurati, gurra (Gallinia); aaf (Kefa); awosetta (Tigrinia).
Trade names: garden Nigelle, black cummin (English); Nigelle cultivée, quatre épices, toute-épice, cumin noir, patte d'araignée (French); Schwarzkümmel, Narden-Samen, Römischer Kümmel (German).

Geographic distribution

N. sativa is most probably indigenous to the Mediterranean region. In Ethiopia, it is sometimes found as an escape, although possibly it could belong to to the indigenous flora. It is cultivated in various parts of the world: Central and Southern Europe, the USSR, Northern Africa, Sudan, Ethiopia, Kenya, Somalia, Djibouti, Syria, Iran, Afghanistan and India (Cufodontis, 1953; Tutin, 1964).

In Ethiopia, the seeds may be found on every market. Small scale cultivation is widespread. Cultivation as a crop is reported from the provinces of Begemdir (Dembia, Gondar), Shoa (Alem-Gena), Bale (Dinsho), Hararge (Chercher Highlands) and Kefa (Jimma Region) (Baldrati, 1950; Cufodontis, 1953; Centr. Stat. Off., 1970).

Description

An erect annual, profusely branched herb, up to 70 cm high, with a well-developed yellow-brown taproot, with many sideroots.

Stem: subterete, ribbed, sometimes hollow when old, puberulous, light- to dark-green.

Leaves alternate, estipulate; petiole strongly broadened at base, light-green, only present in basal leaves, ca 1–6 cm long, ribbed, puberulous; blade up to 7 × 5 cm in outline, bi-, tri-, or even more-pinnately dissected into short, thin, sublinear, divergent, slightly pilose lobes, which normally are green but sometimes turn reddish-brown.

Inflorescence: flowers terminal, solitary; pedicel (2–)4–8(–11) cm long, puberulous, ribbed; all flower parts inserted on a pale-yellow, fleshy, depressed-conical receptacle, ca 2 mm in diam., visible as an orange to brown coloured ring below the carpels in fruit.

Calyx: sepals 5, ovate, 13–17 × 6–12 mm, top obtuse, tapering at base into a 2–3 mm long, 3-veined claw, papillose inside, papillose to scarcely pilose outside, pale-green when young, sometimes partly reddish, turning pale-blue to white on the ventral side and looking petaloid when older, the dorsal side remaining green or reddish-green.

Corolla: petals (6–)8(–11), nectariferous, with a short, ca 1.5–2 mm long, glabrous claw; the blade, perpendicular to the claw, divided into a narrow ventral lobe and a larger, deeply cleft dorsal lobe, together enclosing a nectar-pocket; dorsal lobe ca 3.5–5.5 × 2.5–4.5 mm in outline, split at top into two, ca 2–4 mm long, ovate, minutely papillose parts with a light-green callous thickening at their top, ventrally scarcely pilose, with an upward directed, transverse, light-green tubercle of ca 1 mm wide in the middle and with two transverse, violet lines, limitating a whitish part between the tubercle and the apex, which part curves backward at anthesis, becoming parallel to the claw; a violet nectar-pocket of ca 1.5–2 × 1 mm is situated between the top of the claw and the split, with a cup-like callous thickened base and a horse-shoe-shaped, ventral, puberulous rim on which fits the puberulous-rimmed dorsal base of the ventral lobe as a lid; ventral lobe oblong, ca 2.5–4 mm long, minutely papillose, violet at base, tapering into a long, narrow, white top.

Androecium: stamens in (6–)8(–10) groups of 3–7 stamens each, seldom with some staminodes, each group forming a vertical spiralloid line on the receptacle; filaments linear, 3–9 mm long, glabrous, violet- to pale-blue; anthers 2-celled, basifixed, ca 2 × 1 mm, yellow, with a conspicuous, acuminate, light-green connective, dehiscing lengthwise by two slits; during the development of the protandrous flower the stamens turn from a vertical position (young, short) to a horizontal position (old, long).

Gynoecium: lobed, composed of 3–7 green, white-granular carpels, almost connate to apex, together forming a compound ovary of ca 4–9 mm length, whose free, ca 5–9 mm long, ribbed, beak-like stigmas are twisted and reflexed at anthesis, becoming suberect again in fruit.

Fruit: a capsule, greyish to yellow-brown at maturity, many-seeded, ca 6–16 mm long and 5–12 mm in diam., with persistent, sub-erect stigmas of about the same length as the capsule; each carpel opening by an apical slit into the base of the stigma or slightly beyond (in this case also splitting the remaining stigma at base).

Seeds: 3(4)-sided, obpyramidal, ca 3 mm long and up to 1.5–2 mm in diam., rugose-tuberculate, dark-black, with a carrot-like smell; embryo minute, embedded in copious, greyish-white, fatty endosperm.

Seedling: germination epigeal; taproot white to light-brown, with many side-roots; hypocotyl ca 1 mm long, white to light-brown; cotyledons opposite, thin, elliptic to oblanceolate, entire, ca 1.5–2.5 × 0.5 cm, top obtuse, base attenuate to petiole-like, glabrous to minutely papillose, light-green; epicotyl absent or very short; stem

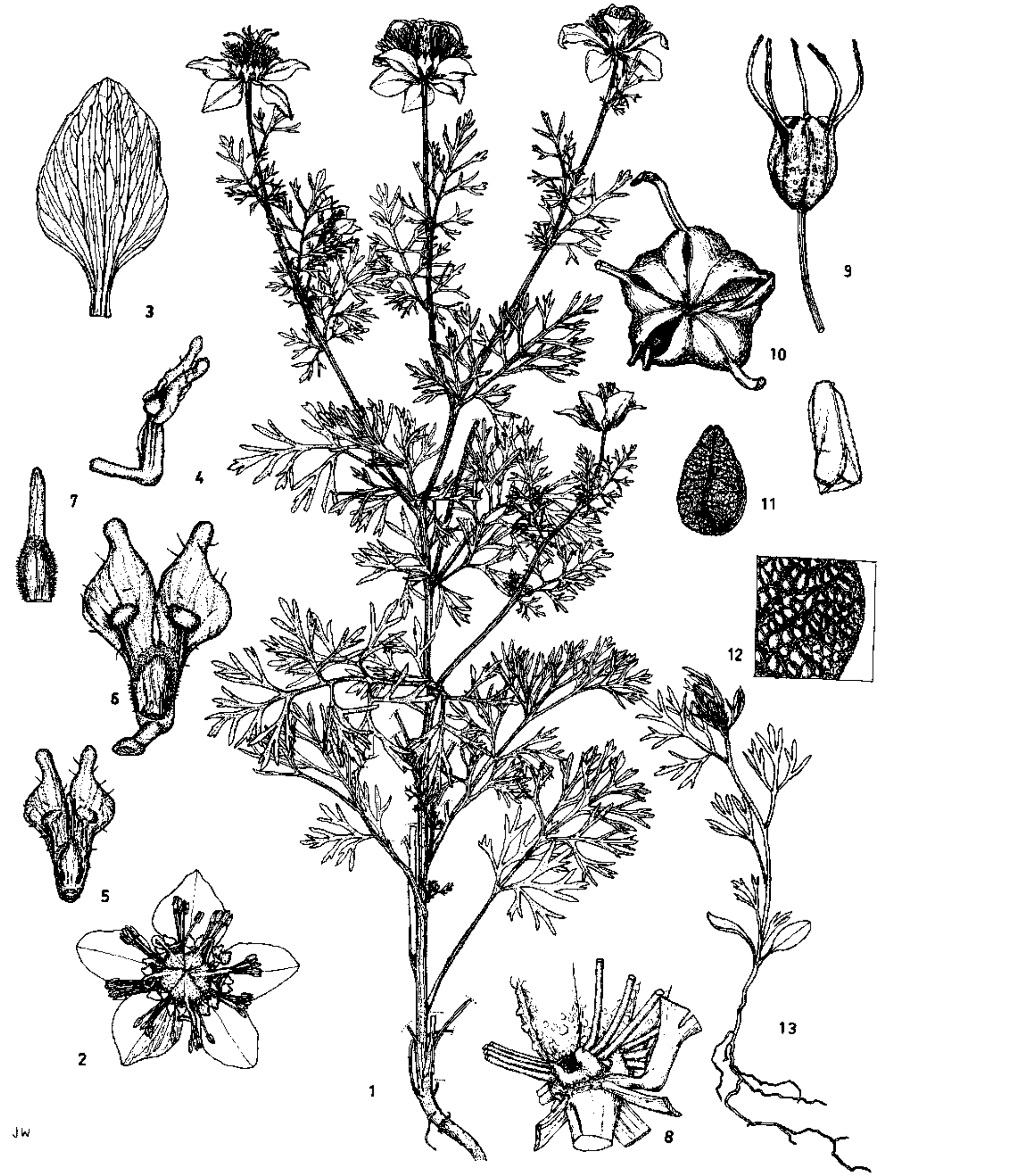


Fig. 8. *Nigella sativa* L. – 1. habit ($\frac{2}{3}\times$); 2. flower, top view ($1\times$); 3. sepal ($2\times$); 4. petal, side view ($4\times$); 5. petal, front view ($4\times$); 6. petal without ventral lobe ($6\times$); 7. ventral lobe of petal ($6\times$); 8. arrangement of stamen groups ($4\times$); 9. fruit ($1\times$); 10. dehiscing fruit, top view ($2\times$); 11. seed ($6\times$); 12. detail of testa ($18\times$); 13. seedling ($\frac{2}{3}\times$). – 1. PJ 1690; 2. PJ 150 (spirit mat.); 3–8. PJ 195 (spirit mat.); 9–12. PJ 2871; 13. PJ 30 (spirit mat.).

ribbed, puberulous; next leaves alternate, with a papery, at base broadening petiole; the first non-seed-leaf usually with a three-lobed blade, subsequent leaves becoming more divided.

Taxonomic notes

(1) Linnaeus (1753) described *Nigella sativa* in Sp. Pl.: '*Nigella* petalis subtricuspidatis foliis subpilosis', and he referred to Hort. Ups. 154, Mat. med. 271, Boehm. lips. 173, *Nigella* flore minore simplici candido Bauh. pin. 145, *Melanthium sativum* Cam. epit. 551 and *Nigella* flore minore pleno & albo Bauh. pin. 146. He copied the description of his Hort. Ups. 154 (1748). In Hort. Ups. Linnaeus remarked about this species: 'Hospitatur sub dio, annua. Semina distinctissima sapore & odore fragrantissima; folia vix manifeste pilosa, ut & caulis; petala tridentata apice, sed laterales dentes obliterati'. In the LINN herbarium, three specimens are present under *Nigella sativa*. Specimen LINN No 700.4 consists of some stems, leaves, one flower and two fruits and on the sheet the (Linnaean) inscription: '*Nigella sativa* se(min)e odorato' and 'HU'. As 'HU' indicates that this specimen originated from a plant cultivated at Uppsala, it might be the specimen Linnaeus based his description upon in his Hort. Ups. (1748). I designate as lectotype of the species *Nigella sativa* L. specimen LINN 700.4.

(2) Mainly on seed colour, branching habit and hairiness, later authors have distinguished different forms or varieties within *N. sativa*. De Candolle (1824) adopted three varieties: var. *cretica* ('stylis flore longioribus'); var. *citrina* ('seminibus luteis, floribus plenis'); var. *indica* ('caule foliis subglabris'). Boissier (1867) had one variety: var. *brachyloba* ('ramosior, hirsutior, laciniae abbreviatae confertae; capsula densius verrucosa'). The correct name for var. *brachyloba* Boiss. is var. *hispidula* Boiss., because Boissier described in 1841 var. *hispidula* Boiss. (Ann. Sc. Nat.: p. 360, 1841) which in 1867 he cited in synonymy to var. *brachyloba* Boiss..

Brand (1895) distinguished two formas ('varieties'): f. *hispidula* Boiss. ('planta maior ramosior, hirsuta; foliorum laciniis abbreviatis; capsulis densius verrucosis'); f. *citrina* DC ('forma culta floribus plenis valde dubia: seminibus luteis'). Except for var. *citrina* DC with yellow seeds, which Boissier (1867) did not mention and Brand (1895) considered as doubtful, the other infraspecific taxa cannot clearly be distinguished from one another, and are, in my opinion, infraspecific modifications that do not merit taxonomic segregation. Plants grown in the greenhouse at Wageningen would fit *N. sativa* var. *sativa* (if distinguished), but plants from the same seed, grown in Ethiopia, would better fit var. *hispidula* Boiss. As these variations are caused by the environment only, they do not justify an infraspecific subdivision of the Ethiopian material. Recent authors like Tutin (1964), Davis (1965), Krasheninnikov (1970) and Damboldt & Zimmermann (1974) do not accept a subdivision either. Davis (1965) considered var. *hispidula* Boiss. (= var. *brachyloba* Boiss.) as a synonym of *N. sativa* L.

(3) Brand (1895) divided the genus *Nigella* into three subgenera based on the dehiscence of the fruits. According to Brand (1895, p. 183 & p. 194), *N. sativa* belongs to the subgenus *Nigellina* with 'Früchte nur aussen aufspringend', 'in der Verlängerung des Griffels' (= dorsally). Lang (1977), however, stated that the fruits

of *N. sativa* dehisce only ventrally and not dorsally, and concluded that Brand's division was not correct. For the Ethiopian material, neither Brand's nor Lang's statement is correct. The fruits dehisce normally only at the top of each carpel (= ventrally), i.e. with a slit from stigma-base to fruit-axis, but sometimes dehiscence includes partial splitting of the stigma and the dorsal rib of the carpel.

(4) The only difference found between plants raised at Wageningen and in Ethiopia was in the habit: slender and sparsely branched at Wageningen, more robust and profusely branched in Ethiopia.

(5) One other *Nigella* species was found in Ethiopia: specimen WP 4900 is *Nigella damascena* L. As this specimen was collected at the experimental station of Debre Zeit, it is probably a recent introduction. *N. damascena* is easily distinguished from *N. sativa* by its leaf-like involucre around flower and fruit. Because the flower of this plant is hidden by the involucre, the British call it: 'love-in-the-mist'.

(6) The description is based on the following specimens:

Arussi	Sire market: SL 141; Robi market: SL 1235.
Bale	Goba market: SL 1219; Goro market: SL 1254.
Begemdir	Debarek market: WP 4970; Gondar market: WP 4990, SL 928.
Gojam	Dejen market: SL 762; Elias market: SL 801; Lumane market: SL 747; Telili market: SL 814.
Hararge	Alemaya, College of Agriculture, cultivated: PJ 1227–1267, PJ 1322–1323, PJ 1325–1329, PJ 1477, PJ 1583–1591, PJ 1682–1705, PJ 1834–1839, PJ 1882–1894, PJ 2025–2026, PJ 2526, PJ 2708–2756, PJ 2870–2908, PJ 2940–2944, PJ 3060–3066, PJ 3186, PJ 3993–3995, PJ 4037–4040, PJ 4042–4043, PJ 4057, PJ 4338–4341, PJ 4509–4510, PJ 4790, PJ 4824, PJ 5133, PJ 5895–5897, PJ 6450–6453; Alemaya garden: WP 710, WP 713, WP 1805, WP 2333, WP 3007; Alemaya market: WP 24, Bos 8066, PJ 5909; Asbe Teferi market: SL 5, SL 460; Assebot market: SL 701; Bedeno market: SL 331; Bedeisa market: SL 674; Chelenko market: SL 267; Deder market: SL 390; Dire Dawa market: WP 112, Bos 8359, PJ 1040, PJ 1042; Feddis market: SL 188; Gelemso market: SL 626; Harar market: WP 66, Bos 8040; Jijiga market: SL 364; Karra market: SL 585, SL 593; Moulu market: SL 452, SL 454; Waichu market: SL 507.
Illubabor	Djemezo market: SL 1438, SL 1453; Gambella market: PJ 5103; Metu market: SL 1491.
Kefa	Agaro market: SL 76; Bonga market: SL 1417, PJ 2209; Chena market: SL 1423; Jimma, Inst. Agr. Res.: PJ 5850; Jimma market: WP 3291, SL 119A, Bos 8624.
Shoa	Ambo market: PJ 1216; Bulbulla market: PJ 3903, PJ 3908; Kuyera market: SL 1207; Melkassa, cultivated (garden IAR Nazareth): PJ 2426–2429, PJ 3594–3597, PJ 4713–4716; Robi market: SL 1158; Shashemene market: SL 1306, SL 1308.
Sidamo	Adillo market: PJ 3665; Awassa market: SL 1320; Kebre Mengist market: SL 1346; Negele market: SL 1395.
Tigre	Adishow market: SL 1025; Axum market: SL 953.
Wollega	Dembidolo market: SL 1531; Ghimbi market: PJ 1175, PJ 1179, PJ 1189.
Wollo	Bati market: SL 1061; Dessie market: SL 1093; Haik market: SL 1123; Kombolcha market: SL 958.
Grown at Wageningen	F. van Gogh (not numbered), PJ 1–45, PJ 149–172, PJ 194–207, PJ 210–214, PJ 237–238, PJ 295–297, PJ 316–326, PJ 372–389, PJ 506–537, PJ 547–554, PJ 564–571, PJ 584–586, PJ 600–602, PJ 604–605, PJ 722–727, WP 7355–7357, J. van Veldhuizen 14–16.

The following specimens, originating from Ethiopia, were seen (all at FT):
I. Baldrati 2178 (18-5-1916, Asmara), 3771 (16-10-1916, Eritrea), 4865 (8-4-1916, Asmara); P. Benedetto 195 (August 1938, Dembidollo, Sajo); R. Bricchetti 231 (1889, Harar); E. Chiovenda 100 (1909, Gondar); R. Corradi 7500 (8–24 Sept. 1939, Mega); J. B. Gillett 14585 (3-12-1952, Aghere Mariam); R. Guidotti 763 (15-2-1936, Adoa); A. Pappi 4933 (28-4-1902, Ad-Rassi, Eritrea), s.n. (25-6-1903, Eritrea), 264 (6-7-1903, Eritrea); G. Piovano 19 (1937, Addis Ababa); E. Taschdjian 148 (21-10-1935, Kachissy market, Shoa), 148 (29-12-1935, Godja, lake Tana).

Ecology

N. sativa is described as a hardy annual, growing on all kinds of soils (Redgrove, 1933; Baldrati, 1950). In Ethiopia, it is cultivated as a rainfed crop in the highlands (ca 1500–2500 m) (Chiovenda, 1912; Kostlan, 1913). The seeds are typical dark-germinators and they seem to germinate better at high temperatures (Damboldt & Zimmermann, 1974). *N. sativa* is most probably, like most other *Nigella* species, an insect pollinated species with protandrous flowers. As the stigmas twist and turn down umbrella-like, self-pollination is possible in older flowers (Damboldt & Zimmermann, 1974). In *Ranunculaceae* a similar floral biology is encountered also in *Aconitum* (de Wit, pers. comm. 1979).

Husbandry

N. sativa is easily raised from seed, but is difficult to transplant (Redgrove, 1933). For cultivation as a crop, the seed is broadcast after the first rains in a well prepared soil at a rate of 20 kg/ha (Baldrati, 1950; Zemedu, undated).

Photograph 13. *Nigella sativa,* flower, PJ 1216.

In Ethiopia sowing dates vary from the beginning of July (Chercher Highlands, Bale) to September (Begemdir). Weeding and sometimes thinning are necessary. Harvest takes place in the dry season (November – March). As the seeds are easily released from the dehiscent fruits, harvesting before complete dryness of the fruits is advised. The seeds come loose easily with light threshing. To conserve the spicy essence, the seeds must be stored dry (Baldrati, 1950). Under normal dry circumstances (room temperature), the seeds keep their viability for at least two years.

In Ethiopia, *Nigella* is more often grown in combination with other crops such as barley and wheat (Baldrati, 1950; Zemedu, undated). At Alemaya (alt. 2000 m) seeds germinated about 14 days after sowing. The plants flowered ca 100 days later and harvest was possible ca 150 days after sowing. Plants grown in a greenhouse at Wageningen had a much quicker cycle, harvest being possible ca 100 days after sowing.

In Ethiopia no serious diseases or pests were observed, although one empty carpel in a fruit is not exceptional. Most probably the young seeds are eaten by a borer larva. Stewart & Dagnatchew (1967) reported that a leaf spot in *N. sativa,* observed in Shoa Province, is caused by *Cercospora nigellae* Hollos.

Uses

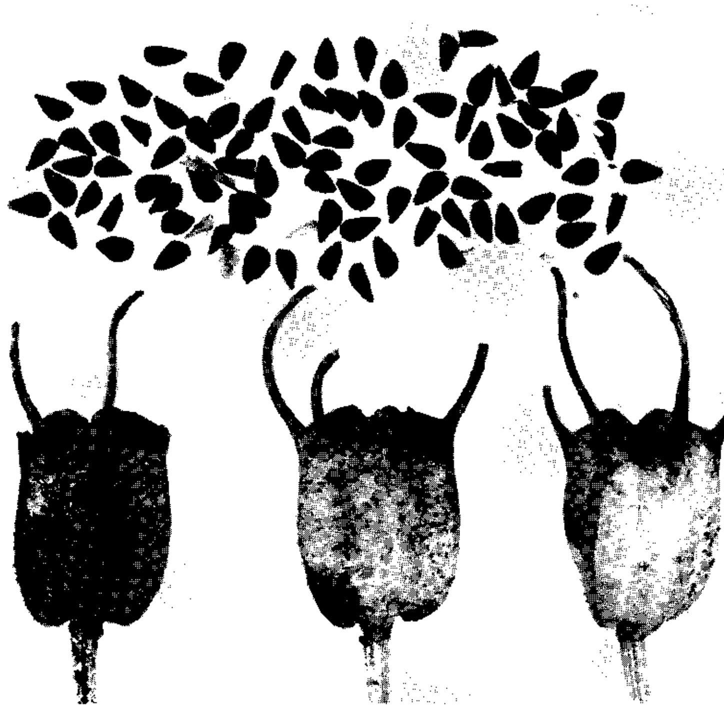
1. Culinary uses

N. sativa is grown for its seeds. The seeds have a strong, pungent, carrot-like smell and an aromatic somewhat acrid oily taste. They have been used as a spice from early times (Lenz, 1859). Whole or crushed seeds are used in or on bread in India, Sri Lanka, Egypt, Turkey and the USSR. As a flavouring agent in vinegar, as a constituent of 'curry', or as a substitute for pepper in cooking, they are used in many eastern countries (Lindley & Moore, 1866; Redgrove, 1933; Bois, 1934; Baldrati, 1950; Krasheninnikov, 1970; Damboldt & Zimmermann, 1974). Some grains in a spoon with honey seems to be a much appreciated aperitif for Arabs (Baldrati, 1950; Lemordant, 1960, 1971).

In Ethiopia, the seeds are used in the preparation of bread, *Capsicum* pepper sauce, curry sauce, 'wot' and local beverages. The seeds are first slightly roasted, ground, sieved, and ground a second time to powder. *Nigella* seeds in wheaten bread are often replaced by other spices, as *Nigella* seeds colour the bread black. For the preparation of the *Capsicum* pepper sauce, *Nigella* seed powder may be added, up to 30% of the weight of the *Capsicum* powder, to reduce the pungency of the pepper and to add flavour and colour. In the 'wot' sauce the *Nigella* powder is added at a late stage of preparation. For local alcoholic beverages like 'areke' and 'katikala', *Nigella* seeds form an ingredient alongside other spices like black pepper, *Aframomum corrorima* and ginger (Kostlan, 1913; Zemedu, undated; Asrat, 1962; Telahun, 1962; Siegenthaler, 1963; Amare, 1976).

2. Medicinal uses

In Ethiopia, *Nigella* seeds are supposed to relieve headaches. Seeds are mixed with melted butter, wrapped in a piece of cloth and sniffed (Telahun, 1962; Asrat, 1962; Amare, 1976). According to Lemordant (1960, 1971) seeds are also used to induce



Photograph 14. *Nigella sativa,* fruits and seeds (3×), PJ 2891.

abortions. In the folk medicine of other countries *Nigella* seeds are said to stimulate lactation, menstruation and urination and to have anthelmintic and carminative properties (Lindley & Moore, 1866; Redgrove, 1933; Bois, 1934; Lemordant, 1960, 1971; Damboldt & Zimmermann, 1974). Agrawala et al. (1971) proved that the lipid part of the ether-extracted seeds really had a galactogogue action in rats. The seeds are said to protect woollen goods and linen against insects (Lindley & Moore, 1866; Redgrove, 1933).

Chemical composition

According to Agren & Gibson (1968), 100 g edible Ethiopian *Nigella* seeds contained the following:

moisture (g)	6.6	calcium (mg)	519
nitrogen (g)	2.2	phosphorus (mg)	594
protein (g)	13.8	iron (mg)	17
fat (g)	32.2	β-carotene equiv. (mg)	0
total carbohydrate (g)	39.9	thiamine (mg)	0.62
fibre (g)	16.4	niacin (mg)	9.5
ash (g)	7.5		

According to Gessner & Orzechowski (1974), *Nigella sativa* seeds contain ca 1.5% melanthine, 0.5–1.5% of a bad-smelling essential oil and 30–40% fatty oil, the bitter substance nigellin and tannin. Melanthine is a very active fish-poison and it is very toxic for other animals too.

The fatty oil component is composed of: stearic acid (2.4%), palmitic acid (6.3%), myristic acid (0.3%), oleic acid (44.5%), and linoleic acid (36.0%) (Mensier, 1957).

In 1904, Suzzi isolated 23.91% oleic acid from the fatty oil of Ethiopian *Nigella* seeds.

According to Salama (1973), 100 g oil from *N. sativa* seeds from Sudan, contained 510 mg sterol, whose composition was cholesterol 2.1%, campesterol 14.6%, stigmasterol 17.2%, β-sitosterol 63.1%, α-spinasterol 3.7%.

2.8 Ocimum basilicum L. — Fig. 9

'Ocimum': derived from the Greek 'okimon', an old plant name for an *Ocimum* species; it may also be related to the Greek 'akinos' which comes from 'ozein' = to smell, or from 'oxys' = sharp, because of the usually strong odour of the *Ocimum* species.
'basilicum': derived from the Greek 'basilikos', 'basileus' = king; so, royal *Ocimum*, probably for its superb smell.

Linnaeus, Sp. Pl. ed. 1: p. 597 (1753).
Type: 'Habitat in India, Persia; *Ocimum* foliis ovatis glabris, calycibus ciliatis' (LINN 749.5, lecto.!).

Synonyms

Ocimum americanum L., Centuria I. Plantarum A. D. Juslenius, no 41 (1755).
Ocimum graveolens A. Braun, Flora 24(17): p. 265 (1841).
Ocimum petitianum Richard, Tent. fl. Abyss. 2: p. 176 (1851).
A lot of other synonyms are known from literature, but only a thorough revision of the genus *Ocimum* L. might evaluate their correct status.

Literature

1775: Forskal, Fl. Aeg.-Arabica: p. 108–111. (tax.)
1832: Bentham, Labiatarum genera et species: p. 1–19. (tax.)
1848: Bentham, in: DC, Prodr. 12: p. 31–44. (tax.)
1859: Lenz, Botanik der alten Griechen und Römer: p. 87, 100, 513–514. (use)
1879: Boissier, Flora Orientalis 4: p. 539. (tax.)
1897: Briquet, in: Engler & Prantl, Die nat. Pflanzenfam., ed. 1, 4, 3a: p. 369–372. (tax.)
1900: Baker, in: Flora trop. Afr. 5: p. 334–348. (tax.)
1912: Chiovenda, Osservazioni botaniche, agrarie ed industriali, Monog. rapp. col. 24: p. 34, 57. (use)
1918: Rolet, Plantes à parfums et plantes aromatiques: p. 284–287. (agric.)
1927: Gams, in: Hegi, Illustr. Fl. Mittel-Eur. B. 5, T. 4, ed. 1: p. 2267–2270. (tax. + use)
1927: Heyne, De nuttige planten van Nederlandsch Indië, ed. 2: p. 1336–1337. (use)
1927: Ochse, Indische vruchten: p. 101–102. (use)
1930: Guillaumin, Les *Ocimum* à essence, Bull. Sc. Pharm. 37, 2: p. 431–449. (tax. + use)
1934: Bois, Les plantes alimentaires chez tous les peuples et à travers les âges, 3, Plantes à épices, à aromates, à condiments: p. 178–182. (agric. + use)
1946: Baldrati, Piante officinali dell'Africa orientale, Centro Studi Colon. 32: p. 99–101. (use)

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1962: Morton, Cytotaxonomic studies on the West African *Labiatae*, Journ. Linn. Soc. (Bot.) 58, 372: p. 231–282. (tax.)
1963: Cufodontis, Enumeratio, Bull. Jard. Bot. État Brux. 33(3), suppl.: p. 845–849. (tax.)
1963: Morton, in: Flora West Trop. Afr., ed. 2, 2: p. 451–452. (tax.)
1963: Siegenthaler, Useful plants of Ethiopia, Exp. St. Bull. 14: p. 7. (use)
1966: Hegnauer, Chemotax. der Pfl., B. 4: p. 313–314. (chem.)
1969: Parry, Spices, 1: p. 217–218; 2: p. 149–152. (use)
1969: Rosengarten, The book of spices: p. 108–113. (use)
1973: Jain & Jain, Investigations on the essential oil of *Ocimum basilicum*, Planta Medica 24: p. 286–289. (chem.)
1974: Darrah, Investigation of the cultivars of the basils, Econ. Bot. 28: p. 63–67. (tax. + agric.)

Local names: basobila, adjuban, hulkot, zakakewe (Amarinia); kassé, kefo, kendama, urgo, zahahene (Gallinia); sessak, sesseg (Tigrinia); rehan (Somalia).
Trade names: basil, common basil, sweet basil (English); basilic, basilic commun (French); Basilie, Basilienkraut, Basilikum, Königskraut (German).

Geographic distribution

It is generally believed that *Ocimum basilicum* L. originates from Central tropical Asia, perhaps from India (Bentham, 1832), or from Iran or Afghanistan (Guillaumin, 1930). The distribution of basil, however, is now almost worldwide. It has been cultivated in many countries since ancient times and sometimes the plant has acquired a place in the wild flora. Obviously this happened also in Ethiopia, where the plant is found in cultivation as well as in the wild in most provinces. Fresh or dried plant parts are for sale on almost every Ethiopian market and small-scale cultivation near houses is widespread. According to Baldrati (1950), several thousands of hectares of basil are cultivated in Ethiopia.

Description

An erect, much branched annual, up to 75 cm high, with a brown, up to 6 mm thick taproot with many side-roots; aerial parts strong-smelling, especially when crushed.

Stem quadrangular, up to 6 × 6 mm, usually rather densely white-pilose in young parts, less so when older, much branched at all heights, light-green to dark-purple.

Leaves simple, decussate, petiolate; petiole up to 4.5 cm long, pilose, light-green to purplish-green; blade ovate to narrowly so, usually ca twice as long as wide, up to 8 × 4 cm, acuminate, attenuate at base, sometimes somewhat obliquely so, margin crenate-serrate, usually shortly ciliate, pale-green and glabrous to scarcely pilose on veins above, often lighter green with purplish midrib and pilose on the slightly prominent veins below; leaves densely glandular punctate, in dried specimens often with brown or red-brown droplets of exudation.

Inflorescence up to 30 cm long, composed of decussate, 3-flowered cymes, appearing as verticils, up to 3 cm apart; peduncle quadrangular, white-pilose, light-green to dark-purple; bracts oblanceolate to rhombate, up to 11 × 3 mm, acuminate, subcrenate-serrate, ciliate, pilose, light-green or purplish, usually persistent; pedicel

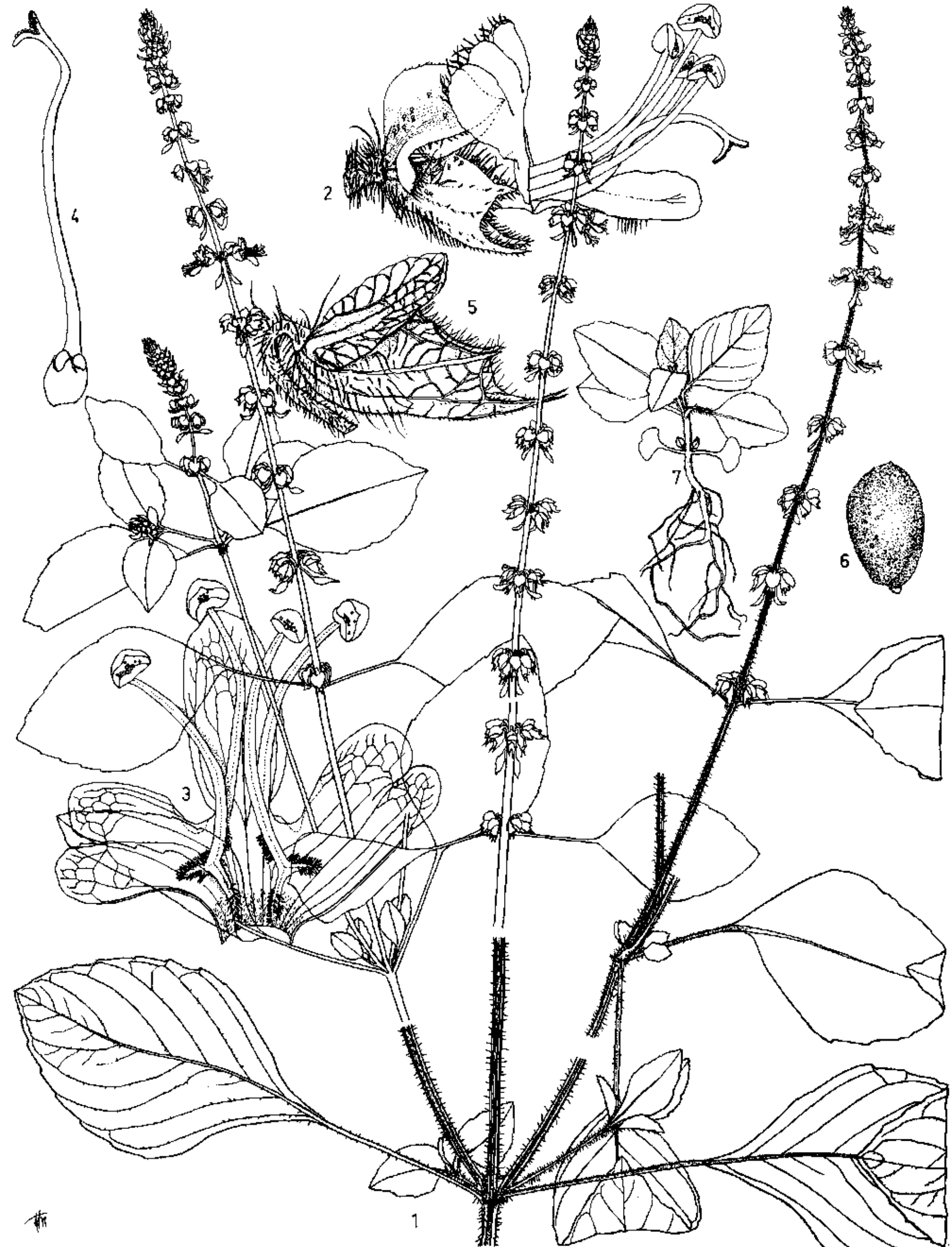


Fig. 9. *Ocimum basilicum* L. – 1. habit inflorescence ($\frac{2}{3}\times$); 2. flower ($6\frac{2}{3}\times$); 3. opened corolla with stamens ($6\frac{2}{3}\times$); 4. pistil ($6\frac{2}{3}\times$); 5. calyx ($6\frac{2}{3}\times$); 6. nutlet ($12\times$); 7. seedling ($\frac{2}{3}\times$). – 1–4. PJ 181 (spirit mat. too); 5–6. PJ 544; 7. PJ 86 (spirit mat.).

up to 4 mm long, densely white-pilose, at top strongly recurved, light-green to dark-purple.

Calyx bilobed, tubular, with a sub-orbicular flat adaxial lobe and a canaliculate abaxial lobe, green to brown-purple, densely glandular punctate; tube conical at base, ca 1–1.5 mm long (in fruit ca 2 mm long), pilose at base outside, densely long hairy inside above the ovary; adaxial lobe in outline up to 3.5 × 3.5 mm (accrescent in fruit to 4.5 × 4.5 mm), slightly apiculate, 2-eared, ciliate, usually glabrous outside and glabrous to scarcely pilose inside, with prominent venation, especially so in fruit, with 3 sub-parallel ribs centrally; abaxial lobe up to 2.5 mm in diam. (in fruit to 3 mm), up to 3.5 mm long (in fruit to 4 mm), sharply 4-toothed at top, the two outer ones shorter than the central ones, slightly pilose, ciliate.

Corolla tubular, two-lipped, whitish-purplish, usually darkest at the top of the lips; tube up to 4 mm long, the adaxial lip larger than the abaxial one, up to 2 × 6 mm, at top strongly recurved and crenately incised, forming four lobes which are pilose outside; centrally, near the base, a shallow pocket is present which is pilose on its convex outside; abaxial lip ovate, entire, flat or slightly concave, up to 3.5 × 2 mm, pilose near the top outside.

Androecium: stamens 4, epipetalous, didynamous, more or less pressed against the abaxial lip, light-purplish, white and slightly pilose at base; the outer ones up to 7 mm long, inserted at ca 1 mm from the base of the corolla tube, provided with a white, pilose, downward directed, ca 0.5–1 mm long tooth at ca 1 mm above their base; the inner stamens up to 5 mm long, inserted near the throat of the corolla, one at each side of the abaxial lobe; anthers one-celled, basifixed, heartshaped, ca 0.6 × 0.75 mm, orange or white, initially dehiscing introrsely by an inversed v-shaped transverse slit.

Gynoecium: ovary ca 1 × 1 mm in outline, light-green, with 4 ellipsoid, one-ovuled lobes, surrounded by a 4-lobed, white disc, the lobes alternating with and usually a bit shorter than the ovary lobes; style gynobasic, up to 9 mm long, white or light-purple, filiform; stigma white, 2-lobed, lobes 0.5–1 mm long, usually one lobe slightly longer than the other one.

Fruit composed of four distinct nutlets, enclosed within the tube of the persistent calyx; nutlets ovoid, up to 1.25 mm long and 1 mm in diam., black or dark-brown, usually with a white scar at base, smoothly muricate; in water the nutlet-wall produces within some minutes a thick white cover of slimy threads.

Seed free within the nutlet; testa white-brown; cotyledons greyish; endosperm scarce or absent.

Seedling: germination epigeal; taproot with the many side-roots light-brown; hypocotyl up to 17 mm long, purplish, pilose; cotyledons opposite, with an up to 9 mm long, pilose petiole and a kidney shaped, up to 5 × 7 mm, entire, glabrous, light-green blade; epicotyl up to 4 cm long, densely pilose, light-green or purplish.

Taxonomic notes

(1) In the protologue of *Ocimum basilicum* (Sp. Pl.: p. 597, 1753), Linnaeus referred to Hort. Cliff. 315, Hort. Ups. 168, Roy. lugdb. 322, Cam. epit. 308 and four times to Bauh. pin. 225–226. The phrase name '*Ocimum* foliis ovatis glabris',

originates from Hort. Cliff., is copied in Hort. Ups. and in Roy. lugdb., but extended with: 'calycibus ciliatis' in Sp. Pl. In the Hort. Cliff. herbarium (BM), under: '2. *Ocimum* foliis ovatis glabris', three specimens are present, representing three 'varieties' mentioned in Hort. Cliff., with phrase names originating from Boerhaave. For the three other 'varieties' mentioned in Hort. Cliff. by phrase names of Bauh. pin., no specimens are present. In Sp. Pl., Linnaeus copied only the varietal phrase names of Bauhin, not those of Boerhaave, which might indicate that Linnaeus was not sure about the identity of the latter ones. So it seems preferable not to look for the type specimen of *O. basilicum* in the Hort. Cliff. herbarium. The best choice as lectotype for this taxon is, in my opinion, specimen LINN 749.5, present in the Linnaean herbarium. Linnaeus extended the description with 'calycibus ciliatis' in 1753, and wrote '*basilicum* 2' on the sheet of this herbarium specimen, which number corresponds with the order of treatment in his Sp. Pl. The presence of the sign 'ϵ' on the same sheet indicates that this specimen had most probably been collected by Gerber in the western edge of Asia (here cited as 'Persia' by Linnaeus). Linnaeus obtained this specimen before or around 1750 (see Stearn, Introd. Sp. Pl. p. 106, 1957). I designate as lectotype of *Ocimum basilicum* L. specimen LINN 749.5.

(2) The taxonomy of the genus *Ocimum* L. in the literature and in the herbaria is in extreme disorder. A thorough revision of the genus is badly needed. Bentham (1848) distinguished nine varieties of *O. basilicum,* but the description of these varieties is rather vague, making identification impossible. Gams (1926) distinguished only 3–4 varieties of Bentham's (with or without *O. minimum* L.), and classified Bentham's other varieties as subvarieties or formas. He also accommodated some taxa described by Alefeld (1866). Gams' descriptions however are as vague as those of Bentham and I cannot satisfactorily order the basils in Ethiopia by Bentham's or Gams' classification. To avoid adding new names to the already overloaded group of *Ocimum* names, I just distinguish groups here and provide them, for convenience only, with a group name, neither intending to publish new taxonomic names nor to give the groups a taxonomic status, as this ought to be postponed till the genus *Ocimum* is revised worldwide.

(3) The first group I indicate as '*basobila*' group, 'basobila' being the most common name for those plants in Ethiopia. To this group belongs the majority of the cultivated basils in Ethiopia and the chapter on *O. basilicum* in this book primarily deals with this group (description, figure, etc.). The 'basobila' group certainly belongs to the taxon *O. basilicum* L. The specimens may differ considerably if grown at different localities. Plants grown in Ethiopia were in general more robust than the more or less etiolated plants grown in a greenhouse at Wageningen. Differences after growing plants (originating from the same seed) at different localities and under different conditions (Wageningen, greenhouse; Alemaya, alt. ca 2000 m; Melkassa near Nazareth, alt. ca 1500 m), are given in Table 6 (differences in average largest sizes).

(4) I call the second group of basils cultivated in Ethiopia the '*alemu*' group (after Mr Alemu Temesgen, who cultivated this taxon at Jimma and Nazareth). The main differences from the 'basobila' group are:

- The plants have a woody base
- The plants have a strong fresh lemon odour

Table 6. Differences (average largest sizes) observed in *Ocimum basilicum* plants from Ethiopia cultivated at three localities.

	Alemaya	Melkassa	Wageningen
total plant height	35 cm	40 cm	60 cm
petiole length	31 mm	19 mm	36 mm
leaf-blade	5.6 × 2.8 cm	5.5 × 2.7 cm	7 × 3.5 cm
inflorescence length	20 cm	15 cm	28 cm
verticillasters distance	18 mm	15 mm	21 mm
bracts	5.5 × 1.5 mm	4.5 × 1.5 mm	9 × 2 mm
pedicel length	3.5 mm	2 mm	3.5 mm
corolla length	6 mm	5.5 mm	7 mm
stamens length	6 mm	4 mm	7 mm
pistil length	7.5 mm	6 mm	8.5 mm
ventral calyx lobe in fruit	4 × 4 mm	3.5 × 3.5 mm	4 × 4 mm

– The leaf-blades are anguste-ovate, up to 8 × 3 cm
– The stamens are up to 9 mm long
– The style is up to 11.5 mm long
– The adaxial lobe of the calyx in fruit is up to 6 × 5 mm and the abaxial lobe up to 9 × 6 mm
– The nutlets are up to 2 mm long and 1.5 mm in diam.

(5) I call the third group of cultivated basils in Ethiopia the '*thyrsiflorum*' group, as the plants are identical with *Ocimum thyrsiflorum* L. The main differences from the 'basobila' group are:
– The plants have a woody base and are up to 1 m high
– The plants have a fresh lemon smell
– The leaf-blades are elliptic to anguste-ovate, up to 7 × 2.5 cm
– The inflorescences are repeatedly decussately branched, ending in very short ultimate branchlets with 2–3 verticillasters of opposite 3-flowered cymes.

(6) The fourth group of basils in Ethiopia is formed by plants growing in the wild, but sometimes offered for sale on the markets. I call this group the '*wild*' group. The plants are woody and perennial. They are close to *O. basilicum,* but are often identified as *O. canum* Sims or as *O. menthaefolium* Hochst. ex Benth. The differences between many of the described species of *Ocimum* related to *O. basilicum,* are very small, and if a perennial and woody character is accepted for *O. basilicum,* the differences might be better expressed at a varietal level. In fact I have observed in Alemaya, Ethiopia, that plants of the 'basobila' group recommenced growth and flowering the second year after sowing. Only a thorough revision may unravel the systematics of *Ocimum.*

(7) The description of the 'basobila' group is based on the following specimens:

Arussi	Sire market: SL 144.
Begemdir	Debarek market: WP 4969.
Hararge	Alemaya, cultivated at the College of Agriculture: Bos 8030, PJ 1815, PJ 2799–2800, PJ 2810, PJ 2945, PJ 4024–4025, PJ 4052, PJ 4330–4331, PJ 4343; Alemaya market: PJ 1173, PJ 5907; Asbe Tefari market: SL 4; Dire

	Dawa market: WP 133, Bos 8352, Bos 8383, PJ 1034; Harar market: WP 72, WP 370, Bos 8037–8038, PJ 1552–1553.
Kefa	Agaro market: SL 2668; Jimma market: Bos 8627; growing in the wild near Wush-Wush: PJ 5410.
Shoa	Ambo market: PJ 1219, PJ 1223; Bulbulla market: PJ 3910–3911; Melkassa, cultivated at Inst. of Agric. Res., Nazareth: PJ 2409, PJ 2435–2436, PJ 3576–3578, PJ 4699–4701; 67 km from Shashemene on road to Kolito, in field: WP 2853.
Sidamo	Dilla, 8 km on road to Wondo, in garden: WP 2827.
Wollega	Bako market: PJ 1212; Ghimbie market: PJ 1174, PJ 1182; Nekemt market: PJ 1193A, PJ 1197–1198.
Grown at Wageningen	PJ 85–86, PJ 142–143, PJ 181–182, PJ 392–393, PJ 544-545, PJ 761–762, WP 6089–6091, WP 7378–7379.

The following specimens, originating from Ethiopia, were seen: A. de Benedictis 423 (FT), 442 (FT); E. Chiovenda 89 (FT), 2560 (FT), s.n. 16-5-1939 (FT); M. Mariottini 377 (FT), 381 (FT); Petit s.n. (ex herb. de Franqueville), Abyssinie (P); R. Pichi-Sermolli 1414 (FT); Quartin Dillon & Petit s.n. Choho (P), Etchelikote (*O. petitianum* Rich.) (P); P. Rovesti 17 (FT); W. Schimper s.n. (herb. Steudel) (P); G. Schweinfurth & D. Riva 96 (K).

(8) The observations on the 'alemu' group are based on the following specimens:

Hararge	Alemaya, in garden, alt. 2000 m: WP 784.
Shoa	Nazareth, spice garden of the Inst. of Agr. Res. at Melkassa, alt. 1500 m: PJ 2437.
Kefa	Jimma, spice garden of the Inst. Agr. Res., alt. 1740 m: PJ 5844.

The following specimens, originating from Ethiopia, were seen:
P. R. O. Bally 11023 (K); A. de Benedictis 161 (FT); J. W. Colville 37 (K), 91 (K); Th. Kotschy, Sennaar 198 (herb. Steudel) (P); M. Mosk 284 (K); H. F. Mooney 8058 (K, FT); Quartin Dillon & Petit s.n. (herb. de Franqueville (K); Ruspoli & Riva 371 (402) (1974) (FT); Schimper 294 (K); W. G. Schimper s.n. 21 Okt. 1854 Dschedscha (P); H. Smeds 1276 (K); Willemse 16610/20 (K).

(9) The observations on the 'thyrsiflorum' group are based on the following specimens:

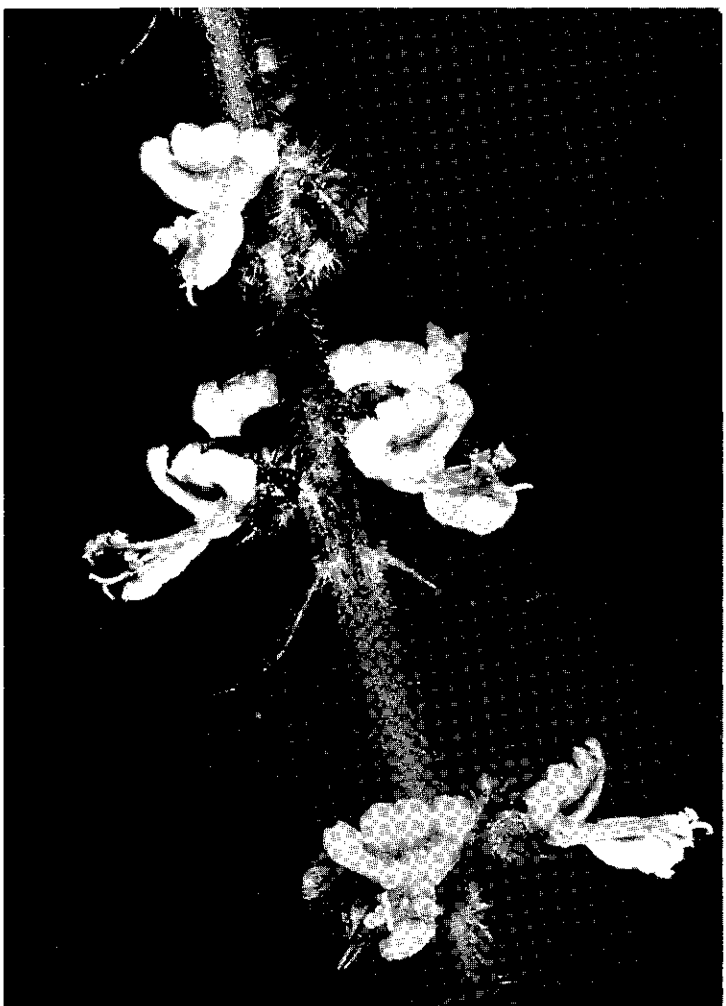
Hararge	Asbe Tefari market: WP 1300; Harar market: Bos 8055.
Shoa	Bulbulla market: PJ 3905; Nazareth-Melkassa, spice garden Inst. of Agr. Res.: PJ 2442.
Tigre	Adishow market: SL 3058.
Wollo	Bati market: WP 4011A.

(10) From the 'wild' group the following specimens, originating from Ethiopia, were seen:
P. R. O. Bally 6736 (K), 6799 (K), 6865 (K), 6931 (K); Bos 7845 (WAG), 7931 (WAG), 8171 (WAG), 8232 (WAG), 10059 (WAG); F. Brown 58 (K); W. Burger 798 (ACD, K); W. Burger & Amare Getahun 343 (ACD, K); Collenette 241 (K); R. Corradi 5451 (FT); P. E. Ellis 213 (K); PJ 3026 (WAG), 3188 (WAG), 3759 (WAG), 4974 (WAG), 6923 (WAG); Kotschy 568 (K); J. K. Lord 8169 (K); C. Parker E.468 (K), E.553 (K); R. E. Perdue 6508 (K); J. Pfund 483 (K); R. Pichi-Sermolli 1413 (FT), 1415 (FT); Quartin Dillon & Petit s.n. (herb. de Franqueville) (K), Chiré (herb. Richard) (P); Ruspoli & Riva 1177 (1300) (799)

(1077) (FT); Schimper 425 (K); Siegenthaler 1536 (K); Speke & Grant s.n. (K); J. E. Strecker s.n. (K); Tadesse Ebba 519 (ACD, WAG); P. Townsend 62 (K); WP 1440–1441 (WAG), 4071 (WAG).

Ecology

Basil should be cultivated in sunny wind-sheltered spots and even light frosts will kill the plants (Gams, 1926; Rosengarten, 1969). According to Ochse (1927) in Indonesia basil is cultivated at altitudes below 500 m, but Heyne (1927) states that basil is cultivated there up to ca 1100 m. In Ethiopia the cultivation of basil is possible up to at least 2000 m altitude, where the plants can stand some light frost (pers. obs. 1975–1977).



Photograph 15. *Ocimum basilicum*, detail of photograph 16.

Basil provides a good food for bees. Insect pollination is normal; the pollen sticks to the underside of the insect as it enters the flower by walking over the lower lip of the corolla on which the stamens and pistil are situated. The pistil is slightly longer than the stamens but this does not preclude self-pollination (Gams, 1926). According to Darrah (1974), self-pollination in basil can give viable seed, but less of it than by open pollination.

Husbandry

Basil is easily propagated by seed. According to Gams (1926) the seeds keep their viability for 4–5 years without special preservation. Sowing is done either directly in the field or first in a nursery. Seed is usually sown directly in the field in rows 50–75 cm apart and at ca 5 kg/ha (Rosengarten, 1969). Within the rows, the seedlings are thinned to ca 15–30 cm apart. If sown in a nursery, the plants are transplanted when they have 4–6 normal leaves (Guillaumin, 1930). The plants do not require a special soil but seem to prefer sunny wind-sheltered spots (Rosengarten, 1969). Germination normally takes 1–2 weeks. In Ethiopia however, basil seeds germinated only after 1.5 month, flowering started ca 1 month later and fruits could be harvested 4–4.5 months after sowing. At Wageningen in a greenhouse, germination took 3 weeks, flowering started 2 months after sowing and fruits could be collected 3 months after sowing (pers. obs. 1974–1977). In Pennsylvania (USA) various basil cultivars differed considerably in the time taken to reach flowering (Darrah, 1974).

Weed control is important, as weeds, included in the harvested crop, might impair or ruin its quality (Rosengarten, 1969). For production of essential oil, the young leafy stems are harvested just before the flowers appear. The plants are only partly cut back so that under favourable circumstances additional crops may be obtained. In California, the crop is cut 3–4 times per year and a total yield of fresh herb can be 25 000 kg/ha. Before the leaves are marketed, they are dried artificially under cover at a temperature of ca 40°C, to preserve the green colour (Rosengarten, 1969). Rolet (1918) claimed that maximum oil content was obtained if the plants were protected against too strong light but did not say why. The essential oil is produced by steam-distillation of the fresh herb and the yield can be up to 30 kg/ha (Rosengarten, 1969). Instead of foliage, the dry or fresh inflorescences (with or without some leaves and stem-parts) are usually harvested in Ethiopia and directly used in food.

From Italy, *Cuscuta australis* R. Br. var. *breviflora* (Vis.) Engelm. is reported to parasitize basil (Gams, 1926). In Shoa Province of Ethiopia, Stewart and Dagnatchew (1967) observed a downy mildew, *Peronospora* sp., on basil.

Uses

1. Culinary uses

Being already a well know herb to the Ancient Greeks and Romans, basil has long been used as a culinary herb. The dried and fragmented leaves are used to flavour many kinds of foods like stews, sauces, salads, soups and meats. In the USA, it is

Photograph 16. *Ocimum basilicum,* flowering plant, PJ 392.

particularly used in tomato-based recipes (Rosengarten, 1968). In Indonesia, the leaves, either raw or cooked, are used mainly to flavour fish and meat dishes (Heyne, 1927). According to Ochse (1927), the seeds of basil, mixed in syrups, are used in Indonesia in the preparation of cold drinks.

The essential oil of basil is used in many perfumes and it is a major ingredient of the liqueur chartreuse (Rosengarten, 1969).

In Ethiopia both dried and fresh inflorescences and leaves of basil are used almost daily as a flavouring agent in the preparation of all kinds of 'wot'. Usually the leaves, flowers, fruits and tender stems of basil are dried, ground and added to sauces, together with other spices. Basil is highly appreciated as some Ethiopians consider spice mixtures lacking basil as worthless. Dried ground basil is also used to flavour butter and is sometimes sprinkled in tea or coffee to add flavour (Telahun, 1962; Siegenthaler, 1963).

2. Medicinal uses

In antiquity and in the Middle Ages, basil was associated with superstitions. In Ancient Greece, sweet basil was the symbol of hatred. In Ancient Rome, it was believed that if basil was pounded and left beneath a stone, a scorpion would breed in its midst, and if chewed and left in the sun, worms would breed in it (Lenz, 1859; Gams, 1926).

In general, basil has been used or is used for external application against snake and scorpion bites, eye diseases and rheumatic pains; for internal use as an aphrodisiac, as a diuretic and as a purgative (Gams, 1926). The odour of basil is reputed to relieve headaches, fevers (steam bath over cooked basil), and to keep insects away (Gams, 1926; Dalziel, 1937). The mucilaginous nutlets of basil are used for coughs and in a drink against gonorrhoea and intestinal disturbances (Gams, 1926; Heyne, 1927). Jain & Jain (1973) report that the volatile oil from basil in India is remarkably anthelmintic.

In Ethiopia basil is used in a medicine against malaria (also as an insect repellent) and as a medicine against headache (Herb. FT; Baldrati, 1946).

Chemical composition

Extremely variable mixtures of essential oil are recorded from *Ocimum basilicum*. According to Hegnauer (1966), the variability results from differences between cultivars or chemotypes, which have long been selected for aroma and taste. Moreover data given in the literature for *O. basilicum* may refer to other *Ocimum* species, as the nomenclature and the taxonomy of the genus are rather confusing. Commercially four types of *Ocimum basilicum* oil are distinguished (Hegnauer, 1966):

(a) The usual oil: containing mainly linalol and methylchavicol and some cineol and eugenol, but no camphor and methylcinnamate;

(b) Camphor containing oil: containing much camphor and some cineol, linalol, methylchavicol and alpha-penes;

(c) Oil containing methylcinnamate: containing 15–75% methylcinnamate;

(d) Eugenol-containing oil: containing 30–80% eugenol.

According to Gams (1926) the content of essential oil is ca 0.02–0.04% of the fresh leaves and inflorescences or ca 1.5% of the dried product. The oil is extracted by steam-distillation.

Rovesti (cited by Hegnauer, 1966) distinguished four chemotypes within *Ocimum menthaefolium* Hochst. (?? *Ocimum basilicum* L.) as growing in Eritrea. He considered them to be ecotypes and classified them as follows:

(a) var. camphorata: contains 23% camphor, 40% estragol (= methylchavicol), 13% cineol, 10% alpha-penes;

(b) var. estragolata: contains some lemon oil, 9% linalol, 5% anethol, 73% estragol;

(c) var. anisata: contains 10% lemon oil, 9% linalol, 39% anethol, 31% estragol;
(d) var. citrata: contains 9% lemon oil, 10% geraniol, 56% citral and 20% estragol.

2.9 Rhamnus prinoides L'Hér. **Fig. 10**

'*Rhamnus*': derived from the Greek plant name 'rhamnos', or from the Celtic 'ram' = 'bush', 'a tuft of branches'.
'*prinoides*': derived from 'Prinos', the old genus name for '*Ilex*', and from 'ides' (Greek: 'eides') = 'looking like'; thus resembling '*Ilex*', probably because of the evergreen leathery leaves.

L'Héritier de Brutelle, C. L., Sertum Anglicum: p. 6 (1789); t. 9 (1790).
Type: 'Habitat ad Promontorium bonae spei'. 'R. inermis, floribus polygamis, stylo subtriplici, foliis ovatis serratis' (G-DC, vol. 2: p. 24, No 7: plant part with the label: '*Rhamnus frondosus.* Cap. Masson. Kew', lecto., microfiche !).

Synonyms

Rhamnus pauciflorus Hochst., on label Schimperi iter Abyss. coll. sect. 2, No 1276 (1842).
Rhamnus prinoides L'Hér. var. *acuminatus* O. Kuntze, Rev. Gen. Pl. 3(2): p. 39 (1898).
Rhamnus prinoides L'Hér. var. *obtusifolius* O. Kuntze, Rev. Gen. Pl. 3(2): p. 39 (1898).

Literature

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1961: Dale & Greenway, Kenya trees & shrubs: p. 390–391. (tax.)
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Local names: gesho, gescha, gisso, gebho, aique, ehk (Amarinia) (Tigrinia); geshi, hope (Gallinia).
Trade names: (also for other *Rhamnus* spp.): buckthorn, dogwood (English); bois de nerprun (French); Kreuzdorn (German).

Geographic distribution

In Ethiopia, *R. prinoides* (gesho) can be found growing in the wild in all provinces, usually at altitudes of 1500–2500 m. In most provinces gesho is cultivated as well. It is present in many gardens near houses and it is sometimes cultivated as a field crop on a larger scale. On markets, fresh leafy branches are often sold. According to the Land Utilization Report (1977), gesho covers ca 1% (= 5000 ha) of the total land area under permanent cultivation in Ethiopia. The most important provinces for gesho are: Shoa (1800 ha), Gojam (1200 ha), Begemdir (1000 ha), Arussi (500 ha), Sidamo (400 ha).

The species has a wide distribution in Africa. It occurs from Ethiopia to South Africa in the east and to Nigeria and Angola in the west (Engler, 1921; Cufondontis, 1958; Johnston, 1972).

Description

An evergreen, usually ascending shrub, up to 5(–8) m high.

Stem: usually terete, up to 5 cm in diam., much branched from base on, glabrous, green-brown to grey-red with light-brown lenticels; twigs terete, light-green, usually densely puberulous.

Leaves alternate, pinnately veined; petiole subterete, 2–16 mm long, light-green, puberulous, more densely so on the margins of the shallow groove above; stipules two, subulate, ca 2–6 mm long, puberulous, light-green, caducous, leaving slightly raised scars; blade elliptic to ovate-elliptic or oblong, up to 13 × 4 cm (usually ca 3 times as long as wide), obtuse to cuneate at base, acuminate, margin glandular-serrulate, glabrous and glossy dark-green above with impressed primary nerves and reticulate veins, glossy pale-green, usually with puberulous prominent primary nerves beneath, often densely so at their axils.

Inflorescence: a sessile axillary fascicle of 1–12 flowers; pedicel terete, ca 5–13 mm long in flower, 10–23 mm long in fruit, puberulous, usually light-green.

Receptacle (calyx-cup): a shallow, 5-angled, obpyramidal cup, ca 0.5-1.5 mm high, 2–3 mm in diam., puberulous and dark-green outside, glabrous and light-green inside, persistent in fruit.

Calyx: lobes 5, triangular, ca 1.5–2.75 mm long and 1–2 mm wide, light-green, puberulous outside, subglabrous inside, usually not persistent in fruit.

Corolla: absent in the studied material.

Androecium: stamens 5, alternating with calyx-lobes, inserted at the rim of the receptacle; filaments usually narrowly triangular, ca 0.5–1.5 mm long, 0.25–0.5 mm wide, glabrous, light-green; anthers 2-celled, ovoid in outline, ca 0.5 mm long and wide, basi- to dorsifixed, yellow, dehiscing by two lateral longitudinal slits.

Gynoecium: pistil 3(–4)-merous, pale-green, glabrous; ovary subglobose, up to 1.5 mm in diam.; ovules ellipsoid, attached basally; style subterete, ca 1–1.5 mm long, lobes 0.3–1 mm long; stigmas capitate, finely papillate, light-green to reddish-green.

Fruit: an obconical to subglobose drupe, up to 7 mm in diam., glabrous, dark-red to purplish-black at maturity, usually containing (2–)3(–4) well developed stones.

Seeds: obconical, up to 6 mm long and 2.5 mm wide, ventrally with an acute ridge, dorsally with a longitudinal, deep, broad furrow, reddish-brown; embryo with strongly curved cotyledons, surrounded by a thin layer of endosperm.

Notes

(1) Although all the flowers are bisexual, functionally male or female flowers probably also occur.

(2) Bisexual flowers often look slightly protandrous.

Taxonomic notes

(1) L'Héritier (1789) described *R. prinoides* as: 'R. inermis, floribus polygamis, stylo subtriplici, foliis ovatis serratis'. He referred to '*Celtis* foliis subrotundis dentatis, flore viridi, fructo luteo. Burm. afr. 242. t. 18', and he mentioned two names of plant collectors: 'Augé. Masson.'

Johnston (1972, p. 18) considered as holotype of this species: Masson (G-DC). The names of collectors cited in L'Héritier's protologue suggest that the specimen Masson (G-DC) is not likely to be the holotype but might be a lectotype. It is known that De Candolle obtained L'Héritier's herbarium and that he inserted it in his own. In the DC herbarium, Prodr. 2: p. 24. No 7, four pieces of *Rhamnus* plants are present. Two might originate from L'Héritier. One of these two bears a label with '*Rhamnus frondosus* Cap. Masson. Kew', the other one: *R. (?) petianum* Lee, *R. frondosus* Banks (?) Hist. Cap. de B. esp. André Auge. Masson. Salisbury'. As the specimen with '*Rhamnus frondosus* Cap. Masson. Kew' bears leaves and flowers, is in agreement with the protologue and originates from Kew, I prefer to designate it as the lectotype of the species *Rhamnus prinoides* L'Hér. L'Héritier perhaps also saw two other specimens (besides living plants at Kew) at BM. At BM, there is a sheet with two *R. prinoides* specimens (in flower), of which the left one is indicated with 'Hort. Kew. 1787', and the right one with 'Hort. gn. Salisbury 1785' (on the back of

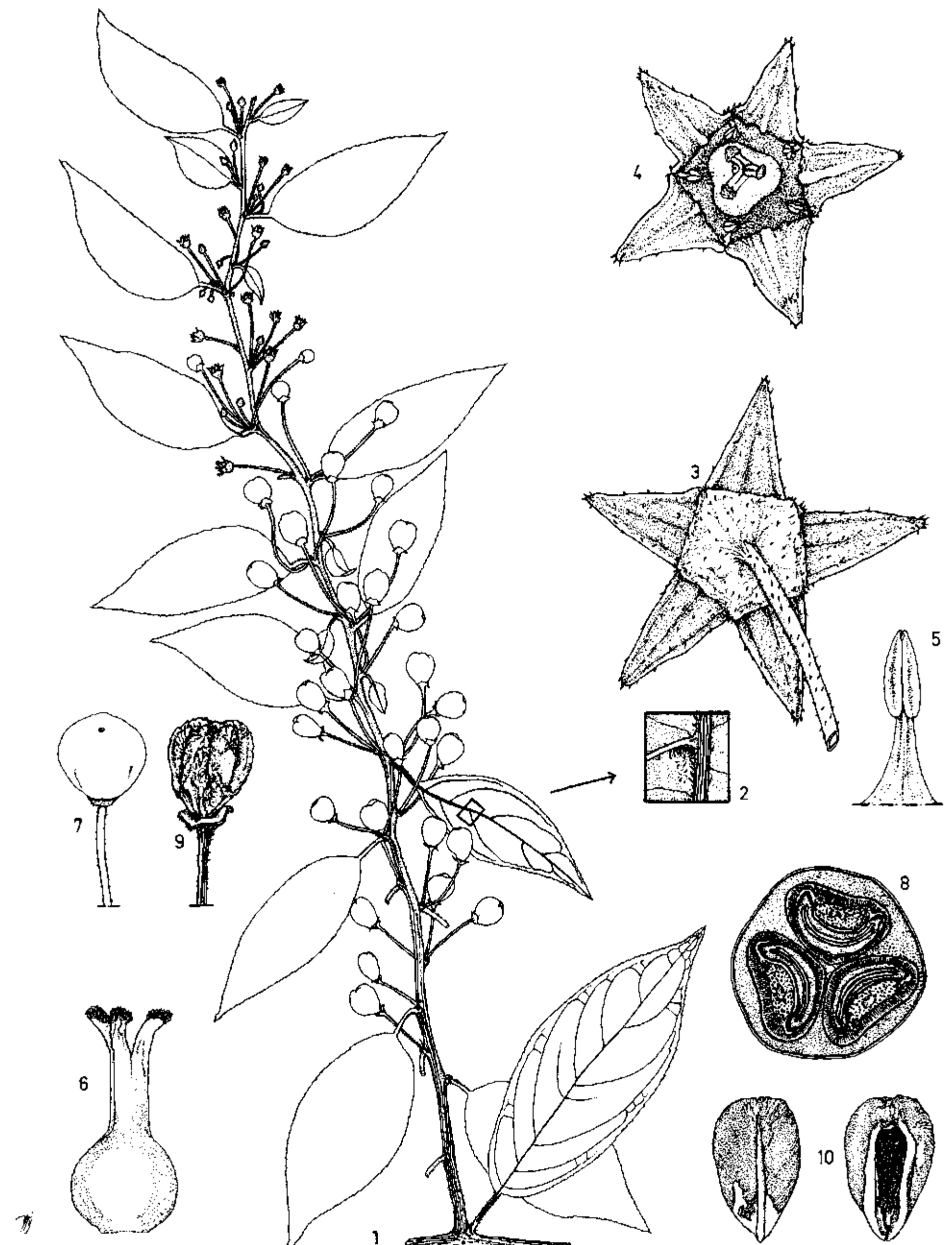


Fig. 10. *Rhamnus prinoides* L'Hér. – 1. habit flowering and fruiting branch ($\frac{2}{3}$×); 2. detail underside leaf ($2\frac{2}{3}$×); 3. flower, underside (8×); 4. flower, upperside (8×); 5. stamen (24×); 6. pistil ($13\frac{1}{3}$×); 7. fruit (2×); 8. cross-section fruit (4×); 9. dried fruit (2×); 10. seed, dorsal and ventral view (4×). – 1–2. W. de Wilde c.s. 6774; 3–6. W. de Wilde c.s. 10765; 7–8. WP 3265 (spirit mat.); 9. W. de Wilde c.s. 6774; 10. PJ 1165.

the sheet). As L'Héritier was in London from 9 September 1786 until early December 1787, he might have seen these specimens.

(2) Kuntze (1898) distinguished two varieties of *R. prinoides:* var. *acuminatus* ('folia acuminata longiora (1 : 2.5–3)') and var. *obtusifolius* ('folia obtusa latiora (1 : 1.5–2.5)'). Like Johnston (1972), I consider these two varieties, based on a variable leaf-character, as too artificial.

(3) In the subdivision of the genus *Rhamnus* of Suessenguth (1953), *R. prinoides* is placed in the subgenus *Rhamnus (Eurhamnus)* Dippel. This taxon is subdivided into species with 5-merous flowers and species with 4-merous flowers. *R. pauciflorus* Hochst. (= *R. prinoides* L'Hér.) is placed in the section with 5-merous flowers and *R. prinoides* in the 4-merous section. Most *R. prinoides* flowers in Ethiopia, however, are certainly 5-merous (see also Cufodontis, 1958).

(4) *Rhamnus staddo* Rich. is another *Rhamnus* species occurring in Ethiopia. The bark of its roots is used to season 'tedj' (mead) (Fiori, 1909). It is a plant growing in the wild (between 1000–3000 m alt.) and it can be distinguished from *R. prinoides* by much smaller leaves (up to 4.5 × 2 cm) and 4-merous flowers (Johnston, 1972).

(5) The description is based on the following specimens:

Begemdir 4 km along road N of Gondar to Axum, then to the left, 13 km along the road to Setit, 12°42'N × 37°27'E, alt. 2200 m, 14-9-1970: J. J. F. E. de Wilde 7140.

Hararge Alemaya market, brought from Amaressa, alt. 2000 m, 30-4-1975: PJ 1165, PJ 1172; Road Alemaya-Harar, in chat and sorghum fields, alt. 2000 m, 6-2-1976: PJ 5138; 136 km W of Dire Dawa, Chercher hills road, 9°14'N × 41°7'E, alt. 1800 m, 6-11-1964: F. G. Meyer 8729; 15 km from Kulubi on road to Asbe Tefari, alt. 2200 m, 4-8-1967: WP 1013.

Illubabor 15 km SW Gera, on trail to Afallo, 7°45'N × 36°18'E, alt. 1900 m, 1-12-1964: F. G. Meyer 8856.

Kefa Along road to Agaro, near Jimma, 31-12-1962: J. A. Frahm-Lelieveld s.n.; Bonga, 1 km SE of catholic mission, alt. 1750 m, 26-2-1966: W. de Wilde c.s. 10237; Road from Jimma to Suntu, 9 km from Jimma, alt. 1960 m, 14-2-1968: WP 3265; Maji, 6°11'N × 35°35'E, alt. 2000 m, 18-1-1970: J. J. F. E. de Wilde 6219.

Shoa 20 km from Nazareth on road to Asella in fruit garden of Ethiop. Electr. Author. employes, alt. 1560 m, 31-8-1967: WP 1528.

Sidamo 3 km SW of Soddo, 6°50'N × 37°44'E, alt. 2000 m, 22-8-1969: J. J. F. E. de Wilde 5547; Market of Adillo, road Shashemene-Soddo, 50 km before Soddo, alt.1890 m, 27-9-1975: PJ 3669.

Tigre 55 km S of Quiha, 13°04'N × 39°31'E, alt. 2350 m. 30-1-1969: J. J. F. E. de Wilde 4447.

Wollega 35 km W of Lekemti, Ghimbie road, alt. 1700 m, 13-4-1966: W. de Wilde c.s. 10765, W. de Wilde c.s. 10764; Nekemt market, alt. 1900 m, 8-5-1975: PJ 1204; 5 km NE of Lekemti, gentle SE slope of Conto mountain, alt. 2500 m, 19-5-1965: W. de Wilde c.s. 6774.

The following specimens, originating from Ethiopia, were seen: W. A. Archer 8680 (K); J. Ash 2841 (K); P. Benedetto 434 (FT); R. Bricchetti 84 (FT); W. Burger 2273 (K), 2398 (K), 2618 (FT, K), 3062 (K); L. Buscalioni 1802 (FT), 2022 (FT); D. R. Chaffey 444 (K); E. Chiovenda 2073 (FT), 2784 (FT); G. Cufodontis 287 (FT); Franqueville s.n. (1862, Abyssinia) (K); I. Friis c.s. 555 (K); I. Friis, G. Aweke, F. Rasmussen, K. Vollesen: 2144 (K); J. B. Gillett 5102 (K, P, FT), 15030 (FT, K); J. L. Guillaumet 1999 (P); Imp. Eth. Coll. Agr. & Mech. Arts: D 91 (K); Massa 626 (FT), 658 (FT); M. Maurel s.n. (Harar, reçu 9-12-1932) (P); F. G. Meyer 7806 (K), 8729 (P), 8856 (K), 9023 (K); G. Negri 198 (FT); A. Pappi 61 (FT), 262 (FT); R. Pichi-Sermolli 415 (FT), 416 (FT), 417 (FT), 418 (FT, K), 2035 (FT); Quartin-Dillon & Petit s.n. (P), s.n. herb. A. de Franqueville 175 (P), s.n. entre Odowa & Gondar, 1840 (P), s.n. Choko, Abyssinie, herb. Richard (P), s.n. Etchelicote, Abyssinie, herb. Richard (P), s.n. Abyssinie, herb. Richard (P), s.n. Abyssinie, herb. de Franqueville (P), 3[e] envoi, 1[e] serie (1840) no 591 (P); Rochet d'Hericourt s.n. Abyssinie, Gondar (P), s.n. Choa, 1842 (P). no 4 (Angobar, 1842) (P); Ruspoli & Riva 623 (FT); Schimper 1184 (BM, K); Schimperi iter Abyssinicum. sect. sec. 1276 (K, P); W. Schimper 89 (P); H. Scott 330 (K); L. Senni 54 (FT), 101 (FT), 170 (FT), 470 (FT), 745 (FT); H. Siegenthaler X-18 (K); H. Smeds 1439 (K); Sollazzo s.n. (FT); E. Taschdjian 378 (FT); A. Vatova 2451 (FT); O. West 5896 (K); W. de Wilde c.s. 10237 (K), 10764 (K), 10765 (K, P).

Ecology

In Ethiopia gesho grows in the wild at altitudes of 1500–2500 m, usually in sub-humid conditions (rainfall up to 1000 mm/year), often along streams (Breitenbach, 1963). According to Baldrati (1950), it grows where coffee will grow. Outside Ethiopia, *R. prinoides* is reported to grow from sea-level (Palmer & Pitman, 1972, South Africa) to 3700 m (Johnston, 1972, East Africa), often along streams, in evergreen bushland and thicket, at forest margins or in open places in evergreen forests, and in montane woodland (Keay, 1958; Evrard, 1960; Drummond, 1966; Johnston, 1972).

In Ethiopia, the plant can be found in flower or fruit in all months of the year, with a maximum towards the end of the dry season (February–April).

Photograph 17. *Rhamnus prinoides*, branch with flowers and fruits, PJ 5138.

In South Africa the main flowering period is from October to December and the fruiting period from January to March (Palgrave, 1977). In South Africa the shrub casts so deep a shade that other plants do not grow around it. The flowers are often visited by bees. Birds do not seem to like the fruits, although domestic fowl eat them (Palmer & Pitman, 1972).

Husbandry

Gesho grows in the wild in Ethiopia but the shrub is often cultivated, as the demand is greater than the wild vegetation can produce. Tye shrub is propagated by seed. Seed is sown in a nursery and the seedlings are transplanted in the field at the beginning of the rainy season, usually 0.5–1 m apart. Without irrigation one harvest of leafy branches per year is usually possible. If the crop is irrigated two harvests per year are possible: one before and one after the rainy season (Kostlan, 1913). As the plant is often grown in the garden, it is available at any time of the year for personal use. According to the Land Utilization Report (1977), ca 40% of the total gesho cultivation in Ethiopia is practised by small farmers with total holdings of up to 1 ha. The harvested leafy branches are either sold fresh (usually on a small scale) or dried (usually on a large, commercial scale). Without exhausting diseases, the shrub can produce branches for many years. Stewart & Dagnatchew (1967) reported the following diseases, observed on the leaves of gesho in Ethiopia: *Endophyllum macowani* P. Evans, a rust, Shoa Province; *Puccinia schweinfurthii* (P. Henn.) Magn., a rust, Kaffa, Begemdir, Shoa and Harar Provinces; *Oidium* sp., a powdery mildew, Shoa Province.

Uses

1. Culinary uses

The gesho leaves and branches are used in Ethiopia in the preparation of alcoholic beverages ('talla' = beer and 'tedj' = mead) and they have a function like hops for beer. 'Talla' is a common household drink for many Ethiopians. It is prepared from water, malt, flour and gesho, the latter giving the beverage a slightly bitter taste. To prepare it, the gesho leaves are dried, crushed and soaked in water for three days. Meanwhile barley (or other cereals) is soaked in water for 24 hours, the water is then poured off, the barley is placed between two layers of leaves and stored until the sprouts are 2.5–4 cm long, dried in the sun and finally ground into flour. Then flour from unsprouted, roasted and ground grains ('asharo') is made into a paste and baked on the 'mitad' (= a griddle). The resulting cake is broken and mixed with the malt flour, and this mixture is added to the container with water and gesho, which is tightly closed and left for 4 days to ferment. Then much more water is added and the container is closed again. When the beer is considered ready for drinking, it is poured from the container in which it was made into freshly smoked pots (Siegenthaler, 1963; Westphal, 1975). If the beer is used within three days, it is called 'gush talla'. Best beer results after at least seven days of fermentation. 'Talla' is prepared by women (Siegenthaler, 1963).

'Tedj' is made from honey, gesho and water. For economic reasons, sugar is added in various proportions. It has a delicious flavour and is the favourite drink of many people. Because honey is expensive, it is usually prepared for special occasions only. To prepare it, the ingredients are put into a well closed pot where it is left for three to ten days (depending on the temperature) to ferment. Then the gesho (here the parcelled uncrushed woody parts are used) is taken out and, if the beeswax had not been removed previously, the liquid is filtered and is ready for consumption (Kostlan, 1913; Siegenthaler, 1963; Westphal, 1975). It is considered an art to produce good 'talla' and 'tedj'. Every woman who prepares it has her own method, which is considered as her secret.

2. *Medicinal uses*

In Ethiopia, gesho is used as a laxative, as a diuretic, as a preventive for syphilis, as a depurative and as a cholagogue. For children with tonsillitis or with tonsils removed (a common practice because the tonsils are considered responsible for 'sickness' in general), some macerated leaves of gesho are put in the mouth to relieve the pain (Baldrati, 1946; Lemordant, 1960, 1971).

In South Africa, a decoction of the decorticated root is taken to cleanse the blood by the Zulu and to treat pneumonia by the Sotho. The leaves are applied as a liniment to simple sprains by the Zulu. An extract of the root, together with the bark of *Erythrina tomentosa* is used by the Chagga to relief colic, and the extract alone also for relief of muscular rheumatism. The root is a Masai remedy for gonorrhoea (Watt & Breyer-Brandwijk, 1962).

In Angola, the bark is used to induce vomiting (Engler, 1921).

3. *Miscellaneous uses*

Parts of the plant are widely favoured as a protective charm to ward off lightning, to protect homes and to safeguard the courts of the chiefs. Green twigs are burned by the Zulu to smoke away evil spirits from the fields and by the Xhosa an infusion of the leaves is sprinkled over members of a hunting party before they set off, to bring them luck in the hunt (Watt & Breyer-Brandwijk, 1962; Palgrave, 1977).

The wood of *R. prinoides* is white to yellow, hard and heavy, often streaked with brown, pink-red or green. It is too small to be generally useful, although small articles (e.g. sticks) are made of it (Palmer & Pitman, 1972; Palgrave, 1977).

The heartwood (also the roots) is used by the Chagga to add to beer to enhance its narcotic effect (Watt & Breyer-Brandwijk, 1962).

In South Africa, the plants are becoming popular as garden plants as the leaves and berries are attractive and make striking floral arrangements (Palgrave, 1977).

Chemical composition

According to Agren & Gibson (1968), gesho leaves contain the following constituents per 100 g edible portion (range of 3 samples):

Moisture	8.9–10.6	g
Nitrogen	1.1–2.1	g
Protein	7.1–9.2	g
Fat	2.0–4.0	g
Carbohydrate	61.9–76.3	g
Fibre	11.7–28.7	g
Ash	5.8–11.5	g
Calcium	1012–2392	mg
Phosphorus	100–190	mg
Iron	15.9–118	mg
β-carotene equivalent	4.82–11.40	mg
Thiamine	0.04–0.08	mg
Riboflavin	0.59–0.67	mg
Niacin	1.8–2.9	mg
Ascorbic acid	4–18	mg

2.10 Ruta chalepensis L. **Fig. 11**

'Ruta': old Latin plant name for rue; the same word means also bitterness, unpleasantness, perhaps referring to the strong smell or taste of rue.
'chalepensis': originating from or first collected at Aleppo, Syria.

Linnaeus, Mantissa plantarum: p. 69 (1767).
Type: 'Habitat in Africa'. '*Ruta* foliis supradecompositis, petalis ciliatis' (Specimen LINN 537.4, holo.!).

Synonyms

Ruta bracteosa DC, Prodr. 1: p. 710 (1824).
Ruta chalepensis L. var. *bracteosa* (DC) Boiss., Flora Orient. 1: p. 922 (1867).
Ruta chalepensis L. var. *tenuifolia* D'Urville, Enum. pl.: p. 44 (1822).
Ruta graveolens L. var. *bracteosa* (DC) Oliver, Flora trop. Afr. 1: p.304 (1868).

Literature

1880: Willkomm & Lange, Prodr. fl. Hisp. 3: p. 516. (tax.)
1907: Pax, Die von Felix Rosen in Abyssinien gesammelten Pflanzen, Bot. Jahrb. 39: p. 628. (tax.)
1912: Chiovenda, Osservazioni botaniche, agrarie ed industriali, Monog. rapp. col. 24: p. 32. (use)
1925: Gams, *Ruta,* in: Hegi, Illustr. Fl. Mittel-Europ., ed. 1, B. 5, 1: p. 68–73. (tax. + use)
1931: Engler, *Rutaceae,* in: Engler & Prantl, Die nat. Pflanzenfam., ed. 2, B. 19a: p. 243–246. (tax. + use)
1946: Baldrati, Piante officinali dell'Africa orientale, Centro Studi Colon. 32: p. 110. (use)
1950: Baldrati. Trattato delle coltivazioni tropicali e sub-tropicali: p. 207. (use)
1956: Cufodontis, Enumeratio, Bull. Jard. Bot. État Brux. 26(3), suppl.: p. 368–369. (tax.)
1957: Cufodontis, Bemerkenswerte Nutz- und Kulturpflanzen Aethiopiens, Senck. Biol. 38, 5/6: p. 409. (use)
1960: Lemordant, Les plantes éthiopiennes: p. 51. (use)
1961: Garnier et al., Ressources médicinales de la flore française, 1: p. 651–653. (use)
1963: Siegenthaler, Useful plants of Ethiopia, Exp. Stn. Bull. 14: p. 18. (use)
1967: Townsend, *Ruta,* in: Flora of Turkey, 2: p. 495–496. (tax.)
1968: Townsend, *Ruta,* in: Flora Europaea, 2: p. 227. (tax.)

1974: Gessner & Orzechowski, Gift- und Arzneipflanzen von Mittel-europa, ed. 3: p. 311–312. (use)
1976–
1977: Kloos, Preliminary studies of Medicinal plants and plant products in markets of central Ethiopia, Ethnomedicine, B. 4, 1/2: p. 85. (use)
1977: Fournier,Les quatre flores de France, ed. 2, 1: p. 629–630; 2: p. 168. (tax.)
1977: Jafri, Flora of Libya 50: p. 2–4. (tax.)

Local names: tenadam, adam, taladdam, gulla (Amarinia); dehn, tenadam (Tigrinia); talatam, talles, dscharta (Gallinia).
Trade names: rue, herb of grace (English); rue, rue des jardins, grande rue, rue d'Algérie (French); Raute, Weinraute, Gartenraute, Kreuzraute (German).

Geographic distribution

R. chalepensis is indigenous to the Mediterranean area, the Canary Islands, Arabia and Somalia. In many countries all over the world, it is cultivated.

In Ethiopia, it is reported from all provinces as a cultivated herb in almost every garden (Engler, 1907; Cufodontis, 1956, 1957; Siegenthaler, 1963; Herb. FT, K, P, WAG).

Description

An erect perennial herb, becoming woody at base, up to 1.5 m high, all green parts glabrous and glandular punctate, usually with a white waxy cover, strongly smelling.

Stems terete, up to 1 cm in diam. at base, branched at all heights, light-green to blue-green.

Leaves alternate, bi- or tri-pinnately compound, ovate in outline, up to 5–13 × 3–9 cm. Petiole terete, 0–4 cm long. Blade with opposite or alternate leaflets, each leaflet again pinnately or bi-pinnately compound, the ultimate segments narrowly ovate to spathulate, 5–30 × 1–5 mm, usually sub-entire and blue-green; the lowest leaflets often stipulelike, up to 2.5 cm long.

Inflorescence corymb-like with irregular, cymose branching, each branch subtended by a heart-shaped, blue-green, usually simple bract, up to 16 × 9 mm, sometimes trifoliolate and up to 2.5 cm long, margins irregularly crenate, the lower bracts always wider than the branch they subtend. Pedicels terete, blue-green, ca 0.5–2 cm long. Central flowers usually 5-merous, the others 4-merous, but very seldom 2-, 3-, or 6-merous flowers occur also. All flowers protandrous.

Calyx with 4 or 5 triangular sepals, connate at the base only, ca 2–6 × 1–4 mm, margins crenate, blue-green.

Corolla: petals 4 or 5, free, boat-shaped, ca 4–8 × 3–6 mm in outline, yellow-green outside, yellow inside, glandular punctate, with an undulating, fimbriate upper margin (threads up to 2 × 0.5 mm) and a short claw of ca 1–2 × 0.5–1 mm.

Androecium with 8 or 10 obdiplostemonous stamens; filaments narrowly triangular, ca 3.5–7 mm long and ca 0.5–1 mm wide at base, light-green; anthers basifixed, 2-celled, ca 1–2 × 0.75–1.25 mm, yellow, dehiscing by lateral longitudinal slits.

Disk annular, fleshy, ruminate when dried, 1.5–3 mm in diam., 0.5–1.5 mm high, in the middle outside with a ring of brownish glands.

Gynoecium: ovary ca ovoid in outline, ca 2–4 × 2–3.5 mm, composed of 4 or 5 carpels, only connate from base to half their length, acute at top; surface of ovary densely glandular punctate to sub-papillate, dark-green; styles 4 or 5, connate where the carpels are separate, up to 5 mm long, light-green; stigmas 4 or 5, connate, capitate, papillate, dark-green.

Fruit a capsule, globose in outline, usually shallowly lobed, ca 5–7 × 5–8 mm, light-green to dark-brown, densely muriculate; each carpel usually with a slightly impressed, central, dorsal longitudinal line, dehiscing apically, by a short ventral longitudinal slit, 5–10-seeded.

Seeds: lunate, ca 1.5–2.5 × 1–1.5 × 1–1.5 mm, with 3–4 sharp sides, more or less whitish rugose, usually dark-brown; embryo slighty curved, yellowish, ca 1.5 × 0.3 mm, with a conical radicle and 2 filiform cotyledons, the whole embedded in grey endosperm.

Seedling: germination epigeal; with a yellow-white taproot and side roots; hypocotyl ca 5–8 mm long, glabrous, yellow-white or dark-purple; cotyledons opposite, with a ca 2–4 mm long petiole and an oblong, entire blade of ca 4–7 × 1.5–2 mm, blue-green and glandular punctate like the following leaves; the first leaves after the cotyledons petiolate, trifoliolate.

Taxonomic notes

(1) Linnaeus described *R. chalepensis* in Mant. Pl. (1767) as: '*Ruta* foliis supradecompositis, petalis ciliatis', and referred to : 'α. *Ruta* chalepensis latifolia, petalis villis scatentibus. Tournef. inst. 257' and to '*β*. *Ruta* chalepensis angustifolia, petalis villis scatentibus. Moris. hist. 2. p. 508. s. 5. t. 35. f. 8'. These two references Linnaeus considered as varieties. He extended the description with: 'Simillima *R. graveolenti* ejusque progenies. Primi flores 5 fidi, reliqui 4 fidi. Petala concava, margineque undulata, ut in *R. graveol.* sed caulis altior. Petala margine ciliata, capsulae lobi acuti, obtusi. *β*. differt petalorum unguibus longioribus, capsulaeque lobis approximatis, nec distantibus', and remarked that the plant was grown in 'Hort. Upsal.'. Only from one herbarium specimen it is evident that Linnaeus identified it as *R. chalepensis:* specimen LINN 537.4, as it bears the Linnaean inscription '*chalepensis*'. Another inscription on the sheet ('HU') might indicate that the plant orginated from the Hort. Ups. Unfortunately specimen LINN 537.4 shows (apart from leaves) only fruits, no flowers. This specimen is, however, certainly in agreement with the (extended) description and I consider LINN 537.4 as the holotype of *Ruta chalepensis* L.

(2) Later authors generally subdivided *R. chalepensis* L. into two varieties: var. *bracteosa* (DC) Boiss. ('bracteae cordato-ovatae vel lanceolatae ramulo latiores') and var. *angustifolia* (Pers.) Willk. & Lange (. . . 'bracteis parvis lanceolatis ramo angustioribus . . .'). Some authors considered *R. chalepensis* L. var. *bracteosa* (DC) Boiss. as identical with *R. chalepensis* L. and *R. angustifolia* Pers. as a separate species. Until there is a critical revision of the genus *Ruta,* I prefer to treat *R. chalepensis* as not divided into varieties. *R. angustifolia* Pers. has not, as yet, been recorded from Ethiopia. According to Townsend (1968) it can be distinguished from *R. chalepensis* as follows:

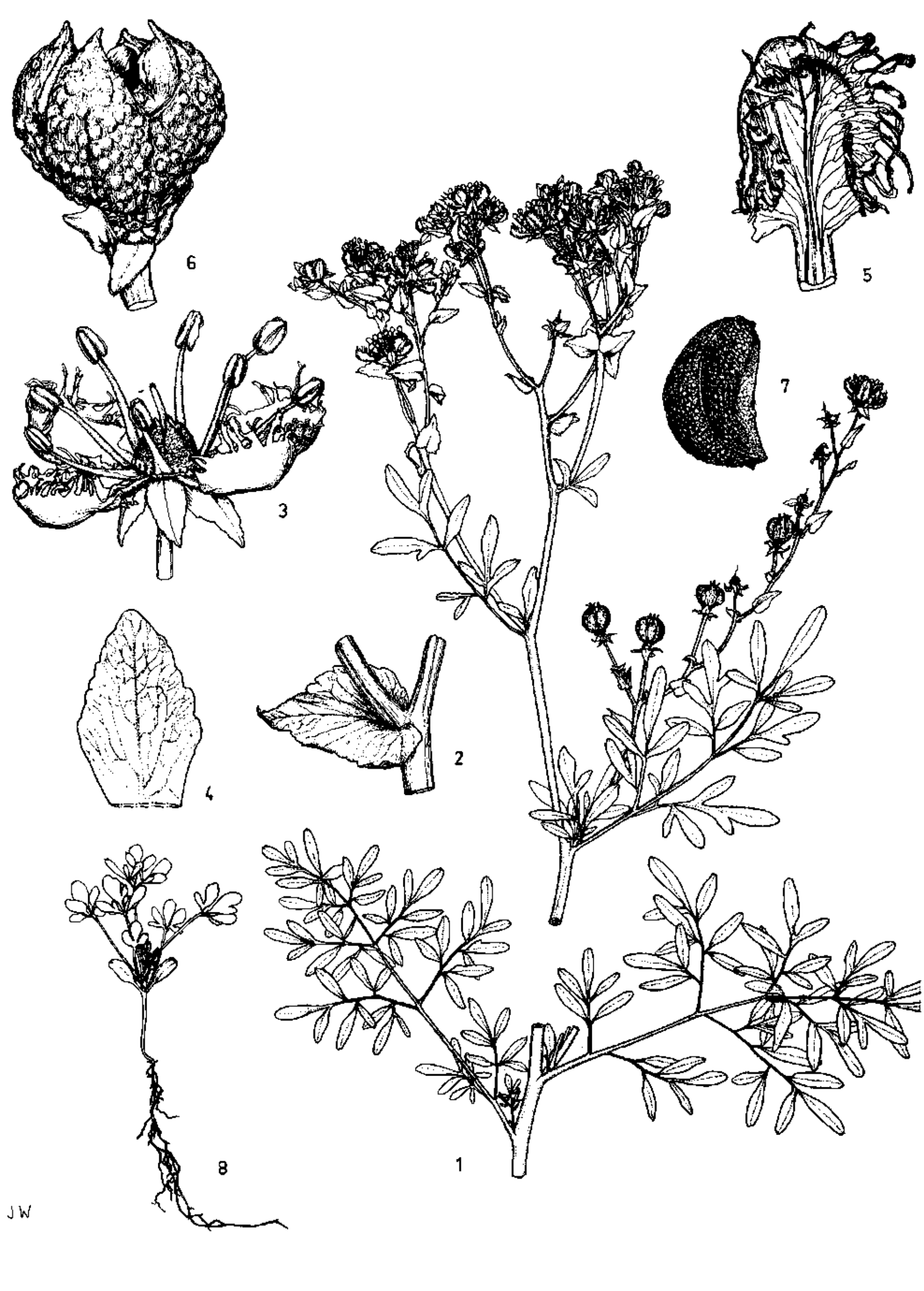


Fig. 11. *Ruta chalepensis* L. – 1. branch with leaves and habit upper plant part (⅔×); 2. branch with bract (2×); 3. flower, 4-merous (3×); 4. sepal (6×); 5. petal (6×); 6. fruit (4×); 7. seed (10×); 8. seedling (⅔×). – 1–5. PJ 6464; 6–7. PJ 1551; 8. PJ 2082 (spirit mat. too).

– narrower leaf-segments, up to 3.5 mm wide;
– lanceolate bracts, not or scarcely wider than the subtended branch;
– glandular-puberulent inflorescences;
– petal-cilia, up to as long as the width of the petal.

(3) If a subsidivion of *R. chalepensis* L. is necessary or desirable, the Ethiopian *Ruta* material studied here best fits *R. chalepensis* L. var. *chalepensis*, with LINN 537.4 as its type and perhaps with *R. bracteosa* DC (= *R. chalepensis* L. var. *bracteosa* (DC) Boiss. and *R. chalepensis* L. var. *tenuifolia* D'Urville) as synonyms.

(4) *Ruta graveolens* L., perhaps the best known rue, has not been recorded from Ethiopia. It much resembles *R. chalepensis* but can be distinguished from it by its denticulate, not fimbriate petals.

(5) The description is based on the following specimens:

Hararge	Alemaya, cultivated at College of Agriculture: PJ 2082, PJ 2811, PJ 4819, PJ 5123, PJ 6464; Alemaya, near College-gate on road to Kombolcha, in garden: WP 396, WP 455, PJ 1759; Dire Dawa market: WP 152, PJ 1046; Hamaressa market (near Harar): Tadessa Ebba 505; Harar market: Bos 8036, Bos 8369, Bos 8376, PJ 1551.
Kefa	Jimma, Institute of Agriculture, spice garden: PJ 5845; Jimma market: WP 3283.
Shoa	Bulbulla market: PJ 3912; Debre Zeit, Experimental Station: WP 1966; Kolito market: WP 2852.
Sidamo	Soddo, in garden: F. G. Meyer 8763, PJ 3715.
Wollega	Ghimbi market: PJ 1191; Nekemt market: PJ 1192.
Grown at Wageningen	WP 6182, WP 8653.

The following specimens, originating from Ethiopia, were seen: C. C. Albers 62021 (Lasta province, Lalibela, 1-11-1962) (K); Amare Getahun B-12 (Alemaya, 28-5-1958) (K); Armbruster & R. E. Massey s.n. (Addis Ababa, Jan. 1914) (K); I. Baldrati D20 (Asmara) (FT); A. Bellini 263 (Adi Ugri, 13-7-1909) (FT); P. Benedetto 241 (Sajo-Dembidollo, Aug. 1938) (FT); R. Bricchetti 254 (Harar, 1889) (FT); L. Buscalioni 538 (Dire Dawa-Harar, 7-2-1916) (FT), 1072 (Acachi, 27-3-1916) (FT); R. Cacciapuoti 1 (Wollega, Bologna, 2-11-1941) (FT); E. Chiovenda 1752 (Gondar, 31-8-1909) (FT); G. Giordano 810 (Bosco di Mannagaccia, 12-6-1937) (FT); M. Gutetta 1031 (Din-din forest, Arussi, 40°15'E × 8°35'N, March 1976) (K); F. G. Meyer 8763 (K); H. F. Mooney 5030 (Addis Ababa, 29-11-1953) (K, FT), 7580 (Addis Ababa, 25-10-1958) (K); R. Pichi-Sermolli 256 (Parte merid. della penisola di Zeghiè, 14-2-1937) (FT); Quartin-Dillon et Petit s.n. (Assai. 19-9-1839) (P), s.n. (Choa) (P), s.n. (Abyssinie) (P), 246 (ex herb. de Franqueville) (P, K), s.n. (Etchelicote) (P), s.n. (Abyssinia, Choa, 1862) (K); Ragazzi s.n. (Shoa, 24, 1888) (FT); W. Schimper s.n. (P); Schimper 531 (Addi Dschoa, 8–7–1862) (BM); H. Scott 251 (Debarek market, 12-11-1952) (K); L. Senni 85 (Addis Ababa, 18-1-1938) (FT), 166 (Addis Ababa, 19-2-1937) (FT), 1281 (Addis Ababa, 6-8-1937) (FT); Tadessa Ebba 505 (K).

For the following section, information recorded in literature for *R. graveolens* L. has also been used, as the use and growth of *R. chalepensis* is almost identical.

Ecology

R. chalepensis grows in the wild on warm dry rocky limestone slopes and fields, in Turkey up to 300 m, in France up to 500 m altitude (Gams, 1925; Garnier et al., 1961; Townsend, 1967).

In Ethiopia it is cultivated between the altitudes 1500–2000 m. *R. chalepensis* has protandrous flowers. The stamens do not develop all at once but one after the other. At maturity a stamen turns towards the centre of the flower, the anther dehisces its pollen and the stamen turns back. In this way the male flowering time is lengthened and the chance of shedding the pollen on a visiting insect increased, as insects usually stand on the ovary to reach the nectar which is present on the disc. Probably because of its strong smell, the flower is often visited by rubbish-visiting flies. At the end of male flowering, the style lengthens and rises above the ovary lobes and the stigma becomes receptive. Cross-pollination is normal, but, as the anthers can approach the stigma because of the wilting process of the stamens, some self-pollination might occur (Knuth, 1898).

Husbandry

Ruta chalepensis is grown from seed or propagated by splitting of older plants. It grows on all kinds of soils, provided they are not too wet. It even grows on dry rocky soils (Gams, 1925; Garnier et al., 1961).

At Alemaya, seed germinated ca 1.5–2 months after sowing, and flowering started ca 3–5 months later. Flowering and fruiting continued permanently, with optima after rains. In Ethiopia, some plants of *R. chalepensis* are cultivated for direct use near almost every house with a garden. As it is an easy-growing perennial plant, no special methods of cultivation were observed. Once the plants start growth, they can

Photograph 18. *Ruta chalepensis,* flowers, PJ 1046.

be harvested for several years at almost any time of the year. On the Ethiopian markets, either dry fruits only, or fresh or dried stem-parts with leaves, flowers and fruits are offered for sale.

In France the plants are sometimes cultivated in rows, ca 80 cm between and ca 40 cm within the rows. The upper plant-parts are harvested twice a year (in spring and in autumn) and are usually dried quickly (Garnier et al., 1961).

According to Gams (1925), germination of the seed is promoted by darkness and frost.

Gams (1925) reported *Sphaerella rhea* Fautr. as a leaf-spot disease on *Ruta*. Stewart & Dagnatchew (1967) observed in Shoa Province, Ethiopia, *Alternaria tenuissima* (Nees ex Fr.) Wiltshire on the stem.

Uses

1. Culinary uses

It is known that the Romans used *Ruta* as a spice. As a culinary herb, it now is almost absent in Europe, although Gams (1925) reported some use as a spice for salads and cakes.

In Ethiopia, the use of *Ruta* as a culinary herb is very common. Ground mature fruits are an ingredient of the spicy *Capsicum* sauce 'berbere'. Washed leaves are added to sour milk in order to make a local cheese. Fresh leaves are also used to flavour a beverage called 'kuti', which is prepared by infusing coffee leaves (Cufodontis, 1957; Asrat, 1962; Ketema, 1962; Telahun, 1962; Siegenthaler, 1963).

2. Medicinal uses

In the past the use of *Ruta* as a medicinal plant was perhaps more important than as a spice. At present its medicinal use is rather restricted because of its unpleasant, sometimes dangerous, secondary effects. Both the herb and its essential oil have been widely used in the past as a stomachic, a colic remedy, an emmenagogue, an abortifacient and an anthelmintic, as well as in hysteria and epilepsy. The oil has frequently been used to induce abortion, although in ordinary doses it appears to have practically no effect on the uterus. The oil, if repeatedly applied to the skin, causes burning, redness and blistering. If taken internally in large doses, gastroenteritis associated with severe epigastric pain, vomiting, prostration, confusion of mind, convulsive twitches and, in pregnant women, abortion, may result (Watt & Breyer-Brandwijk, 1962).

In South Africa, a decoction of the leaf of *Ruta* is used against fevers. Leaf sap is given to infants and children with convulsions and fits, and the bruised leaf is placed in hollow teeth and in the ears to relieve toothache and earache, respectively. An infusion or a wine tincture of the leaf is regarded as hypnotic and is taken by adults suffering from respiratory and heart diseases (Watt & Breyer- Brandwijk, 1962).

In Ethiopia *Ruta* is considered as an important medicinal plant. The Amarinia name 'tenadam' means 'health of Adam'. The following uses were observed or reported:

- A decoction of plant parts, mixed with tea, is drunk against headache, cold, heart-pain, earache and intestinal disorders. Sometimes garlic or *Cymbopogon citratus* decoctions are added when used against intestinal pains (Cufodontis, 1957; Lemordant, 1960);
- Ground and dried fruits, boiled in milk, are used against diarrhoea (Lemordant, 1960; 1971);
- The juice of crushed leaves, mixed with water is given to babies against colic (Baldrati, 1946; Siegenthaler, 1963);
- Plant parts boiled in local beer or prepared together with 'wot' are used against influenza (Lemordant, 1960, 1971; Gelahun, pers. comm., 1976);
- Ground plant parts are an ingredient of an ointment used against haemorrhoids (Lemordant, 1960; 1971);
- The plant is believed to have disinfectant properties (Chiovenda, 1912).

Chemical composition

Ruta chalepensis contains an essential oil, which can be obtained by steam distillation. It is a yellow-green oil tasting and smelling bitter, with a bluish-violet fluorescence, present up to 0.6% in plants growing in the wild and up to 0.08% in fresh cultivated plants or ca 0.1% in dried cultivated plants (Watt & Breyer-Brandwijk, 1962). This oil contains up to ca 80% methyl-n-heptylketon and ca 10% methylnonylketon (in *R. graveolens* the ratio of the substances is exactly the reverse) (Garnier et al., 1961). The yellow colour of the petals is caused by the presence of rutin, which is a rhamno-glucoside of quercetin. Rutin is a substance which has a constrictor action on the capillary bed and decreases the permeability and the fragility of the vessels (Watt & Breyer-Brandwijk, 1962). Fresh leaves contain 390 mg vitamin C per 100 g (Garnier et al., 1961).

2.11 Trachyspermum ammi (L.) Sprague ex Turrill — Fig. 12

'Trachyspermum': from the Greek 'trachys' = 'rough', and 'sperma' = 'seed'; rough seed, i.e. rough fruit because of the numerous papillae on the fruit.
'ammi': perhaps derived from the Greek 'ammos' = 'sand', probably referring to the sandy habitat of the original plant with this name.

Turrill, W. B., On the flora of the nearer East 4, Kew Bull.: p. 228 (1929).
Type: 'Habitat in Apulia, Aegypto'. '*Sison* foliolis caulinis subcapillaribus' (LINN specimen No 356.5, lecto.!).

Synonyms

Sison ammi L., Sp. Pl. ed. 1: p. 252 (1753) (basionym).
Trachyspermum copticum (L.) Link, Enum. Hort. Berol. 1: p. 267 (1821).
Ammi copticum L., Mant. Pl.: p. 56 (1767).
Ammios muricata Moench, Meth. Pl.: p. 99 (1794).
Bunium aromaticum L., Mant. alt.: p. 218 (1771).

Carum copticum (L.) Benth. & Hook. f. ex C. B. Clarke, in: Hook. f., Fl. brit. Ind. 2: p. 682 (1879).
Deverra korolkowii Rgl. & Schmalh., Tr. Bot. Sada 5, 2: p. 589 (1878).
Ligusticum ajawain Roxb. ex Fleming, As. Res. 11: p. 171 (1810).
Ptychotis coptica (L.) DC, Mem. Soc. phys. Geneve 4: p. 496 (1828).
Selinum copticum (L.) Krause, in: Sturm, Deutschl. Fl. ed. 2, 12: p. 43 (1904).
For more synonyms see Thellung (1925, p. 1167–1168) and Wolff (1929, p. 87–88).

Literature

1830: De Candolle, Prodr. 4: p. 108. (tax.)
1872: Boissier, Flora Orient. 2: p. 891–892. (tax.)
1874: Flückiger & Hanbury, Pharmacographia: p. 269–271. (use)
1874: Roxburgh, Flora indica, repr. ed. 1832: p. 271. (tax. + use)
1895: Engler, Pflanzenw. Ost-Afrikas & Nachbargebiete, B, Nutzpflanzen: p. 280. (use)
1897: Drude, *Umbelliferae*, in: Engler & Prantl, Die nat. Pflanzenfam., ed. 1, B. 3, 8: p. 188–189. (tax.)
1912: Chiovenda, Osservazioni botaniche, agrarie ed industriali, Monog. rapp. col. 24: p. 31. (use)
1913: Kostlan, Die Landwirtschaft in Abessinien 1, Beih. Tropenpflanzer 14: p. 232. (agric.)
1922: Book-notes, news etc., Journ. Bot.: p. 212–213. (tax.)
1925: Thellung, *Umbelliferae*, in: Hegi, Illustr. Fl. Mittel-Eur., ed. 1, B. 5, 2: p. 1167–1168. (tax. + use)
1927: Wolff. *Trachyspermum*, in: Das Pflanzenreich 4, 228: p. 87–89. (tax.)
1933: Redgrove, Spices and condiments: p. 223–224. (agric.)
1934: Bois, Les plantes alimentaires chez tous les peuples et à travers les âges, 3, Plantes à épices, à aromates, à condiments: p. 167–168. (use)
1946: Baldrati, Piante officinali dell'Africa orientale, Centro Studi Colon. 32: p. 39–41. (use + agric.)
1950: Baldrati, Trattato delle coltivazioni tropicali e sub-tropicali: p. 197–199. (use + agric.)
1957: Ferrara, Tecnologia delle spezie, Rivista Agric. subtrop. & trop.: p. 295–296. (chem. + use)
1957: Mensier, Dictionnaire des huiles végétales, Encycl. Biol. 52: p. 477. (chem.)
1959: Cufodontis, Enumeratio, Bull. Jard. Bot. État Brux. 29(3), suppl.: p. 643. (tax.)
1961: Joshi, These new spices will pay you well, Indian Fmg. 10(10): p. 26–27. (agric.)
1963: Siegenthaler, Useful plants of Ethiopia, Exp. Stn. Bull. 14: p. 14–15. (use)
1973: Shishkin, *Umbelliferae*, in: Flora of the USSR, Engl. ed., 16: p. 272–273. (tax.)
1976: Amare Getahun, Some common medicinal and poisonous plants used in Ethiopian folk medicine: p. 56. (use)

Local names: netch-azmud (Amarinia); azmud-addi, kamon, kamuni (Gallinia); azmud, camun (Tigrinia); gummur-hurtui (Somalia).
Trade names: bishop's weed, true bishop's weed, weed-seed, Ethiopian caraway (English); ajowan, omam, omum (India).

Geographic distribution

According to Wolff (1927), *Trachyspermum ammi* is only known from cultivation and its country of origin is unknown. Thellung (1925) stated that it is endemic in Egypt, Ethiopia, and in the area from SW-Asia to E. India. Cultivation is reported from N. Africa, Asia Minor, Ethiopia, E. India, Iran and some European countries. In the USSR it is cultivated experimentally in Central Asia and the Crimea (Shishkin, 1973).

In Ethiopia, the fruits are offered for sale on almost every market. Small-scale cultivation is widespread. Cultivation as a field crop is reported from the provinces: Bale, Begemdir, Eritrea, Gojam and Shoa (Chiovenda, 1912; Baldrati, 1950; Centr. Stat. Off., 1970).

Description

A decumbent or erect, annual herb, up to 160 cm high, with a light-brown taproot and many side roots; all green parts with a bloom.

Stem subterete, up 1 cm in diam. at base, sulcate, internodes often hollow, profusely branched at all heights, glabrous or very sparsely papillate, ribs often whitish.

Leaves: lower ones with an up to 10 cm long, sulcate petiole and an in outline ovate to subelliptic blade, up to 13 × 12 cm; petiole sheathing at base; sheath with narrow, white, scarious, papillate to subciliate margins; blade imparipinnate, each leaflet again pinnately dissected into acute lobes up to 10(–35) × 2 mm; upper leaves usually smaller and ovate in outline; the petiole reduced to the sheathing part only, up to 2 cm long; blade up to 10 × 7 cm in outline, imparipinnate, each leaflet pinnately dissected into very narrow, linear to filiform lobes of up to 3 cm length and usually with a slightly swollen, acute, sometimes mucronate apex; leaves glabrous or sparsely subpapillate, sheaths usually lighter green.

Inflorescence a compound umbel, up to 6 cm in diam.; peduncle subterete, sulcate, ca 2–10(–19) cm long, sparsely white papillate; bracts (3–)4–7(–9) per umbel, linear to lanceolate, up to 1 mm wide, unequal in length, varying from 0.1–2.5 cm, usually 2–3-lobed at apex, margins scarious, sheath-like at base, gradually narrowing to or almost to the apex, ciliate or subciliate, glabrous above, sparsely white papillate below; primary rays (5–)9–17(–21) per umbel, subterete, sulcate, unequal in length, (0.2–)0.5–3(–5) cm long, sparsely puberulous or papillate; bracteoles 5–9 per umbellet, shaped as the bracts but less often lobed at apex and up to 1 cm long; secondary rays (12–)18–25(–28) per umbellet, characters as of the primary rays but more puberulous or papillate and shorter, ca 0.5–5(–11) mm long (shortest situated centrally); all flowers bisexual and actinomorphic, protandrous.

Calyx: usually with 5 fleshy, subtriangular teeth, up to 0.5 mm long, glabrous or sparsely puberulous at margin, light-green, persistent in fruit.

Corolla: petals 5, white, heart-shaped in outline, up to 1.25 × 1.5 mm, apex strongly inflexed, usually notched, central dorsal region hirsute.

Androecium: stamens 5; filaments conical, up to 1.5 mm long, white; anthers dorsifixed, 2-celled, ca 0.3 × 0.3 mm, red or reddish-brown, dehiscing by 2 longitudinal slits.

Gynoecium: ovary inferior, subellipsoid, up to 1–1.5 × 1–1.5 × 0.5 mm, densely white papillate, white-green; stylopodium conical, ca 0.25–0.50 mm high and wide, white, fleshy, persistent in fruit; styles 2, sometimes 3 or 4, filiform, glabrous, ca 0.75–1.50 mm long, each with a somewhat thickened, semiglobose, brownish stigma, often persistent in fruit.

Fruit a flattened, subglobose schizocarp, ca 1.5–2 × 1.5–2 × 0.5–1 mm, easily splitting into 2, one-seeded mericarps; mericarps convex dorsally, with 5, slightly prominent, densely grey-white papillate, longitudinal, subparallel ribs, which alternate with 4 oil containing, grey-white papillate, not prominent ducts (vittae), flat to slightly concave ventrally, showing usually 2 glabrous, brown vittae; at maturity the mericarps are usually only connected by the carpophore, which remains usually attached for the whole length to one of the two mericarps; seldom the mericarps only connected at the top of the carpophore, which is usually splitted up to 1/3 of its length.

Seed: testa adnate to mericarp-wall; embryo usually straight, ca 1 mm long, thin, white, with conical radicle and 2 small cotyledons; endosperm copious, grey.

Seedling: germination epigeal; taproot thin, dirty white with many laterals; hypocotyl 0.5–2 cm long, green to brown-green; cotyledons opposite, oblanceolate, with attenuating petiolelike, slightly sheathing base, ca 5–15 × 1–2 mm, glossy-green, glabrous; next leaf (1 or sometimes 2) usually simple; petiole sheathing at base with narrow, white, scarious margins, ca 0.5–3 cm long; blade ovate to subovate in outline, ca 5–12 × 5–15 mm, shiny, light-green, deeply divided into usually 3 lobes, repeatedly incised each, forming acute lobules.

Taxonomic notes

(1) *Trachyspermum copticum* (L.) Link is considered by many authors as the correct name for this taxon (Thellung, 1925; Wolff, 1927; Cufodontis, 1959 and many more). This name is based on Linnaeus's '*Ammi copticum*' (Mant. Pl.: p. 56, 1767, '*Ammi* foliis supradecompositis linearibus, seminibus muricatis'). For a long time too, the name '*Carum copticum* C. B. Clarke' was used for this taxon. The generic name '*Trachyspermum* ' is now a 'nomen conservandum', with *T. copticum* (L.) Link as the type-species.

A report of the meeting of the Linnean Society on 15 June 1922 (Journ. Bot.: p. 212–213, 1922) states that Sprague had discovered, 'by examination of the type-specimens', that '*Sison ammi* L.' was identical with '*Carum copticum*'. Turrill (1929) followed this view and published the new combination (in the correct genus): *Trachyspermum ammi*, citing Sprague for the authority. As, however, Turrill (1929) is the only author of the article in which this name was published, the correct citation is : Sprague ex Turrill.

(2) The taxon '*Sison ammi* L.' has been a source of confusion in the literature. Linnaeus described it in 1753 as : '*Sison* foliolis caulinis subcapillaribus', and cited : Hort. Ups. 63; Mat. med. 140; *Ammi* lacinulis foliorum caulis capillaribus Hort. Cliff. 89, Roy. lugdb. 96; *Ammi* parvum, foliis foeniculi Bauh. pin. 159; and *Ammi* Cam. epit. 522. Although Linnaeus slightly changed the description of this taxon between 1738 (Hort. Cliff.) and 1753 (Sp. Pl.), the best choice as lectotype for this taxon is, in my opinion, specimen No 356.5 of the LINN herbarium. The sheet of this specimen is annotated as '4 *Ammi*' in the writing of Linnaeus, number corresponding with the order in Sp. Pl. I agree with Sprague (1922), Turrill (1929) and Bertoloni (Fl. Ital. 3: p. 306, 1837) that this specimen indeed is *Trachyspermum ammi* Sprague ex Turrill *(T. copticum* (L.) Link), *(Carum copticum* C. B. Clarke). In my opinion, the following specimens belong to this taxon too: Hort. Cliff. herb. (BM) p. 89(2): '*Ammi* semine tenuissimo et odoratissimo'; van Royen herb. (L): '*Ammi majus. Ammi* laciniis foliorum caulis capillaribus'; LINN No 341.4 *(Ammi copticum)*.

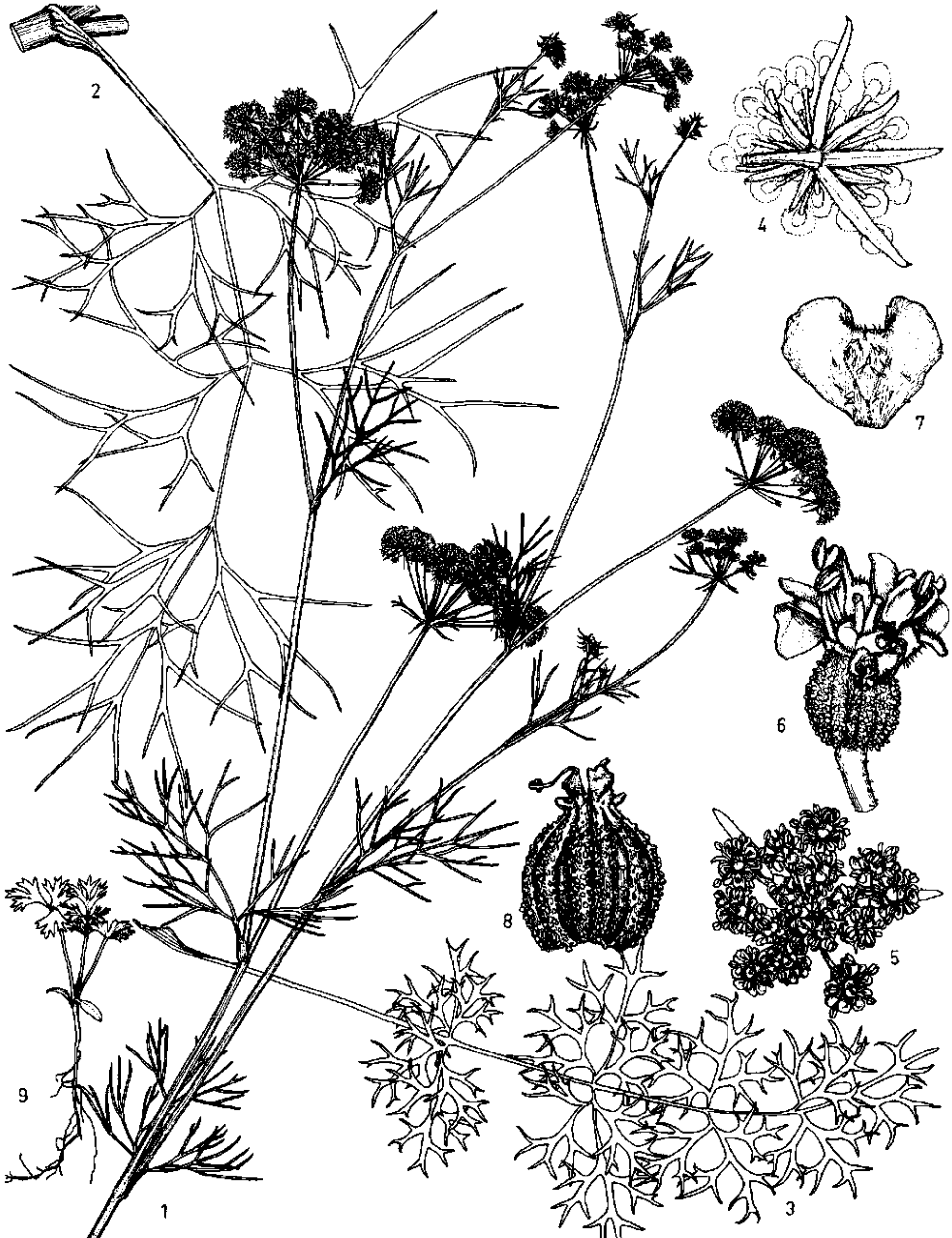


Fig. 12. *Trachyspermum ammi* (L.) Sprague ex Turrill. – 1. habit flowering plant part ($\frac{2}{3}\times$); 2. basal leaf-type ($\frac{2}{3}\times$); 3. basal leaf-type ($\frac{2}{3}\times$); 4. bracteoles at underside of umbellet ($3\times$); 5. flowering umbellet, top view ($3\times$); 6. flower, one petal removed ($12\times$); 7. petal, dorsal view ($20\times$); 8. fruit ($10\times$); 9. seedling ($\frac{2}{3}\times$). – 1. PJ 581; 2. PJ 351; 3. PJ 580; 4–7. PJ 2938 (spirit mat.); 8. PJ 910; 9. PJ 106 (spirit mat.).

(3) As long as closely related genera of the *Umbelliferae* are maintained as separate genera, based on characteristics better expressed as specific than as generic differences, many specimens will continue in the 'merry-go-rounds' like: '*Ammi, Carum, Sison, Ptychotis, Trachyspermum*'.

(4) The Ethiopian material of *T. ammi* studied by me is rather uniform. The variation, however, is such, that selection programs will almost certainly result in a range of cultivars.

(5) The species '*Trachyspermum aethusifolium* Chiov.' and 'var. *maritimum* Chiov.' of the species *T. ammi,* listed by Cufodontis (1959), were not observed in Ethiopia, nor in Ethiopian herbarium material. The type specimens (FT!) of these taxa originate from Somalia.

(6) The following differences were found between plants originating from the same seed raised in Ethiopia and at Wageningen:

	Ethiopia		Wageningen	
habit	often decumbent		erect (etiolated?)	
length of peduncle	2–10	cm	5–11 (–19)	cm
length of primary rays	2–23	mm	7–46	mm
length of secondary rays	0.5–5.5	mm	0.5–11	mm

(7) The description is based on the following specimens:

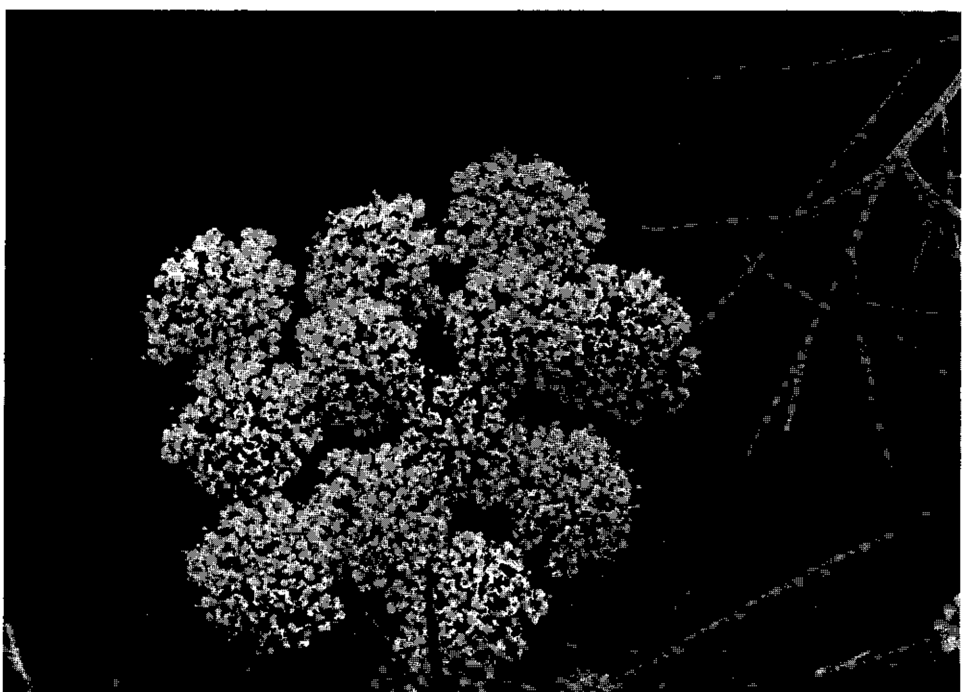
Arussi	Kofale market: SL 1284; Robi market: SL 1157, SL 1163; Sire market: SL 140.
Bale	Goba market: SL 1216: Goro market: SL 1256.
Begemdir	Gondar market: WP 4993, SL 921; Infranz market: SL 844.
Eritrea	Adi Caier market: SL 876.
Gojam	Dedjen market: SL 766; Elias market: SL 794; Lumane market: SL 744; Telili market: SL 815.
Hararge	Alemaya, cultivated at College of Agriculture: PJ 1330–1333, PJ 1335–1339, PJ 1829–1833, PJ 2529–2583, PJ 2909, PJ 2938–2939, PJ 3067–3081, PJ 3183–3185, PJ 3391–3408, PJ 3996–4011, PJ 4032–4036, PJ 4336–4337, PJ 4373–4377, PJ 4508, PJ 4820–4821; Alemaya, cultivated in garden: WP 719, WP 3006, WP 3038; Alemaya market: WP 28, PJ 5904; Asbe Tefari market: SL 8, SL 462; Assebot market: SL 707; Bedeisa market: SL 673; Chelenko market: SL 268; Deder market: SL 369; Dire Dawa market: WP 113, Bos 8358, Bos 8386, PJ 1036, PJ 1042; Gelemso market: SL 627; Harar market: WP 67, Bos 8039; Jijiga market: SL 362; Karra market: SL 586, SL 594; Moulu market: SL 455; Waichu market: SL 506.
Illubabor	Djemezo market: SL 1452; Gambella market: PJ 5106; Metu market: SL 1492.
Kefa	Agaro market: SL 89; Chena market: SL 1424; Jimma market: WP 3280, WP 3292, Bos 8623; Jimma, Inst. of Agr. Res.: PJ 5853.
Shoa	Ambo market: PJ 1217; Kolito market: WP 2859; Kuyera market: SL 1205–1206; Nazareth, cultivated at Inst. of Agr. Res.: PJ 2430–2434, PJ 3589, PJ 3598–3602, PJ 4710, PJ 4717–4721; Shashemene market: SL 1312; 67 km from Shashemene on road to Kolito, in field: WP 2851.
Sidamo	Awassa market: SL 1321; Kebre Mengist market: SL 1349; Negele market: SL 1394.
Tigre	Adishow market: SL 1026; Axum market: SL 938.

Wollega	Dembidollo market: SL 1533; Ghimbi market: PJ 1178, PJ 1185, PJ 1190; Nekemt market: PJ 1196.
Wollo	Bati market: SL 1033; Dessie market: SL 1094; Haik market: SL 1124; Kombolcha market: SL 959, SL 989.
Grown at Wageningen	WP 5697–5701, WP 5840–5842, WP 6019, WP 6997–6998, WP 7345–7346, WP 7358–7359, PJ 87–127, PJ 141, PJ 148, PJ 341–371, PJ 401, PJ 573–583, PJ 629–653, PJ 685–695, PJ 712–719, PJ 728–729, PJ 747–749, PJ 800–833, PJ 889–894, PJ 909–910, J. van Veldhuizen 17–18.

Ecology

According to Baldrati (1950), *Trachyspermum* is often cultivated in Ethiopia together with barley and teff, which are cultivated at ca 1700–2200 m altitude. *Trachyspermum* grown at Alemaya (alt. ca 2000 m) had a less satisfactory fruit-setting than plants grown near Nazareth (alt. ca 1500 m). This suggests that the plant grows best at altitudes below 2000 m. Kostlan's statement, that *Trachyspermum* is grown in Ethiopia around alt. 1700 m supports this view (Kostlan, 1913).

The climate of Central Europe is not suited for this plant. Cultivation in Europe ceased more than 250 years ago. Yet the plant is sometimes found in Europe in a (semi-)wild state (Thellung, 1925). Ramanujam et al. (1964) reported ca 70–80% cross-pollination in *Trachyspermum* in India.



Photograph 19. *Trachyspermum ammi,* flowering umbel, PJ 341.

Trachyspermum ammi is raised from seed. It grows best on soils of medium texture. In Ethiopia, seeds are broadcast, sometimes on small fields near a house, more often on larger fields in a mixture with teff or barley. The seeds need a light covering of soil. Ca 20 kg seed is needed per ha (Baldrati, 1950; Zemedu, undated). In India, seeds are sown in rows, 45 cm apart and 30 cm between plants in the rows. Germination takes ca 10–15 days (Joshi, 1961). In Ethiopia, germination took ca 1 month (pers. obs., 1975–1977). Heavy rains retard growth, yet sowing is done at the beginning of the rainy season in Ethiopia (Baldrati, 1950). In India, the crop is usually irrigated on light soils and rainfed on heavy soils (Joshi, 1961). In Ethiopia, plants flowered ca 3–4 months after sowing, and could be harvested ca 5–6 months after sowing (pers. obs., 1975–1977). The fruits are often harvested before they are fully ripe, to prevent losses due to falling. Unripe fruits seem to contain as much essential oil as ripe fruits. Baldrati (1950) concluded that it was difficult to obtain good seed and advised to leave some plants on the field for seed production. Many of the fruits for sale on markets in Ethiopia are empty. As the fruits are rather small, it is difficult to see whether they are empty or not full-grown (pers. obs. 1975–1977).

Stewart & Dagnatchew (1967) reported two leaf spot diseases of *Trachyspermum* observed in Shoa Province, Ethiopia. One was caused by *Alternaria dauci* (Kuehn) Groves & Skolko and the other one by *Cercospora* sp. In India ca 10% loss of fruits is

Photograph 20. *Trachyspermum ammi* in field.

caused by the larva of the chalcid fly *Systole albipennis* Walk., which feeds upon the embryo or endosperm of the seed.

Uses

1. Culinary uses

The fruits of *Trachyspermum ammi* are described as having an aromatic smell and a pungent taste (Roxburgh, 1874).

In Ethiopia, the fruits are a normal daily ingredient of the sauce or powder made from *Capsicum* pepper and seem to reduce its pungency. In other foods (curry 'wot', 'alicha wot', wheat bread), they also serve as a flavouring spice, often together with other spices, but not *Nigella sativa.* Usually the fruits are dried, roasted and ground before use (Kostlan, 1913; Baldrati, 1950; Asrat, 1962). Asrat (1962) reported that Amhara women in Harar and Dire Dawa use this spice (together with other spices) to make a special kind of bread, made at New Year's Day and Christmas. On the Feast of the Assumption (15 August) the bread is given to children when they go round houses singing. Sometimes it is prepared for priests. Amare (1976) reported that, in preparation of 'katikalla' beverage, the fruits are sometimes added before fermentation and distillation.

In India, the fruits are also used as a condiment in food (Roxburgh, 1874; Redgrove, 1933; Baldrati, 1950). Besides this local use, it has considerable industrial use in India and the fruits are exported to Great Britain, Japan, Germany and the USA (Baldrati, 1950). On the Seychelles, the plant is only cultivated for essential oil; the press-cake is used as cattle food (Baldrati, 1950).

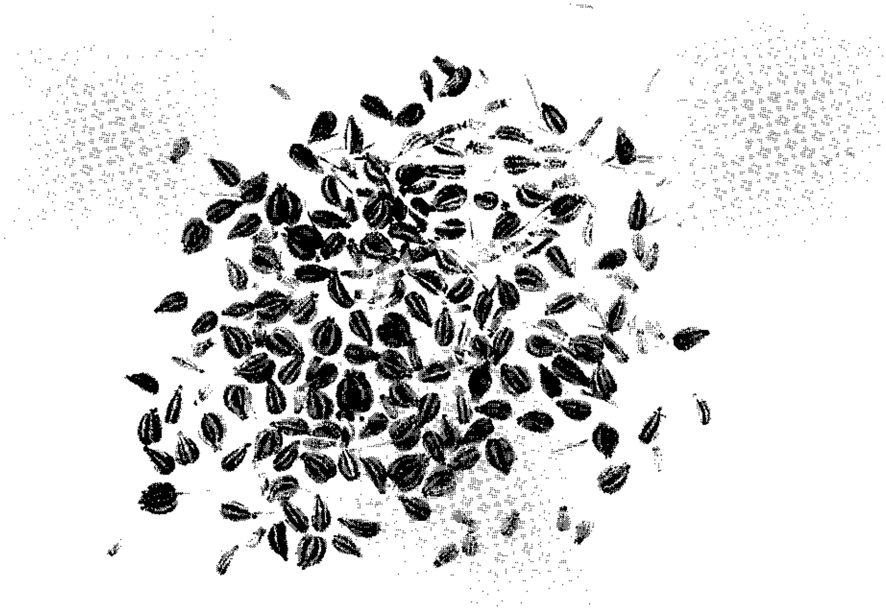
2. Medicinal uses

In Ethiopia, the fruits and the roots of *T. ammi* (in a mixture with other spices) are used against stomach complaints (Amare, 1976; Gelahun, pers. comm. 1976). Lemordant (1971) stated that the fruits are used in Ethiopia as a vermifuge and as an abortive. In Somalia, the fruits are chewed against diarrhoea (Baldrati, 1946). The oil seems to be strongly antiseptic and parasiticidal (Redgrove, 1933; Baldrati, 1950). In India, *Trachyspermum* fruits are also used to produce thymol, which is used against cholera and against hookworms (Wolff, 1927; Redgrove, 1933).

Chemical composition

According to Ferrara (1957), the fruits of *T. ammi* contain (approximately) (mass fraction, g/kg):

moisture	90
crude protein	150
ether extract	180
nitrogen-free extract	390
crude fibre	120
ash	70



Photograph 21. *Trachyspermum ammi*, mericarps (3×), PJ 830.

Depending on origin and cultivar, the content of essential oil of the fruits ranges from 3–10%. It is a light-brown liquid, with a strong smell and a pungent taste. About half of the essential oil is thymol. After extraction of the thymol, the residue (thymene) is used to perfume soaps. Thymol may be added to foods as a preservative (Ferrara, 1957). Thymol is also widely used in the manufacture of toothpaste and elixirs (Shishkin, 1950). It is a source for the production of menthol (Joshi, 1961). Thellung (1925) reported that the essential oil was bright-blue and that the fruits contained ca 15–17% of protein and 25–32% of fats. Ethiopian fruits contain 9% essential oil of which 55% is thymol of very good quality. Fruits from the Seychelles contained 10% essential oil, of which half was thymol (Baldrati, 1950). According to Joshi (1961) the best cultivar of India contained 10% essential oil, of which 60% was thymol.

2.12 Zingiber officinale Rosc. — Figs. 13, 14

'*Zingiber*': perhaps from Sanskritic 'singabera', meaning 'shaped like a horn', probably because of the resemblance of the rhizomes to a deer's antler.
'*officinale*': from Latin 'officina' = 'workshop'; in early Latin, it meant 'in the pharmacy', meaning that it had a medicinal use.

Roscoe, W., New arrangement of the plants of the monandrian class usually called *Scitaminea*, Trans. Linn. Soc. 8: p. 348 (1807).

Type: 'Habitat in Indiis inter tropicos'. Figure 12 in: Rheede tot Draakestein, H. A. van, Hortus indicus malabaricus, vol. 11: p. 22–23, (1692), (lecto.!).

Synonyms

Amomum zingiber L., Sp. Pl. 1: p. (1753), (basionym).
Zingiber zingiber (L.) Karsten, Deutsche Flora: p. 471 (1881).

Literature

1738: Linnaeus, Hort. Cliff.: p. 3. (tax.)
1828: Roscoe, Monandrian plants of the order *Scitamineae* chiefly: *Zingiber officinale* (no pages). (tax.)
1874: Flückiger & Hanbury, Pharmacographia: p. 574–577. (use)
1895: Engler, Pflanzenw. Ost-Afrikas & Nachbargebiete, B, Nutzpflanzen: p. 264–265. (tax. + use)
1904: Schumann, *Zingiberaceae,* in: Das Pflanzenreich, 4, 46, H. 20: p. 170–172. (tax.)
1912: Ridley, Spices: p. 389–421. (agric.)
1913: Kostlan, Die Landwirtschaft in Abessinien 1, Beih. Tropenpflanzer 14: p. 232. (agric.)
1930: Loesener, *Zingiberaceae,* in: Engler & Prantl, Die nat. Pflanzenfam., ed. 2, B. 15a: p. 586–587. (tax.)
1933: Redgrove, Spices and condiments: p. 31–45. (agric.)
1934: Bois, Les plantes alimentaires chez tous les peuples et à travers les âges, 3, Plantes à épices, à aromates, à condiments: p. 76–83. (agric.)
1946: Baldrati, Piante officinali dell'Africa orientale: p. 124–125. (use)
1950: Baldrati, Trattato delle coltivazioni tropicali e sub-tropicali: p. 179–181. (agric.)
1955: Dalziel, Useful pl. W. Trop. Afr., 2nd repr.: p. 474. (use)
1962: Ketema, A report on preparation and economic uses of spices in Harar, unpublished JECAMA report, Alemaya: p. 8–11. (use)
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1963: Siegenthaler, Useful plants of Ethiopia, Exp. Stn. Bull. 14: p. 20–21. (agric.)
1964: Maistre, Les plantes à épices: p. 11–49. (agric.)
1968: Agren & Gibson, Food composition table for use in Ethiopia, CNU-ENI report 16: p. 14. (chem.)
1969: Parry, Spices, vol. 1: p. 194–195; vol. 2: p. 45–49, 196–198. (use)
1969: Rosengarten, The book of spices: p. 254–261. (use)
1970: Centr. Stat. Off., Major crops and crop seasons in 13 provinces, Stat. Bull. 3. (agric.)
1972: Paulose, Ginger cultivation in India, in: Spices, proceedings of the conference on spices: p. 117–121. (agric.)
1972: Purseglove, Tropical Crops, Monocotyl. 2: p. 533–540. (agric.)
1976: Amare, Some common medicinal and poisonous plants used in Ethiopian folk medicine: p. 59. (use)
1976: Cobley & Steele, Introd. bot. trop. crops, ed. 2: p. 230–232. (agric.)

Local names: zingibel, zinjibil, zanzai, tshen-schibel (Amarinia); gingebela, zenjibil (Gallinia); dendabil (Tigrinia); kundi (Neghelli).
Trade names: ginger (English); gingembre (French); Ingwer (German).

Geographic distribution

Ginger is known only as a cultivated plant and its origin is unknown. Probably it originates from India or China.

In the 13th Century, the Arabs brought ginger from India to East Africa and ginger has perhaps been known since then in Ethiopia. Kostlan reported in 1913 that ginger was still little grown or used in Ethiopia. Ginger is now well known in Ethiopia and fresh or dry rhizomes are for sale on most markets. It is mainly grown in the wetter regions of Kaffa, Illubabor, Gemu-Gofa, Sidamo and Wollega, mostly in gardens. Larger-scale production is reported from around Gore (Illubabor), Wollamo (Sidamo) (Centr. Stat. Off., 1970). For the Gumuz people (Gojam, Begemdir), it is the major cash-crop (Kuls, 1962).

India, China, Taiwan, Nigeria, Jamaica, Sierra Leone, Mauritius and Australia are the largest producers of ginger (Purseglove, 1972).

Description

A herb with a thickened, fleshy, perennial, subterranean rhizome and with one or more aerial leafy stems.

Rhizome strong, up to 2 cm thick, irregularly branched but normally only in a vertical direction, covered with deciduous, thin scales, which leave ring-like scars; epidermis corky, pale yellow to light-brown, irregularly wrinkled in the dried rhizome; roots terete, thin, fibrous, white to light-brown; on dried rhizomes scars of leafy stems visible as shallow cup-like holes.

Stem erect, unbranched, mainly formed by the leaf-sheaths, up to 1 m high, pale-green, often reddish at base; scales covering the lower part oblong, pale-brown, ca 6 × 1 cm, scarcely white-pilose outside, with prominent parallel veins, slightly notched or double notched at apex, margins glabrous, scarious.

Leaves distichous; sheath prominently veined, densely appressed pilose, especially so in the upper part, with white, scarious, glabrous margins; ligule up to 5 mm long, bilobed, glabrous to sparsely pilose, scarious, usually with some short brownish stripes on the outer surface; blade entire, linear to lanceolate, up to 20 × 2 cm, acuminate at top, attenuate at base, finely parallel-veined, glabrous above, scarcely pilose below, light to dark-green.

Inflorescence arises direct from rhizome, spiciform, ca 15–25 cm long; scape slender, 10–20 cm long, below the spike covered with scales as on the leafy stem bases, the upper ones sometimes with short leafy tips; spike ovoid to narrow-ellipsoid, 4–7 × 1.5–2.5 cm, light-green; bracts appressed, ovate to elliptic, 2–3 × 1.5–2 cm, yellow-green, margin scarious, incurved, the lower ones with slender whitish acute tips, glabrous, finely parallel-lined; in the axil of each bract one flower may be produced; flowers fragile, short-lived, surrounded by a spatha-like bracteole; bracteole ca as long as the bract, scarious, glabrous, finely lined, apex slightly notched.

Calyx thin, tubular, spathaceous, ca 10–12 mm long, whitish.

Corolla tubular, pale-yellow, widening at top into three lobes; tube 18–25 mm long; dorsal lobe long ovate, ca 15–25 × 7–8 mm, with beak-like, rounded apex,

Fig. 13. *Zingiber officinale* Rosc. – 1. leafy branch (⅔×); 2. ligule (2×); 3. rhizome part (⅔×); 4. dried rhizome part (⅔×). – 1–2. WP 5519; 3. Bos 8381 (spirit mat.); 4. PJ 5102.

curved over the anther; ventral lobes ca oblong, ca 13–15 × 2–3 mm, apex rounded, 3-veined, strongly recurved.

Androecium: labellum ca circular in outline, ca 12–15 mm in diam., tubular at base (tube ca 3–4 mm long), 3-lobed above; central lobe ca obovate, ca 12 × 9 mm, side lobes ca elliptic, ca 5 × 3.5 mm; labellum ca pale-yellow outside, inside dark-purple at top and at margins, mixed with yellowish spots, scattered pilose at throat; filament ca 1.5 × 1 mm; anther 2-celled, ca ellipsoid, ca 7–9 × 3 mm, cream coloured, dehiscing by two longitudinal slits; connectivum prolonged into a slender, curved, beak-like appendage of ca 7 mm length, enclosing the upper part of the style.

Gynoecium: ovary globose, ca 2 mm in diam., 3-locular, each locule with ca 7 ovules; style ca 3.5 cm long, white, filiform, slightly recurved and widening at top, ending in a funnel-shaped white stigma; stigma provided with a circle of ca 0.5 mm long, rather stiff hairs at its upper margin. On top of the ovary 2–3 fleshy, sublinear, ca 5 × 0.5 mm white nectaries are situated against the style.

Fruits: not observed. Purseglove (1972) describes the seldom produced fruits as thin walled, 3-valved capsules, with small black arillate seeds.

Taxonomic notes

(1) Roscoe (1807) described *Zingiber officinale* from a plant in the Botanic Garden at Liverpool: 'Bracteis ovato-lanceolatis, laciniis corollae revolutis, nectario trilobato', and referred to *Amomum zingiber* Willd., Sp. Pl. 1: p. 6. Willdenow (1797) extended Linnaeus's description: '*Amomum* scapo nudo, spica ovata' with: 'Squamis ovatis, foliis lanceolatis ad apicem margine ciliatis'. Linnaeus's (1753) *Amomum zingiber* is the basionym of the species. The genus *Amomum* of Linnaeus is a nomenclatural synonym of the conserved generic name: *Zingiber* Boehm. (see Burtt & Smith, 1968). The specific epithet '*zingiber*' could not be used in the genus *Zingiber*. Thus *Zingiber officinale* is the correct name. In the protologue of *Amomum zingiber,* Linnaeus (1753) only described the inflorescence: 'Scapo nudo, spica ovata'. None of the 6 references given by Linnaeus in the protologue, however, directly indicate the element from which he could have taken his description. In the LINN herbarium, specimen LINN 3.1 (ex H.U.) is a sterile plant part with 8 leaves. In the Hort. Cliff. herbarium (BM), the specimen *Amomum zingiber* is sterile and bears 5 leaves. In Flor. zeyl. 3 (p. 1–2) he gave a more extended description but he took the phrase name from his Hort. Cliff. As the description of this taxon in Sp. Pl. (1753) is the same as in Hort. Cliff. (1738: p. 3), Linnaeus's conception of the species had not altered since 1738 and so one should seek the type in Hort. Cliff. (as suggested also by Stearn, Introd. to Sp. Pl. 1, p. 45, 1957). Herbarium specimens with floral parts being absent from the references in the protologue of *A. zingiber* in Hort. Cliff., it is likely that Linnaeus derived his description from the reference to: Inschi, Rheed. mal. 11. p. 21. t. 12 (H. A. van Rheede tot Draakestein, Hortus indicus malabaricus, vol. 11, p. 21, tab. 12, 1692), where tab. 12 shows a ginger plant with an inflorescence exactly as described by Linnaeus. This plate I designate as lectotype of the species *Zingiber officinale* Rosc.

(2) No different clones could be observed in the material studied here. According to Purseglove (1972), it seems that the number of clones is limited. Each centre of

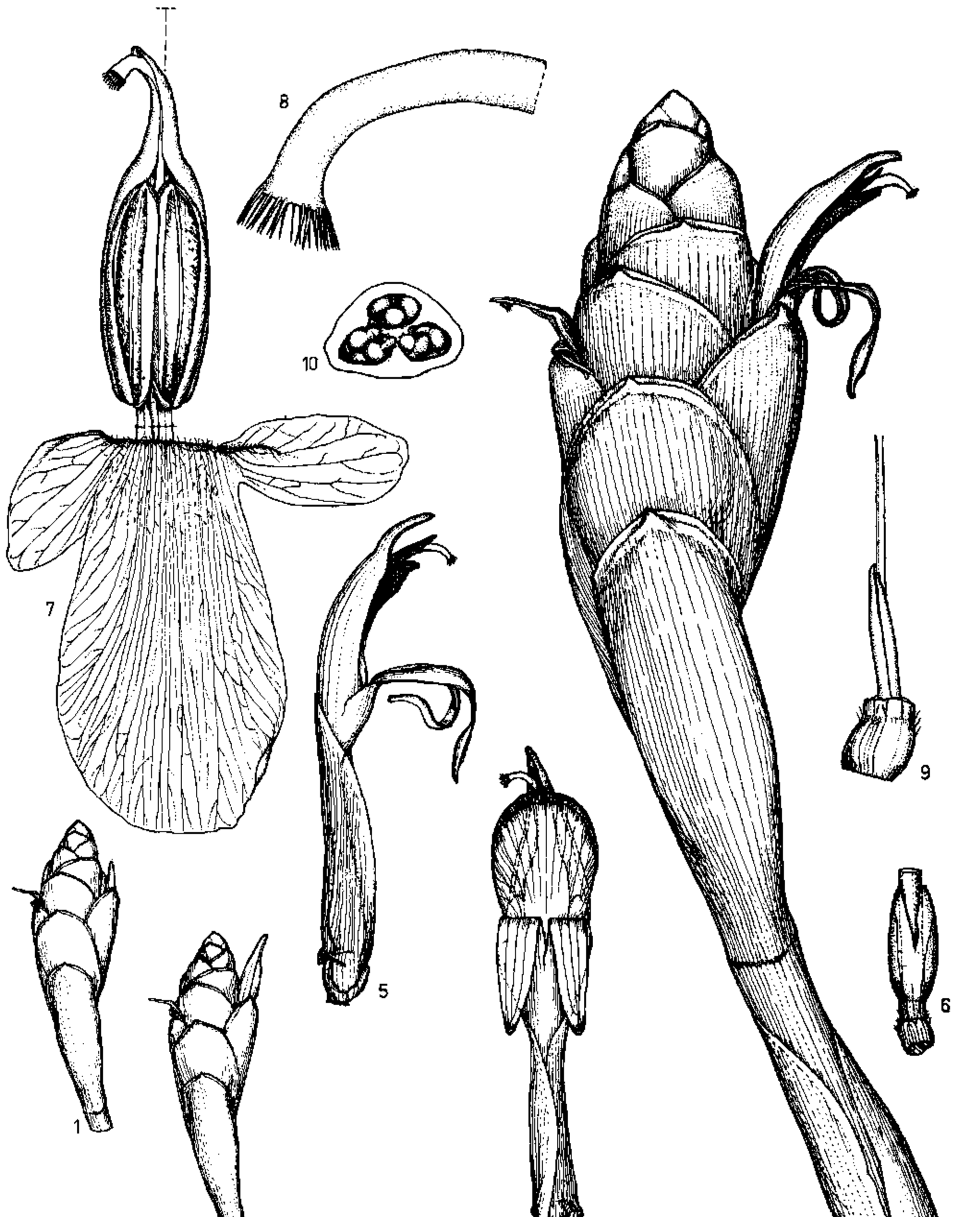


Fig. 14. *Zingiber officinale* Rosc. – 1. inflorescence with flower bud ($\frac{2}{3}\times$); 2. inflorescence with flower bud ($\frac{2}{3}\times$); 3. inflorescence with two flowers (2×); 4. flower, front view (2×); 5. flower, side view (2×); 6. calyx (2×); 7. androecium with recurved labellum (4×); 8. part of style with stigma (16×); 9. style base with two nectaria (4×); 10. cross-section ovary (8×). – 1–10. PJ 7287 (from Bos 8381; living plant and spirit mat.)

ginger production tends to produce a distinctive type, but the differences are influenced by soil, climate, method of culture and method of preparation. Clones may differ in fibre content, in yield and in colour.

(3) The description is based on the following specimens:

Hararge	Alemaya market: PJ 1170, PJ 5903; Dire Dawa market: Bos 8355, Bos 8381, PJ 1039; Harar market: Bos 8045.
Illubabor	Gambella market: PJ 5102.
Kefa	Bonga market: PJ 2203–2204, PJ 5545; Jimma market: Bos 8634; Serbo market: WP 5519.
Sidamo	Adillo market: PJ 3668; Soddo market: WP 2942.
Shoa	Bako market: PJ 1211; Shashemene market: WP 1728.
Wollega	Ghimbie market: PJ 1176–1177; Nekemt market: PJ 1201.
Grown at Wageningen	WP 6768, PJ 7287.

At BM, FT, K, P, no herbarium specimens of ginger, originating from Ethiopia, were present.

Ecology

In general, ginger is cultivated in the tropics from sea-level up to 1500 m altitude, in areas with an annual rainfall of 1500 mm or more (with only a short dry season), and high temperatures for at least part of the year (Purseglove, 1972). In Ethiopia, ginger is often cultivated under suboptimal conditions, for instance at altitudes up to 2000 m, with rainfall often less than 1500 mm per year and at lower temperatures.

Husbandry

As ginger exhausts the soil, newly cleared land is often used for it. Otherwise large dressings of manure are necessary for good yields. A good tilth is required in order to obtain well shaped rhizomes.

Ginger is propagated by planting pieces of rhizome (ca 2.5–5 cm long), on which at least one good bud is present. The pieces are planted ca 5–10 cm deep and ca 25–30 × 15–25 cm apart. To plant 1 ha, ca 850–1700 kg of parts are needed. If the soil can become too wet, ginger is usually planted on ridges. After ca 10 days, the first shoots appear and growth continues for ca 9–10 months. The plants withstand light shade (pigeon peas or castor in India; yams in Jamaica). The water supply is crucial and irrigation may be used if rainfall is too low. In Kerala (India) farmers apply cattle manure 25–30 tons/ha or apply compost at planting and N 36, P 16 and K 66 kg/ha. The crop is often mulched. When the leaves start turning yellow and the stems stop growing, the crop can be harvested, usually by hand.

For the manufacture of preserved ginger, the rhizomes are harvested before they are fully mature. Yields vary, for green ginger up to 38 tons per ha. Dried ginger represents ca 20–30% of the weight of green ginger. In the production of dried ginger, the rhizomes are cleaned of dirt and of roots, and are washed in water. If the epidermis of the rhizome is scraped off or peeled, the product is called 'uncoated' ginger; if left, the ginger is called 'coated'. After drying for 5–6 days in the sun, the product is ready for the market.

Photograph 22. *Zingiber officinale*, flowering plant, PJ 7287.

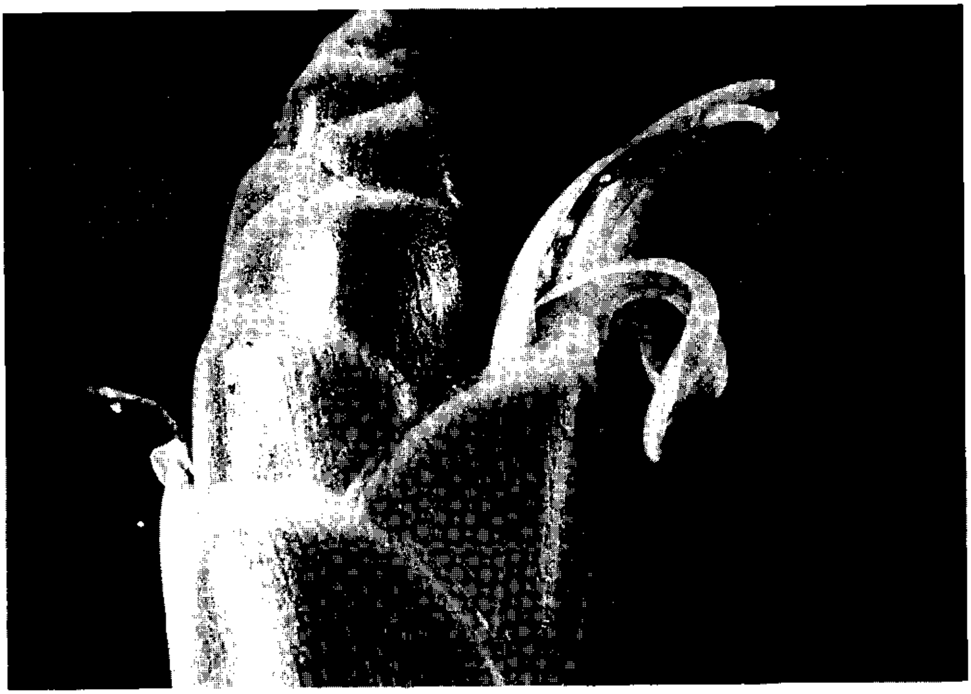
The main diseases of ginger are leafspot, soft rot and black rot of the rhizomes. The sets should be treated with a fungicide before planting. Pests of ginger are root-knot nematodes and shoot-borers (Purseglove, 1972).

According to Baldrati (1950), the Wollamo people in Ethiopia plant ginger in carefully prepared holes, which are filled with a mixture of soil and pulverized wood-ash. Ginger is sometimes grown as a perennial crop in Ethiopia. The Gumuz people in Ethiopia usually grow ginger on newly cleared land and the crop is tended by women (Kuls, 1962). According to Baldrati (1946, 1950) Ethiopia exports some fresh (green) ginger to Egypt, Saudi Arabia and Yemen, and imports dried ginger from India, as the Ethiopians do not know well how to process fresh ginger in order to obtain a good dried product. In his opinion, the fresh Ethiopian ginger is a good product with a nice colour and quality, which can be stored quite long.

Uses

1. Culinary uses

Ginger can be used as a flavouring in the preparation of a lot of foods and beverages (gingerbread, biscuits, cakes, puddings, soups and pickles, ginger beer, ginger wine, etc.). It is often an ingredient of curry powder. For the preparation of confections (candied ginger, crystallized ginger, preserved ginger), fresh green rhizomes are cleaned, peeled, shaped, boiled, and preserved in sugar solutions.



Photograph 23. *Zingiber officinale*, detail of photograph 22.

The essential oil of the rhizome is used in the manufacture of flavouring essences and in perfumery. An oleoresin (with the pungent principle) is used for flavouring (Purseglove, 1972).

In Ethiopia, ginger is a popular spice and is used, together with other spices, as a food spice in 'wots'. The fresh ginger is washed and scraped, chopped into small pieces, pounded to a pulp and used either immediately or after drying. Dried ginger has the same use. Ginger is also an ingredient of the mixture from which local alcoholic drinks are prepared and some people use it to flavour their tea (Ketema, 1962; Telahun, 1962; Siegenthaler, 1963).

2. Medicinal uses

In general, ginger is used internally as a stimulatory carminative, externally as a rubefacient and counter-irritant (Purseglove, 1972).

In Ethiopia, the following medicinal uses are reported:

- The fresh rhizome is chewed to cure an infected uvula (Siegenthaler, 1963).
- As a powder in tea, it is considered to be a medicine against colds (Amare, 1976).
- Chewing of ginger, sometimes with seeds of *Lepidium sativum*, is believed to relieve stomach aches (Amare, 1976).
- Ginger is used internally in treatments against fever and influenza (Amare, 1976).

For South and East Africa, Watt & Breyer-Brandwijk (1962) reported the following uses:

- A paste is applied to the head against headache.
- As a powder together with cloves, it is moistened and rubbed over the body for the relief of rheumatism.
- It is used against coughs.
- The Yar, Ndonde and Makonde people mix the pounded rhizome with fresh leaves of *Cajanus cajan* and with sesame oil, as a wound dressing.
- In Tanzania, ground ginger is used as a galactogogue.
- Eating of ginger is supposed to give the body an odour that repels mosquitoes.
- Large doses of zingerone (the pungent principle) can cause paralysis.

For West Africa, Dalziel (1955) reported the following uses:

- Ginger is chiefly used for catarrh, rheumatic pains, toothache and neuralgia.
- It is believed to delay the action of poison.
- People drink a decoction as a tonic and as a stomachic.
- It is used against fevers and to relieve thirst.
- Drops of the juice extracted by warming over a fire are used against eye diseases.
- Pounded and warmed leaves are applied as a poultice to bruises.

Chemical composition

Dried ginger has a moisture content of ca 10%. The rhizomes contain a volatile oil (ca 1–3%), of which the chief component is zingiberene. Zingerone is the pungent principle, present in the oleoresin (Purseglove, 1972).

For fresh ginger from Ethiopia, the following data are reported by Agren & Gibson (1968):

moisture (g/kg)	722–854
crude protein (g/kg)	24–42
fat (g/kg)	5–11
carbohydrate (g/kg)	207–223
fibre (g/kg)	13–19
ash (g/kg)	9–17
nitrogen (g/kg)	4–6
calcium (mg/kg)	270–430
phosphorus (mg/kg)	470
iron (mg/kg)	33–283
β-carotene equivalent (μg/kg)	2000
thiamin (mg/kg)	0.3–0.7
riboflavin (mg/kg)	0.1–11
niacin (mg/kg)	5–17
ascorbic acid (mg/kg)	10–50

3 Medicinal plants in Ethiopia

Amare (1976) estimated that more than 85% of the Ethiopian population are not reached by modern medicine and rely on traditional medicine, which is based on curative plants. Small wonder that Ethiopia still has a rich medical plant lore! It is amazing indeed to discover, while working in this field, that almost all plants of the Ethiopian flora are used somewhere somehow medicinally.

The knowledge of the medicinal properties of plants in Ethiopia has been passed down orally from one generation to the next by priests ('debteras', witch-doctors or medicine-men, 'wogeshas') and the folk medicines by the population. Old medical treatises of Ethiopian scribes exist too. The study of those old manuscripts (often written in 'Geez', the language of the Ethiopian Coptic Church) is far from completed. Moreover, traditional data on medicines and diseases are fragmentary and interwoven with many superstitious stories and prescriptions (Griaule, 1930; Strelcyn, 1968; Tsehai, 1971). Nevertheless those medical treatises may improve our knowledge of Ethiopian medicinal plants. A major problem in those writings is that usually only vernacular names are used to indicate plants. New collections of plants (stored in well kept herbaria) and new information will be necessary to be sure which plants are meant by the vernacular names. Often vernacular names are used for more than one species. The medicinal properties described in the old manuscripts seem to be closely related to ancient Greco-Arabian medicine. Yet, most remedies described concern indigenous Ethiopian plants.

The traditional local doctors in Ethiopia would be the best source of information about medicinal plants. Many practising local doctors are still present in Ethiopia but, with the progress of modern medicine, the influence and the number of those doctors will decrease rapidly. Their knowledge will be lost if it is not recorded. It is, however, very difficult to obtain information from local doctors. They consider their knowledge as a professional secret that is only entrusted to their successor in the job (usually the oldest son). The latter has to swear to keep the knowledge secret and to pass it only to his own successor. Examinations of the prescribed medicines of the local doctors usually will not reveal the curing plant. Often only roots or woody parts or plant powders are applied. According to Amare (1976), they may also provide a long list of plants to be used, of which only one is the real medicine. This recalls the highly complex recipes for the medicines (simplicia) in Mediaeval Europe.

Besides this professional knowledge, the local population is also a source of information about traditional folk medicine. It is from this last source that I obtained most of my information. Local medicines are sold on most markets and the vendors are more willing to tell what disease their medicines should be used for. Country folk are also willing to tell what they know about medicinal plants. Often they grow some medicinal plants in their garden or field, or they will show where it can be found in the wild.

The number of plants used in Ethiopia is so large that it was difficult to select a few for detailed treatment. I wanted to combine the most used, best known and widest distributed medicinal plants. The following 13 species were chosen (with plant family, Amarinia name and part used):

(1) *Adhatoda schimperiana* (Hochst.) Nees, *Acanthaceae,* 'sensel'; part used: all parts;

(2) *Brucea antidysenterica* J. F. Mill., *Simaroubaceae,* 'wooginos'; part used: all parts;

(3) *Calpurnia aurea* (Ait.) Benth., *Papilionaceae,* 'digita'; part used: all parts;

(4) *Catha edulis* (Vahl) Endl., *Celastraceae,* 'chat', part used: fresh shoots;

(5) *Cordia africana* Lam., *Boraginaceae,* 'wanza'; part used: all parts;

(6) *Croton macrostachyus* Hochst., *Euphorbiaceae,* 'bissana'; part used: all parts;

(7) *Embelia schimperi* Vatke, *Myrsinaceae,* 'enkoko'; part used: fruits;

(8) *Hagenia abyssinica* (Bruce) Gmelin, *Rosaceae,* 'kosso'; part used: inflorescence;

(9) *Juniperus procera* Hochst., *Cupressaceae,* 'ted'; part used: all parts;

(10) *Lepidium sativum* L., *Cruciferae,* 'feto'; part used: seeds;

(11) *Myrsine africana* L., *Myrsinaceae,* 'kachamo'; part used: all parts;

(12) *Phytolacca dodecandra* L'Hér., *Phytolaccaceae,* 'endod'; part used: all parts;

(13) *Tamarindus indica* L., *Caesalpiniaceae,* 'hamar'; part used; all parts.

Some other Ethiopian medicinal plants are listed in Chapter 4.

Two species of the plants treated in detail are cultivated in Ethiopia: *Catha edulis* and *Lepidium sativum. Catha* is primarily a stimulant. It is one of the major products of Ethiopian agriculture in terms of cultivated area, production, consumption and export. It is the famous 'chat' plant of East Africa.

Lepidium is cultivated to a lesser extent. Both species are listed by Vavilov (1951) as forming primary gene centres in Ethiopia. This study does not confirm Vavilov's statement. Vavilov's designation of Ethiopia as an important gene centre might apply to only a small number of species. A study of Vavilov's field data and his herbarium collections seems desirable.

The other treated species all grow in the wild and are common in most provinces of Ethiopia.

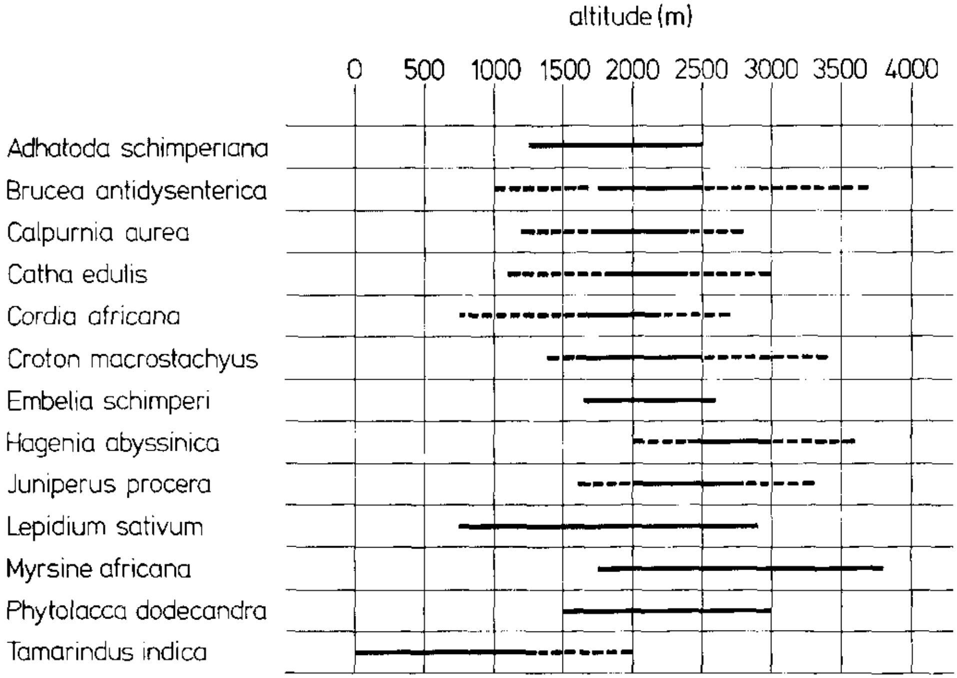
Phytolacca, however, was recently brought into experimental cultivation. It seems that Ethiopia might be a centre of diversity for this species.

The altitudinal range of the 13 treated medicinal plants is given in Table 7.

All the treated species have a wider distribution than Ethiopia alone. *Adhatoda, Brucea, Embelia, Hagenia* and *Juniperus* are restricted to eastern or central and southern Africa; *Croton* and *Phytolacca* occur also in west Africa; *Calpurnia, Catha, Cordia, Myrsine, Tamarindus* and *Lepidium* occur also in other parts of the world.

Medicinal plants are often grouped according to their medicinal activity. Here this is not considered as useful as most species are used against many diseases. The recorded uses could not be checked. Most of the records originate from several sources. The Ethiopian uses are linked with herbarium specimens, collected on the spot where the information was obtained.

Table 7. Altitudinal range of 13 Ethiopian medicinal plants.



It may be noted that *Embelia, Hagenia* and *Myrsine* are typical Ethiopian anthelmintics and that *Phytolacca* has attracted interest because of its significance in the struggle against bilharzia.

For *Catha,* separate markets exist in the production areas of Ethiopia. *Embelia, Hagenia, Lepidium, Myrsine* and *Phytolacca* can always be found on Ethiopian markets. *Tamarindus* fruits are sometimes present on markets, the other species rarely.

3.1 Adhatoda schimperiana (Hochst.) Nees — Fig. 15

'*Adhatoda*': latinization of 'adhatodai', a local plant name on Ceylon.
'*schimperiana*': after W. Schimper (1804–1879), a famous traveller and plant collector in Ethiopia from 1837 on.

Nees ab Esenbeck, Chr. G., in: DC, Prodr. 11: p.388 (1847).
Type: 'In vallibus apricis prope Adoam'. 'Frutex'. Schimperi iter Abyssinicum collection, sectio prima, plantae Adoënses: No 27 (1-12-1837) (K, specimen ex herb. Hookerianum, lecto.!).

Synonyms

Gendarussa schimperiana Hochst., label Schimperi iter Abyss. coll., sectio 1: No 27 (1840) (basionym).
Justicia schimperiana (Nees in DC) Anderson, Journ. Linn. Soc. (Bot.) 7: p. 38 (1864).

Literature

1851: Richard, Tent. fl. Abyss. 2: p. 155. (tax.)
1895: Lindau, *Acanthaceae,* in, Engler & Prantl, Die nat. Pflanzenfam., ed. 1, 4, 3B: p. 349. (tax.)
1900: Clarke, *Acanthaceae,* in, Flora trop. Afr. 5: p. 221–222. (tax.)
1911: Fiori, Boschi e piante legnose dell'Eritrea, Agricolt. Colon. 5: p. 131. (tax.)
1937: Chiovenda, La collezione bot. E. Taschdjian, Malpighia 34: p. 515. (tax.)
1946: Baldrati, Piante officinali dell'Africa orientale, Centro Studi Colon. 32: p. 11–12. (use)
1960: Lemordant, Les plantes éthiopiennes: p. 44. (use)
1963: Siegenthaler, Useful plants of Ethiopia, Exp. Stn. Bull. 14: p. 16. (use)
1964: Cufodontis, Enumeratio, Bull. Jard. Bot. État Brux. 34(4), suppl.: p. 977. (tax.)
1965: Cufodontis, Beitrag zur Flora von Godjam 2, Senck. Biol. 46(2): p. 117. (tax.)
1972: Sebald, Beitrag zur Floristiek Äthiopiens 3, Stuttg. Beitr. Naturk. 244: p. 32. (tax.)
1976: Amare Getahun, Some common medicinal and poisonous plants used in Ethiopian folk medicine: p. 8. (use)
1976: Kokwaro, Medicinal plants East Africa: p. 12. (use)

Local names: sensel, sansal, sensal, selsel, senselet, samizza, simiza, timisa (Amarinia); sameggia, semmassa, schimesa, soda, shimfa (Tigrinia); dumoga, tumoga (Gallinia, Kaffa); dumuga, gemuga (Kottu, Hararge).
Trade names: unknown. For other *Adhatoda* species, Miller (1754) used the name 'Malabar nut'.

Geographic distribution

Adhatoda schimperiana is common in the highlands of Ethiopia, usually at ca 2000 m alt. It can be found in all provinces (Clarke, 1900; Cufodontis, 1964; Herb. WAG).

The shrub is also reported from Kenya and Tanzania (Clarke, 1900; Cufodontis, 1964). Most probably it occurs also in other countries of east Africa.

Description

An erect shrub, up to 5 m high, usually much-branched from base, as a fence forming an impenetrable evergreen natural barrier.

Stem: branches woody, subterete, up to 1.5 cm thick, usually pale-grey, glabrous to finely pubescent; twigs usually inflated above the nodes (constricted in dried specimens), dark-green to light-brown, usually densely puberulous; in dried specimens a thin, small, slightly protruding ring usually connects two opposite petioles.

Leaves herbaceous, decussate, petiolate, estipulate, simple; petiole canaliculate, up to 3(–5) cm long, green, usually densely puberulous; blade subelliptic to oblong-ovate, up to 23 × 12 cm, base usually attenuate, seldom subobtuse, acuminate at top, margin entire; the upperside usually dull dark-green with brownish, pinnately arranged lateral nerves, glabrous to (sub)puberulous, sometimes mainly so on the midrib; the underside usually pale to greyish green with prominent yellowish lateral nerves, subglabrous to rather densely puberulous; cystoliths present, sometimes clearly visible as white or brown dots and lines on both sides.

Inflorescences thyrsoid, with densely flowered spikes up to 20 × 2–4 cm, terminating main axis and branches; peduncle up to 1 cm long (measured from last two, usually small leaves, to the first bract of the spike); peduncle and rhachis usually subangular, light-green to brown-green, usually densely pubescent; flowers decussate, subsessile, pedicel ca 0.5 mm long, subtended by a bract and two bracteoles; bracts imbricate, covering the bracteoles and the flower bud totally, deltoid to orbicular, ca 13–19 × 13–18 mm, acuminate to aristate, entire, puberulous both sides, usually shortly stipitate, with an ovate-acuminate light-green central part, surrounded by a scarious white to very pale-green band ca 2–5 mm wide; bracteoles lateral, one on each side of the flower, strongly curved over the bud, suborbicular to elliptic, ca 13–18 × 10–14 mm, sessile, like the bracts in other characteristics; bracts and bracteoles persistent in fruit.

Calyx campanulate with short tube and 5 long lobes, light-green, finely pubescent outside, ca glabrous inside, persistent in fruit; tube obconical, ca 2–3 mm long; lobes narrowly triangular to narrowly ovate; posterior lobe usually the largest, ca 8–11 × 3–5 mm; the other lobes almost equal, ca 6–10 × 2 mm.

Corolla bilabiate, up to 3.5 cm long, white to creamy-white, finely pubescent outside, caducous; tube ca obconical, ca 10–12 mm long, 4–5 mm diam.; anterior lip spreading to reflexed, ca narrowly ovate in outline, 15–21 × 10–16 mm, ending into 3 ovate, obtuse lobes, the central one suborbicular, 3–4.5 mm diam., the 2 lateral ones suborbicular, 2–4.5 mm diam., glabrous inside, with ca 4 pairs of pinnately arranged prominent ridges (folds) at base; posterior lip suberect, elliptic to narrowly ovate, 18–23 × 8–12 mm, apex obtuse, usually shallowly (0.5–1 mm) notched; inside the corolla is folded on the posterior side and forms a prominent densely hairy ridge, in the furrow of which the pistil is situated; throat 'closed' by two prominent hairy ridged hook-like folds at the base of the posterior lip.

Androecium: stamens 2, inserted in the corolla tube slightly below the throat, ca 7–9 mm from the corolla base, one at each side of the anterior lip; filaments subfiliform, 12–21 mm long, slightly puberulous at base, white; in the corolla tube, the filaments continue for ca 3–7 mm towards the base (adnate to the corolla) and are there densely hairy; anthers with 2 thecae, situated at different height, slightly curved, acute-ellipsoid, yellow to brown-green or greyish-purplish, ca 3–4 ×1 mm, dehiscing by a longitudinal slit; the upper theca usually totally adnate to the connective at one side, the lower one (situated ca 1–2 mm lower) with free basal part usually with a very short obtuse thin tubular outgrowth (sometimes also present in the upper one).

Gynoecium: gynophore subcylindrical, ca 1–2 mm long and wide, but widening at top, glabrous; disc fleshy, obconical, 1–1.5 mm long, 1.5–2.5 mm diam., surrounding the base of the ovary; ovary ellipsoid, flattened, ca 3.5–5 × 2–2.5 × 1–1.5 mm, densely white woolly, 2-locular, with usually 2 ovules per locule; style filiform, 22–30 mm long, white, woolly hairy, glabrous at top; stigma capitate, hemispherical in outline, 2-lobed; lobes less than 1 mm long, usually slightly unequal in length, glabrous, white.

Fruit a capsule, clavate, 18–26 mm long, 3–6.5 mm thick, stipitate, top acute, usually densely puberulous, light-brown at maturity, dehiscing luculicidally, usually 4-seeded; funiculus provided with a hook-like, stiff, curved retinacula ca 3.5–4 mm long; inside glabrous, rarely with a sparsely hairy septum.

Seed ca flat-discoid, 3–4 × 2.5–4.5 × 0.5–1.3 mm, usually with two shallow wide

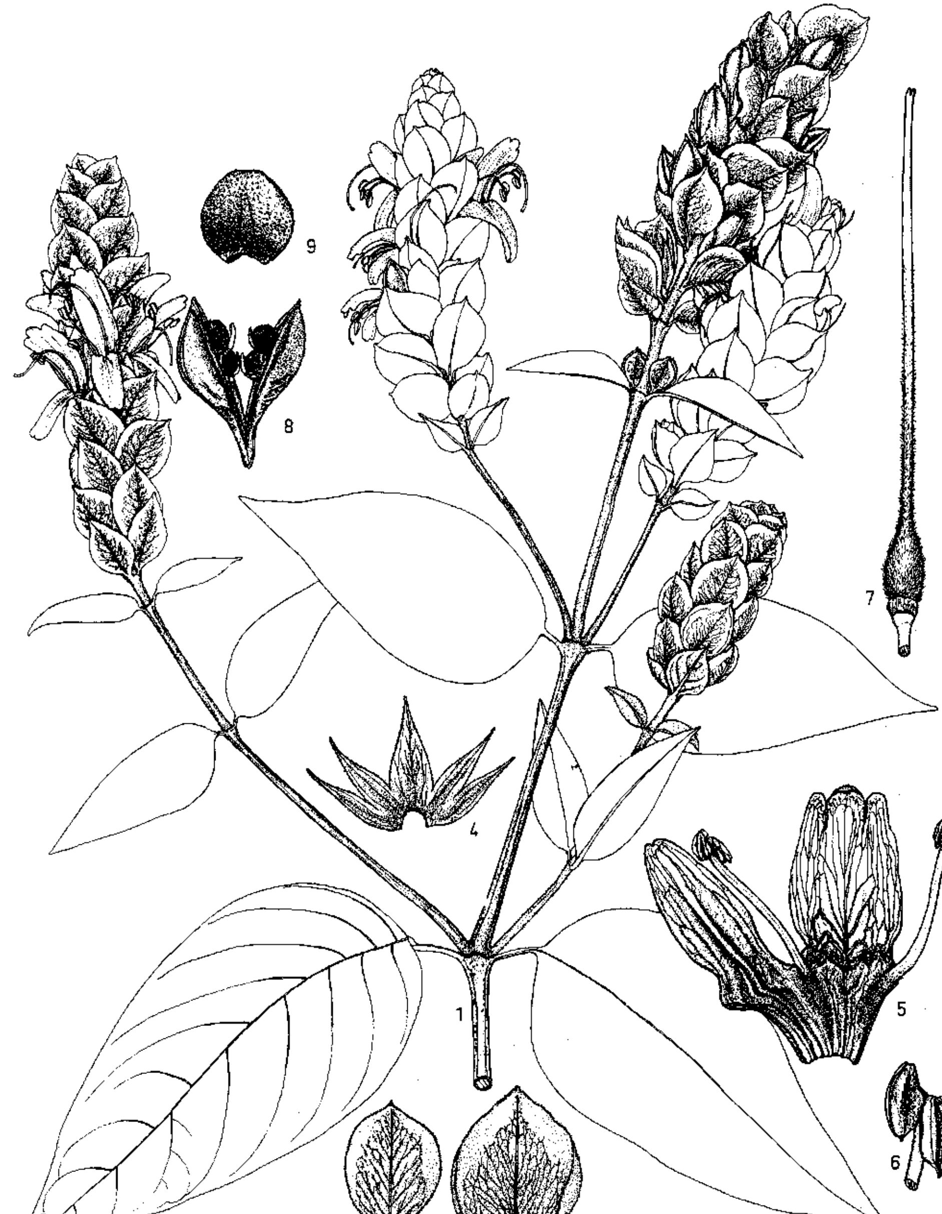


Fig. 15. *Adhatoda schimperiana* (Hochst.) Nees. – 1. habit flowering branch ($\frac{2}{3}\times$); 2. bract ($1\frac{1}{3}\times$); 3. bracteole ($1\frac{1}{3}\times$); 4. opened calyx ($1\frac{1}{3}\times$); 5. opened corolla with stamens ($1\frac{1}{3}\times$); 6. filament part with anther ($2\frac{2}{3}\times$); 7. pistil ($2\frac{2}{3}\times$); 8. open fruit ($1\frac{1}{3}\times$); 9. seed ($2\frac{2}{3}\times$). – 1. J. J. F. E. de Wilde 4243 and W. de Wilde c.s. 8952; 2–7. SL 2858; 8–9. J. J. F. E. de Wilde 4243.

grooves on one side; testa thin, light-brown, densely finely rugose; embryo white, with 2 flat subfleshy suborbicular cotyledons and a curved cylindrical radicle; endosperm absent.

Note

Specimen W. de Wilde et al. 9227 bears, abnormal, as well as normal flowers: calyx sometimes 6-lobed; corolla-lips sometimes with a much deeper parted lobe at top; sometimes 4 stamens (2 normal ones and 2 at base of posterior lobe, with anther-thecae at almost equal height); stigma sometimes 3-lobed; ovary sometimes with 6 ovules.

Taxonomic notes

(1) Hochstetter (1840) published the name: '*Gendarussa (Adhatoda) schimperiana* Hochst. on a printed label of the 'Schimperi iter Abyssinicum' collection, 'sectio prima: plantae Adoënsis: 27'. On the label is added: 'nomen Abyssinicum: semmassa. In vallibus apricis prope Adoam. Frutex. d. 1. Dec. 1837'. As the word 'frutex' is added, this name has been validly published (description, Art. 32 of the Code). Although Hochstetter added *(Adhatoda)* after '*Gendarussa*', he certainly was of the opinion that the correct name for the species was '*Gendarussa schimperiana*', as he also in 1841 published this name only in Flora, Intell. 24, in a list of available Schimper plants. In 1847 Nees ab Esenbeck published the name '*Adhatoda schimperiana*' and referred to Schimperi iter Abyss., Sect. 1, No 27, Sect. 3, No 1549 and to Quartin-Dillon 471. He mentioned Hochstetter's name in synonymy. Nees himself (in Wallich, 1832) is the author of the genus '*Gendarussa*' and he transferred '*Gendarussa schimperiana* Hochst.' to the genus *Adhatoda* Mill. If Nees' opinion is followed (as is done here), the correct name for the species is *Adhatoda schimperiana* (Hochst.) Nees.

(2) Nees (1847) stated that he had seen the cited Schimper specimens from Hooker's herbarium and from his own (?DC) herbarium ('v. in h. Hook., un. iten. et propr.').

Although Nees (1847) referred to 'Schimp. it. Abyss., Sectio 3, No 1549' (published 1844) emphatically in the protologue of '*Adhatoda schimperiana*', Hochstetter's basionym had been published earlier on the label of 'Schimp. it. Abyss., Sectio 1, No 27' in 1840. I designate as lectotype of *Adhatoda schimperiana* (Hochst.) Nees, specimen 'Schimperi iter Abyssinicum, Sectio prima, No 27', ex herb. Hookerianum, present at Kew. I prefer this specimen, as the isotype present in DC herbarium (G) bears also the label 'Schimp. it. Abyss., Sectio 3, No 1549' besides the label 'Schimp. it. Abyss., Sectio 1, No 27'.

(3) The Acanthaceous genera *Justicia* L., *Adhatoda* Mill., *Gendarussa* Nees, *Duvernoia* E. Mey. ex Nees, and perhaps also *Rungia* Nees, are very close and are separated by characteristics that are hardly distinctive. In the literature, there is much confusion about these genera and complete revision is necessary.

(4) The description is based on the following specimens:

Arussi Asella, alt. 2300 m, 7-12-1965: W. de Wilde c.s. 9227 (see note description).
Hararge Road Alemaya-Gara Mulatta, 14 km from Adele, 10-7-1975, alt. 1870 m: PJ 2074; College of Agriculture, Alemaya, alt. 1980 m, 5-4-1974: Bos 7603; Around College

of Agriculture, Alemaya, alt. 2000 m, 15-4-1976: PJ 5999; Around College of Agriculture, Bati, alt. 2000 m, 31-8-1976: PJ 7054; Dacata Valley, 40 km S of Harar-Jijiga road, alt. 1270 m, 5-10-1974: Bos 9034; About 1 km on road Harar-Jijiga, 9°17'N × 42°08' E, alt. 1900 m, 18-12-1968: J. J. F. E. de Wilde 4243; 1½ km on road to Kombolcha from entrance of Alemaya College, alt. 2011 m, 5-7-1967: WP 412; 4 km from Langie to Kulubi, alt. 2050 m, 2-11-1972: SL 2858; Rock valley, between Erer and Dakata valley, along the Harar-Jijiga road, alt. 1500 m, 1-6-1974: Bos 7859.

Kefa — Bonga area, Geetsha river, about 2 hours walking distance in SW direction from the small village Wush-Wush, about 14 km along the new road from Bonga to Mizan Tefari, 7°12'N × 36°06'E, alt. 2200 m, 26-1-1970: J. J. F. E. de Wilde 6281; 35 km N of Jimma along Cossa road, 7°53'N × 36°42'E, alt. 2000 m, 29-11-1970: I. Friis, A. Hounde & K. Jacobsen 526.

Shoa — Addis Ababa near University college, alt. 2300 m, 13-12-1965: W. de Wilde c.s. 9243; Addis Ababa, hedgerow in suburb, alt. 2400 m, 15-5-1966: W. de Wilde c.s. 10990; About 10 km W of Ambo, near Guder, alt. 1800 m, 16-11-1965: W. de Wilde c.s. 8952; Debre Zeit, Ilca experimental field station on the slopes facing the crater-lake, alt. 1700–1800 m, 15-10-1976: L. Boulos 9938; About 30 km W of Addis Ababa, Menagesha state forest, alt. 2500 m, 10-4-1965: W. de Wilde c.s. 6190; Near Menghasha village, 28-10-1961: C. C. Albers 4115 (ETH).

Sidamo — About 20 km S of Shashemene, alt. 2100 m, 22-10-1965: W. de Wilde c.s. 8534.

The following specimens, originating from Ethiopia, were seen: Abyssinia, Harar s.n., s.n. (P); C. C. Albers 61/15 (K); J. W. Ash 91 (K), 245 (K); I. Baldrati 4789 (FT), 4896 (FT); P. R. O. Bally B3045 (K); E. Beals & M. Prosser B11 (K); A. Bellini 29 (FT); P. Benedetto 293 (FT); A. de Benedictus 258 (FT); W. Burger 3576 (ACD, K); G. Dainelli & O. Marinelli 61 (FT); I. Friis c.s. 526 (K), 2002 (K); A. Fiori 140 (FT), 741 (FT); M. G. Gilbert & Getachew Aweke 2891 (K); J. B. Gillett 4594 (FT), 5057 (FT, K), 14832 (K); J. M. Hildebrandt 457 (BM), 2341 (BM, P); R. G. Hillier 941 (BM, K); Kebede Koomsa A-55 (K); Mana 585 (FT); Mattu 302 (FT); F. G. Meyer 7500 (K), 7828a (FT, K), 7999 (K); Milizia forestale 173 (FT); H. F. Mooney 5103 (K), 5332 (FT, K), 6054 (K), 6669 (FT, K); G. Negri 121 (FT); A. Pappi 1491 (FT), 2683 (FT), 3577 (FT), 3878 (FT), 5189 (FT), 7913 (FT); R. E. Perdue 6344 (K); R. Pichi-Sermolli 1499–1503 (FT), 1504 (FT, K), 1505–1512 (FT); Quartin-Dillon et Petit 47 (P), s.n. (herb. A. de Franqueville 292) (K, P), s.n. (Hica, 21-10-1839) (P), s.n. (dernier envoi 1844) (P); Rochet d'Hericourt 123 (P), s.n. (royaume de Choa) (P); Rousseau s.n. (L); Russel s.n. (P), 298 (P); D. Saccardo 39 (FT); Salt s.n. (BM); Schimperi iter Abyss. 27 (BM, FI, K (ex herb. Hook., lectotype), L, P), 930 (K, L, P), 1549 (BM, FI, K, L, P); Schimper 458 (18-11-1842) (FT), 702 (BM), 888 (7-10-1852) (P); W. Schimper, pl. Abyss. 185 (P), Hohenack. 1852 (P); G. Schweinfurth & D. Riva 741 (FT, K), 1067 (P); H. Scott 298 (BM, FT, K); L. Senni 43 (FT); R. B. Stewart B34 (ACD, K); E. Taschdjian 831 (FT); A. Terracciano & A. Pappi 826 (FT), 828 (FT), 898 (FT); A. C. B. Thomerson 828 (K); A. Vatova 479 (FT), 1057 (FT); W. de Wilde c.s. 8952 (K), 9227 (K), 10990 (K).

Ecology

In Ethiopia, the shrub can most often be found in fences around houses and cultivated fields, where it has usually been planted. In the wild, the plant grows at altitudes of 1250–2500 m, on mountain slopes, along roadsides, along rivers, in forests and forest edges.

The plant can be found in flower and fruit all the year round, most abundantly so in the dry period from October till January (Fiori, 1911; Chiovenda, 1937; Cufodontis, 1965; Sebald, 1972; Herb. WAG).

Photograph 24. *Adhatoda schimperiana*, flowering plant near Ambo.

Husbandry

The plant is an excellent fence plant, forming a natural barrier around compounds of houses, and is mainly cultivated for this purpose.

It can be propagated by seed or cutting. In Ethiopia, it does not seem to be cultivated widely for medicinal purposes.

Uses

1. Medicinal uses

The following medicinal uses of *A. schimperiana* have been reported from or observed in Ethiopia:

Photograph 25. *Adhatoda schimperiana,* detail of photograph 24.

– The leaves are used as a medicine in the treatment of malaria. Fresh leaves are crushed and boiled in water. Sugar is sometimes added. One cup a day is taken for three subsequent days. It is recommended to drink good 'talla' (a local beer) after each cup of the medicine. If the patient becomes weak from the medicine, he should eat very well (Siegenthaler, 1963).
– All plant parts are used in a treatment of excessive pellagra, a disease characterized by loss of strength, digestive disturbances, reddening, drying and peeling of the skin (Amare, 1976).
– Sap of the plant is used as a laxative (Amare, 1976; Kokwaro, 1976).
– A visitor to sick people takes the leaves as protection (Lemordant, 1960).
– Smoke of the plant is believed to invigorate the body and is used for instance

against coughs (Baldrati, 1946); it is also believed that smoke protects against contagious diseases of animals (label Schimper 702, BM).

Kokwaro (1976) reported that the roots are used elsewhere to treat headache. Lemordant (1960) reported that smoke of the leaves is used against asthma, and sap of the leaves as an expectorant.

2. Miscellaneous uses

The following uses are reported from Ethiopia:
- The plant is popular as a hedge around compounds; besides its protective value, the shrub has ornamental value (Siegenthaler, 1963; and many other authors).
- The stems are used for building walls of houses (Siegenthaler, 1963).
- The roots are used to fortify local alcoholic drinks (Baldrati, 1946; Lemordant, 1960).
- Twigs are used as tooth-brush (label Scott 298, K).
- The plant is a very good honey-producer (Baldrati, 1946).
- According to Lemordant (1960), students write the name of God on the leaf and eat it in order to study better and to become wise.

According to Baldrati (1946), an *Adhatoda* sp. is used as a natural fertilizer (rich in nitrates) and as a source of potash in India. He stated that the plant has insecticidal and algicidal properties in rice fields.

Chemical composition

No data traced.

3.2 Brucea antidysenterica J. F. Miller **Fig. 16**

'*Brucea*': named after James Bruce (1730–1794), a Scottish traveller in Ethiopia in the years 1768–1773, who brought seeds of this plant to Europe.
'*antidysenterica*': derived from the Greek 'anti' = 'against', and 'dusenteria' = 'bad bowels'; so, active against e.g. dysentery.

J. F. Miller, Icones Animalium et Plantarum: Plate 25 (1779 or 1780).
Type: 'Habitat in Africa'. J. F. Miller, Icones Animalium et Plantarum: Plate 25 (holo., copy at BM !).

Synonyms

Brucea ferruginea L'Hér., Stirp. Nov.: p. 19–20, t. 10 (1794).
Brucea abyssinica Spreng., Purgill. 2: p. 90 (1815).
Brucea erythraeae Chiov., Ann. Bot. Roma 10: p. 384 (1912).

Literature

1785: Lamarck, Encycl. 1(2): p. 471–472. (tax.)
1790: Bruce, Trav. 5, app.: p. 69–73. (use)
1791: L'Héritier, Stirpes nov.: p. 19–20, t. 10 (tax.)
1825: De Candolle, Prodr. 2: p. 88 (tax.)

1847: Richard, Tent. fl. Abyss. 1: p. 128. (tax.)
1868: Oliver, in, Flora trop. Afr. 1: p. 309–310. (tax.)
1912: Chiovenda, Osservazioni botaniche, agrarie ed industriali, Monog. rapp. col. 24: p. 48–49. (bot. + use)
1912: Fiori, Boschi e pianti legnose dell'Eritrea, Agricol. Colon. 5, suppl.: p. 270–271. (tax.)
1912: Pergola de, La *Brucea antidysenterica* e le sue applicazioni, Monog. rapp. col. 18. (bot. + use)
1931: Engler, *Brucea,* in, Engler & Prantl, Die nat. Pflanzenfam., ed. 2, B. 19a: p. 386–387. (tax.)
1932: Chiovenda: La esplorazione dello Uabi-Uebi Scebeli: p. 394. (tax.)
1935: Lebrun, Essenc. forest. Congo orient.: p. 104–105. (tax.)
1937: Chiovenda, La collezione bot. E. Taschdjian, Malpighia 34: p. 491. (tax.)
1946: Baldrati, Piante officinali dell'Africa orientale, Centro Studi Colon. 32: p. 28–29. (use)
1951: Eggeling & Dale, Indig. trees Uganda, ed. 2: p. 408. (tax.)
1956: Cufodontis, Enumeratio, Bull. Jard. État Brux. 26(3), suppl.: p. 374–375. (tax.)
1957: Mensier, Dictionnaire des huiles végétales, Encycl. Biol. 52: p. 104. (chem.)
1958: Cufodontis, Syst. Bearb. Äthiop. ges. Pfl. 2, Senck. biol. 39: p. 306. (tax.)
1958: Gilbert, *Simaroubaceae,* in, Flore Congo Belge 7: p. 129–130. (tax.)
1960: Lemordant, Les plantes éthiopiennes: p. 53. (use)
1961: Dale & Greenway, Kenya trees & shrubs: p. 535. (tax.)
1962: Watt & Breyer-Brandwijk, Medicinal & poisonous plants S. & E. Afr., ed. 2: p. 940–941. (use)
1963: Breitenbach, Indigenous trees Ethiopia, ed. 2: p. 224–225. (tax.)
1963: Wild & Phipps, *Brucea,* in, Flora Zambesiaca 2(1): p. 212–214. (tax.)
1971: Lemordant, Contribution à l'ethnobotanique Ethiopienne, Journ. Agric. Trop. Bot. Appl. 18: p. 174. (use)
1976: Amare Getahun, Some common medicinal and poisonous plants used in Ethiopian folk medicine: p. 51–52. (use)
1976: Kokwaro, Medicinal plants East Afr.: p. 203. (use)
1978: Fresno et al., Bruceantin (isolated from *B. antidysenterica),* Biochim. Biophys. Acta 518(1): p. 104–112. (chem.)

Local names: kakero, killa-wanza, shoitanbuna, waginos, woinos, wooginos, (Amarinia); abalo, andur-guoila, dadatu, gata, gironta, guduba, gumanio, hambuhobo, hatawi, hatoytu, komanjo, komeni, tamicha, tamiggia, tollo (Gallinia); melita (Tigrinia); hadawi (Somalia); atanico, atavichu (Sidamo).
Trade names: none.

Geographic distribution

In Ethiopia, *B. antidysenterica* is a common shrub or treelet and grows in the wild in all provinces, usually at altitudes around 2000 m.

Outside Ethiopia the plant is reported from Angola, Burundi, Cameroon, Central African Republic, Congo, Kenya, Malawi, Mozambique, Nigeria, Ruanda, Sudan, Tanzania, Uganda, Zaire, Zambia, Zimbabwe (Cufodontis, 1956; Wild & Phipps, 1963).

Description

An evergreen dioecious, erect shrub or small tree, up to 7 m high.

Stem sparsely to richly branched from the base, (sub)terete, ca 5–15(–30) cm diam., dull grey to grey-brown, marked by the persistent heart-shaped leaf-scars, ca

Seed: ovoid, acute at apex; testa light-brown, with on one side near the base a large ovate red to dark-brown spot; embryo with large, fleshy, pale-yellow cotyledons and a small conical plumule, situated near the apex of the seed; endosperm absent.

Taxonomic notes

(1) According to Bruce (1790) this plant became known in Europe as follows: 'This shrub was not before known to botanists. I brought the seeds to Europe and it was grown in every garden, but has produced only flowers and never came to fruit. Sir Joseph Banks, president to the Royal Society, employed Mr. Miller to make a large drawing from this shrub as it had grown at Kew. The drawing was as elegant as could be wished and did the original great justice. To this piece of politeness Sir Joseph added another, of calling it after its discoverer's name: *Brucea antidysenterica*'.

According to Hepper (Journ. Soc. Bibliography Nat. Hist., 1980), Bruce had sent from Italy seeds of 'wooginos' (= *B. antidysenterica),* collected in Ethiopia at Sakalla or at Hor-Cacamoot in Ras el Feel (N of Debra Tzai), to Kew in 1773.

(2) If Bruce's statement is correct, Sir Joseph Banks supplied the name *Brucea antidysenterica.* J. F. Miller actually published the name and one might thus also cite the name as *Brucea antidysenterica* Banks ex J. F. Miller.

(3) According to Britten (Journ. Bot. 51: p. 255–257, 1913) Miller's Plate 25 was published in 1779. According to Stafleu (1967) in 1779 or 1780. Plate 25 of Miller, published in 'Icones Animalium et Plantarum' represents a printed drawing in colour of *B. antidysenterica* with a habit drawing (branch with 7 leaves and 3 inflorescences) and 13 drawings of details. The plate only bears the name '*Brucea*'. On the page before the drawing the specific epithet and an explanation of the figures are added ('Tabula XXV. Fig. 1. *Brucea antidysenterica.* LIN Sp. Pl. Classis XXII. Ordo IV. Spec. Habitat in Africa,' etc.).

The genus name *Brucea* is a 'nomen conservandum' and the genus is typified by *B. antidysenterica.* Both names (generic and specific) are supposed to be published by Miller's Plate 25. Plate 25 is also the holotype of the species *Brucea antidysenterica* J. F. Miller in the absence of relevant herbarium specimens.

(4) F. N. Hepper (pers. comm., 1979) kindly drew my attention to a herbarium specimen of *B. antidysenterica* in BM, with on the back of its sheet the written information: 'Hort. Kew. sem. ex Abyssinia Bruce'. The specimen consists of 3 leaves and 6 inflorescences, all detached. No date of collection of these materials is recorded. Miller's plate, however, was certainly not made from these herbarium materials, and thus this specimen cannot be accepted as part of the protologue. It may be presumed that the BM materials were collected at Kew at some other date from possibly the same cultivated plant that Miller used for his typifying drawing.

(5) The description is based on the following specimens:

Hararge Amaressa (above Harar town), alt. 2000 m, 30-1-1975: Bos 9724; 64 km from Asbe Tefari on road to Kobbo, alt. 2380 m, 18-8-1967: WP 1334; Road Bedeno-Langhe, 17 km from Bedeno, alt. 2450 m, 26-10-1967: WP 2438; Around Bati village, near gate of College of Agriculture, alt. 2000 m, 5-3-1976: PJ 5204; Deder, road to hospital, alt. 2300 m, 23-11-1972: SL 2936; Gara Mulatta, S. slope, alt. 2460 m, 30-4-1976: PJ 6135; 15 km SE of Harar, alt. 1000 m, 2-2-1965: W. de Wilde c.s.

9882; Foothills Mt. Kondudu, 9°29'N × 42°16'E, alt. 2500 m, 16-11-1969: J. J. F. E. de Wilde 5900.

Kefa Road to Agaro, 15 km from Jimma, alt. 2125 m, 30-8-1972: SL 2555; Bonga, near roman catholic mission, alt. 2000 m, 14-8-1965: W. de Wilde c.s. 7671; Bonga, forest behind catholic mission, alt. 1750 m, 21-7-1975: PJ 2174; Bonga, around catholic mission station, alt. 1750 m, 20-3-1976: PJ 5391; 3.5–4.5 km N of Jimma, above the Limu road, 7°43'N × 36°48'E, alt. 1900 m, 25-12-1964: R. E Perdue 6388; 6 km NW of Jimma on Agaro road, 7°42'N × 36°45.5'E, alt. 1750 m, 26-11-1964: F. G. Meyer 8838, 8838a; About 20 km NW of Jimma, along Agaro road, S of Yebu, 7°45'N × 36°45'E, alt. 2000 m, 7-11-1970: I. Friis c.s. 155; Mt. Maigudo, ca 37 km from Jimma-Addis road on Omo-Nadda track, 7°30'N × 37°23'E, alt. 2550 m, 3-12-1972: I. Friis c.s. 1509; S of Yebu, along road Jimma- Agaro, 7°43'N × 36°48'E, alt. 2000 m, 1-11-1970: I. Friis c.s. 24.

Shoa 10 km W of Gheddo, Lekemti road, alt. 2000 m, 17-4-1965: W. de Wilde c.s. 6368; 5 km along road from Ghion to Addis, 8°34'N × 38°00'E, 11-7-1969: J. J. F. E. de Wilde 5445, 5446; Ca 30 km W of Addis Ababa, Menagesha state forest, alt. 2500 m, 10-4-1965: W. de Wilde c.s. 6178.

Sidamo Adame, 4 km N of Yirge Cheffe, 6°12'N × 38°13'E, alt. 1808 m, 13-11-1964: F. G. Meyer 8745; 11 km on road Agere Selam to Kebre Mengist, alt. 2620 m, 18-11-1967: WP 2683; Road Shashemene-Soddo, 25 km before Soddo, alt. 2000 m, 27-9-1975: PJ 3705; N edge of Soddu-Wolamo town, 130 km W of Shashemene, 7°52'N × 37°46'E, alt. 1750 m, 14-11-1964: F. G. Meyer 8764.

Wollega 5 km E of Lekemti, alt. 2200 m, 16-4-1965: W. de Wilde c.s. 6316; 20 km W of Lekemti, alt. 1900 m. 2-7-1965: W. de Wilde c.s. 7218; Road Nekemt-Ghimbie, 4 km out of Nekemt, alt. 2070 m, 17-5-1976: PJ 6327.

The following specimens, originating from Ethiopia, were seen: Alemayehu Haile 1131 (K); J. W. Ash 396 (K); P. R. O. Bally B. 3092 (K); P. Benedetto 326 (FT); W. Burger 1351 (ACD, K), 1676 (ACD, K); L. Buscalioni 574 (FT), 1262 (FT); A. Chinderi s.n. (FT); E. Chiovenda 386 (FT), 1079 (FT), 2738 (FT); DRC 318 (K); A. Fiori 197 (FT), 198 (FT), 528 (FT), 529 (FT); I. Friis, G. Aweke, F. Rasmussen & K. Vollesen 24 (K), 1509 (K), 2103 (K); I. Friis, A. Hounde, K. Jacobsen 155 (K); J. Gay s.n. (13-4-1818) (K); J. B. Gillett 5083 (FT, K, P); G. Giordano 423 (FT), 2496 (FT); Goodenough s.n. (Hort. Kew.) (K); M. Gutetta 1013 (K), 1043 (K), 1072 (K); Hort. Kew. sem. ex Abyssinia Bruce (BM); IECA E-53 (K); Marchetti 12 (FT); F. G. Meyer 7868a (K), 7868b (K), 7917a (K), 7917b (K), 7940a (K), 7940b (K), 8127 (K), 8745 (K); R. Milchersich 52 (FT); H. F. Mooney 4816 (FT, K), 6230 (FT, K), 8797 (FT, K); A. Pappi 5279 (FT); A. Petit 279 (15–30 Sept. 1841, 4ᵉ envoi) (P); R. Pichi-Sermolli 340 (FT), 341 (FT), 342 (FT), 343 (FT, K); Plowden s.n. (Abyssinia) (K); Quartin-Dillon & Petit s.n. (herb. A. de Franqueville 268, route Maigouagua-Debresina, 1840) (K, P), numerous specimens Quartin-Dillon & Petit s.n. (Chiré, Memsa, ex herb. E. Drake, Richard, de Franqueville) (P); Rochet D'Hericourt 111 (1850) (P), s.n. (1842, royaume de Choa) (P); Schimper 81 (Dec. 1842, Adoa) (FT), 104 (27-8-1862, Amba sea) (BM), 104 (21-10-1862, Anadehr) (BM), s.n. (Amba sea, 16-3-1856) (P); Schimperi iter Abyss. sectio prima 204 (K), 234 (BM, K, P); Schimper, Pl. Abyss. 185 (distr. 1860) (P); W. Schimper, envoi 1853, no 1 (P); L. Senni 2351 (FT); Siegenthaler 1491 (K); H. Smeds 1366 (K); Steudner s.n. (9-4-1862) (K); E. Taschdjian 159 (FT); A. Terracciano & A. Pappi 299 (FT); A. Vatova 23 (FT), 1157 (FT); W. de Wilde c.s. 6178 (K), 7218 (K), 7671 (K), 9882 (K).

Ecology

In Ethiopia, *B. antidysenterica* can be found at altitudes 1000–3700 m but most frequently at 1750–2500 m (Herb. WAG; Breitenbach, 1963). The shrub or tree is often found in regrowth of deforested areas or at forest edges. Its water requirements are not known, but it grows both in dry and in wet habitats. It flowers or fruits all the year round. The plant is not usually eaten by cattle, sheep or goats, although it bears fresh-looking green leaves, even in the dry season.

Husbandry

In areas of Ethiopia where the plant might be cultivated, it usually grows in the wild. As far as is known it is not cultivated. According to Bruce (1790) *Brucea antidysenterica* can be easily propagated from seed.

Uses (medicinal only)

Photograph 26. *Brucea antidysenterica,* flowering plant near Alemaya.

In Ethiopia, the dry powdered bark of the root is mixed with warm camel-milk or water, and taken against dysentery. Bruce (1790) reported that he took a heaped teaspoonful of it in a cup of camel milk twice a day. The first day he was very thirsty, but he was not allowed to drink anything. The second day he felt almost recovered. He described the medicine as 'a plain simple bitter, without any aromatic or resinous taste. . . . It only leaves in your throat and palate something of roughness. . . .'. It worked much better than all other medicines he had tried before.

Decoctions of the fruits and of the leaves are used also against dysentery, and against diarrhoea and fevers (Richard, 1847; De Pergola, 1912; Engler, 1931; Lemordant, 1960, 1971). A paste prepared from the powdered leaves and young twigs with unsalted butter or lard is used as a remedy for caries of bone, scrofula, cancerous tumours, skin diseases, including leprosy and wounds. A similar preparation, to which is added the chopped fruit of the plant, is applied to galls and chafe sores on animals, especially mules (Chiovenda, 1912; De Pergola, 1912; Baldrati, 1946; Watt & Breyer-Brandwijk, 1962; Amare, 1976). People treated with this medicine feel tired, have no appetite and are feverish for three days, after which they sweat abundantly. Heat from the sun or from fires feels painful. If a burning feeling is felt on the treated part, recovery is near. Treated wounds of animals recover completely in eight days (De Pergola, 1912).

Crushed ripe fruits mixed with honey or butter are a very good ointment for wounds. The roots are also used against rabies (Gelahun, pers. comm., 1975).

According to Amare (1976) the fruits seem fatal to livestock (particularly sheep) but a decoction of the plant is given to animals to prevent bloat.

Lemordant (1971) reported that as a treatment for leprosy the diseased part is cut open and powder of *Brucea* leaves and *Bryonia* roots is put in it. He also stated that Arabs use the root of *Brucea,* together with butter and mercury, to treat syphilis.

Among the Chagga tribe of South Africa, the leaf and root are remedies for abdominal upsets and pains, and a milk infusion is give to children for the relief of asthma. The bark and root are used as an anthelmintic too. Extracts from the root have proved useless against malaria (Watt & Breyer-Brandwijk, 1962; Kokwaro, 1976).

Chemical composition

Fruits of *B. antidysenterica* from Ethiopia contain ca 22% fixed oil and a small amount of volatile acids, as well as 1% of a resin, and a bitter principle, a yellow substance and dextrose. The bark has a bitter taste, and contains several bitter principles, a considerable amount of dextrose, resins, phytosterol and volatile acids. It contains ca 0.023% volatile oil. The plant is said to contain the bitter substance brucamarin (Watt & Breyer-Brandwijk, 1962). The fixed oil is dark green and contains palmitic acid, oleic acid, linoleic acid and some butyric and acetic acid (Mensier, 1957).

Recently, bruceantin, a drug isolated from *B. antidysenterica,* has attracted interest in studies on polypeptide elongation, as this drug is a specific inhibitor of peptide bond formation (Fresno et al., 1978).

3.3 Calpurnia aurea (Ait.) Bentham **Fig. 17**

'Calpurnia': named by E. Meyer after the Latin poet Titus Calpurnius Siculus, who in the middle of the First Century, wrote poetry similar to that of Virgilius; the genus *'Calpurnia'* closely resembles the genus *'Virgilia'* (named after Virgilius).
'aurea': derived from Latin 'aurum' = 'gold', referring to the golden-yellow flowers.

Bentham, G., Commentationes de leguminosarum generibus: p. 25–26 (1837).
Type: 'Nat. of Africa'. *'Sophora* foliis pinnatis: foliolis numerosis oblongo-ovalibus supra glaberrimis, caule fruticoso'. A specimen at the BM herbarium, labelled 'Hort. Kew., 1778' (BM!, lectotype designated by Brummitt, 1967, said to have been introduced to Kew from Abyssinia).

Synonyms

Sophora aurea Ait., Hort. Kew. ed. 1, 2: p. 44–45 (1789) (basionym).
Robinia subdecandra L'Hér., Stirp. Nov.: p. 157–158 (1791).
Virgilia aurea (Ait.) Lam., Tabl. Encycl. 1, 2(2): p. 470–471 (1793).
Podalyria aurea (Ait.) Willd., Sp. Pl. ed. 4, 2: p. 502 (1799).
Calpurnia lasiogyne E. Mey., Comm. Pl. Afr. Austr.: p. 3 (1836).
Calpurnia aurea (Ait.) Benth. var. *major* E. G. Baker, Leg. Trop. Afr. 2: 593–594 (1929).
Calpurnia subdecandra (L'Hér.) Schweickerdt, Bothalia 3: p. 237 (1937).

Literature

1808: Poiret, in, Lam., Encycl. 8: p. 678. (tax.)
1825: De Candolle, Prodr. 2: p. 98. (tax.)
1847: Richard, Tent. fl. Abyss. 1: p. 234. (tax.)
1867: Schweinfurth, Beitrag zur Flora Aethiopiens: p. 21. (tax.)
1871: Baker, *Papilionaceae,* in, Flora trop. Afr. 2: p. 252–253. (tax.)
1891: Taubert, *Leguminosae,* in, Engler & Prantl, Die nat. Pflanzenfam., ed. 1, 3, 3: p. 197–198. (tax.)
1911: Fiori, Boschi e piante legnose dell'Eritrea, Agricolt. Colon. 5: p. 187–188. (tax.)
1946: Baldrati, Piante officinali dell'Africa orientale, Centro Studi Colon. 32: p. 123. (use)
1951: Eggeling & Dale, Indig. trees Uganda, ed. 2: p. 298. (tax.)
1953: Toussaint, *Papilionaceae,* in, Flore Congo Belge 4: p. 44–45. (tax.)
1955: Cufodontis, Enumeratio, Bull. Jard. Bot. État Brux. 25(2), suppl.: p. 226. (tax.)
1958: Cufodontis, Syst. Bearb. S. Äthiop. ges. Pfl. 2, Senck. biol. 39: p. 294. (tax.)
1961: Dale & Greenway, Kenya trees & shrubs: p. 355. (tax.)
1962: Watt & Breyer-Brandwijk, Medicinal & poisonous plants S. & E. Afr., ed. 2: p. 565. (use)
1963: Breitenbach von, Indigenous trees Ethiopia, ed. 2: p. 101. (tax.)
1965: Gillett, An earlier name for *C. subdecandra* (L'Hérit.) Schweick., Kew Bull. 19(3): p. 421. (tax.)
1967: Brummitt, *C. aurea* (Ait.) Benth., a cape species in trop. Afr. and S. India, Kirkia 6(1): p. 123–132. (tax.)
1971: Gillett et al., *Papilionaceae,* in, Flora Trop. East Afr.: p. 46–49. (tax.)
1975: Fröman, An illustrated guide to the pasture legumes of Ethiopia, Rural Developm. Studies 3: p. 18. (tax.)
1976: Kokwaro, Medicinal plants East Afr.: p. 132. (use)
1977: Eijk van & Radema, Some alkaloids of Ethiopian *C. aurea* and *Cadia purpurea,* Planta Medica 32(3): p. 275–279. (chem.)
1977: Palgrave, Trees of S. Africa: p. 299–300. (tax.)
1979: Radema et al., Alkaloids of S. African samples of *C. aurea* subsp. *sylvatica,* Phytochem. 18: p. 2063–2064. (chem.)

1979: Vermin et al., Calpurmenin and its 13α -(2'-pyrrolecarboxylic acid) ester, Acta Cryst. 35: p. 1839–1842. (chem.)

Local names: digita, digissa, missirik (Amarinia); hezanz, hezantz, sutara, setara (Tigrinia); cheka, chika (Hararge, Kottu); ceca, chekkata, sotellu (Gallinia).
Trade names: East African Laburnum, Wild Laburnum, Natal Laburnum (English).

Geographic distribution

Calpurnia aurea grows in the highlands of tropical east Africa, north to Eritrea and as far west as the Central African Republic, Zaire, Angola, extending south to South Africa and in southern India (Brummitt, 1967; Gillett et al., 1971).

In Ethiopia, it is common in the mountain regions of all provinces (Cufodontis, 1955; Herb. WAG).

Description

An erect evergreen shrub or small tree, ca 1–5(–10) m high.

Stem: up to 10 cm diam.; branches subterete to subangular, grey-brown, to grey-green, sometimes with brown corky stripes, usually pubescent, becoming subglabrous when old; twigs usually subangular, dull-green, usually greyish-pubescent.

Leaves alternate, stipulate, petiolate, imparipinnately compound; stipules subtriangular, ca 2–5 mm long, ca 0.5–1.5 mm wide, subfleshy, the basal part usually stiff, long persistent, usually densely pubescent outside, subglabrous inside; petiole subterete, grooved above, ca 1–3 cm long, thickened at base, usually glaucous-green and densely pubescent; blade up to 20 cm long with 2–30 opposite, subopposite to alternate leaflets and one top-leaflet; rhachis subterete, grooved above, usually brown-green, densely pubescent; petiolules ca terete, ca 1–4 mm long, brown-green, usually very densely pubescent; leaflet-blades usually oblong to elliptic, more rarely ovate to obovate, 1–4.5 × 0.5–2 cm, margin entire, base obtuse to cuneate, usually slightly asymmetrical, top obtuse, usually slightly notched, mucronate, dull dark-green to glaucous-green and glabrous to densely appressed pubescent above, light-green to greyish-green and moderately to densely appressed pubescent beneath, most prominently so on the midrib; young, developing leaves are very densely covered with usually silvery appressed hairs; sometimes whitish, irregularly shaped cystoliths are visible on both surfaces of dried leaves.

Inflorescence racemose, axillary or terminal, usually pendulous, rarely branched, ca 6–23 cm long, up to 30-flowered, in terminal position sometimes appearing in dense clusters when the supporting leaves have not developed; peduncle and rhachis subangular, usually grooved above,light-green to brown-green, densely pubescent; peduncle ca 1–5 cm long; flowers usually single, rarely in clusters of 2–3, ca 1.5–2.5 cm long, 1–2 cm wide; bracts subtriangular, 1.5–3.5 mm long, 0.5–1 mm wide, usually densely pubescent outside, subglabrous inside, margins usually incurved; pedicel ca 1–3 cm long, light-green to brown-green, usually densely pubescent, usually slightly thickened and jointed at top; bracteoles sometimes present, ca linear to triangular, ca 0.5–1.5 × 1 mm, usually densely pubescent, margins usually incurved.

Hypanthium: obconical, 2.5–4.5 mm long, 3–5 mm diam., usually densely appressed, brownish pubescent and obscurely or prominently ribbed outside, glabrous inside.

Calyx campanulate, usually irregularly 5-lobed, 6–11 mm long, 6–9 mm diam., usually densely appressed pubescent outside, (sub)glabrous inside, usually brownish-green; lobes ovate to triangular, ca 1–5.5 mm long, 2–5 mm wide, anterior ones usually short acuminate, posterior ones usually rounded at apex and slightly shorter.

Corolla usually bright dark-yellow, glabrous. Standard: limb subobcordate to suborbicular in outline, 10–18.5 × 9–16 mm, usually strongly reflexed at margins, apex rounded with a notch, 1–3 mm deep; claw deeply canaliculate, 3–8 × 2–3(–4.5) mm, fleshy, situated ca perpendicular to the limb. Wings: limb slightly curved suboblong to subovate or elliptic in outline, 10–20 × 5–8.5 mm, usually rounded at top, sometimes irregularly lobed, usually with a subacute-ovate auricle up to 2.5 mm long at base; claw ca linear, 4–10 × 1–1.5 mm. Keel: usually consisting of two separate petals, sometimes partly connate at anterior margin; limb slightly curved suboblong to subovate or elliptic in outline, 10–15 × 5–7 mm, apex usually rounded, sometimes irregularly shallowly lobed, at base usually with a subacute-ovate auricle up to 2 mm long; claw ca linear, 5–10.5 × 1–1.5 mm.

Androecium: stamens 10, unequal in length, monadelphous, glabrous; filaments joined at base into a short tube-like sheath; tubular part 1–3 mm long, longest on the anterior side; on the posterior side, opposite the standard, a ca heart-shaped hole is present; free parts 10–20 mm long, ca 1 mm diam., white; stamens a bit fleshy and slightly thickened at base; anthers ellipsoid, 1–1.5 × 0.5–1 mm, 2-celled, dorsifixed slightly above the centre, dehiscing by two longitudinal slits, yellow.

Gynoecium: pistil 1; stipe ca terete, 4–9 × 0.5–1 mm, white, velutinous at apex; ovary flat, ca oblong, cuneate both ends, 6–15 × 1–2 mm, 9–15-ovuled, densely silvery velutinous; style ca conical, 5–8 × 0.5 mm, velutinous at base, often persistent in fruit; stigma ca flat discoid, apical, very small, finely papillate, white.

Fruit flat, oblong, indehiscent, papery, 3–13 × 1–2 cm; stipe ca 0.5–1 cm long; beak 0–8 mm long; the upper suture with a membranous wing 1.5–3 mm wide; up to 12-seeded, appressed-pubescent and light to dark green when young, very pale-brown and sparsely pubescent when mature, usually prominently veined; irregularly wrinkled pericarp around the seeds, which alternate between the two sides; usually the fruits remain long on the plant, often far into the next flowering season.

Seeds subovoid to subellipsoid, ca 5–7 × 2.5–4.5 × 1–3 mm, glabrous, light-brown to dark-brown; hilum near the narrowest end; the radicle of the embryo is visible on the seed as a small rounded hook-like outgrowth below the hilum; embryo with two large cotyledons, a prominent conical incurved radicle and a very small plumule; endosperm absent.

Taxonomic notes

(1) The species was first described in Aiton's Hortus Kewensis (1789), as *Sophora aurea.* Although in Aiton *Robinia subdecandra* L'Hér. is mentioned as a synonym, L'Héritier's name was not effectively published until 1791 (Gillett, 1965;

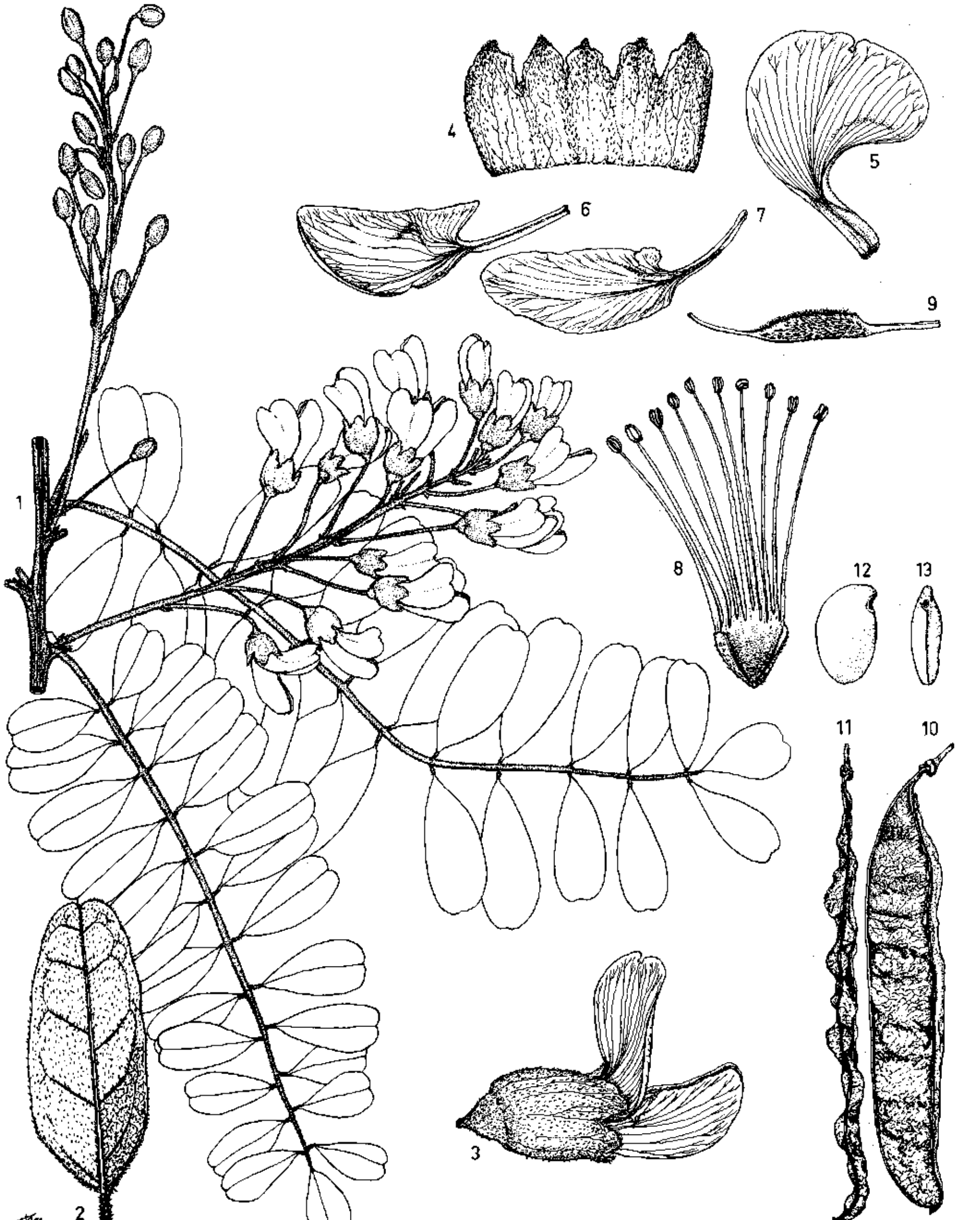


Fig. 17. *Calpurnia aurea* (Ait.) Bentham. – 1. habit flowering branch ($\frac{2}{3}\times$); 2. leaflet underside ($1\frac{1}{3}\times$); 3. flower ($2\times$); 4. opened calyx ($2\times$); 5. standard ($2\times$); 6. wing ($2\times$); 7. keel ($2\times$); 8. opened androecium ($2\times$); 9. gynoecium ($2\times$); 10. fruit ($\frac{2}{3}\times$); 11. fruit, side view ($\frac{2}{3}\times$); 12–13. seed ($2\times$). – 1–2. W. de Wilde c.s. 6357; 3–9. PJ 5186 (spirit mat.); 10–13. PJ 5142.

Stafleu, 1967). The author (in Aiton) saw a part of L'Héritier's manuscript and one may debate whether distribution of parts of a manuscript (with drawings !) to various correspondents at the same time constitutes effective publication.

However, Brummitt (1967), designated as lectotype a specimen from a plant cultivated at Kew and preserved at BM, labelled 'Hort. Kew., 1778'. The author in Aiton (1789) remarked that the plant described had been introduced to Kew in 1777 by 'Mons. Thouin', and that it flowered in July.

It seems highly improbable that Thouin donated to Kew a living plant. If he did not, it is hardly possible that the type specimen with flowers is from a plant one year after sowing.

Therefore the specimen 'Hort. Kew., 1778', very likely is not collected from Thouin's gift, but a specimen from a plant grown at Kew after seeds had been received from Bruce at an earlier data (cf *Brucea antidysenterica*, p. 144).

Brummitt's typification ought to be maintained but it is uncertain whether the type specimen is the holotype, a lectotype or a neotype.

(2) Brummitt (1967) distinguished 3 subspecies within *C. aurea:*

(a) subsp. *aurea:* growing from Eritrea to South Africa in mountainous regions (at lower alt. in S. Africa) and in Angola, Centr. Afr. Rep., Sudan. Lectotype as for the species. Distinguishing characters: ovary and under-surface of the leaflets appressed-pubescent, perigynous zone (2.5–)3–4.5(–5) mm long, calyx (5–) 6–9(–10) mm long with the teeth shorter than the campanulate part, petals (11–) 12–20(–22) mm long.

(b) subsp. *sylvatica* (Burch.) Brummitt: growing in South Africa. Basionym: *Sophora sylvatica* Burch.. Holotype: Burchell 3138 (K). Distinguishing characters: glabrous ovary and glabrous leaflets.

(c) subsp. *indica.* Brummitt: growing in southern India. Holotype: India-Mysore: Courtallum, 1851, Thomson (K). Distinguishing characters: ovary and under-surface of the leaflets appressed-pubescent, perigynous zone 2–2.5 mm long, calyx 3–4 mm long with the teeth equalling or usually exceeding the campanulate part, petals 9–11 mm long.

In this subdivision all 20 Ethiopian specimens I studied belong to subsp. *aurea.* As measurement of these specimens alters the range of some characteristics given by Brummitt (e.g. the number of pairs of leaflets, length of petals, length of calyx lobes), the subspecies is more variable than Brummitt described. In my opinion, the subdivision into 3 subspecies is based on rather weak diagnostic characteristics. Subsp. *'indica'* has smaller flowers only and subsp. *'sylvatica'* and subsp. *'aurea'* overlap in geographic distribution and in characteristics. Investigation of more specimens may, however, justify Brummitt's subdivision. Recent chemical research by Radema et al. (1979) supported Brummitt's view.

(3) In 1929 Baker distinguished var. *major* Oliv. & Baker ex Baker f. in the species *C. aurea* as: 'leaflets larger than in type, 4.5–5.5 cm long, ca 2 cm broad'. Brummitt (1967) and Gillett et al. (1971), considered this taxon as falling into the normal range of variability of the species not deserving a separate status.

(4) The description is based on the following specimens:

Arussi Asella, about 175 km SSE of Addis Ababa, lower slopes of Mt. Cilalo, alt. 2500 m, 6-5-1965: W. de Wilde c.s. 6569.

Hararge Campus College of Agriculture, Alemaya, alt. 2000 m, 25-3-1974: Bos 7557; 27-5-1974: Bos 7821; Around the College of Agriculture, Alemaya, alt. 2000 m, 1-3-1976: PJ 5186; Road Alemaya-Harar, alt. 2000 m, 6-2-1976: PJ 5142; 35 km from Asbe Tefari on road to Kobbo, alt. 2260 m, 17-8-1967: WP 1312; Chercher highlands near Kharsa, 12 km from the Dire Dawa-Harar junction on the Kulubi road, 10-4-1975: Bos & Jansen 10024; 7 km from Harar on the road to Jijiga, 9°16'N × 42°09'E, alt.1725 m, 18-12-1968: J. J. F. E. de Wilde 4246; Harla, alt. 1800 m, 11-3-1975: Bos & Jansen 9846.

Kefa Around catholic mission station at Bonga, alt. 1750 m, 20-3-1976: PJ 5393; About 25 km from Bonga, on road to Dekja, alt. 1930 m, 25-3-1976: PJ 5587; About 10 km E of Jimma, alt. 2000 m, 12-8-1965: W. de Wilde c.s. 7634; About 20 km NW of Jimma, S. of the village Yebu, along the road between Jimma and Agaro, 7°45'N × 36°48'E, alt. 2000 m, 7-11-1970: I. Friis, A. Hounde & K. Jacobsen 152.

Shoa Near Gheddo, alt. 2000 m, 22-3-1966: W. de Wilde c.s. 10444; Mountain just beyond Guder, N slope, alt. 2100 m, 6-5-1975: Bos & Jansen 10154; Lake Verde (crater lake) Debre Zeit, alt. 1700–2000 m, 19-2-1970: J. W. Ash 232; Mt. Zuquala, about 60 km S of Addis Ababa, alt. 2800 m, 30-10-1965: W. de Wilde c.s. 8618.

Sidamo 10 km S of Awasa, 13-2-1975: Bos 9756.

Tigre About 51 km S of Quiha, 13°06'N × 39°30'E, alt. 2300 m, 30-1-1969: J. J. F. E. de Wilde 4441.

Wollega About 30 km E of Lekemti, alt. 2200 m, 17-4-1965: W. de Wilde c.s. 6357.

The following specimens, originating from Ethiopia, were seen: J. W. Ash 232 (K); I. Baldrati D-41 (FT), 4088 (FT), 4089 (FT), 4902 (FT); G. Bartolemmei-Gioli 82 (FT); E. Beals B217 (K), B257 (K); N. Beccari 97 (FT); P. Benedetto 64 (FT); R. Bricchetti 261 (FT), 296 (FT); W. Burger 411 (ACD, K), 698 (ACD, K), 1090 (ACD, K), 1769 (ACD, K); L. Buscalioni 2014 (FT); D. R. Chaffey 469 (K); A. S. Cheke 7 (K); N. C. Cockburn s.n. (April 1910) (K); R. Corradi 4436 (FT), 4437 (FT); G. Cufodontis 360 (FT), 476 (FT); A. Fiori 116 (FT), 117 (FT), 508 (FT); I. Friis, A. Hounde & K. Jacobsen 152 (K); J. B. Gillett 5008 (K), 14244 (BM, FT, K); Giordano 120 (FT); M. Griaule s.n. (7-3-1933, Bota 15) (P); M. Gutetta 1067 (K); R. G. Hillier 918 (FT, K); Hort. Kew s.n. (1778) (BM, lectotype); D. Hundessa 30 (K); G. Mangano 3 (FT); F. G. Meyer 7685 (K); Milizia forestale 152 (FT); H. F. Mooney 5327 (K), 7891 (FT, K); Herb. Moquin-Tandon s.n. (Abyssinie) (P); G. Negri 655 (FT); A. Pappi 5 (FT), 15 (FT), 45 (FT), 52 (FT), 76 (FT), 288 (FT), 322 (FT), 1419 (FT), 2311 (BM, FT), 3095 (FT), 3436 (FT), 3525 (FT), 4098 (FT), 4257 (FT), 4371 (FT), 4593 (FT); R. Pichi-Sermolli 626-628 (FT), 629 (FT, K), 630–633 (FT); F. G. Piovano 246 (FT); Herb. Poiret s.n. (herb. Moquin-Tandon) (P); Quartin-Dillon & Petit s.n., several specimens, ex herb. Richard, Sholada, herb. A. de Franqueville 38, Abyssinie, (dernier envoi 1844) (P); Ragazzi 1316/87 (FT); V. Rigazzi 193 (FT), 276 (FT); Roth 174 (K); Russel 200 (2-1-1860) (P); Saccardo s.n. (1939) (FT); Schimperi iter Abyss. coll. 72 (BM), 200 (BM, K, P), 278 (BM, K, P), 1898 (BM, K, P); Schimper pl. Abyss. 176 (7-10-1842) (FT), 439 (7-11-1854) (FT, P); W. Schimper 453 (20-7-1852) (P), 453 (1853) (K, P), 709 (P), s.n. (ex herb. Schweinfurth, 1854) (BM); G. Schweinfurth & D. Riva 874 (FT, P), 1326 (FT, K, P); L. Senni 837 (FT), 1448 (FT); Siegenthaler 1543 (K); H. Smeds 487 (FT), 790 (FT); Sollazzo 102 (FT); Steudner 157 (K); Stower, Smith & Gilliland 4014 (BM); A. Tellini 1139 (FT), 1188 (FT); A. Terracciano & A. Pappi 257 (FT), 298 (FT), 811 (FT), 1330 (FT), 1464 (FT), 1927 (FT), 1940 (FT); M. Thulin 1510 (K); A. Vatova 1079 (FT), 1169 (FT), 2006 (FT); O. West 5801 (K); W. de Wilde c.s. 6357 (K), 7634 (K).

Ecology

In Ethiopia, *C. aurea* grows on mountain slopes, in forest regrowth, in shrub vegetation along rivers, in scrub borders, at forest edges and in overgrazed grass-lands, between altitudes of (1200–)1700–2400 (–2800) m (Schweinfurth, 1867; Fiori, 1911; Cufodontis, 1958; Breitenbach, 1963; Fröman, 1975; Herb. WAG).

The shrub may be found flowering or fruiting in all months of the year, but most abundantly from February to May (Herb. WAG).

Fröman (1975) reported that the plant is not touched by cattle and that it may be considered as a weed in Ethiopia.

Cufodontis (1958) remarked that the shrub is often found under *Ficus* spp. in Ethiopia.

L'Héritier (1791) described the roots as woody, branched, grey, with a smell and taste of sticks of liquorice.

For East Africa, Gillett et al. (1971) reported that the species occurs at margins

Photograph 27. *Calpurnia aurea*, flowering plant.

and clearings of upland rain-forest and riverine forest at altitudes of 1300–2250 m. Dale & Greenway (1961) gave as altitudinal range in Kenya 2300–2700 m. In South Africa, the shrub occurs from sea-level up to 1500 m (Brummitt, 1967, Palgrave, 1977).

Husbandry

In southern Europe and in several other regions, the shrub is cultivated as an ornamental (Cufodontis, 1955).

According to the literature, the shrub has been used and perhaps still is used as a shade tree in coffee plantations (Dale & Greenway, 1961; Gillett et al., 1971).

In Ethiopia, the shrub seems to be cultivated only in hedges around houses. It is easily propagated from cutting or seed (Breitenbach, 1963).

Stewart & Dagnatchew (1967) observed a leaf rust *(Aecidium* sp.) on this species in Kefa Province of Ethiopia.

Uses

1. Medicinal uses

In Ethiopia, sap of *Calpurnia* leaves and roots is used against eye-diseases and against vomiting and amoebic dysentery. It is used also against diarrhoea of animals. A decoction of the flowers is used against stomach ache and is said to exhaust the patient. Roasted and ground fruits mixed with butter are used as a medicine against scabies (Griaule, Bota 15, herb. label, P). According to Baldrati (1946), the medicinally used roots are called 'scitora, sutara or sitara'. Fresh juice, obtained from the leaves after grinding and squeezing, is applied to wounds to kill maggoty sores of people and cattle, and is used as an insecticide (Baldrati, 1946; Watt & Breyer-Brandwijk, 1962; Kokwaro, 1976).

2. Miscellaneous uses

The following uses have been reported or observed.

- Leaf-sap is used as an aromatic on the head by Ethiopian women (Schimper 72, label, BM).
- In Ethiopia, the wood (yellow and strong) is used to make handles for hammers and axes and in house building. The roots are used to make charcoal (Fiori, 1911; Baldrati, 1946; Cufodontis, 1958).
- The shrub is grown as an ornamental, as a shade tree in coffee plantations and as a hedge around houses (Richard, 1847; and many other sources).
- Sticks are used as torch-lights (Breitenbach, 1963).
- The seeds are used as fish poison in Ethiopia (W. de Wilde c.s. 7634, 10444, herb. label, WAG).

Chemical composition

Van Eijk & Radema (1977) isolated three quinolizidine alkaloids from *C. aurea* originating from Ethiopia: calpurnin, angelictic ester of 13-hydroxylupanin and virgilinpyrrolcarboxylic acid. In South African *C. aurea* subsp. *sylvatica*, Radema et al. (1979) discovered three alkaloids that were not present in Ethiopian *C. aurea:* calpurmenine (12β, 13α-dihydroxylupanine) and its 13α-pyrrolylcarboxylic acid ester, and 10, 13-dihydroxylupanine.

Watt & Breyer-Brandwijk (1962) reported that the leaves and twigs of *C. aurea* yielded ca 4.4% tannin.

3.4 Catha edulis (Vahl) Endl. **Fig. 18**

'*Catha*': latinization of the Arabic plant name 'cat', which is possibly derived from the word 'cut' = 'sustenance, driving principle'.
'*edulis*': derived from Latin 'edere' = 'to eat'; edible.

Endlicher, S., Enchiridion Botanicum: p. 575 (1841).
Type: 'In Yemen colitur iisdem hortis cum *Coffea;* in montibus, Bulgose, sive Hadie'. Herb. Forskal No 505 (C, lecto., microfiche !).

Synonyms

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Catha inermis Gmel., Syst. Nat., ed. 13, 2: p. 411 (1791).
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Local names: chat, tchat, dschat (Amarinia); jimma, gofa, chai, ciut (Tigrinia, Gallinia); gat, kat, khat (Arabic); mira (Kikuyu).
Trade names: chat, cat, Abyssinian tea, African tea, Arabian tea, Bushman's tea, Somali tea, khat tea, flower of paradise, Chirinda redwood (English). Literal translations in French and German.

Geographic origin

The country of origin of *C. edulis* (chat) is unknown. Some authors believe it is Yemen (e.g. Loesener, 1942); most authors believe it is Ethiopia (e.g. Vavilov, 1951).

In fact chat is reported to grow in the wild in SW Arabia and in Africa from Ethiopia down to South Africa (including Somalia, Kenya, Tanzania, Uganda, Zaire, Ruanda, Burundi, Zimbabwe, Mozambique) (Cufodontis, 1958; Wilczek, 1960; Brooke, 1960; Robson, 1966).

The plant is grown in many countries of these regions, and has also been reported from Turkestan and Afghanistan. However, as a major crop, it is known only from Ethiopia and Yemen (Hill, 1965; and many other authors). Ethiopia is the most important producer of chat. It is cultivated in all provinces, but ca 95% of the production originates from the two provinces Hararge (ca 60%) and Shoa (ca 35%) (Land utilization report, 1977).

Description

An erect, evergreen, glabrous shrub 2–6 m high, or a tree up to 25 m high. (In cultivation, a much-branched regularly pruned shrub).

Stem straight and slender, pale grey-green; branches terete, pale grey to brownish-grey; young twigs usually flattened, dull green or dull brownish-red.

Leaves simple, usually alternate on sterile branches, opposite on flowering branches; stipules triangular, ca 3 × 1 mm, with fimbriate margins, light-green, caducous, leaving a rim-like scar; petiole terete, 3–11 mm long, light to dark-green; blade narrowly obovate or oblanceolate, rarely ovate or elliptic, (1.5–)2–3(–4) times as long as wide, up to 11 × 6 cm, attenuate at base, acutish and sometimes notched at apex, margin usually glandular-crenate or serrulate, (sub)leathery, usually shiny dark-green above, paler green beneath, with yellow-brown veins both sides, usually prominently reticulate beneath.

Inflorescence an axillary dichasium, up to 3.5 cm in diam.; peduncle up to 1 cm long, light-green; bracts and bracteoles usually ca triangular, up to 2.5 mm long, more or less fleshy, with fimbriate margin, light-green to brownish-green; in the lower branchings the central flower usually remains rudimentary; pedicel 1–2.5 mm long, light-green; flowers 2–4 mm diam., bisexual, probably protandrous.

Calyx: sepals 5, basally connate, broadly ovate, ca 0.5–1 × 0.5–1 mm, often slightly unequal, with fimbriate margin, light-green.

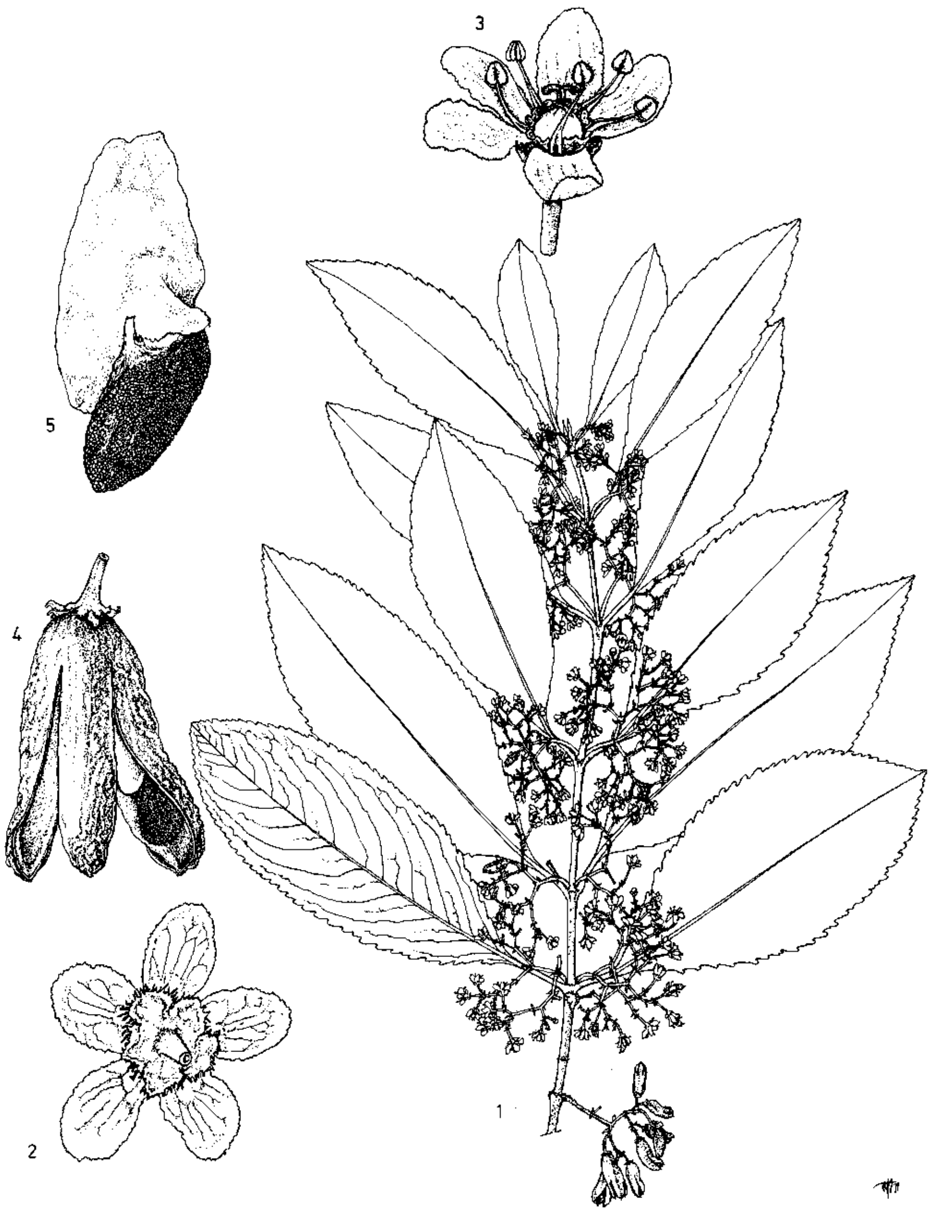


Fig. 18. *Catha edulis* (Vahl) Endl. – 1. habit flowering branch ($\frac{2}{3}\times$); 2. flower underside ($8\times$); 3. flower ($8\times$); 4. open fruit ($8\times$); 5. seed with wing ($8\times$). – 1–3. PJ 7140; 4–5. WP 3172.

Corolla: petals 5, free, narrowly ovate, ca 1.5–2.3 × 1–1.5 mm, white or pale-yellow, usually with finely serrulate to short fimbriate margin.

Androecium: stamens 5, free; filaments linear, slightly broader at base, 1–1.5 mm long, light-green; anthers ovoid to short pyramidal, ca 0.3 mm long and diam., basifixed, yellow, dehiscing by two lateral longitudinal slits.

Disc intrastaminal, at base adnate to ovary, patelliform, ca 0.3–0.5 mm high, thin, fleshy, shallowly 5-lobed, each lobe slightly notched, pale yellow.

Gynoecium: ovary subglobose, 0.5–1 mm diam., 3-locular, light-green; each locule usually containing two ovules; style very short, ca 0.3 mm long, light-green, with 3 linear, recurved light-green stigma-lobes up to 0.5 mm long.

Fruit a 3-angular, subprismatic, usually slightly curved, loculicidal, 3-valved, (1–)3(–6)-seeded capsule, ca 6–12 mm long, with sides ca 1–4 mm wide, light to dark-brown or reddish-brown.

Seed flat, obovoid, ca 3–3.5 mm long and 1.5 mm wide, at base acute, with a submembranous, white ring (aril) ca 5–5.5 × 2.5–3 mm; testa dark-brown, strongly rugose-papillose; embryo with two long, thin, pale-green cotyledons and a small plumule, embedded in copious endosperm.

Taxonomic notes

(1) In Forskal's Flora Aegyptiaco-Arabica, published in 1775 by C. Niebuhr, 12 years after Forskal's death, a description of *Catha* is given on pages 63 and 64 (indicated by '4. *Catha'),* followed by a description of *Catha spinosa* (indicated by '5. *Catha spinosa').* Although this arrangement of the text looks like a generic description ('4. *Catha')* followed by a specific description ('5. *Catha spinosa*'), Forskal explicitly mentioned under 4. *Catha* 'gat or kat', the species whose leaves were eaten in Yemen. He gave more details about its use and cultivation after the description. He also had a Latin name for this species. On page cvii, in an enumeration of plants of the Flora (without reference to the pages on which they are described), Forskal indicated under *Catha:* 'a) *edulis,* b) *spinosa'.* As the name *Catha spinosa* is mentioned on page 64 (under 5), Forskal's name of the plant described under '4. *Catha*' should be *Catha edulis.* Unfortunately Forskal described these two species under a generic name *(Catha),* that had been unknown and undescribed. So these species descriptions and names were not valid (Art. 43, Code). As Robson (1966) noticed, it was Scopoli who in 1777 first published the genus *Catha* validly. Scopoli referred to Forskal's *Catha* and excerpted the generic description of *Catha* literally from Forskal's description of *Catha edulis.* The genus *Catha* Forsk. ex Scopoli thus is typified by Forskal's *Catha edulis.* In 1790 Vahl described Forskal's *Catha edulis* as *Celastrus edulis,* the first valid name for the species. The name *Catha edulis* was ultimately validly published by Endlicher in 1841 (referring to Forskal). From this history it can be deduced that the correct name for chat is: *Catha edulis* (Vahl) Endl.. Often the authority is given as Forsk. (e.g. Cufodontis, 1958; Wilczek, 1960), or as (Vahl) Forsk. ex Endl. (e.g. Robson, 1966; Verdcourt & Trump, 1969).

(2) In the Forskal herbarium at Copenhagen, 4 sheets of *Catha edulis* are present: No 504, 505, 506 and an unnumbered one. As sheet No 505 best fits Forskal's

description, I designate the specimen on that sheet as the lectotype of *Catha edulis* (Vahl) Endl.

(3) Number 4627 in the list of the 'Nomina generica conservanda et rejicienda' (Code, 1978), records the conservation of the genus *Gymnosporia* (Wight et Arnott) J. D. Hooker. As one of the 'nomina rejicienda' is listed *Catha* Forskal ex Schreber, Gen. 147, Apr. 1789. Although the genus *Catha* was described by Scopoli in 1777, this earlier name is also rejected in favour of *Gymnosporia* (Code, Art. 14.7, 1978). However, as I consider the genus *Catha* as being different from the genus *Gymnosporia*, the name *Catha* can be maintained (Art. 14.6), and for *Catha* the conservation is only relevant if the genera *Gymnosporia* and *Catha* are united.

(4) According to Amare & Krikorian (1973), chat growers in the Harar area of Ethiopia distinguished 5 different 'morphological types' of chat. It is possible that these 'types' represent different cultivars, but in the Ethiopian material, I could not distinguish cultivars. Amare & Krikorian (1973) listed the following not clearly distinguishable 'types'. The first two were already distinguished by Brooke in 1960:
(a) 'Dallota' (new moon): with small, pale yellowish or light-green leaves; the taste of the leaves is said to be less acid and this type is preferred in the Harar area.
(b) 'Dimma' (red): with medium sized reddish leaves; the red chat is said to have a stronger physiological effect than the pale yellow or green one; in general it is considered second in quality and fetches lower prices; however, recovery of the plants after harvest is better and requires less care by the grower.
(c) 'Hamercot': intermediate between 'dallota' and 'dimma'.
(d) 'Gohoba': resembling 'dimma'.
(e) 'Mohedella': with green to olive leaves.

My collections in the same area did not enable me to identify or segregate these 5 'types'. Nevertheless, the vernacular names indicate differences, which may prove to be valuable and possibly could be established after agricultural experiments.

(5) The description is based on the following specimens:

Hararge Road Alemaya to Kombolcha, 2 km from College entrance, alt. 2000 m, 6-7-1967: WP 431; 4 km from College entrance, Alemaya, on road to Kombolcha, alt. 2175 m, 17-7-1967: WP 665; College of Agriculture, Alemaya, alt. 2000 m, 4-5-1974: Bos 7739; Alemaya village, alt. 2000 m, 6-5-1974: Bos 7740; College of Agriculture, Alemaya, alt. 2000 m, 8-5-1974: Bos 7756; In fields around Awoday (near Alemaya), alt. 2000 m, 16-9-1976: PJ 7140; Road from Bedessa to main road to Kulubi, 11 km from Bedessa, alt. 2140 m, 27-1-1968: WP 3172; Near Harar, alt. 1800 m, 5-2-1966: W. de Wilde c.s. 9954; 10 km NW of Harar on Dire Dawa road, alt. 2000 m, 9°19'N × 42°7'E, 5-11-1964: F. G. Meyer 8721; Road Harar-Dire Dawa, ca 1 km NW of the crossing with the road to Addis Ababa via Kulubi and Asbe Tefari, alt. 2000 m, 9°29'N × 41°54'E, 28-9-1968: J. J. F. E. de Wilde 4078.

The following specimens, originating from Ethiopia, were seen: I. Baldrati 1359 (FT), 4929 (FT); P. R. O. Bally 3039 (FT, K); P. Benedetto 529 (FT); Bota 190–192 (P); L. Buscalioni 557 (FT), 560 (FT), 602 (FT); E. Chiovenda 1837 (FT); R. Corradi 8379 (FT); G. Cufodontis 216 (FT); C. Curli 169 (BM); F. G. Meyer 8721 (K); Milizia forestale 1026 (FT); H. F. Mooney 5614 (FT, K); M. Pavirani 4 (FT); Plowden s.n. (Abyssinia) (K); Quartin-Dillon et Petit 3ᵉ envoi 120 (A. de Franqueville, Aug. 1840) (K), s.n. (Franqueville 1862, Choa) (K), s.n. (dernier envoi 1844) (P), s.n. (Abba-Garima) (P), s.n. (herb. A. de Franqueville) (K), s.n. (P); Rochet d'Hericourt 6 (P), 22–23 (P), 67 (P); Roth 210 (?) (K); D. Saccardo s.n. (FT);

Savouré et Cie s.n. (P); Schimperi iter Abyss. 649 (15-7-1840) (BM, K, P), 1478 (28-11-1842) (K, P); Schimper s.n. (Plantae Abyssinicae ex Tigre v. Begemder, Atta Gerima 30-3-1863) (BM, K), 781 (17-12-1862) (BM); W. Schimper 91 (29) (15-7-1840) (FT), 390 (233/4) (18-11-1842) (FT), s.n. (prope Genniam) (P); E. Taschdjian 37 (FT); A. C. B. Thomerson 584 (K).

Ecology

As a tree growing in the wild, *Catha edulis* (chat) can become very large and rough barked (Baker, 1911). It occurs in evergreen submontane forests, usually near the margins, or in woodland often on rocky hills (Robson, 1966). In cultivation, chat is forced to grow as a shrub, usually reaching no more than ca 4 m height. In the area of the Flora Zambesiaca, the tree is reported to occur at altitudes between 1100–1435 m, in Uganda up to 1800 m (Robson, 1966); in Kenya and Ethiopia at 1300–3000 m (Brooke, 1960; Dale & Greenway, 1961; Breitenbach, 1963; Verdcourt & Trump, 1969).

In the main area of chat cultivation in Ethiopia, Hararge Province, chat is cultivated mainly at the altitudes 1800–2400 m, often on terraced hillsides. The temperature is mild, 18–21°C on average (rarely as high as 32°C or as low as 7°C). Rainfall is ca 800–1100 mm per annum, concentrated over 4–6 months. The soils are red-brown sandy loams, with a low content of clay, usually well drained, from moderately acid to moderately alkaline (Brooke, 1960; Hill, 1965). The same area is well known for its coffee cultivation, although chat is now more important.

The main flowering period of chat in Ethiopia is during and after the rainy season (July to Sept.). The fruiting period is from Nov. to Jan. Some flowering and fruiting occurs almost the whole year round (Herb. WAG).

Chat is reported to be a remarkably hardy plant. Growers said that the shrub rarely became seriously diseased and could live for 75 years or more if carefully tended (Brooke, 1960).

Husbandry

In Ethiopia chat comprises ca 14% (= ca 6300 ha) of the total area under permanent crops. Ca 80% of the chat is cultivated on farms not larger than 1 ha, so it is an important small-farm crop (Land utilization report, 1977).

Chat is mainly propagated from rooted suckers or by cuttings. Although possible, it is not often propagated from seed. Seed soon loses its viability but fresh seed germinates in 15–20 days (Baldrati, 1950).

In Harar Province, chat is often cultivated on terraced hills. Steep hillsides are bench-terraced, with one row of chat trees at each level. Shallower slopes selected for chat are ploughed once or twice in the rainy season. With the typical crooked-handled shovel, called 'akafa', a series of parallel ridges are prepared, 2–2.5 m apart, ca 30 cm high, roughly along the contours. At equal intervals of about 1.5–2.5 m, shallow holes are dug on the ridges. During the rainy season, cuttings ca 30–50 cm long are planted upright in the holes (sometimes two per hole). If the rainfall is insufficient to keep the soil moist, water is added until the plants start to grow. The soil is kept loose and aerated, and is weeded regularly. Farm dung is added when

Photograph 28. *Catha edulis*, field near Dire Dawa.

available. For 5–6 years after planting, crops like maize, sorghum, barley, teff, peppers, sweet potatoes, tobacco, onions and beans may be interplanted. After that the chat plants cause too much shade to make intercropping profitable. After 3 years the plants are ca 80 cm high and a first small harvest is possible. After 5–8 years the normal production can be reached. The plants are pruned frequently to keep their height usually at ca 2.5 m. They are not usually mulched or manured. In 1888 already, Paulitschke stated that chat cultivation was a real 'predatory cultivation'. It is very likely that manuring, especially with nitrogen would raise yield considerably, but there are no data on the effect of fertilizers.

Shoots with tender small leaves and buds are picked. Large leaves are considered less valuable and are often taken by the grower for his own use. From irrigated plots, tender shoots are plucked for export during the dry season but most chat is not irrigated and produces for export only during the rainy season. If irrigation is impossible, farmers may remove all leaves of the plants in the dry season to prevent excessive transpiration. The amount of shoots picked varies greatly from one day to another. One fairly large handful is considered an adequate amount for about two hours of chewing. This measure is called an 'akara' and is about the average daily consumption for a man. The minimum amount picked for the market is about six 'akaras'. In the harvest season the crop is usually picked 2–3 times a week. When large amounts of twigs are taken, they are sometimes placed loose in jute sacks and carried to the market. More frequently, the bundles of sprigs are wrapped in a common local weed (e.g. *Rumex nervosus),* banana or false banana-leaves, grass or castor-bean leaves, and are often sprinkled with water to keep the chat fresh until sold. Even with these precautions the leaves become stale two or three days after plucking and only fresh chat can be sold. To reduce wilting, shoots are picked early in the morning or late in the evening (Brooke, 1960; Hill, 1965).

Reliable production figures are not available. In the Harar area, the annual yield of fresh chat is ca 800–1000 kg/ha (Hill, 1965; Amare & Krikorian, 1973), which seems very low. For home consumption, the chat is harvested when wanted. For the market the crop can be harvested two or three times a year.

The price of chat varies with quality, the total quantity offered (dry or rainy season!), and even the time of the day. Early in the morning the price may be about twice as high as in the afternoon (when the chat is too late for export). Chat is much higher priced in the dry season than in the wet season. Chat growers like to irrigate their crop in the dry season, but usually there is no opportunity. In the Harar area, chat seems to be much more profitable than coffee. As farmers expressed the difference: one chat tree gives at least 10 Ethiopian birr per year, one coffee tree only 1 birr. Chat sale accounts for 30–50% of the total cash income of a family. It is estimated that chat cultivation takes ca 2000 working hours per ha per year. The average price of chat fluctuates from ca 20 to 30 birr per kg (Amare & Krikorian, 1973). The total annual production of chat in Ethiopia is at least 50 million kg. As only ca 2 million kg of chat are exported yearly, mainly by air to Djibouti and Aden, the local consumption of chat is high. For the country's economy, however, the export of chat is important.

Chat is subject to attack by a wide range of insects. One insect, however, a leafhopper *(Empoasca* sp.), called 'kudda', is considered beneficial, as its characteristic damage to the plant results in a quality of chat that is preferred by many chewers. The insect causes the older tips to wilt and die off, encouraging new shoots to develop. Around Harar the following insect pests are known to cause serious damage:

- The flat headed borer *Chrysobothris dorsata.* It is found burrowing under the bark as a larva.
- The weevil *Systates* sp. nr. *noxius.* As adult it feeds on the leaf margins.
- The caterpillars *Nadiasa concana* and *Aphilopota panerostigma.* They feed on leaves and young stems. The latter is parasitized by the wasp *Apanteles africanus.*
- The lima bean pod borer *Etiella zinckenella.* The caterpillar of this insect feeds on young leaves and stem tips.

– Insect pests of lesser importance are caused by *Argyroploce leucotreta, Chrysopoloma crawshayi, Chrysopoloma isabellina, Cryptocephalus* sp., *Dysphylia viridella* Rag., *Penthimia vinula, Thalassodes digressa, Zophosis* sp. nr. *congesta.*

Chemical insect control is almost non-existent in Hararge. Apart from the difficulty of obtaining chemicals, farmers fear that the beneficial leafhopper would also be killed (Hill, 1965).

The following bacterial and fungal diseases of chat are reported from Ethiopia (Stewart & Dagnatchew, 1967):

– *Cicinnobolus cesatii* d. B., a hyperparasite on an *Oidium* sp., in Hararge prov.
– *Coryneum microstictum* B. & Br. found on a bacterial gall in Hararge.
– *Dillsiella pollaccii* Cicc. & E. Cast., a black spot in Hararge, Tigre and Sidamo.
– *Diplodia* sp., found on a bacterial gall in Hararge.
– *Oidium* sp., a powdery mildew in Hararge and Shoa.
– *Septoria* sp., in Hararge.
– *Pseudomonas savastanoi,* a stem and twig gall in Hararge.

Sometimes mole-rats *(Tachyoryctes* sp.) damage the main trunks of young trees just below the soil surface (Hill, 1965).

A semiparasite, *Loranthus* sp., also occurs on chat. Frost and hailstorms may reduce yield and quality. Chat should also be protected against higher animals. To repel animals, hyena dung is sometimes gathered and placed around the base of the trees (Brooke, 1960).

According to the chat growers, merchants and consumers in Ethiopia, several qualities of chat are distinguished, based for example on place where grown, time of harvest and tenderness of leaves and twigs.

Amare & Krikorian (1973) listed seven qualities of chat, but the distinction between the different groups was not clearly described:

A. The 'kudda' group (wet season crop):
(1) 'Kerti', long slender young branches
(2) 'Kudda-kerti', chat harvested after the first harvest
(3) 'Kudda', tender chat, originating from bud growth which is stimulated by the damage of the beneficial leafhopper 'kudda'; it is the best quality of chat

B. The 'kudda-kerti' group (irrigated, dry season crop):
(4) 'Urretta', short and branched chat
(5) 'Fahaka' (or 'tacherro'), a poor quality with old leathery leaves
(6) 'Cheballa'
(7) 'Ferress-azem'.

Paulitschke (1888), mentioned four qualities without specification: 'Arus', 'Gambat', 'Taglej' and 'Walej'.

Uses

1. Use as a stimulant

Chewing of chat is a very old practice in East Africa and Southern Arabia. Some authors believe that the use of chat was known before the use of coffee in these areas (Amare & Krikorian, 1973). Chat chewing is primarily a Moslem habit, although it is gaining popularity also with people of other religions in the area. In the past, chat was chewed by older Moslem men only in association with religious rites (e.g. to keep themselves awake during night prayers and to feel less hungry during fasting days). At present, chat has become a daily necessity for many people in East Africa and South Arabia.

Usually the chewing of chat is practised in a group, and religious and family festivals like births and marriages cannot pass without large amounts of chat being offered to the visitors. The fresh leaves are removed from the branches and a large wad of them is placed in the mouth. If the best quality chat is taken ('kudda'), the branchlets are eaten too. The wad is chewed until all the juices are extracted. Large amounts of water or tea are taken at the same time, but no hot drinks or food. Often a cigarette or pipe is smoked too. The leaves are chewed for periods of up to ten minutes and the residue is swallowed. Usually one bundle of chat of ca 500 g is chewed per person (ca 2 hours chewing). If the chat is taken however as a drug, some people can chew as much as five bundles.

It is a general custom among farmers in the Harar area to chew a bundle of chat in the morning, sitting or lying together under a tree. So stimulated, they can then work very hard without feeling fatigue. In the afternoon, they pause once to eat and chew chat again, after which they continue to work. Here the chat has a beneficial function and if taken in moderate amounts there are obviously no harmful effects. In urban centres, however, chat chewing has become a pastime activity and large amounts are often consumed. The habit then often results in behaviour reminiscent of drug addiction; it can become a social problem (Peters, 1952; Brooke, 1960; Amare & Krikorian, 1973).

The stimulatory effects of chat are proportional to the amount chewed. The first 1.5–2 hours the user feels euphoric; he is gay, excited; his memory is stimulated and he is talkative. The next 4 hours he lives in a world of illusion; he has a feeling of well being, feels intelligent (but with bad concentration); he feels strong (but he is clumsy) and sexually potent (which seems quite imaginary). The following 5–6 hours the chewer enters a state of depression; he is silent, sleepless and feels unhappy. This phase ends in deep sleep and he awakes with a hangover (Le Bras & Frétillière, 1965; Margetts, 1967).

Perhaps the chewing of chat became so popular in the Moslem world as alcoholic drinks are forbidden by the Koran. Chat is praised, even by the Moslem theologians: 'It enables us to pray without becoming drowsy throughout the nights of Ramadan, and to work without tiring from noon to night' (Brooke, 1960).

Ferry (1966) reported that the chewing of chat in Djibouti is a real socio-economic problem. Because of the high prices of chat (air transport!), the men usually spend too much money on their daily bundle, leaving too little for the rest of the family to live on. The chat is called 'salad' ('la salade') and it is not chewed but 'grazed' ('broutée'). In a review of the history of the ethnobotany of chat in Yemen, Radt (1969) considered chat as a 'plague' for that country too.

Quite a lot of literature describes the evil influences of chewing chat, and most chat importing countries once forbad its import. In 1964, the World Health Organization (WHO) ranked chat 'like the amphetamines, perhaps lower', in contradiction to older views that chat was really a drug to which one might become addicted.

Photograph 29. *Catha edulis* market between Harar and Dire Dawa.

According to WHO, 'Inasmuch as a craving for amphetamines exists in certain individuals, it does not generally reach the same degree as is often observed with drugs of morphine-like effect. Toxic psychosis as a result of abuse occurs much less often with chat than with chemically pure amphetamine-type drugs' (cited by Amare & Krikorian, 1973). The eating of chat leaves is limited by bulk whereas pure chemical drugs can be taken almost without a limit.

At present, chat is not forbidden in any country. The governments of the producing and the importing countries profit from the trade by import and export duties.

To a much smaller extent, chat is also used as a dried product:

- A pulverized form is used by older people who cannot chew any more or is taken on journeys to areas where the fresh product is not available. Sometimes honey or sugar are added.
- To a small extent, chat leaves are used to produce a stimulatory kind of 'tea'.
- In Arabia, dried chat leaves are smoked (Amare & Krikorian, 1973).

2. Medicinal uses

In general, chat is used to stop melancholy, to feel no fatigue, hunger or sleep, and to animate conversation (Le Bras & Frétillière, 1965).

In Ethiopia, especially in Hararge Province, people believe that chat can effect 501 different kind of cures, which number corresponds to the numerical value of the letters of its Arabic name ga-a-t (= 400 + 100 + 1) (Amare & Krikorian, 1973).

Some more circumscribed uses, reported or observed in Ethiopia are as follows:

- It is chewed in the belief that it gives protection against pestilence (also in Arabia) (Watt & Breyer-Brandwijk, 1962).
- Infusions are administered to invalids as a cure (Peters, 1952).
- Moslems chew small fragments of the leaves and spit it on the sick while pronouncing a blessing (Peters, 1952).
- Chat is chewed against corpulence and against hysteria and epilepsy (Baldrati, 1946).
- To relieve stomach complaints leaves are boiled in honeywater and drunk in the morning (Siegenthaler, 1963).
- Sap of the leaves is dropped in the eye to cure eye diseases (Gelahun, pers. comm., 1976).
- The bark of the roots is crushed and drunk as a gonorrhoea treatment (Gelahun, pers. comm., 1976).
- Leaves are chewed against common cold and headache.

The following medicinal uses are reported from other countries:

- In Arabia chat is used against bubonic plague (Watt & Breyer-Brandwijk, 1962); it is used also as an astringent medicine. It is believed that a twig of chat carried on the bosom is a certain safeguard against infections (Peters, 1952). It is believed that chat protects against leprosy, cholera and malaria (Baldrati, 1946).
- In Somalia, it is used to stimulate urinary activity and in the treatment of urogenital diseases. It is believed that it protects against malaria (Peters, 1952).
- In Tanzania, the leaves and roots are used as an influenza remedy, the root for stomach troubles and the leaf to improve dental health (Watt & Breyer-Brandwijk, 1962).
- In South Africa it is used against cough, asthma and other diseases of the chest (Watt & Breyer-Brandwijk, 1962; Palmer & Pitman, 1972; Palgrave, 1977).
- Brooke (1960) reported that a chat extract was the principal ingredient of a patent medicine for nervous disorders sold in France around 1900.

According to Watt & Breyer-Brandwijk (1962) extracts of the plant had no antibiotic activity and the plant was of no use in treating loss of memory.

3. *Miscellaneous uses*

The wood of the chat tree is pale golden-yellow to dark-brown, lustrous, very straight-grained, fine and even in texture and moderately hard and strong. It saws and planes well, gives smooth finish and polishes highly without filling. These factors, taken in conjunction with the handsome appearance of the wood, point to its suitability for cabinet-making. The air-dry wood weighs ca 670 kg per m^3. The wood pulp has been reported to be excellent as blotting paper (Dale & Greenway, 1961; Breitenbach, 1963). The wood is borer-proof and is used for making posts and rafters in Kenya and Tanzania (Watt & Breyer-Brandwijk, 1962; Palmer & Pitman, 1972). In Tanzania, the wood is used also to make spoons and combs (Watt & Breyer-Brandwijk, 1962). In the Konso area of Ethiopia, chat is also grown, not to chew the leaves, but only for ritual purposes (Hallpike, 1970). In Hararge, Ethiopia, chat twigs are sometimes placed on a grave for seven days and visitors to the grave chew a twig (Watt & Breyer-Brandwijk, 1962).

Chemical composition

Krikorian & Amare (1973) critically reviewed the literature on the chemical composition of chat. Some of their findings and conclusions were as follows:

- Flückiger & Gerock (1887) reported that no caffein was present in chat (as was believed before). The alkaloid base(s) they isolated was called 'katine' (often changed by later authors into cathine, cathin or katin).
- Mosso (1891) isolated from chat a product called 'celastrina' (celastrin). It is unclear if 'celastrina' is identical with 'katine'.
- Beitter (1900) discovered that the alkaloid content of chat was chiefly in the leaves and bark of young twigs (most probably in total 0.2 g per kg dried leaves). He called the substance 'katin' and believed it to be identical with 'katine' and 'celastrina'. He also noted the presence of an abundance of tannins.
- Stockman (1912, 1913) distinguished three distinct alkaloidal fractions in chat and called them 'cathine', 'cathinine' and 'cathidine'. He suspected also a fourth one, but failed to define those fractions adequately.
- Wolfes (1930) identified D-norpseudoephedrin from chat and called it 'cathin', probably believing it to be identical with Beitter's 'katin'.
- Alles et al. (1961) claimed to have chemically demonstrated the absence of 'substantial amounts' of any extractable bases from chat other than D-norpseudoephedrin.
- Friebel and Brilla (1963) suggested that an alkaloid they obtained as an oxalate, and only from fresh chat plants, might be a labile precursor of D-norpseudoephedrin, from which it could not be differentiated by infrared spectometry or paper chromatography. The suggestion was supported by the findings of various other authors. After drying the plants, the precursor would turn into D-norpseudoephedrin.
- Elkiey et al. (1968) distinguished five alkaloids in chat: ephedrin, edulin, cathin, cathinin and cathidin. They reported that the leaves contained markedly more alkaloids than the branches and stems, and young leaves more than mature leaves (in the mature leaves, fresh or dried, 0.9 g per kg).
- Ascorbic acid is reported in a considerable amount in chat: 1.61 g per kg (Darby, 1959); 1.36 g per kg (in twigs and leaves), 3.25 g per kg in leaves only (Mustard, 1952).
- The following data are available:

Alkaloid content (g/kg):

Beitter (1900)		0.2
Paris & Moyse (1958)	Ethiopia	1.7
	Tanzania	0.7–1.8
	France	1.8
	Lebanon	2.0
Alles et al. (1961)	dried leaves and stems	1.1–1.6
	whole plant	0.2

Ristic & Thomas (1962)	dried leaves	0.2
Elkiey et al. (1968)	fresh or dried leaves	0.9

The alkaloid content of chat seems to vary with the part of the plant examined, the age of the plant, the season when harvested, origin and extraction method.

Tannin content (g/kg):

Alles et al. (1961)	dried leaves and stems	55–79
	whole plant	56–60
El Sissi & Abd Alla (1966)	dried leaves	145.2

Ash content (g/kg):

Beitter (1900)	115.9
Darby (1959)	16

Ascorbic acid content (g/kg):

Mustard (1952)	leaves and twigs	1.36
	leaves	3.24
Darby (1959)		1.61

In Ethiopian chat, Darby (1959) also measured the following substances (g/kg):

thiamine	<0.0005
niacin	0.148
riboflavin	<0.0005
β-carotene	0.018
iron	0.185
calcium	2.90
protein	52
fibre	27

3.5 Cordia africana Lam. **Fig. 19**

'*Cordia*': named by Linnaeus after the German botanist V. Cordus (1515–1544).
'*africana*': from the Latin 'africanus' = 'African', from Africa.

Lamarck, J. B. A. P. Monnet de, Tabl. encycl. 1, 2(1): p. 420, no 1896 (1792).
Type: 'Ex Africa'. '*Cordia* foliis subrotundo-ovalibus, integris; panicula terminali; calycibus turbinatis; drupa nucleo triquetro' (specimen in P. JU. cat. no 6475 with inscription: 'Sebestem prosp. alp. de plant aegypt. Lippi-', lecto.!).

Synonyms

Cordia sebestena var. B *(africana)* Poiret, in, Lamarck, Encycl. 7: p. 45 (1806).
Cordia abyssinica R. Br., in, Salt, A voyage to Abyssinia, app.: p. 64 (1814).
Varronia abyssinica DC, Prodr. 9: p. 469 (1845).
Cordia abyssinica R. Br. var. *acutifolia* Rich., Tent. Fl. Abyss. 2: p. 80 (1851).
Cordia holstii Gürke, in, Pflanzenw. Ost-Africa C: p. 335, t. 41 (1895).
Calyptracordia abyssinica (DC) Friesen, Bull. Soc. Bot. Genève, Ser. II, 24: p. 180 (1931–1932).

Literature

1790: Bruce, Trav. 5, app.: p. 54–56. (use + bot.)
1806: Poiret, in, Lamarck, Encycl. 7: p. 45. (tax.)

1817: Poiret, in, Lamarck, Encycl. suppl. 5: p. 497–498. (tax.)
1845: De Candolle, Prodr. 9: p. 469. (tax.)
1851: Richard, Tent. fl. Abyss. 2: p. 80–81. (tax.)
1867: Schweinfurth, Beitrag zur Flora Aethiopiens: p. 117–118. (tax.)
1888: Ritter von Beck, in, Paulitschke, Harar, Forschungsreise: p. 457. (tax.)
1893: Gürke, *Boraginaceae,* in, Engler & Prantl, Die nat. Pflanzenfam., ed. 1, B. 4, 3a: p. 82–83. (tax.)
1905: Baker & Wright, *Cordia,* in, Flora trop. Afr. 4(2): p. 8–9. (tax.)
1910: Fiori, Boschi e piante legnose dell'Eritrea, Agricolt. Colon. 4: p. 92–96. (tax.)
1912: Chiovenda, Osservazioni botaniche, agrarie ed industriali, Monog. rapp. col. 24: p. 113–114. (bot.)
1950: Aubréville, Flore forestière Soudano-Guinéense: p. 490–493. (tax.)
1951: Eggeling & Dale, Indig. trees Uganda, ed. 2: p. 46–48. (tax.)
1955: Dalziel, Useful pl. W. Trop. Afr., repr. 2: p. 424–425. (use)
1960: Lemordant, Les plantes éthiopiennes: p. 53. (use)
1961: Cufodontis, Enumeratio, Bull. Jard. Bot. État Brux. 31(4), suppl.: p. 766–767. (tax.)
1961: Dale & Greenway, Kenya trees & shrubs: p. 68–69. (tax.)
1961: Irvine, Woody plants of Ghana: p. 727. (tax.)
1962: Watt & Breyer-Brandwijk, Medicinal & poisonous plants S. & E. Afr., ed. 2: p. 148. (use)
1963: Breitenbach von, Indigenous trees Ethiopia, ed. 2: p. 281–283. (tax.)
1963: Heine, *Boraginaceae,* in, Flora West trop. Afr., ed. 2, 2: p. 318–320. (tax.)
1963: Siegenthaler, Useful plants of Ethiopia, Exp. Stn. Bull. 14: p. 19–20. (use)
1964: Haerdi, in, Haerdi et al., Afrikanische Heilpflanzen, Acta Tropica, suppl. 8: p. 150. (use)
1971: Taton, *Boraginaceae,* in, Flore du Congo du Rwanda et du Burundi: p. 3–6. (tax.)
1976: Amare Getahun, Some common medicinal and poisonous plants used in Ethiopian folk medicine: p. 13. (use)
1976: Kokwaro, Medicinal plants East Afr.: p. 38. (use)
1977: Palgrave, Trees of S. Africa: p. 799. (tax.)

Local names: wanza, wanzey, wonsa (Amarinia); wodessa, wadessa (Gallinia); auheh, ehki, auchi, auhi (Tigrinia); diho (Mao); madir, awehé (Saho); bout (Omager); wadicho (Sidamo); mokoto, mokota (Wolamo).
Trade names: Sudan teak (English in E Sudan); Sébestier d'Afrique (French).

Geographic distribution

In Ethiopia *Cordia africana* is a common tree in the highlands and it is reported from all provinces (Bruce, 1970; Cufodontis, 1961, Herb. WAG).

In Africa it is widespread in the tropical regions: from Guinea to Ethiopia and from Sudan to Malawi and Angola. It is reported also from tropical Arabia (Aubréville, 1950; Cufodontis, 1961; Heine, 1963; Taton, 1971).

Description

An evergreen tree, usually 6–10 m high, rarely up to 30 m high, with a rounded to flat, densely foliate crown.

Stem: bole subcylindric, 2–6(–12) m long, 25–60(–100) cm diam., with a smooth or rectangularly reticulate, grey-brown to dark-grey bark; slash pale-yellow, turning darker to brown; heartwood pale-pink; branches subterete, soft-woody, light-green to light-brown, sometimes with prominent ellipsoid light-brown lenticels; twigs brown-green, usually powdery tomentellous, sometimes velutinous.

Leaves alternate (sometimes subopposite), estipulate, simple, coriaceous; petiole subterete, (1–)5–8(–11) cm long, usually slightly grooved above, light-green to yellow-green, powdery tomentellous to villous or woolly, sometimes with cracked, corky, light-brown bands on the upper side; blade usually ovate to elliptic, sometimes orbicular, up to 22(–36) × 18(–33) cm; base usually obtuse, sometimes slightly cuneate, cordate or oblique; apex usually slightly acuminate, sometimes prominently so; margin usually obscurely, irregularly crenate-serrate to dentate, sometimes entire; upper surface shiny dark-green with yellowish veins, glabrous to sparsely powdery tomentellous, rarely woolly at base of the midrib; lower surface yellow-green to brownish-green, with prominent yellow-brown veins, usually villous to woolly, sometimes only powdery tomentellous to glabrous, vesture most prominent on the veins; tertiary veins usually running subparallel; young leaves usually very densely brown soft hairy.

Inflorescence a widely branched panicle, consisting of scorpioid cymes; branches and rhachis usually angular, brown, usually densely powdery tomentellous, sometimes also with longer hairs; pedicel ca 0–1.5 mm long, with same indumentum as rhachis; flower buds subellipsoid to obovoid, at top with a blunt velutinous apicula ca 1.5–2.5 mm long, after anthesis remaining attached to one of the calyx lobes; flowers bisexual, slightly fragrant, all opening within a short time.

Calyx tubular-campanulate, ca 7–9 mm long and 4–7 mm wide, usually irregularly 5-lobed; tube coriaceous with usually 10(–13) prominent longitudinal ribs; lobes subdeltoid, 1–2 × 1.5–4 mm, thinner than the tube tissue, one lobe usually bearing the apicula of the flower bud; dark brown, densely pubescent to woolly outside, especially so on the ribs and the lobe margins, ca glabrous inside, persistent and slightly widening in fruit.

Corolla funnel-shaped, ca 20–27 mm long and 15–25 mm wide, white to creamy-white with contrasting thin veinlets, usually sparsely puberulous outside, glabrous inside, thin subspongy (like tissue-paper), with 5 spreading, emarginate and slightly undulately margined lobes of ca 2.5–5 × 10–15 mm, the main veinlet of each lobe continuing to or beyond the notch as a villous brownish apicula, which is ca 0.5 mm long.

Androecium: stamens 5 (seldom 6), adnate to and inserted ca 3.5–4(–5.5) mm from base in the corolla tube, alternating with the corolla lobes; filaments filiform, 6–9(–12) mm long, upper part glabrous, basal part (2–3.5 mm long) hirsute, white to creamy-white; anthers ellipsoid in outline, deeply cordate at base, 2–3 × 1–2 mm, dorsi-basifixed, dehiscing by two longitudinal slits, brown to grey-black.

Gynoecium: ovary subconical to ovoid, ca 2–4 mm long, 1–3 mm diam., glabrous, light-green, 4-locular, one ovule per locule, sometimes slightly 4-lobed; disc adnate to the base of the ovary, fleshy, cup-like, nectariferous; style 1, filiform, 12–21 mm long (stigma included), bifurcating 2.5–11.5 mm from the base, each branch again bifurcating 9–17.5 mm from the style-base, white to creamy-white; stigmas 4, terminal, linear, ca 0.5–3 long, with a fleshy, finely papillate inner surface.

Fruit drupaceous, ovoid, ca 10–13 mm long, ca 9–11 mm diam., usually acuminate at top; exocarp and mesocarp fleshy, yellow-brown and sweet at maturity; stone with a wall ca 0.5–1 mm thick and usually 4 unequal chambers, each containing 0–1 seeds; the fruit is surrounded by the persistent calyx and disc.

Fig. 19. *Cordia africana* Lam. – 1. habit flowering branch (⅔×); 2. habit fruiting branch (⅔×); 3. detail leaf underside (⅔×); 4. calyx (4⅔×); 5. opened corolla with stamens (1×); 6. pistil (3⅓×); 7. cross-section ovary (10×); 8. fruit with calyx remnants (4×). – 1. W. de Wilde c.s. 10704; 2. **PJ** 5166; 3. W. de Wilde c.s. 10704; 4–7. **WP** 2577; 8. **PJ** 5166.

Ecology

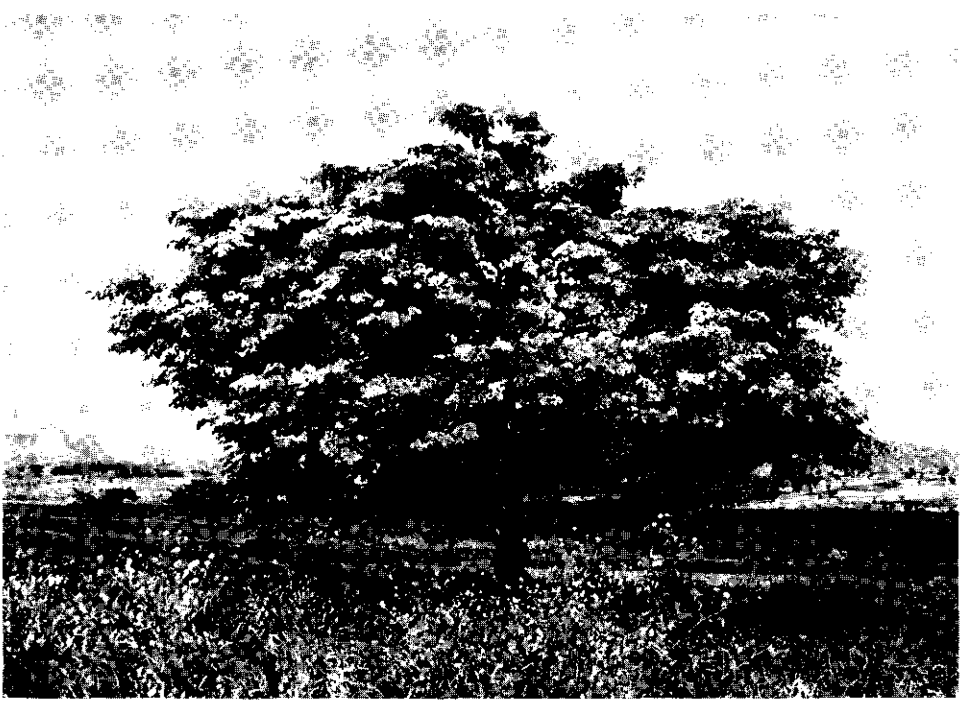
The 'wanza' tree can be found in Ethiopia along streams, in forest borders, on mountain slopes, and, perhaps often planted, near and in villages and cultivated fields, at altitudes of (750–)1600–2200(–2700) m (Bruce, 1790; Schweinfurth, 1867; Fiori, 1910; Breitenbach, 1963; Herb. WAG).

In other parts of tropical Africa, it is reported as a savanna tree, as growing along forest-borders, on wasteland and along streams, and also near and in villages at altitudes up to 2000 m (Aubréville, 1950; Eggeling & Dale, 1951; Irvine, 1961; Dale & Greenway, 1961; Taton, 1971; Palgrave, 1977).

In Ethiopia the tree can be found in flower or in fruit all the year round, but the main flowering period is from October to March. The fruits ripen in three to five months. A flowering tree is spectacular, all the flowers open within a short time and give the tree a white snowy cover (Bruce, 1790).

Husbandry

As a source of useful timber and as a shadow tree in villages and cultivated fields (e.g. in coffee), 'wanza' is sometimes planted and, according to Breitenbach (1963), even cultivated orchard-like. The tree is easily raised from seed, in the nursery or directly in the field (Breitenbach, 1963). Palgrave (1977) reported that germination



Photograph 30. *Cordia africana*, flowering tree between Addis Ababa and Debre Zeit.

seemed rather erratic. Once growth has started, however, the tree grows fast and reaches 6–8 m height within 7 years, after which it flowers profusely. Plantations should be laid out very dense in order to obtain straight stems. Annual prunings are necessary (Breitenbach, 1963).

According to Palgrave (1977) the tree is sensitive to frost, although in Ethiopia a resistance to light frosts has been observed.

Stewart & Dagnatchew (1967) reported a powdery mildew (*Oidium* sp.) on 'wanza' in Shoa and Begemdir Provinces of Ethiopia.

According to Palgrave (1977) ca 1700 seeds weigh 1 kg.

Uses

1. Medicinal uses

In Ethiopia, the following medicinal uses of *C. africana* are reported or were observed:

– Fried leaves are used, together with butter, as a bandage for all kinds of wounds.

– Wood-ash, mixed with butter is used against skin-troubles, locally referred to as 'spider-disease', as people believe that a spider causes the trouble by its excretions on the skin while the people are asleep (Amare, 1976).

Elsewhere the following uses are reported:

– Tanzania: dried leaf powder is used to cure old wounds and a root decoction is drunk against bilharzia (Haerdi, 1964).

– East Africa: the fresh juicy bark of the tree is used to tie broken bones (Kokwaro, 1976).

– South and East Africa: the leaf is eaten by the Masai and the Chagga people as a potent remedy for intestinal worms (Watt & Breyer-Brandwijk, 1962).

2. Miscellaneous uses

– In Ethiopia and elsewhere, *C. africana* is considered as a good kind of timber for building and furniture. The pale-pink to red-brown wood takes a good polish, hardly warps and is very easy to work. It is soft and light, but strong, tough and very durable. Air-dry it weighs ca 450 kg per m^3. It is used, for instance, to make stools, chairs, mortars and pestles, beds, containers and other utensils, beehives, canoes and houses (Eggeling & Dale, 1951; Breitenbach, 1963; Siegenthaler, 1963).

– The fruits are edible. They are very sweet. According to Schweinfurth (1867), eating of the fruit causes slight irritation of the throat. The sweet fruit-pulp, often with honey, is used as a sweetmeat or to sweeten cereal pulp (Dalziel, 1955).

– According to Lemordant (1960), in Ethiopia beehives are often hung in *Cordia* trees when bees are swarming.

– The dried fruits have about the same size as natural sun-dried coffee-berries and they are often mixed with coffee by unreliable merchants (Siegenthaler, 1963).

– According to Bruce (1790), the tree received divine honours in the past in Ethiopia. Under such a tree, the king was chosen and he held his first council under it. His sceptre, a bludgeon, called 'buco', was made from the wood of this tree.

– In Africa, the fibre is used for making cord, for caulking boats and as tying material (Watt & Breyer-Brandwijk, 1962).
– In Nigeria, the bark and the fruits are prepared with stems of *Hibiscus cannabinus* as a tonic and stimulant against fatigue and exhaustion both for man and animal (Dalziel, 1955).

Chemical composition

No data traced.

3.6 Croton macrostachyus Hochst. — Fig. 20

'*Croton*': the latinization of the Greek 'kroton' = 'tick'; the seeds of *Croton* species look like ticks.
'*macrostachyus*': derived from the Greek words 'makros' = 'large', and 'stachus' = 'spike'; with large spike-like inflorescence.

Hochstetter, C. F., on the printed labels of the 'Schimperi iter Abyssinicum' collection, 'sectio secunda', No 1134 (1842).
Type: from Ethiopia, 'Abor prope Schoata'. 'd. 15 Juli'. 'Schimperi iter Abyssinicum' collection, 'sectio secunda', No 1134 (specimen present at L lecto.!).

Nomina nuda

Croton acuminatum R. Br.. In: Salt, Voy. Abyss. app.: p. 65 (1814).
Rottlera schimperi Hochst. et Steud., label Schimperi iter Abyss. coll. sect. 1: No 196 (1840).

Synonyms

Croton macrostachyus Hochst. ex Del.. In: Ferret & Galinier, Voy. Abyss. 3: p. 158 (1847).
Croton macrostachys Hochst. ex Rich., Tent. fl. Abyss. 2: p. 251 (1851).
Croton zambesicus Auct. non Müll. Arg., De Wild., Ann. Mus. Congo Belge Bot., Ser. 5, 2: p. 278 (1908).
Croton guerzesiensis Beille, Bull. Soc. Bot. Fr. 61, Mém. 8: p. 294 (1917).
Croton butaguensis De Wild., Rev. Zool. Afr. 9, suppl. bot.: p. B16 (1921).
Croton megalobotryoides De Wild., l. c.: p. B18 (1921).
Croton claessensii Vermoesen ex De Wild., Ann. Soc. Scient. Brux. 44, 1: p. 541 (1925).
Croton seretii Vermoesen ex De Wild., l. c.: p. 543 (1925).
Croton mearnsii De Wild., Pl. Bequart. 3: p. 457 (1927).
Croton macrostachys var. *butaguensis* (De Wild.) Lebrun, Essenc. forest. Congo orient.: p. 121 (1935).
Croton macrostachys var. *mollissima* Chiov., Miss. Biol. Borana 4: p. 98 (1939).

Literature

1851: Richard, Tent. fl. Abyss. 2: p. 251–252. (tax.)
1861: Fournier, Des ténifuges employés en Abyssinie: p. 57–59. (use)
1866: Müller-Argoviensis, *Euphorbiaceae*. In: DC, Prodr. 15(2): p. 528. (tax.)
1867: Schweinfurth, Beitrag zur Flora Aethiopiens: p. 35. (tax.)
1912: Chiovenda, Osservazioni botaniche, agrarie ed industriali, Monog. rapp. col. 24: p. 115. (bot. + use)
1912: Fiori, Boschi e piante legnose dell'Eritrea, Agricolt. Colon. 5, suppl.: p. 279–280. (tax.)

1912: Hutchinson. In: Flora trop. Afr. 6(1): p. 772. (tax.)
1935: Lebrun, Essenc. forest. Congo orient.: p. 120–121. (tax.)
1946: Baldrati, Piante officinali dell'Africa orientale, Centro Studi Colon. 32: p. 64–65. (use)
1950: Aubréville, Flore forestière Soudano-Guinéense: p. 193–196. (tax.)
1951: Eggeling & Dale, Indigenous trees Uganda, ed. 2: p. 120–122. (tax.)
1952: Andrews, Flow. Pl. Anglo-Egypt. Sudan 2: p. 60–61. (tax.)
1956: Cufodontis, Enumeratio, Bull. Jard. Bot. État Brux. 26(3), suppl.: p. 419–420. (tax.)
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1976–
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Local names: bissana, bessana, mesanna (Amarinia); makanissa, bakanissa, badessa, alaleh, dogoma (Gallinia); wush, masincho, masincio (Sidamo); tambuch, tambush, tambuk, ambuk, ambuch, tambo, bereri-islamai (Tigre); massaganta (Konso); wago (Kaffinia); amado, businna (Saho).
Trade names: none.

Geographic distribution

C. macrostachyus has been reported from all provinces of Ethiopia (Cufodontis, 1956; Breitenbach, 1963; Herb. WAG).

The species is widespread in Africa from Guinea to Ethiopia and from Ethiopia to Angola and Mozambique (Aubréville, 1950; Cufodontis, 1956; Keay, 1958; Léonard, 1962).

Description

An evergreen tree, up to 25–30 m tall, with a wide, open, ca hemispherical crown.

Stem usually cylindrical, up to 60–80 cm diam. at breast height; bark irregularly fissured and cracked, usually greyish and subglabrous; slash light-brown to reddish-brown; branches usually with long-linear, light-brown lenticels; younger branches and twigs angular to subterete, grey-brown to green-brown, usually densely stellate-hairy.

Leaves alternate, simple, stipulate, glabrescent; stipules linear to narrowly triangular in outline, up to 15 × 0.5 mm, caducous, entire or, usually particularly so near the base, lobed, light-brown, usually densely stellate-hairy outside to subglabrous inside; petiole subterete, up to 12(–20) cm long, usually slightly grooved above and slightly thickened at base, densely stellate-hairy, usually brownish-green, with 2, seldom 4 stipitate glands at the underside near the blade; stipe of gland up to 1 mm long, usually stellate-hairy; gland flat-ellipsoid, ca 1 mm diam., glabrous, fleshy, cream-coloured; blade subcoriaceous, ovate-elliptic or nearly circular, up to 17(–25) × 14(–20) cm, usually acuminate at top, slightly to deeply cordate at base, margin irregularly glandular-subcrenate to subdenticulate, usually rather densely stellate-hairy both sides, dark-green above, whitish-green beneath; veins pinnately arranged, yellow-brown, usually densely stellate-hairy.

Inflorescence racemose, up to 35 cm long, 0–5 cm pedunculate; flowers single, or, more often, in clusters; peduncle and rhachis usually subangular, usually densely stellate-hairy, especially so at base of the flower clusters, light-green to brown-green; bracts linear, up to 5(–7) × 1 mm, caducous, densely stellate hairy outside, subglabrous inside; the flowers more or less arranged in 4 ways, occurring on the same or on different trees:

(1) the inflorescence only bears male flowers, usually arranged in clusters of up to 11 flowers;

(2) the inflorescence bears only female flowers, usually single, seldom geminate;

(3) the inflorescence bears single female flowers in the lower part and clusters of up to 11 male flowers in the upper part;

(4) the inflorescence bears over its whole length clusters of one female flower surrounded by up to 6 male flowers.

All flowers unisexual and fragrant.

Male flowers:

Pedicel usually terete, 3–10 mm long, light-green, densely stellate hairy.

Calyx campanulate, subfleshy, 5-lobed; tube ca 1 mm long; lobes ovate to triangular, 2.5–3.5(–4) × 1.5–3 mm, margin densely white-villous, particularly so around the top, stellate hairy outside to subglabrous inside, light-green, entire.

Corolla: petals 5, oblong to oblanceolate, 3–4.5 × 1–2 mm, margin villous, especially so around the apex, pubescent to subglabrous, light-green.

Androecium: (13–)15–17(–20) stamens, on a hemispherical, villous disc; filaments filiform, 3–5.5 mm long, villous in lower half, subglabrous in upper part, whitish to yellow-green; anthers ovoid to subconical, ca 1–1.5 × 1 mm, yellow, basifixed, dehiscing by 2 longitudinal slits, connective conspicuous.

Gynoecium: absent.

Female flowers:

Pedicel usually subfleshy, subterete, 2–4 mm long, up to 2 mm thick, stellate-hairy.

Calyx: as in male flowers or slightly more triangular, persistent in fruit and sometimes more hairy inside.

Corolla: absent or present with up to 5 vestigial, linear, ciliate petals of ca 0.5–1.5(–3.5) × 0.5 mm.

Androecium: absent or present with up to 2 filiform, glabrous or hairy staminodes, 0.5–3 mm long.

Disc flat, usually white-hairy at margin, fleshy, yellow-brown.

Gynoecium: ovary subglobose, ca 2–3.5 mm diam., slightly 3-lobed, very densely

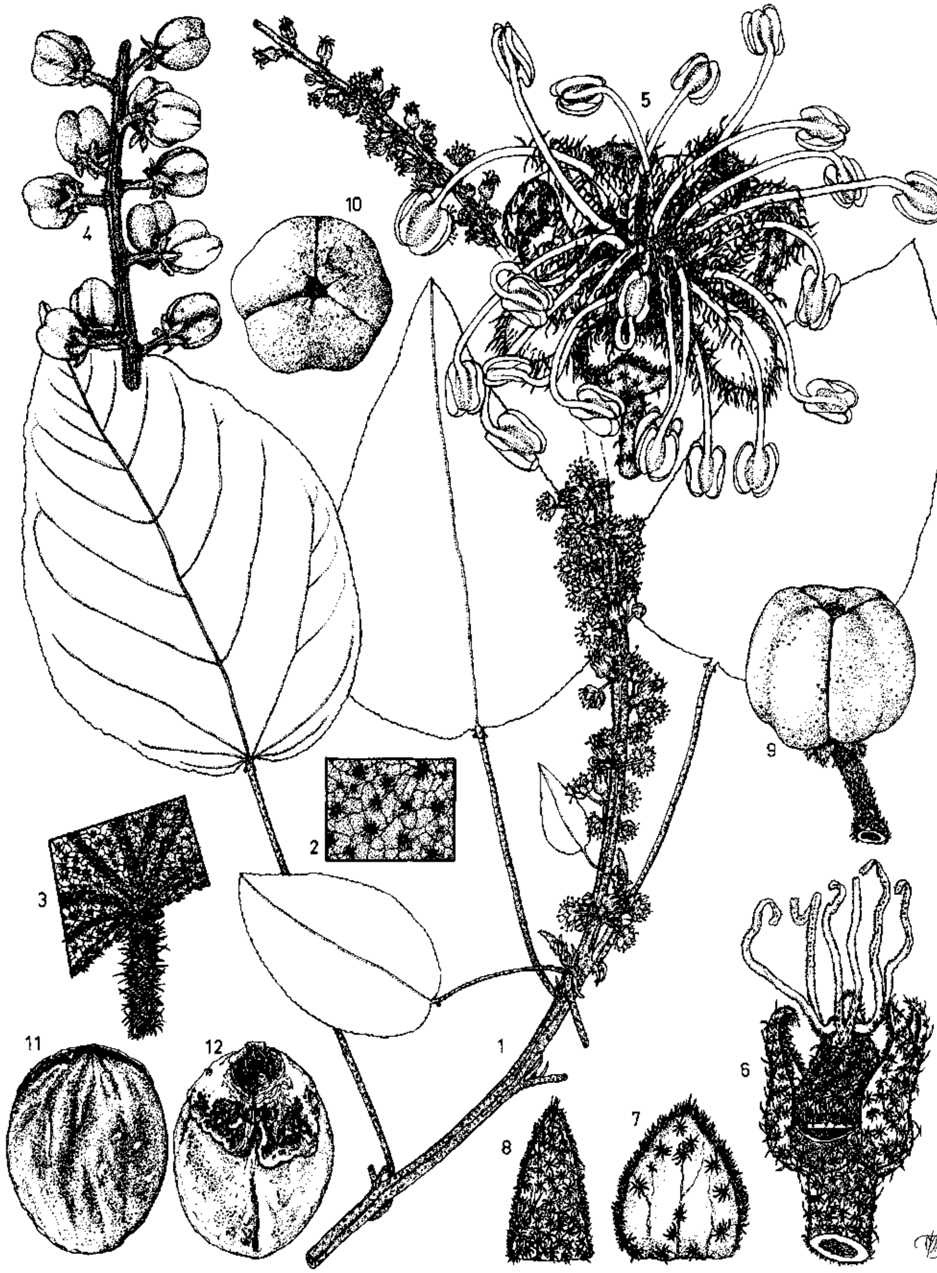

Fig. 20. *Croton macrostachyus* Hochst. – 1. habit branch with leaves and inflorescence ($\frac{2}{3}\times$); 2. detail of leaf upperside ($4\times$); 3. detail leaf underside and top of petiole with two glands ($2\times$); 4. habit fruiting raceme ($\frac{2}{3}\times$); 5. male flower ($6\frac{2}{3}\times$); 6. female flower ($6\frac{2}{3}\times$); 7. sepal male flower, dorsal side ($6\frac{2}{3}\times$); 8. sepal female flower, dorsal side ($6\frac{2}{3}\times$); 9. fruit, side view ($2\times$); 10. fruit, top view ($2\times$); 11. seed, dorsal side ($4\times$); 12. seed, ventral side with caruncle-outgrowth ($4\times$). – 1. J. J. F. E. de Wilde 5801; 2–3. J. J. F. E. de Wilde 4834; 4. W. de Wilde c.s. 8466; 5. PJ 5997 (spirit mat.); 6. J. J. F. E. de Wilde 5801; 7. PJ 5997 (spirit mat.); 8. J. J. F. E. de Wilde 5801; 9–12. PJ 3894.

stellate-hairy, light-green to greyish-brown, 3-locular with 1 ovule per locule; styles 3, divided nearly from base into 2 filiform to linear branches of 3–6 mm length, usually irregularly twisted and curved, finely-papillate over the whole outer surface, dull-yellow to greenish-yellow.

Fruit capsular, loculicidal, subcylindrical, slightly 3-lobed, with rounded, centrally depressed top and rounded base, ca 8–12 mm long, ca 8–12 mm diam.; stalk up to 1 cm long; exocarp thin, densely stellate-hairy, light-brown to grey-green brown, with 3 impressed lines of dehiscence; septa 3, thin papery with a thicker columella, each compartment containing 1 seed.

Seed: subellipsoid, flattened, 6–8 × 4–5.5 mm, usually slightly pointed at top; testa irregularly striate to slightly wrinkled, shiny light-brown to greyish-brown, usually with darker brown to blackish spots; caruncula fleshy, whitish or yellowish, crenately lobed, covering ca $\frac{1}{2}$ to $\frac{2}{3}$ of the raphal seed-side; embryo with a conical-cylindrical radicle of ca 1 mm length and ca 0.75 mm diam. and two flat, thin, ovate cotyledons of ca 1.5 × 1 mm, embedded in a cavity in the copious, yellowish endosperm.

Note: Although this plant normally develops into a tree, it is often collected as a 'shrub'.

Taxonomic notes

(1) Much confusion exists in the literature about the correct name and author of this species. In short the history is as follows:

1814: Brown (in Salt, 1814) published the 'nomen nudum' *Croton acuminatum.*

1840: Hochst. et Steud. published the name *Rottlera schimperi* on a printed label of the Schimperi iter Abyssinicum collection, Sect. 1, No 196. They added on the label: 'nomen Abyssinicum: Tambuch; in regione inferiori septentrionali montis Scholada'. As nothing is said about the plant itself (and neither a reference is made) this is also a 'nomen nudum'.

1842: Hochstetter published the name *Croton macrostachyus* on a printed label of the Schimperi iter Abyssinicum collection, Sect. 2, No 1134 and added: 'Arbor prope Schoata'. Although this addition is very short, it tells something about the plant: it is a tree. As the Code does not define exactly what a description should be, I consider the word 'arbor' as the description of this species and hence the name is valid. Though formally '*macrostachyus*' is not admissible as a descriptive datum to the species name, nevertheless it supplies information about the characteristics of the proposed species. Specimens with this printed information were distributed to several herbaria in the world (like many other Schimper specimens).

1844: Hochstetter again identified a plant of the Schimperi iter Abyssinicum collection, Sect. 3, No 1665, as *Croton macrostachyus* Hochst. On the printed label he added: '(= nr. 1134 sect. 2, ubi planta mascula, et nr. 196 sect. 1, ubi fructifera sub nomine *Rottlera schimperi).* Arbor incolis nomine 'Tambuch' prope Djeladjeranne'.

1847: Delile (in Ferret et Galinier, 1847) published the name *Croton macrostachyus* Hochst. (referring to Schimper No 1665 and No 196) and provided a longer description of the species. At present most authors consider Delile's description as the validation of Hochstetter's name and cite as authors: Hochst. ex Delile.

1851: Richard published the name *Croton macrostachys* Hochst., referring to

Schimper No 1134 and No 1665, accompanied by a longer description. Some authors considered Richard's description as a validation of Hochstetter's name and cite: *Croton macrostachys* Hochst. ex Rich.

(2) I consider Hochstetter's name of 1842 as the correct name for the species. Hochstetter did not designate a holotype of the species. The specimen(s) that were present at Berlin, were destroyed in World War II. I designate as lectotype of *Croton macrostachyus* Hochst. the specimen of the Schimperi iter Abyssinicum collection, Sect. 2, No 1134, present at L. This is a flowering specimen with an inflorescence bearing clusters consisting of one female flower surrounded by up to six male flowers over its whole length.

(3) Concerning the synonyms of this species, I agree with Léonard (1962), who stated: 'La mise en synonymie des taxa précités se justifie aisément par les variations fréquentes de l'indument des feuilles avec l'âge (parfois sur le même rameau), par la nature des inflorescences uni- ou bisexuées ainsi que par les variations dans le nombre des pétales des fleurs femelles (0–5)'.

(4) The description is based on the following specimens:

Arussi	Asella, about 180 km S of Addis Ababa, lower slopes of Mt. Cilalo, alt. 2400 m, 14-2-1966: W. de Wilde c.s. 10038.
Begemdir	Along the road to Ifag, 4 km from Debre Tabor, 23-3-1937: R. Pichi-Sermolli 1653.
Gemu-Gofa	Road Arba-Minch to Soddo, last 50 km along the road, alt. ca 1600 m, 30-9-1975: PJ 3877.
Gojam	About 6 km WSW of Bahar Dar, 11°31'N × 37°21'E, alt. 1850 m, 30-9-1969: J. J. F. E. de Wilde 5801; W of Selcien (Bahr-Dar), 8-2-1937: R. Pichi-Sermolli 1647.
Hararge	2 km from Alemaya, along road to Kombolcha, alt. 2030 m, 10-7-1967: WP 520; Mountain slopes above Alemaya, alt. 2000 m, 11-5-1974: Bos 7803; 13 km from Alemaya College on Awalle road towards Dire Dawa, alt. 1900 m, 22-4-1975: Bos & Jansen 10126, 10127; Road to Alemaya, 1.5 km from gate of College of Agriculture, alt. 2000 m, 11-6-1975: PJ 1516; Road Alemaya-Harar, alt. 2000 m, 6-2-1976: PJ 5143; 6 km N of Asbe Tefari, 9°08'N × 40°50'E, alt. 1700 m, 24-8-1963: W. Burger 3178 (ETH); 64 km from Asbe Tefari, road to Kobbo, alt. 2380 m, 18-8-1967: WP 1326; Awalle valley, about 12 km from College at Alemaya, alt. 1930 m, 7-7-1975: PJ 1965; Bati village (near Alemaya), alt. 2000 m, 23-8-1976: PJ 7027; Chercher highlands near Kharsa, 12 km from the Dire Dawa-Harar junction on the Kulubi road, alt. 2000 m, 10-4-1975: Bos & Jansen 10022, 10023; Chercher highlands, 70 km from Alemaya on road to Asbe Tefari, 3 km out of Chelenko, alt. 2100 m, 18-6-1975: PJ 1618; Road College of Agriculture to Alemaya, ca 1 km from College, alt. 2050 m, 20-7-1967: WP 810; Damata area (near Alemaya), alt. 2000 m, 14-4-1976: PJ 5997; About 17 km on the road Dire Dawa-Harar, 9°29'N × 41°54'E, alt. 1600–1700 m, 29-3-1969: J. J. F. E. de Wilde 4834; Feddis road, ca 4 km S of Harar-Dire Dawa road junction at the access to Harar, alt. 1900 m, 10-7-1974: Bos 8124; Gara Mulatta, south slope, alt. 2460 m, 30-4-1976: PJ 6129; About 8 km from Harar to Dire Dawa, 9°21'N × 42°04'E, alt. 2000 m, 18-1-1969: J. J. F. E. de Wilde 4435.
Kefa	5 km from Bonga-Jimma road, alt. 1700 m, 30-8-1974: Bos 8423; About 20 km W of Jimma, alt. 2000 m, 5-6-1965: W. de Wilde c.s. 6990; Wush-wush tea plantation (near Bonga), alt. 1900 m, 23-3-1976: PJ 5468.
Shoa	About 35 km S of Addis Ababa, alt. 2000 m, 1-4-1965: W. de Wilde c.s. 6077; About 30 km W of Addis Ababa, Menagesha State Forest, alt. 2500 m, 10-4-

1965: W. de Wilde c.s. 6181: 9 km from Nazareth, on road to Asella, alt. 1710 m, 31-8-1967: WP 1510; About 10 km S of Shashamane, alt. 1900 m, 18-6-1965: W. de Wilde c.s. 7124.

Sidamo — Awasa, NE of lake Awasa, alt. 1700 m, 22-10-1965: W. de Wilde c.s. 8466; Awassa, near the lake, alt. 1600 m, 1-10-1975: PJ 3894.

Wollega — Road Addis-Lekemt, 45 km before Lekemt, alt. 1785 m, 15-5-1976: PJ 6240.

The following specimens, originating from Ethiopia, were seen: J. Ash 236 (K), 399 (K), 1058 (K); P. R. O. Bally 9230 (K); E. Beals B 119 (K); A. Bellini 280 (FT), 288 (FT); P. Benedetto 405 (FT); R. Bricchetti 83 (FT), 174–175 (FT); W. Burger 591 (ACD, K), 779 (ACD, FT, K), 991 (ACD, K), 3178 (ACD, K); L. Buscalioni 383 (FT), 1232 (FT), 2057 (FT), 2134 (FT), 2299 (FT); D. R. Chaffey 279 (K); R. E. Cheesman 7441 (BM); Chiovenda 375 (FT), 462 (FT), 2733 (FT); R. Corradi 5726 (FT), 5832 (FT), 5841 (FT), s.n. (FT); G. Cufodontis 312 (FT), 432 (FT); E. Drake s.n. (P); Drake-Brockman s. n. (K); A. Fiori 175–177 (FT); I. Friis c.s. 28 (K); M. G. A. S. B. Gilbert 1316 (K); J. B. Gillett 5088 (FT, K), 14419 (K); D. Giugliarelli 543 (FT); C. F. Hemming 1196 (BM, FT, K), 1200 (BM); E. M. Hering 6441 (K); R. G. Hillier 947 (K, P); F. Hummel 73 (K); J. Jannone 4 (FT); G. Mangano 20 (FT); F. G. Meyer 7433 (K), 7744 (K); Milizia forestale 664 (FT), 681 (FT), 1023 (FT), 1322 (FT), 1400 (FT), 1596 (FT), 2354 (FT); H. F. Mooney 4803 (FT, K), 5347 (FT, K), 7354 (K); G. Negri 284 (FT), 515 (FT), 518 (FT), 698 (FT), 934 (FT); Neuville s.n. (Rothschild 3-8-1904) (P), s.n. (Tchorré 21-8-1904) (P); A. Pappi 170 (FT), 953 (FT, L, P), 1257 (FT), 1469 (FT), 1792 (FT), 3010 (FT), 3369 (FT); R. E. Perdue 6290 (K), 6315 (K); A. Petit 81 (1 juin-23 juillet, 1841, 4ᵉ envoi) (P); R. Pichi-Sermolli 1638–1642 (FT), 1643 (FT, K), 1644–1645 (FT), 1646 (FT, P), 1647–1654 (FT), 1655 (BM, FT), 1656 (FT), 1686 (FT); F. G. Piovano 521 (FT); Plowden s.n. (Abyssinia) (K); Quartin-Dillon et Petit 1 (Massoua à Adowa) (P), 10 (vallée Chahaguené) (P), 81 (dernier envoi 1844) (P), s.n. (A. de Franqueville 92) (K, P), s.n. (A. de Franqueville) (P), s.n. (dernier envoi 1844) (P); Rochet d'Hericourt s.n. (1842 Choa, Abyssinie) (BM); P. Rovesti s.n. (FT); Ruspoli & Riva 152 (FT), 1287 (FT); D. Saccardo s.n. (FT); W. Salt s.n. (Abyssinia) (BM); Schimperi iter Abyss. 196 (BM, FT, K, L, P), 1134 (BM, FT, K, L (lectotype), P), 1665 (BM, FT, K, L, P); Schimper 95 (plantae Abyssinicae ex Tigre v. Begemder, 1863–8) (BM); Schimper s.n. (Capt. Pulleu, 1863) (K), s.n. (Amba-Sea 18-6-1856) (P), s.n. (Amba-Sea 19-6-1856) (P); W. Schimper 1693 (P), s.n. (K, P); Schweinfurth & D. Riva 1759 (FT, K, P); H. Scott 332 (K); L. Senni 1069 (FT), 1400 (FT); I. E. Siegenthaler X-24 (K); V. Sotto 833 (FT); Steudner 999 (K); E. Taschdjian 128 (FT); A. Terracciano & A. Pappi 89 (FT), 314 (FT), 613 (FT), 726 (FT), 808 (FT), 1027 (FT), 1251 (FT), 1288 (FT), 1328 (FT), 1503 (FT); A. Vatova 2123 (FT), 2133 (FT); O. West 5815 (K); W. de Wilde c.s. 7124 (K).

Ecology

Croton macrostachyus is a common tree in the highlands of Ethiopia, growing at altitudes of (1400–)1600–2500(–3400) m. It can be found on mountain slopes, in (secondary) forests (where it reaches its largest size), on the edge of thickets, in borders of cultivated fields, on waste ground, and along rivers and lakes. Its main flowering period is from April to September. A flowering tree spreads a fragrant sweet smell. Fruits are mainly found from February to October (Herb. WAG; Schweinfurth, 1867; Fiori, 1912; Cufodontis, 1958; Breitenbach, 1963).

From other countries, it has been reported as a savanna tree with altitudinal range between 700 and 2300 m (Aubréville, 1950; Keay, 1958; Dale & Greenway, 1961; Léonard, 1962).

From Ethiopia, Lotto & Nastasi (1955) reported the insects *Pulvinaria* sp. and *Saissetia oleae* Bern. as occurring on it. Stewart & Dagnatchew (1967) reported that in Harar Province a leaf spot was caused by the fungus *Cylindrosporium* sp. or *Phaeophleospora* sp. They reported also the occurrence of a semiparasitic plant (*Loranthus* sp.) on it in Shoa Province.

Husbandry

No data available. As far as known, the plant is not cultivated but often retained in gardens and fields for its wood and its medicinal value (pers. obs. 1975–1977; Kloos 1976/1977).

Photograph 31. Man climbing in *Croton macrostachyus*, near Wush-Wush.

Uses

1. Medicinal uses

From Ethiopia the following medicinal uses are reported:

– The pulverized bark is used together with dried kosso flowers *(Hagenia)* (soaked in water overnight) as a very effective purgative and anthelmintic (Cufodontis, 1956; Lemordant, 1960; Breitenbach, 1963; Amare, 1976). According to Fournier (1861) and Schweinfurth (1867) the inner parts of the bark of female individuals is mainly used.

According to Kloos (1976–1977) the bark is usually not mixed with kosso in treatments of children. Women use it during childbirth to prevent blood clotting.

– As a medicine against venereal diseases, people use the fruits, a decoction of the roots, dried pulverized bark in tea or in a thick pasty fluid, the bark of the root in 'tedj' or milk. In general these treatments are considered as severe and they may leave the patient in a weakened condition (Cufodontis, 1956, Lemordant, 1960; Breitenbach, 1963; Siegenthaler, 1963; Gelahun, pers. comm., 1975; Amare, 1976).

– Young shoots are used in treatments against worms (long boiled, ground, with butter eaten with 'injera') and against jaundice (paste from it, together with leaves of *Adhatoda schimperiana,* pepper and butter, eaten with bread; plenty of milk is drunk with it, but meat or oily food must be avoided) (Siegenthaler, 1963; Amare, 1976). Eating of leaves and young shoots (only a small amount) is believed to expel fevers (Baldrati, 1946).

– Against skin diseases, people use ripe crushed fruits mixed with butter or honey, sap of the petiole, ground leaves (sometimes mixed with soil from termite-hills and leaves of *Commelina benghalensis)* (Lemordant, 1960; Gelahun, pers. comm., 1975; Amare, 1976).

– According to Baldrati (1946) and Amare (1976) the seeds and the resin are toxic and are used as a fish poison.

– According to Siegenthaler (1963) some very common medicines are prepared from the blossoms, and a decoction of the roots is used as a laxative.

– According to Baldrati (1946) & Lemordant (1960) oil of the seed is used against ear-inflammations.

– People drink sap of the leaves for headaches; inhaling smoke from burning leaves or drinking the leaf-sap is said to relieve pains of a woman in labour; chewing the root, bark or wood relieves toothache (pers. inf. 1975–1977).

From East Africa Kokwaro (1976) reported the following additional uses:

– A decoction of the leaves or the ash of burned leaves, is used against coughs.

– Sap from fresh leaves is applied on fresh wounds to hasten blood clotting.

– Juice from boiled roots is taken against malaria.

– The tree is most famous because of a superstitious belief: a patient suffering from mumps should trot singing around the tree and the mumps is said to disappear gradually.

Watt & Breyer-Brandwijk (1962) reported that the Chagga use the leaf-sap, together with fresh green leaves of *Embelia schimperi* as an anthelmintic.

2. Miscellaneous uses

– The wood of the tree is suitable for indoor carpentry, ordinary furniture, veneers, inner layers of plywood, boxes and crates. It is cream-coloured, very soft and light, rather fissile, very strong and tough. In the ground, it rots quickly. Outdoors it is prone to be attacked by fungi and algae. It is not suitable for firewood because of the bad smell and smoke when burned. Volumic mass of air-dry wood is ca 540 kg per m^3 (Dale & Greenway, 1961; Breitenbach, 1963).
– Because of the fragrant flowers, beehives are often placed in or near these trees during flowering (Chiovenda, 1912; Siegenthaler, 1963).
– The leaves are used to wash 'talla' containers (Siegenthaler, 1963).

Chemical composition

The seeds contain ca 19% oil. The oil is fluid, slightly viscous, yellow-orange and it is slightly vesicant (Mensier, 1957).

According to Watt & Breyer-Brandwijk (1962) the bark contains crotin.

Extracts of the whole plant have been screened by the Cancer Chemotherapy National Service Center (USA) with negative results. However, crotepoxide ($C_{18}H_{18}O_8$), a cyclohexane diepoxide, present in the fruits, inhibits certain tumors in animals (Farnsworth et al., 1969).

According to Baldrati (1946) & Amare (1976) the resin of the plant is more toxic than the insecticide rotenone.

3.7 Embelia schimperi Vatke — Fig. 21

'Embelia': latinization of the Ceylon plant name 'Aembilla'.
'schimperi': named after W. Schimper (1804–1879), the famous German traveller and plant collector in Ethiopia from 1837 on.

Vatke, W., Plantae abyssinicae collectionis nuperrimae Schimperianae enumeratae, Linnaea 40: p. 206–207 (1876).
Type: from Ethiopia, collected near Debra Tabor, at: 'Herroe Gottes Georgis bei Gaffat, 27 Nov 1863'. 'Staude nie frei stehend, klettert auf in hohen Gebüschen im tiefen Schatten, 5400′ über Meer' (Schimper 1432, specimen at BM, lecto.!).

Synonyms

Embelia abyssinica Baker, Fl. trop. Afr. 3: p. 497 (1877).
Embelia kilimandscharica Gilg, Bot. Jahrb. 19, Beibl. 47: p. 45–46 (1895).
Embelia nyassana Gilg, Bot. Jahrb. 30: p. 96 (1902).

Literature

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1902: Mez, *Myrsinaceae,* in, Engler, Das Pflanzenreich, IV 236, H. 9: p. 329–330. (tax.)
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1960: Lemordant, Les plantes éthiopiennes: p. 70–71. (use)
1961: Dale & Greenway, Kenya trees & shrubs: p. 330. (tax.)
1962: Watt & Breyer-Brandwijk, Medicinal & poisonous plants S. & E. Afr., ed. 2: p. 786–787. (use)
1963: Breitenbach von, Indigenous trees Ethiopia, ed. 2: p. 206. (tax.)
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1976–
1977: Kloos, Preliminary studies of medicinal plants and plant products in markets of central Ethiopia, Ethnomedicine 4(1/2): p. 70. (use)

Local names: enkoko, inkoko, ankoko, enikoko, unkoko, angogo (Amarinia, Tigrinia); hanku, kanko (Gallinia).
Trade names: unknown.

Geographic distribution

In Ethiopia, *Embelia schimperi* has been collected in all provinces, except Hararge and Eritrea (Cufodontis, 1960; Herb. WAG).

The plant has been reported also from Angola, Burundi, Cameroun, Kenya, Malawi, Tanzania and Uganda (Mez, 1902; Robijns, 1947; Cufodontis, 1960; Dale & Greenway, 1961; Hepper, 1963).

Description

A dioecious, lianoid, woody climber, more seldom a shrub or a treelet, up to 10 m long.

Stem and branches terete, up to 10 cm in diam., grey-brown, glabrous, covered with prominent ellipsoid greyish lenticels; twigs light-green, glabrous.

Leaves petiolate, alternate, estipulate; petiole slightly canaliculate, up to 1.5 cm long, light-green to red-brown, glabrous or minutely glandular hairy in the groove, leaving a prominent, long persistent scar on the stem after shedding; blade usually obovate, sometimes elliptic, ovate or oblong, up to 12.5 × 5.5 cm, usually slightly more than two times as long as broad, attenuate at base, apex usually acute, sometimes obtuse, slightly fleshy to thick coriaceous, glossy dark-green with very pale-green midrib above, which is sometimes glandular hairy at base, very pale-green with a prominent brown-reddish midrib beneath, glandular dotted (although hardly visible in fresh leaves), margin entire and usually very narrow white membranous.

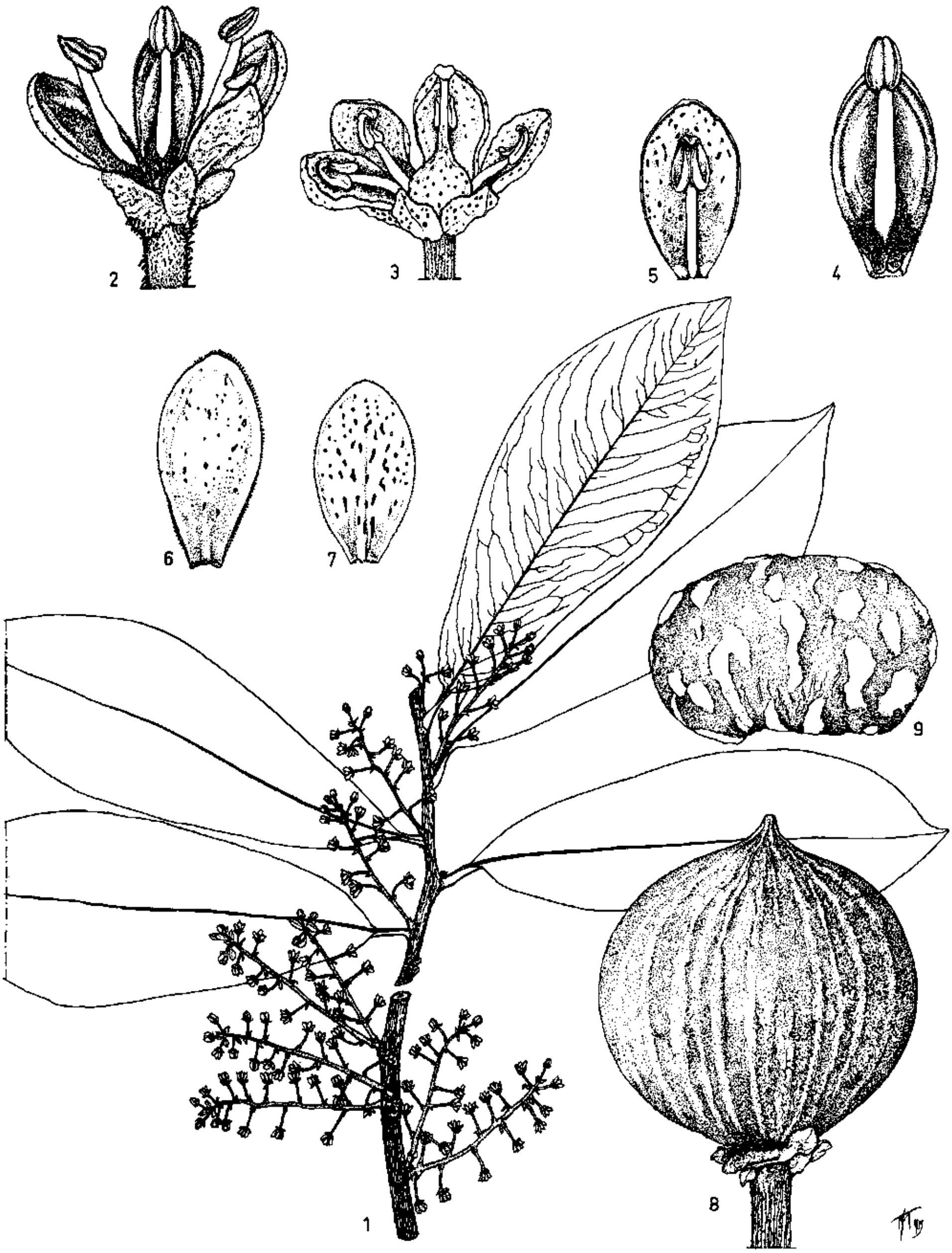


Fig. 21. *Embelia schimperi* Vatke. – 1. habit female flowering branch ($\frac{2}{3}\times$); 2. male flower, one petal removed ($8\times$); 3. female flower, one petal removed ($8\times$); 4. petal and stamen of male flower ($10\times$); 5. petal and staminode of female flower ($10\times$); 6. dorsal side petal of male flower ($10\times$); 7. dorsal side petal of female flower ($10\times$); 8. fruit ($6\frac{2}{3}\times$); 9. seed ($6\frac{2}{3}\times$). – 1, 3, 5, 7. W. de Wilde c.s. 6632; 2, 4, 6. J. J. F. E. de Wilde 6168 (spirit mat.); 8–9. PJ 7030.

Inflorescence an axillary simple raceme, up to 6 cm long, many-flowered; rhachis light-green to red-brown, finely glandular hairy, at base surrounded by numerous, imbricate, triangular, fimbriate, rather stiff pointed, small bracts; bracteoles ca deltoid, sometimes ovate, up to 2.5 × 1.5 mm, fleshy at base, minutely glandular-hairy, usually dark-brown, with glandular spots and lines and a fimbriate to ciliate margin; pedicel up to 7 mm long, finely glandular hairy, light-green to red-brown; flowers usually 5-merous, rarely 4- or 6-merous, ca 2–3 mm long and 4–5 mm wide, unisexual, usually fragrant.

Calyx: sepals shortly connate at base; lobes ca deltoid to triangular, up to 1.5 × 1.5 mm, glandular dotted and lined, sometimes finely glandular-hairy; margin glandular-ciliate; pale yellow-green, usually persistent in fruit.

Corolla: petals slightly connate and fleshy at base, obovate to ovate, ca 2–3 × 1.5 mm, usually largest in male flowers; apex obtuse, margin glandular-ciliate; upper part usually slightly cucullate; pale yellow-green to slightly red-brown, provided with brown glandular dots and lines outside, densely granular-papillate, especially so around the insertion point of the stamen inside.

Androecium: stamens inserted on the base of the petals. In male flowers: filaments filiform, for ca 1 mm adnate to petal base and the free part ca 2 mm long, usually slightly longer than petals, light-green, glabrous; anthers ca ovoid, ca 1–1.5 × 0.5 mm, dorsifixed, yellow, connective with some dark glandular spots, dehiscence by two longitudinal slits. In female flowers: staminodes present; filaments for ca 0.5–1 mm adnate to petal base, the free part ca 0.5 mm long; anthers pyramidal, ca 1 mm long, 0.3–0.5 mm wide, usually shorter than the petals.

Gynoecium: In female flowers: pistil glabrous, green, with brownish glandular spots and lines; ovary subglobose, slightly flattened, up to 1.3 mm diam.; placenta subglobose, ca 1 mm diam., with 3–5 ovules, which are partly embedded in the placenta tissue, more or less arranged in a circle; style filiform, ca 1.5–2 mm long; stigma capitate, irregularly discoid, ca 0.5–0.7 mm diam., yellow-green.

In male flowers: pistillode present; ovary ca 0.5–1 mm diam.; style up to 0.5 mm long; stigma very small.

Fruit a subglobose, usually slightly flattened drupe, up to 8 mm diam.; exocarp and mesocarp pale green, thin, fleshy, turning light-red at maturity; endocarp crustaceous, enclosing one seed, which is totally or partly surrounded by a brown papery membrane (remnants of the placenta and the not developed ovules); the dry fruits are reddish-brown, usually with very fine longitudinal ribs and with a finely acute apex (style base).

Seed subglobose, flattened, up to 6 mm in diam., with a hole at the base; testa brown; endosperm ruminate, horny, copious, grey; embryo small cylindrical, 2–3 mm long, white; the folds in the testa (ruminate endosperm !) are filled with a yellow-brown powdery substance.

Taxonomic notes

(1) Vatke (1876) based the description of *Embelia schimperi* on the Schimper specimens No 1432 and 1493. Schimper 1432 represents specimens in fruit only, collected in Ethiopia at 'Herroe Gottes Georgis bei Gaffat, 5400′ (8400′) über Meer,

27 Nov. 1863'. Schimper 1493 represents specimens in flower (male) and specimens in fruit, collected in Ethiopia at 'Gerra Abuna Tekla Haimanot, 8000' über Meer, die Blüthen vom 20 August, die Früchte vom 18 Dec 1863'. As *E. schimperi* is dioecious, the male and female specimens of Schimper 1493 almost certainly originate from different plants. The specimens seen by Vatke were most probably present at Berlin, but were destroyed in World War II. I designate as lectotype of the species *Embelia schimperi* Vatke, specimen Schimper 1432, present at BM. This specimen bears two branches with leaves and fruits, the printed label: 'Plantae abyssinicae ex Tigre v. Begemder, collegit Schimper a. 1863–8' and a handwritten label with: 'Staude nie frei stehend, klettert auf in hohen Gebüschen im tiefen Schatten, 5400' über Meer. Herroe Gottes Georgis bei Gaffat 27 Nov 63'.

(2) The synonymy of *E. schimperi* is not quite clear. In 1954 Brenan stated: 'The characters used by Mez (1902) and Gilg to separate *E. schimperi* (Vatke, 1876), *E. kilimandscharica* (Gilg, 1894) and *E. nyassana* (Gilg, 1902) elude me'. I agree with Brenan that the descriptions of *E. kilimandscharica* and *E. nyassana* by Gilg and Mez fall within the possible variation of the species *E. schimperi* Vatke. Brenan continued: 'Specimens from SW Tanganyika have been distributed as *E. kagoje* and *E. stolzii,* both of them Gilg's unpublished names, which to me seem to be *E. schimperi.* I suspect that *E. mujenja* Gilg and *E. pellucida* (Hiern) K. Schum. may prove also to be synonymous'.

(3) The description is based on the following specimens:

Arussi — About 5 km NE of Asella, about 170 km SSE of Addis Ababa, alt. 2300 m, 8-5-1965: W. de Wilde c.s. 6632 (f); Asella market, 2-9-1967: WP 1598 (fruits only).

Hararge — Alemaya market, 26-8-1976: PJ 7030 (fruits only); Harar market, 22-3-1976: PJ 5917 (fruits only).

Kefa — Belleta forest, some 40 km SW of Jimma on Bonga road, 7°35'N × 36°38'E, alt. 2000 m, 10-11-1970: I. Friis, A. Hounde & K. Jacobsen 241 (sterile WAG); Bonga, near Roman catholic mission, alt. 2000 m, 14-8-1965: W. de Wilde c.s. 7673 (f), 7698 (f); Ca 45 km from Bonga on the way to Jimma, alt. 1650 m, 18-8-1967: Taddesse Ebba 542 (m + f); Bonga market, 19-7-1975: PJ 2205 (fruits only, mixed with dry *Hagenia abyssinica* flowers and fruits); road to Dekja, ca 25 km from Bonga, alt. 1930 m, 25-3-1976: PJ 5599 (m); about 10 km W of Jimma, alt. 2000 m, 4-6-1965: W. de Wilde c.s. 6949 (f); Maji, 6°11'N × 35°35'E, steep wet slope with waterfall below the Presbyterian mission, alt. 2250 m, 14-1-1970: J. J. F. E. de Wilde 6157 (f), hill just N of Presbyterian mission, alt. 2250 m, 15-1-1970: J. J. F. E. de Wilde 6168 (m); tea plantation area at Wush-Wush (near Bonga), alt. 1960 m, 22-3-1976: PJ 5452 (f).

Shoa — About 5 km NW of Addis Ababa, alt. 2600 m, 27-3-1965: W. de Wilde c.s. 5954 (f); about 5 km NW of Addis Ababa, along Blue Nile road, alt. 2500 m, 23-4-1965: W. de Wilde c.s. 6402 (flower buds).

Sidamo — Ca 13 km WSW of Soddo, ca 6°50'N × 37°40'E, alt. 1900 m, 24-8-1969: J. J. F. E. de Wilde 5589 (f).

Wollega — Conto mountain, about 5 km E of Lekemti, alt. 2500 m, 16-4-1965: W. de Wilde c.s. 6332 (f).

The following specimens, originating from Ethiopia, were seen: Bally 3095 (K); P. Benedetto 391 (FT); I. Friis c.s. 241 (K), 2111 (K); GBW.410 (K); G. Giordano 1158 (FT), 2224 (FT); M. Gutetta 1022 (K); F. G. Meyer 7546 (K), 7919 (K), 7954 (K), 8857 (FT, K); Milizia forestale 1366 (FT), 1745 (FT), 2325 (FT); H. F. Mooney 6945 (FT, K), 8866 (FT, K); G. Negri 254 (FT); R. E. Perdue 6386 (K), 6411 (K), 6495 (K); F. G. Piovano 407 (FT);

Ruspoli & Riva 1639 (FT); Schimper (Plantae abyssinicae ex Tigre v. Begemder 1863–8): 1432 (BM, lectotype, K), 1493 (BM, K); H. Scott 82 (K); L. Senni 744 (FT), 1151 (FT), 2234 (FT); Siegenthaler 1629 (K), X-25 (K); Taddesse Ebba 542 (K); W. de Wilde c.s. 5954 (K), 6332 (K), 6632 (K), 6949 (K), 7698 (K).

Ecology

In Ethiopia, *E. schimperi* can be found growing along creeks on mountain slopes, in dense moist montane forests, in montane thicket-borders around grassy fields, usually climbing in trees or shrubs, at altitudes of 1650–2600 m. The plant flowers and fruits the whole year round, but mainly in the period January to September (herb. WAG).

From the Cameroons, Hepper (1963) reported its occurrence at 1300–2400 m altitude in upland thickets.

As the flowers are (functionally) unisexual, cross-pollination will be normal.

Husbandry

The plant is not cultivated as far as is known. In Ethiopia, the fruits are collected from wild plants and offered for sale on markets, where they are available (usually dry) the whole year round.

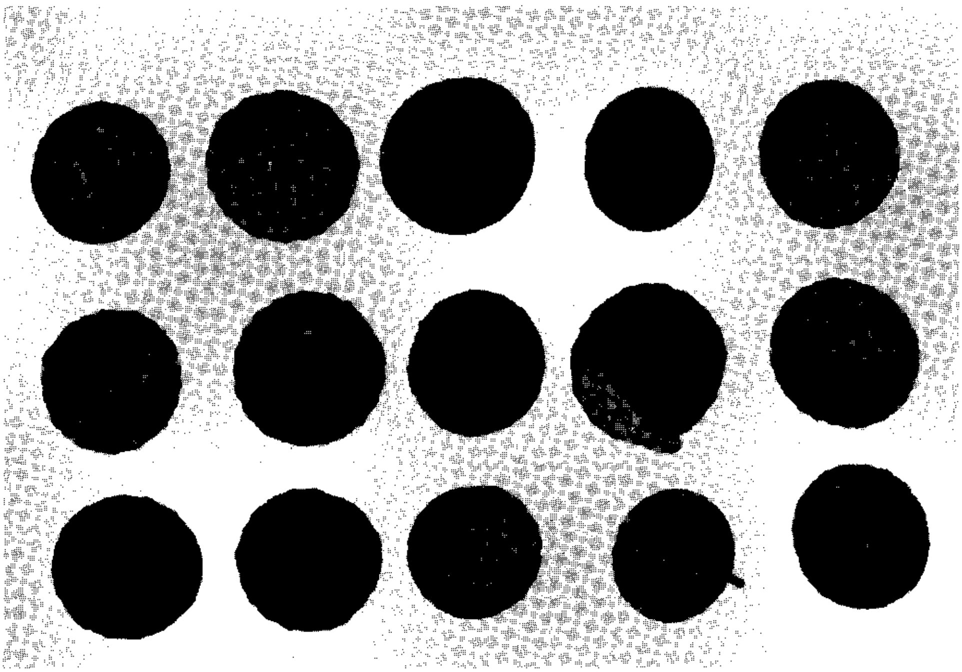
Uses

1. Medicinal uses

– In Ethiopia *Embelia* fruits are, after kosso (*Hagenia*), the most popular worm medicine. Dry fruits are chewed and the juice is swallowed (ca one teaspoon of fruits, three times a day), or the dry fruits are hulled and coarsely ground and one teaspoon of powder swallowed with water three times a day. If this is not effective enough, the fruits are mixed with kosso. The treatment will cause the urine to turn red temporarily. An individual will become very emotional before taking 'enkoko', thus showing his bravery and stimulating his blood flow (Siegenthaler, 1963).

– Lemordant (1960) reported another way of use of 'enkoko' in Ethiopia. A handful of dry fruits is boiled in water for 2–3 hours. Then the fruits are crushed through a coarse sieve and the resulting product is put into two large glasses of water. These are left standing for one night. In the morning the first glass is taken before breakfast and the second three hours later. The first glass induces evacuation of the bowels and half an hour after consumption of the second glass the worm is expelled. For children, honey is often added to the medicine. It is considered as a safe medicine, less dangerous and less strong than kosso, but often used together with kosso, or, when the kosso treatment failed, alone. In the Harar area, the fruits are taken mixed with seeds of *Cucurbita pepo* L. In Tigre the fruits are eaten together with barley grains (Baldrati, 1946).

– Kloos (1976–1977) reported that in Ethiopia the fruits are eaten to expel both tapeworms and roundworms and that the medicine also has antimalarial properties. Some people believe that fresh fruits are more effective than dried ones.



Photograph 32. *Embelia schimperi*, fruits (3×), PJ 7030.

– Besides the fruits, the roots are used as a purgative and as a vermifuge in E. Africa. Roots are boiled or soaked in water and the infusion is drunk. In Tanzania the fruits are the most popular anthelmintic. An overdose of either fruits or roots is said to be fatal for humans (Watt & Breyer-Brandwijk, 1962; Verdcourt & Trump, 1969; Gelahun, pers. comm., 1975; Kokwaro, 1976; Amare, 1976).
– The bark, mixed with butter, is a Masai purgative, as are the fruits, which are chewed or crushed and mixed with hot milk or blood (Watt & Breyer-Brandwijk, 1962).
– The leaves are used in E. Africa as a liniment for swollen breasts of mothers. Women with difficulties in childbirth use it to relieve pains (Kokwaro, 1976).

2. *Miscellaneous uses*

The leaves are said to be edible. They have a sorrel-like flavour and are used as a food in Uganda (Dale & Greenway, 1961; Watt & Breyer-Brandwijk, 1962). Verdcourt & Trump (1969) however, reported the death of four calves, with symptoms resembling those of bloat, believed to be caused by this plant.

Chemical composition

The fruit of *E. schimperi* yields 4.8–7.5% of embelin (= embelic acid, $C_{18}H_{28}O_4$: 2: 5-dihydroxy-3-undecyl-1: 4-benzoquinone), and 1% of quercitol. As an anthelmintic, embelin is used in a dose of 0.2–0.4 g.

The plant gives strongly positive alkaloidal tests and is said to yield a toxic protein (Baldrati, 1946; Watt & Breyer-Brandwijk, 1962; Hegnauer, 1969).

3.8 Hagenia abyssinica (Bruce) J. F. Gmelin — Figs. 22, 23

Hagenia Gmelin: nom. cons. prop. versus: *Bankesia* Bruce.
'*Hagenia*': probably derived from and named in honour of Dr C. G. Hagen of Königsberg (1749–1829) by Gmelin in 1791.
'*abyssinica*': derived from 'Abyssinia', an old name for Ethiopia.

Gmelin, J. F., Systema Naturae, ed. 13, vol. 2(1): p. 613 (1791).
Type: from 'the high country of Abyssinia'; Bruce, J., Select specimens of Natural History collected in Travels to discover the source of the Nile in Egypt, Arabia, Abyssinia and Nubia, vol. 5, app.: two plates next to page 74 (1790), lecto.!

Synonyms

Bankesia abyssinica Bruce, Trav. 5, app.: p. 73–76 (1790) (basionym, nom. rej. prop.).
Brayera anthelmintica Kunth, in: Brayer, Notice (1822, fide Pritzel, 1872).
Brayera anthelmintica Kunth var. *psilanthera* Bitter, and var. *epirhagadotricha* Bitter, Feddes Rep. 12: p. 378 (1913).
Hagenia anthelmintica (Kunth) Eggeling, Indig. trees Uganda: p. 188 (1940).
Hagenia abyssinica (Bruce) Gmelin var. *viridifolia* Hauman, Bull. Jard. Bot. État Brux. 22: p. 90 (1952).

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Local names: kosso, cosso, kosso-meder, kusso (Amarinia); duccia, dusha, edo, eta, fieto, hatou, heto, hetou (Gallinia); habbi, hepah (Tigrinia); tchema (Gouragé); kabotz (Arabic). Trade names: cusso, koso, kosso, kooso (English); cossoutier, cousso, cusso, kosso (French); Cusso, Koso, Kosso (German).

Geographic distribution

In Ethiopia, the kosso tree is common and can be found in every province at altitudes above 2000 m. The tree is mainly growing in the wild, but, according to Bruce (1790), it is planted also near churches. In areas where the soil is used for agriculture, the tree can be found scattered in the fields. In uncultivated areas, denser stands may occur. The dried female inflorescences are offered for sale on most Ethiopian markets at ca 5 birr-cts per handful.

Outside Ethiopia, *H. abyssinica* is reported from the mountainous regions of Kenya, Tanzania, Mozambique, Malawi, Zimbabwe-Rhodesia, Zambia, Zaire, Burundi, Ruanda, Uganda and Sudan (Graham, 1960; Cufodontis, 1954). Perhaps it has been introduced in Madagascar (Lemordant, 1972).

Description

A dioecious, rarely a polygamous tree, up to 20 m high, with a rather wide, often umbrella-shaped crown.

Stem: rarely straight, diameter at breast height up to 60 cm; bark pale-brown to red-brown, flaky; the young branches and twigs densely covered with short, villous and long, erect, silvery, soft, often glandular hairs, becoming light-brown to reddish-green when older; the fallen leaves leaving ring-like, slightly raised scars on the twigs, giving them an articulated appearance, gradually peeling off after some years.

Leaves petiolate, compound, up to 50 cm long; petiole up to 15 cm long, with 2, up to 1.5 cm wide, thin, leafy, lateral wings (adnate stipules), nearly as long as the petiole and at base surrounding the twig as a sheath; petiole densely villous with long silky hairs as well; wings often reddish- or brownish-green above, lighter-green beneath, usually rather densely papillate both sides; blade imparipinnate, broadly elliptic in outline, up to 35 × 30 cm, leaflets up to 17, alternate to subopposite, shortly petiolulate to sessile, narrowly oblong to elliptic, ca 9–15 × 2–5 cm, acuminate, slightly obliquely obtuse at base, margin serrate and long silky hairy, the teeth usually ending in a thickened, usually yellowish but sometimes bright red gland; leaflets usually moderately to densely papillate, dark-green, sometimes reddish tinged above, densely papillate and pale-green, with prominent, yellowish, villous and long silky hairy veins beneath, sometimes also with scattered silky hairs on the reticulate smaller veinlets; alternating with the pairs of normal leaflets, much smaller, suborbicular, up to 2.5 cm long, opposite or subopposite pairs of leaflets may occur.

Inflorescence a terminal drooping, much branched many flowered panicle, up to 60 × 30 cm, light-green to yellowish, often bright red tinged; branches villous to long silky hairy, sticky, subtended by leafy bracts, rhachis usually more or less zig-zag; pedicel ca 0–3.5 mm long, densely hairy; subtending bracts orbicular to ovate, ca 3–8 × 2–6 mm, obtuse at top, slightly folded at base and clasping the pedicel, glabrous both sides, margins short to long ciliate; bracteoles 2, (seldom 4), ca reniform, 1.5–7 × 1.5–9 mm, glabrous inside, densely papillate outside.

Calyx a conical, long silky hairy tube (hypanthium) with 2 whorls of green or often reddish tinged lobes; tube 2–3 mm long; in female flowers the outer lobes 4–5, unequal, ovate to oblong, ca 3 × 1.5 mm in flower, up to 10 × 4 mm in fruit, obtuse at top, finely villous both sides, with prominent veins, stiff in fruit; the inner lobes 4–5, irregularly ovate to orbicular, 2.5–4 × 1.5–3 mm, thin, scarcely to densely pilose outside (densest at top and at base), glabrous inside; in male flowers the outer lobes much smaller (ca 1–2 × 0.5–1 mm), the inner ones larger (ca 3–5 × 2–3.5 mm); in both sexes, within the staminal whorl the flower is closed by a thin membrane, leaving only a hole in the center through which the styles pass.

Corolla: petals 4–5, vestigial, scarious, usually oblong, 0.75–1.5 × 0.25–0.3 mm, glabrous, alternating with the inner calyx lobes.

Androecium: In male flowers: stamens usually 15–20; filaments filiform, 2.5–3 mm long, white or yellowish; anthers subovoid, ca 1 × 1 mm, basifixed, 2-celled, yellow, dehiscing by 2 lateral slits.

Fig. 22. *Hagenia abyssinica* (Bruce) J. F. Gmelin. – 1. branch with female inflorescence part ($\frac{4}{9}\times$); 2. leaflet ($\frac{2}{3}\times$). – 1–2. W. de Wilde c.s. 9773.

In female flowers: staminodes ca 15–20, with linear-filiform, up to 1.5 mm long, white filaments and very small, ca 0.25 × 0.25 mm, usually light-brown anthers without pollen.

Gynoecium: In female flowers: pistils usually 2 (seldom 3 or 4), free; ovary ovoid, up to 2 mm long and 1 mm in diam., usually with a tuft of hairs around the top; styles subfiliform, up to 2 mm long; stigmas broadly capitate, ca 1 × 1 mm, roughly papillate to warty, usually brown-green; ovule one per ovary, pendent, subellipsoid, ca 1 mm long and 0.3 mm in diam.; usually only one pistil per flower develops in fruit.

In male flowers: pistillodes; ovary ca 0.5–1 mm long, 0.25–0.5 mm in diam.; styles 0.5–1 mm long; the gynoecium of the male flowers looks rather normal, but apparently it is usually functionally sterile.

Fruit an achene, globose, subglobose or irregularly ovoid, up to 2.5 mm in diam., with a thin, papery, pale to dark-brown, around the top white-hairy pericarp, enclosed by the dry persistent calyx, with the outer calyx-whorl serving as wings.

Seed subglobose or subovoid, only slightly smaller than the fruit, usually with a wrinkled, brown, glabrous testa; endosperm absent.

Taxonomic notes

(1) In 1790 Bruce published in his Travels a chapter on the kosso tree with two drawings, an up to that time unknown plant species. Unfortunately Bruce used two different scientific names:
above chapter (p. 73): Cusso, *Bankesia abyssinica;*
under the drawings (next to p. 74): *Banksia abissinica;*
in the contents report (p. ii): *Bankesia abyssinica;*
in the index (unnumbered): *Bankesia abyssinica;*
in the list of plates (unnumbered): *Banksia abyssinica.*

On p. 76 he stated: 'I have named this beautiful and useful tree after Sir Joseph Banks, president of the Royal Society'. Although one might conclude that '*Banksia*' is the correct spelling of the generic name Bruce had in mind when describing the kosso tree, a letter at Kew, dated 16 December 1789, from Bruce to Banks, proves that Bruce really intended to use the name *Bankesia.* The name *Banksia* should be considered as an orthographic error. The name *Bankesia* Bruce was validly and effectively published and has priority over any other name. However, hardly anyone accepted *Bankesia* because it was considered an orthographic error of the name *Banksia. Banksia,* however, was an occupied name in *Proteaceae.* In consequence the kosso tree became known as *Hagenia abyssinica,* named by J. F. Gmelin in 1791. To avoid change from the well known name *Hagenia,* Hauman (1952) proposed informally and now Jansen, Hepper and Friis (1980), propose formally to conserve the generic name *Hagenia* Gmelin against *Bankesia* Bruce. Cufodontis' statement in 1954 that *Hagenia* was a 'nomen conservandum' was incorrect.

(2) Gmelin (1791) based his description of *H. abyssinica* on the data of Bruce and he referred to Bruce's publication. Bruce gave a description illustrated with two plates: one nice plate shows the habit of a branch with leaves and flowers, the other with details of the female inflorescence, female flowers and one leaflet. The second plate shows also details of the first one. As Bruce's description of the flower is partly

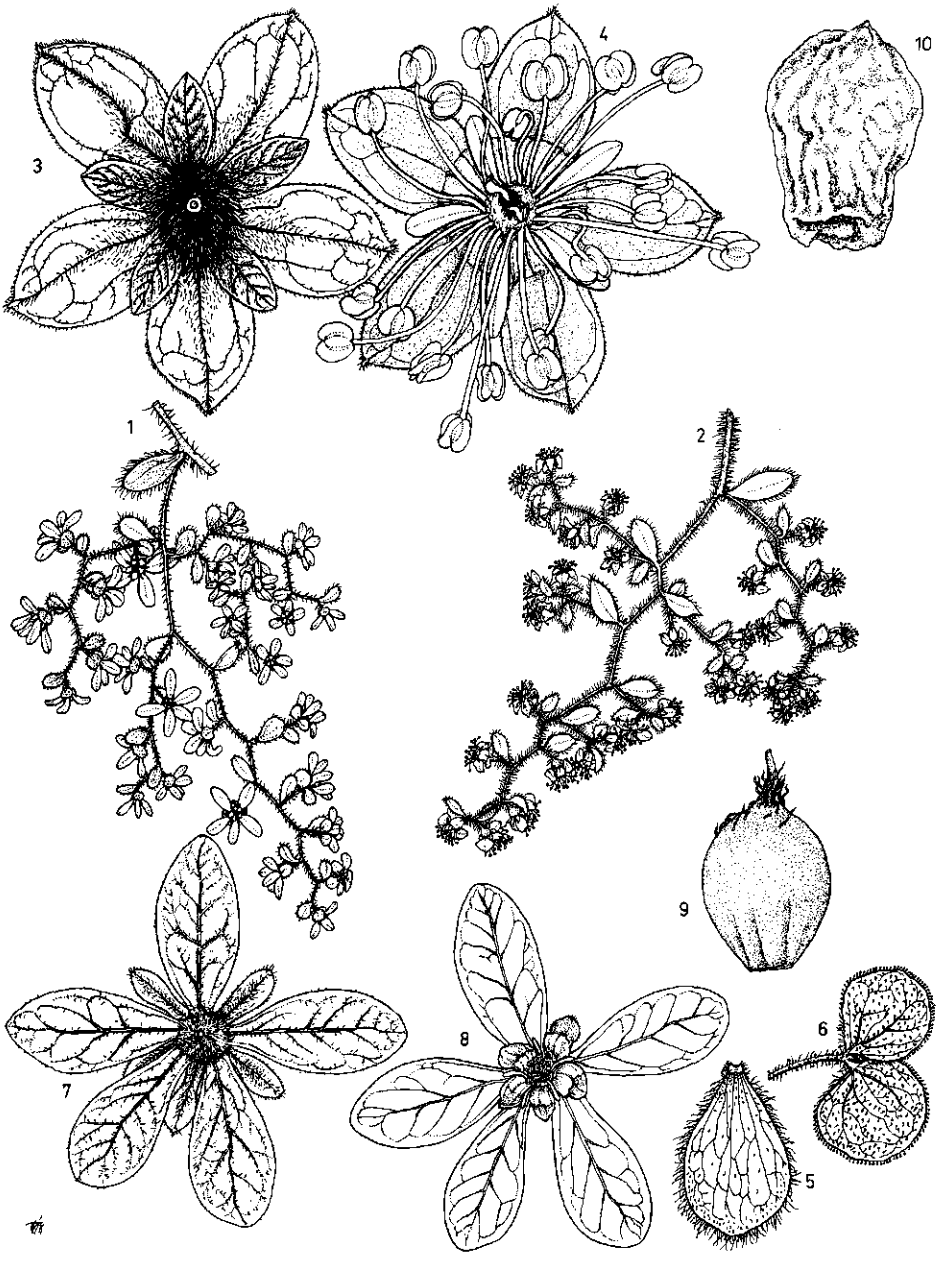

Fig. 23. *Hagenia abyssinica* (Bruce) J. F. Gmelin. – 1. detail female inflorescence-part ($\frac{2}{3}\times$); 2. detail male inflorescence part ($\frac{2}{3}\times$); 3. male flower, underside ($6\frac{2}{3}\times$); 4. male flower, upperside ($6\frac{2}{3}\times$); 5. bract of female flower ($2\frac{2}{3}\times$); 6. bracteole of a female flower ($2\frac{2}{3}\times$); 7. female flower, underside ($2\frac{2}{3}\times$); 8. female flower, upperside ($2\frac{2}{3}\times$); 9. fruit ($8\times$); 10. seed ($16\times$). – 1. W. de Wilde c.s. 9086; 2–4. WP 2441; 5–8. W. de Wilde c.s. 9086; 9–10. PJ 5916.

incorrect. I prefer to designate as lectotype the two drawings.

(3) Lamarck (1793) published *Hagenia abyssinica* (Cusso d'Abyssinia) in Tabl. encycl. p. 442, t. 311, without referring to Bruce, nor to Gmelin, although he obviously used the plates of Bruce (his drawings are exactly the same, only the habit drawing has one leaf less) and the name by Gmelin. In Encycl. suppl. 2(2): p. 422 (1812), Poiret still did not mention Bruce or Gmelin. He remarked that the tree had been discovered by Brown. Some later authors considered Lamarck as the author of *Hagenia abyssinica.*

(4) Willdenow (1799) published *Hagenia abyssinica* also, in Sp. Pl. 2: p. 331, and he referred to Bruce and the name Cusso or *Banksia abyssinica,* but referred *Hagenia* to Lamarck, not to Gmelin.

(5) Kunth (1822) published a new name for the same species: *Brayera anthelmintica.* He based this name on rather poor material, flowers and flower-parts of a pharmacological sample of kosso only. He was followed by De Candolle (1825) and later on this name became the most common name for the kosso tree. According to Fresenius (1837), R. Brown discovered that *Brayera* Kunth was identical with *Hagenia* Willd., the Cusso of Bruce. Fresenius preferred to maintain the name *Brayera* as Willdenow based his description of the plant on the partly incorrect description of Bruce.

(6) In 1940, Eggeling made the combination: *Hagenia anthelmintica* (Kunth) Eggeling. In 1948 finally, Robyns made the correct combination and author citation: *Hagenia abyssinica* (Bruce) Gmelin, and this name is used at present.

(7) By the hairiness of the anthers, Bitter (1913) distinguished two varieties: var. *psilanthera* (anthers glabrous) and var. *epirhagadotricha* (anthers with several hairs). Hauman (1952) distinguished var. *viridifolia* (with subglabrous leaves). Like Graham in 1960, I cannot distinguish these varieties within the Ethiopian material studied.

(8) The description is based on the following specimens:

Arussi West slope of Mt. Boruluccu, along road to Ticcio, ca 25 km SE of Asella, alt. 3100 m, 2-12-1965: W. de Wilde c.s. 9086.

Bale 64 km on road Adaba to Dincho, 1 km from road (Heck's farm), alt. 3100 m, 21-1-1968: WP 3134.

Hararge Alemaya market: PJ 5916, PJ 7032; Road Bedeno-Langhe, 17 km from Bedeno, alt. 2440 m, 26-10-1967: WP 2440, WP 2441; Road Bedeno-Langhe, 19 km from Bedeno, alt. 2525 m, 26-10-1967: WP 2442; Gara Mulatta, ca 20 km N of Alemaya, alt. 2800 m, 3-2-1966: W. de Wilde c.s. 9937; South face of Gara Mulatta, 50 km W of Harar, 9°13'N × 41°46'E, alt. 2700 m, 18-10-1969: J. J. F. E. de Wilde 5836, 5837; Gara Mulatta, just outside Curfacelli, alt. 2400 m, 15-1-1975: Bos 9682; Gara Mulatta, 45 km from road Alemaya-Dire Dawa, alt. 2400 m, 23-10-1975: PJ 4273; Along road to Harawacha, 25 km from Deder, alt. 2620 m, 1-11-1967: WP 2529.

Kefa Bonga market: PJ 2205; 7°34'N × 37°22'E, alt. 2300 m, 27-12-1964: F. G. Meyer 9042; 7°34'N × 37°21'E, alt. 2450 m, 27-11-1970: I. Friis, A. Hounde & K. Jacobsen 493.

Shoa Mt. Entoto (near Addis Ababa), alt. 3000 m, 8-10-1967: WP 1950; Mussolini Pass, Debre Sina side, alt. 2600 m, 19-1-1966: W. de Wilde c.s. 9773; Mt. Uociacia, 15 km W of Addis Ababa, alt. 2800 m, 4-1-1966: W. de Wilde c.s. 9544.

The following specimens, originating from Ethiopia, were seen: J. Ash 1388 (K); Bourg de Bozas (1801) 446 (P); W. Burger 1415 (ACD, K, FT), 2442 (ACD, K); L. Buscalioni 729 (FT); D. R. Chaffey 360 (K); E. Chiovenda (herb. Gavioli No 25706) (FT), 2937 (FT), 3003 (FT); J. O. Cooper s.n. (9-9-26 between Djem-Djem and Kouramboulchi) (K); De Benedictis 340 (FT); I. Friis, A. Hounde & K. Jacobsen 493 (K); J. B. Gillett 5178 (K, FT, P); G. Giordano 45 (FT), 1830 (FT), 1920 (FT); Th. Grant s.n. (camp Dildee, 1-4-1868) (K); Guidotti (1933) s.n. (FT); Hohenack. Arz. und Handelspfl. 19 (P); Massa 66 (FT), 738 (FT); E. A. Mearns 27 (BM); F. G. Meyer 7632 (K), 7951 (K); Milizia forestale 167 (FT); M. Mogk 418 (K); H. F. Mooney 8380 (K, FT); Lt. Napier of Magdala s.n. (29-4-1868) (K); R. Pichi-Sermolli 652–653 (FT), 654 (K, FT, P); Quartin-Dillon et Petit 23 (P), 24 (P), s.n. (FT, P); Rochet d'Hericourt (1849) Choa No 2 (P), s.n. (1845) (P); Rousseau s.n. (Addis Ababa, juin 1912) (P); Ruppell s.n. (Abyssinia) (BM); D. Saccardo s.n. (Dec. 1937); Schimper: Schimperi iter. 920 (BM, K, P), Schimper Urahut (27-10-1862) 659 (BM), W. Schimper s.n. (herb. J. Gay) (K), ex Kralik, Egypt (P), ex A. Prior herb. 12-12-1838 (K), M. W. Schimper 1676 (Dec. 1847) (P), s.n. (P), M. G. Schimper s.n. (Dendera, Dec. 1854, ex herb. Silbermann) (P), Schimper Pl. Abyss. s.n. (distr. 1860) (P), Schimper, Abyssinia s.n. (ex herb. de Franqueville) (P); A. Vatova 809 (FT); W. de Wilde c.s. 9086 (K, P), 9544 (K), 9773 (P).

Ecology

In Ethiopia, *Hagenia* is a dominant tree in subhumid mountain-woodland (2000–)2400–3000 m, and an accompanying tree in humid mountain-woodland (Breitenbach, 1963). Rainfall in the subhumid mountain-woodland ranges from 1000 to 1250 mm per year (Logan, 1946). In this area the tree occurs in pure stands or is accompanied by e.g. *Schefflera volkensii* (Harms) Harms, *Ilex mitis* (L.) Radlk., *Nuxia congesta* R. Br. ex Fres.. In the humid mountain-woodland (2500–3400 m altitude, rainfall up to 1600 mm per year), *Arundinaria alpina* K. Schum. (tree-bamboo) is dominant (Breitenbach, 1963). According to Engler (1910, 1915), the tree occurs in Ethiopia up to 4300 m, but is common and tallest at 3100–3600 m ('auf etwas feuchten Boden').

In the flora of East Africa, Graham (1960) states for *Hagenia:* 'Upland rain-forests, often above the moist bamboo-thickets, and in upland evergreen bushland, 2400–3600 m'.

H. abyssinica is either a male or a female tree, seldom polygamous. In Ethiopia, it flowers between October and February (usually the dry season) (Herb. WAG). On sunny days, the flowers are much visited by bees (Fournier, 1861).

Stewart & Dagnatchew (1967) observed the following diseases on *Hagenia* in Ethiopia:
Coniothyrium abyssinicum Tassi, on the inflorescence;
Phleospora hageniae Castell, on the leaves;
Stigmatea hageniae Castell, on the leaves.

Husbandry

In Ethiopia, the tree is planted around churches (together with *Juniperus),* but cultivation for its medicinal properties is not known (Bruce, 1790; Fournier, 1861). The kosso medicine is collected mainly from plants growing in the wild.

Photograph 33. *Hagenia abyssinica,* flowering tree, Gara Mulatta Mountains.

Uses

1. Medicinal uses

In the past, kosso medicine was very important in Ethiopia and still is to some extent. Bruce (1790), the Scottish traveller who made the kosso tree known in Europe, stated: 'Every individual (Abyssinian) once a month, evacuates a large quantity of worms; these are not the tape worm, or those that trouble children, but they are the sort of worm called *Ascarides*'. Later authors however, identify the worms as tape worms *(Taenia)* (Ferret & Galinier, 1847; Richard, 1847; Flückiger & Hanbury, 1874; and many others). Ferret & Galinier (1847), observing that every Ethiopian from the age of six or seven on has this incommodity, think that the Ethiopian food habits are important for its spread (eating raw meat and injera, drinking beer and impure water). Eating raw meat certainly may be a cause, but the Ethiopian way of eating (all participants eating by hand from one plate) also encourages spread. So, many Ethiopians indeed have to expel the tapeworm every one to three months, and the most used medicine for it is obtained from the dried female flowers of the kosso tree. The female inflorescences are collected and dried and can be used the whole year. Some people however think that fresh flowers are strongest and that old flowers lose strength (Fournier, 1861). On markets, however, one can hardly find fresh flowers. There are many possible preparations and administrations of the medicine. The powdered flowers are put in cold water, in hot water, in beer (talla) or in tedj (honey drink) and usually left for one night. In the morning the medicine is taken before breakfast and after about half an hour to two hours, its laxative action starts. As, according to Ferret & Galinier (1847), the head of the worm is seldom expelled also, the worm can grow again and the one to three months' cycle is created. During the kosso treatment the people are usually isolated and many customs, ceremonies and tales exist around this necessary inconvenience. Johnston (cited by Flückiger & Hanbury, 1874) stated: 'The effects of koso are dreadfully severe. Even in Abyssinia it is barely tolerated and if any other remedy equally efficient for dislodging the tapeworm were to be introduced, koso would be soon abandoned'. Ferret & Galinier (1847) however, are less gloomy. They state that the Abyssinians consider the tapeworm as an incommodity which is inherent in a good constitution. Nevertheless, the kosso drink is strong, and the amount used depends on the health of the person as excess dosages can cause death (Amare, 1978). Usually 8–16 g of dried flowers are used (Watt & Breyer-Brandwijk, 1962). In Ethiopia, however, the amount used may be as high as 35 g (Fournier, 1861). If taken too much, coffee or ether injections are used as an anti-poison. Frequent use can cause gastritis and gastro-enteritis (Lemordant, 1960). Edemariam Tsaga et al. (1978) report that kosso is toxic to mice, but it is not hepatotoxic.

Only female flowers of the kosso are said to be active as anthelmintics, and they are called: 'red kosso'. According to Lemordant (1972), the male flowers cause much more vomiting and are called by the Ethiopians: 'donkey's kosso, dog-kosso or hyena-kosso'. Berhanu Abegaz & Ermias Dagne (1978), however, found no difference in the action of male and female flowers. The name 'kosso' is used in several ways in Ethiopia. It can indicate the tree *(Hagenia)*, the female inflorescence (the medicine), the parasite, or in general a medicine (Lemordant, 1972). The real name of the parasite ('banna' in Amharic) is not used as it has an obscene meaning as well (Fournier, 1861).

According to Lemordant (1972), kosso is often used together with the following plants to render its action more agreeable:

Malva verticillata L. (whole plant, 'let');
Linum usitatissimum L. (seeds, 'telba');
Zehneria scabra (L. f.) Sonder (whole plant, 'haffafalo').

Often, kosso is used in mixtures together with the following plants, which all have also anthelmintic properties (Lemordant, 1972):

Buddleja polystachya Fresen. (whole plant, 'amfar');
Phytolacca dodecandra L'Hér. (fruits and roots, 'endod');
Croton macrostachyus Hochst. (bark, 'besenna');
Euphorbia depauperata Hochst. ex A. Rich. (roots, 'adandash');
Verbascum sinaiticum Benth. (roots, 'ternaha');
Euphorbia schimperiana Hochst. ex Scheele (leaves + flowers, 'handugdug');
Olea africana Mill. (leaves, 'weira');
Grewia ferruginea Hochst. ex A. Rich. (bark of young roots, 'doconnu');
Dichrocephala chrysanthemifolia (Blume) DC, and *D. integrifolia* (L. f.) O. Kuntze (whole plant, 'tabaghidde').

Other medicinal uses of kosso are (Lemordant, 1972):

a) Against syphilis:
– Together with powdered bark of *Albizzia anthelmintica* (Rich.) A. Brong.. One teaspoon of *Albizzia* bark powder + two tablespoons of powdered kosso in a glass of talla, which is prepared from barley only. After drinking the mixture, the disease should disappear after vomiting or diarrhoea.
– Together with *Hibiscus crassinervius* Hochst. ex Rich. ('abba negus').
– Together with leaves and flowers of *Vigna luteola* (Jacq.) Benth. ('wodal asfas', also against inactive ulcers).
– Together with *Eriosema scioanum* Avetta ('embwatcho'), flowers and leaves.
– After kosso and hot water, an ointment of *Smilax mauritanica* Poir. is applied.
b) Against scrophulous tumour, kosso is used together with *Rumex abyssinicus* Jacq. ('makmako').
c) Against cough, kosso is used together with *Rumex steudelii* Hochst. ex Rich. ('tult').

According to Gelahun (pers. comm. 1975), in Ethiopia the kosso is considered as a panacea, and the tree is one of the most useful of the country.

In other parts of the world, kosso has played an important role too. Between 1817 and 1954, kosso was listed in the pharmacopoeias of 29 countries (mostly between 1850–1930). Often sugar or honey were added to suppress the bad taste (Lemordant, 1972). In East Africa the roots of the plant are cooked with meat and the soup drunk against general illness and against malaria, besides its use as an anthelmintic (Kokwaro, 1976). The pounded bark in water is drunk as a remedy for diarrhoea and stomach ache. Hauman (1952) reports that the medicinal use of kosso as anthelmintic is unknown in Zaire, although the plant is common. Kobert (cited by Watt & Breyer-Brandwijk, 1962) thought that the stiff hairs found in kosso may play a part in producing the anthelmintic action.

2. *Miscellaneous uses*

The sapwood of the kosso tree is creamy yellow. The heartwood dark-red to red-brown, soft and light (density 0.552), straight grained with some silver grain when cut radially; the wood is not very durable and subject to attack by borers; it has a handsome appearance and it is very suitable and appreciated for furniture, cabinet work, floors and especially veneers. Kiln-drying is indispensable, since shrinkage in air-seasoning extends over several years. The weight is ca 600 kg per m^3 air-dry wood (Logan, 1946; Eggeling & Dale, 1951; Breitenbach, 1963). According to Chiovenda (1932), the wood is used also for tool preparation in Ethiopia. In Zaire, the wood is used for fences and for the preparation of pans in which the milk is curdled (Hauman, 1952). In the Kilimanjaro area the bark is used for dyeing textiles a yellowish red (Watt & Breyer-Brandwijk, 1962).

Chemical composition

As active principles in *H. abyssinica,* four phloroglucinol derivatives (of the type from the *Dryopteris* ferns) have been isolated: kosotoxin, protokosin, kosidin and kosin (α & β). All are mixtures of isobutyryl, isovaleryl and 2-methylbutyryl side chain homologues of methylene-bis-pseudo-aspidinol. The kosins are presumably located in the typical glandular hairs occurring on the epidermis (Lounasmaa et al. 1973, 1974; Lounasmaa, 1977; Lounasmaa & Varenne, 1978). Bernard et al. (1974) analysed a sample of kosso and reported the following composition: moisture 9%; ash 6.4%; sodium 0.02%; potassium 1.22%; calcium 0.82%; acids 49.5 meq./100 g. They identified six organic acids: fumaric acid (3% of total acidity); α-ketoglutaric acid (3%); succinic acid (3%); glycolic acid (3%); malic acid (59%); citric acid (19%). The following amino acids were identified (in total ca 18.2% of the sample; values are mg/g in dried flower sample): aspartic acid 26.2; threonine 9.2; serine 9.9; glutaminic acid 26.1; proline 14.4; glycocol 9.9; alanine 10.4; valine 10.9; cystine 0.0; methionine 0.4; iso-leucine 10.5; leucine 15.2; tyrosine 5.8; phenylalanine 14.2; histidine 6.1; arginine 12.4. Except for the higher proline content, these values are in accordance with comparable findings in plant tissues.

In a comparative study of different anthelmintics, Berhanu Abegaz & Ermias Dagne (1978) found that the kosins of *H. abyssinica* were as active as dichlorophen and niclosamide.

3.9 Juniperus procera Hochst. Fig. 24

'Juniperus': old Latin plant name, believed by some to have been derived from the Celtic word 'jeneprus' = 'spiny' (juvenile leaves are spinescent), by others from the Latin 'juvenis' = 'young' and 'parere' = 'to give birth to', perhaps referring to the continuous appearance of new leaves or to the use as an abortivum of some species.
'procera': derived from Latin 'procerus' = 'very tall, high'.

Hochstetter, C. F., on the printed label of the 'Schimperi iter Abyssinicum' collection, 'sectio secunda', No 537 (1842).
Type: from Ethiopia (NE of Gondar): 'Ad ecclesiam Adda Mariam prope Enschedcap'. 'Arbor ingens lignum fabricarium praebens'. Schimperi iter Abyssinicum, sectio secunda, No 537 (specimen at P, female branch on sheet ex herb. Steudel, lecto.!).

Synonyms

Juniperus abyssinica Hort. ex C. Koch, Dendrol. 2(2): p. 132 (1873).
Sabina procera (Hochst.) Antoine, Cupress. Gatt.: p. 36, t. 47 (1857–1860).

Literature

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1865: Henkel & Hochstetter, Syn. Nadelhölzer: p. 341–342. (tax.)
1867: Schweinfurth, Beitrag zur Flora Aethiopiens: p. 193. (tax.)
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Local names: ted, tid, zad, sareda (Amarinia); tid, tsadi, zeddi, nerret (Tigrinia); gattira, birbirre, danghesa, daughera, idensa, judes, sareda, serid (Gallinia); dayib, deyib, sigib, tajib, zerida (Somalia).
Trade names: African pencil cedar, cedar, Juniper, red-wood, East-African Cedar, East-African Juniper (English); genévrier d'Abyssinie, genévrier allongé (French); Abessynische Wacholder, Abessynische Sadebaum, Abyssinischer Sevenstrauch, Ostafrikanische Bergwacholder (German).

Geographic distribution

J. procera Hochst. (s.s.) occupies at present an isolated position in East Africa. It has been reported from Ethiopia and Sudan to Zimbabwe-Rhodesia, but it occurs outside Ethiopia and Kenya usually only in rather small patches on mountains. Perhaps the tree used to occupy much larger areas. Perhaps it formed a continuous belt, uniting the present remnants (De Philippis, 1940; Cufodontis, 1953; Melville, 1958; Exell & Wild, 1960; Kerfoot, 1964).

If *J. procera* (s.l.) is considered as a synonym of *J. excelsa* Bieb., the range of the species is immense: from Yugoslavia to western Tien-Shan and from Arabia to Zimbabwe-Rhodesia (Kerfoot, 1975).

In Ethiopia, *J. procera* (s.s.) has been reported from all provinces. It is a fairly common tree of the mountainous regions (Fiori, 1912; Cufodontis, 1953; Herb. WAG).

Description

An erect, evergreen, usually dioecious, more seldom monoecious tree, up to 30(–45) m high; crown conical in outline when young, more spreading when older.

Stem: bole usually straight, conical, usually irregularly and deeply ribbed, ca 1(–3) m diam. at breast height, usually richly branched from base on when young, from some meters height when older; bark grey-brown to reddish-brown, thin, peeling off in suboblong papery flakes; older branches usually glabrous, grey-brown, arching; young twigs ca 1 mm diam., usually covered with scale-like leaves, brown-green to light-green.

Leaves differing with the age of the tree, light-green to glaucous-green; juvenile leaves in whorls of 3, decurrent, acicular, oblong, ca 10(–12) × 1 mm, free upper part ca 7–8 mm long, spreading, whitish spine-tipped, the dorsal side provided with a linear to narrow-elliptic, whitish resin gland, running from base to ca $\frac{3}{4}$ part of the leaf-length, the ventral side usually provided with a whitish waxy central band; gradually the juvenile leaf-form changes into the adult form; adult leaves decussate, scaly, acicular, oblong, ca 1.5–4 × 0.5–1.5 mm, basal part ca square, adnate to the branchlet, upper part free, triangular-concave, ca 0.5–2 mm long, usually slightly appressed to the branchlet, with a narrow scarious margin and dorsally provided with a linear to narrow-elliptic, whitish resin gland, running from base to ca $\frac{1}{2}$ to $\frac{3}{4}$ of the leaf length.

Androecium: cones solitary and terminal, ellipsoid to subglobose, 2–3 × 1.5–2 mm, usually with a short stipe of ca 0.5 mm length at base, yellow-brown, with ca 5–6 decussate pairs of scales; scales subovate to rotundate, peltate, ca 0.5–1.5 × 0.5–1.5 mm, obtuse, thin, light-brown; pollen sacs (1–)2–4 per scale at base inside, the largest basal scales usually bearing 3–4 pollen sacs, the smaller, top scales usually only (1–)2; pollen sacs ovoid to ellipsoid, ca 1 mm long and 0.5 mm diam., pale-yellow, dehiscing by a longitudinal slit; the unopened pollen sacs usually project beyond the base of the scale.

Gynoecium: cones solitary, terminal, usually less numerous than male cones, irregular subglobose in outline, 1.5–2 mm long, 2–3 mm diam., light-brown to bluish-black, at base subtended by 1–2(–3) decussate pairs of small, ovate, light-brown, (sub)persistent bracts; cones composed of (1–)2–3 pairs of decussate scales, ventrally fleshy, inside basally each with 1–2 ovules, 2–8 ovules per cone in total; when the cone is composed of 3 pairs of fleshy scales, the upper pair is sterile usually;

ovules subovoid with a long tubulus which rises just above the surface of the fleshy scale; after pollination the scales become more fleshy and fuse totally, resulting in a berry-like fruit.

Fruit subglobose, ca 5–8.5 mm diam., 1–4(–6)-seeded, turning from white waxy light-green when young to waxy bluish-purple at maturity, the surface bearing the usually brownish small apices of the scales and the scar lines of the fused scales. In the flesh numerous resin-ducts are present. Seeds separated by irregular, false septum-like membranes.

Seed stone-like, irregularly ovoid to pyramidal, 3.5–5.5 × 2–4 mm, acute, often flattened at one or more sides and obscurely angular; testa thick woody, light-brown; embryo white, obconical, with 2 small cotyledons and a long radicle.

Taxonomic notes

(1) In general, three different author citations can be found in the literature for the name *Juniperus procera: J. procera* Hochst. (1842), *J. procera* Hochst. ex Endl. (1847), and *J. procera* Hochst. ex A. Rich. (1851). The last citation is certainly incorrect as it is preceded by Endlicher's validly published name. The question remains whether Hochstetter or Endlicher published the name validly, as they both published the name effectively (Hochstetter on printed labels, accompanying distributed herbarium specimens, Endlicher in Syn. conif. p. 26). One of the conditions for a valid publication of a name is that it should be accompanied by a description or diagnosis of the taxon or by a reference to a previously and effectively published description or diagnosis of it (Art. 32, Code). The Code does not (and in my opinion cannot) define what a description is. Many authors seem to suppose that a valid description should contain at least a diagnostic character of the described taxon. The Code, however, just demands a description or a diagnosis. As it is impossible to define exactly what a description is or should be, one has to accept as a description every pertinent information concerning the characters of a plant, even if this is only one word as for example 'tree' or 'shrub' or 'herb'. If such short 'descriptions' be rejected as invalid, the consequence will be that many established plant names would be rejected. It follows that the Hochstetter name *Juniperus procera* on the printed labels of the distributed Schimper plants is validly published, as the label bears the description: 'Arbor ingens lignum fabricarium praebens' ('A giant tree, which produces (timber) wood'). The description is even diagnostic in this case: *J. procera* is the largest known juniper. So, the correct name for this taxon is: *Juniperus procera* Hochst.

(2) Hochstetter based the name *J. procera* on plant specimens collected by W. Schimper in Ethiopia. The oldest collection of W. Schimper of this taxon is dated July 6, 1838, and was collected 'Ad ecclesiam Adda Mariam prope Enschedcap', which is situated NE of Gondar town in Ethiopia. The labelled plants were distributed in 1842 as No 537 of the 'Schimperi iter Abyssinicum' collection, 'sectio secunda'. Hochstetter did not designate a holotype. The set of Schimper plants kept by Hochstetter was destroyed in Berlin during World War II. The remaining isotypes of Schimper 537 usually show mixtures of male and female plant parts. In general, *J. procera* is described as a dioecious tree. Parlatore (in DC, 1868) however, described

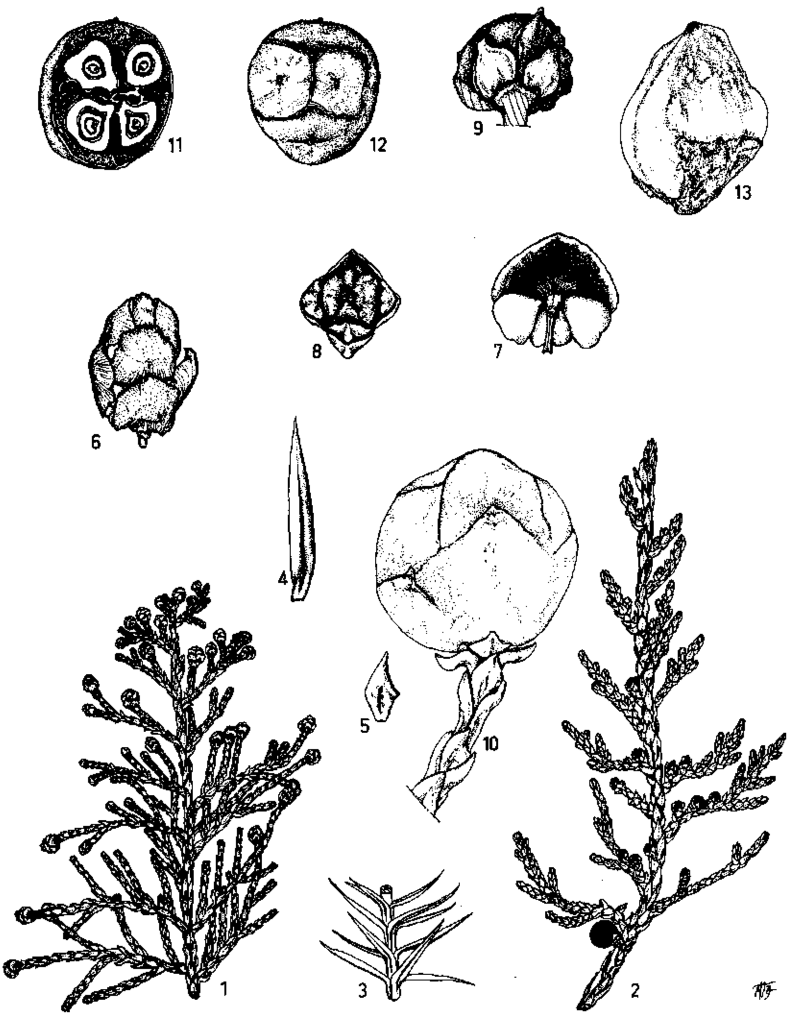

Fig. 24. *Juniperus procera* Hochst. – 1. habit male flowering branch (1½×); 2. habit female flowering branch (1½×); 3. part of branchlet with juvenile leaves (1½×); 4. juvenile leaf (3×); 5. adult leaf (6×); 6. male cone (9×); 7. male cone scale with three pollen sacs (15×); 8. female cone (7½×); 9. opened female cone with two ovules (15×); 10. branchlet with fruit (4½×); 11. cross-section fruit (3×); 12. fruit, top view (3×); 13. seed (6×). – 1, 5, 6, 7. J. J. F. E. de Wilde 4338; 2, 8, 9. W. de Wilde c.s. 8050; 3, 4, 10, 11, 12, 13. J. J. F. E. de Wilde 5991.

it as a monoecious tree. In fact, the Schimper specimen 537 at Paris (sheet ex herb. Steudel) bears one branch that is certainly bisexual (and another, pure female branch). As almost all other examined specimens of *J. procera* are unisexual, I think the taxon is normally dioecious but can exceptionally also be monoecious. It is possible (and in my opinion quite probable) that the Schimper 537 specimens were collected from at least two trees. I designate as lectotype of *Juniperus procera* Hochst. the pure female branch of the Schimperi iter Abyss. collection, sect. sec. No 537 (sheet ex herb. Steudel) present at P.

(3) The real status of *J. procera* Hochst. has always been and still is an unsolved problem. Only a thorough revision of the genus *Juniperus* might clarify this situation. When the name was published, Hochstetter (1842) remarked that *J. procera* Hochst. was 'inter *J. excelsam* M. B. et *virginianum* L. intermedia'. Endlicher (1847) remarked: 'Species *J. foetidissimae* et *J. excelsae* arcte affinis, sed bene distincta'. Richard (1851) was of the opinion that *J. procera* was identical with *J. phoenicea* L. Kerfoot (1961) stated: 'It [*J. procera*] has sometimes been regarded as a variety of the European species *J. excelsa* Bieb., but there is little justification for this assumption'. In 1975, Kerfoot changed his opinion: '*J. procera* Endl. is closely related to *J. polycarpos* Koch (= *J. macropoda* Boiss.), *J. excelsa* Bieb., *J. turcomanica* Fedtsch. and *J. seravschanica* Kom. As a result of taxonomic studies (in litt.) the present author [Kerfoot, 1975] has concluded that we are dealing with a complex generic group with its epicentre in Asia Minor and that all the 'species' cited above are one variable taxon *Juniperus excelsa* Bieb.'.

(4) The description is based on the following specimens:

Arussi	Lower slopes of Mt. Cilalo, near Asella, alt. 2000 m, 10-9-1965: W. de Wilde c.s. 8050.
Bale	Ca 75 km before Goba, on road Shashemene-Goba, alt. 2450 m, 24-6-1976: PJ 6585; Just outside Gobba, alt. 2800 m, 14-2-1973: SL 3110.
Begemdir	Near village Furié (Zeghié), 16-2-1937: R. Pichi-Sermolli 15; Semien mountains national park, along road between Dirne and Dihuara, alt. 2840 m, 13-9-1974: V. Magda 324; Forest near church of Zara Enda Michael, 16-3-1937: R. Pichi-Sermolli 19.
Eritrea	39 km N of Asmara on old road to Massawa, 15-1-1965: Meyer 9098; At the source of the river Mai-Amus near Az-Nefas, 2-11-1902: A. Pappi 3595.
Hararge	Alemaya, college of agriculture, alt. 1950 m, 1-1-1975: Bos 9659; Ca 23 km from Alemaya on road to Kulubi, alt. 2100 m, 21-7-1967: WP 829; Ca 40 km from Alemaya on road to Kulubi, alt. 2260 m, 7-8-1967: WP 1033; Gara Ades, ca 100 km from Alemaya on road to Asbe Tefari, alt. 2500 m, 28-9-1976: PJ 7211; NW side of Gara Mulatta Mts, 9°17'N × 41°43'E, alt. 2700 m, 6-12-1969: J. J. F. E. de Wilde 5991; Mt. Gara Mulatta, about 20 km W of Alemaya, alt. 2800 m 3-2-1966: W. de Wilde c.s. 9909; Between Hirna & Deder along Harar-Addis highway, alt. 2500 m, 15-8-1974: Bos 8313; About 18 km on road from Dire Dawa to Harar, 9°31'N × 42°53'E, alt. 1600 m, 2-1-1969; J. J. F. E. de Wilde 4338.
Shoa	About 5 km NW of Addis Ababa, along Blue Nile road, alt. 2500 m, 23-4-1965: W. de Wilde c.s. 6389.
Tigre	14 km on road Adigrat to Axum, alt. 2200 m, 3-12-1971: SL 2160.

The following specimens, originating from Ethiopia, were seen: P. R. O. Bally 3041 (K), 9183 (K); I. Baldrati 434 (FT), 1700–1701 (FT); G. Bartolommei-Gioli 60 (FT), 66 (FT); N. Beccari 9 (FT); A. de Benedictus 468 (FT), 473 (FT); Bota (M. Griaule) 178 (P); M. Buchinger 1872 (P); W. Burger 1412 (ACD, K), 1453 (ACD, K), 1777 (ACD, K); L.

Buscalioni 345 (FT), 549 (FT), 594 (FT), 727 (FT), 1075 (FT), 1532 (FT),1584 (FT), 1596 (FT), 1954 (FT), 2159 (FT); E. Chiovenda 105 (FT), 1770 (FT); R. Corradi 90–92 (FT), 10508–10512 (FT); G. Cufodontis 7 (FT), 569 (FT); A. Fiori 1–2 (FT), 452 (FT); J. B. Gillett 5109 (FT, K); M. Gordani 127 (FT); G. Gordon s.n. (K); C. F. Hemming 1192 (K); E. J. Herbert 81 (K); Hooker s.n. (K); Jago 16 (K); M. Gutetta 1014 (K); F. G. Meyer 7610 (K), 8104 (K), 9098 (K); R. Milchersich 13 (FT); Milizia forestale 150 (FT), 668 (FT), 1012 (FT), 1544 (FT), 1615 (FT); H. F. Mooney 4705 (FT, K), 5102 (K); G. Negri 278 (FT), 330 (FT); Neuville 23 (P), 194 (P); J. Omer-Cooper s.n. (K); A. Pappi 1125 (FT), 1162 (FT), 2770 (FT), 3595 (FT, P), 3617 (BM, FT), 3751 (FT), 3847 (FT), 3925 (FT), 4327 (FT); M. Pavirani 2 (FT), 13 (FT); R. E. Perdue 6293 (K); A. Petit 118 (P); R. Pichi-Sermolli 15–23 (FT), 24 (FT, K), 25–28 (FT); G. Piovano 93 (FT); Quartin-Dillon & Petit (ex herb. de Franqueville) 101 (P), 103 (P), 107 (K, P), s.n. (Ouedjerate) (P), s.n. (Choho) (P); Quartin-Dillon & Petit 27 (P), s.n. (P); Rochet d'Hericourt 115 (P), s.n. (P); Ruspoli 610 (FT), 690 (FT), 1503 (FT); Russel 133 (P), s.n. (P); Schimperi iter Abyss. coll. 537 (BM, FT, K, L, P: female branch on sheet ex herb. Steudel, lectotype), 919 (BM, P); Schimper plantae Abyss. 501 (K), 532 (FT, P); W. Schimper 144 (K, P); G. Schweinfurth & D. Riva 776 (FT, K, P), 782 (FT, K, P), 1210 (FT, K), 1211 (FT, K, P); L. Senni 150 (FT), 1054 (FT); Sollazzo s.n. (FT), 394–395 (FT); Steudner 1335 (BM, K); Taniani 82 (FT), 107 (FT), 113 (FT); E. Taschdjian 263 (FT); A. Terracciano & A. Pappi 135 (FT), 310 (FT), 651 (FT), 2479 (FT), 2537 (FT); A. Vatova 216 (FT), 1762 (FT); O. West 5873 (K); W. de Wilde c.s. 9909 (K); Zinna Abebe 548 (K).

Ecology

Juniperus procera is a large tree of the mountains of East Africa. It grows mainly between the altitudes of (1600–)2000–2800(–3300) m, rarely as low as 1100 m (Ogaden region Ethiopia) (Herb. WAG; De Philippis, 1940; and many other authors).

The soils on which it grows are described as shallow, red to light-brown, seldom blackish. In general, they are rather fertile. Logan (1946) stated that cleared *Juniperus* forest areas afford valuable arable and pasture lands, especially well suited for cereal cultivation.

In the distribution of *J. procera* over the mountains of E. Africa, most probably the total rainfall and radiation characteristics are important limiting factors (Gardner, 1926; Kerfoot, 1965). The trees are found mainly in the drier parts of the mountain vegetation types, with an annual rainfall of ca 450–1200 mm and a pronounced dry period. It is not known why the tree is not found in areas with a higher rainfall. Perhaps it cannot compete with other species (De Philippis, 1940; Kerfoot, 1964).

J. procera can stand a wide range of temperatures. According to Gardner (1926), it survives even extreme temperatures as high as 65°C and as low as −12°C, but Gardner did not indicate how these data were obtained.

In East Africa, the tree can be found in three vegetation types: in a pure montane *Juniperus* forest, as a dominant tree in montane vegetations and as an accompanying tree in mixed evergreen montane forests. In the non-*Juniperus* forest types, the tree is often associated with other trees of which the most characteristic ones are *Olea africana, Hagenia abyssinica* and *Podocarpus gracilior.* At the best sites the *Juniperus* trees are often loaded with lichens, hanging from the branches (Giordano, 1948 and many other authors).

The trees can be found flowering or fruiting in Ethiopia in all the months of the year (Herb. WAG).

Photograph 34. *Juniperus procera,* tree near Ticho.

The trees are almost always dioecious, they are seldom bisexual (Herb. WAG, P, K, BM).

The berry-like fruits are eaten by animals and birds seem to be especially responsible for the natural distribution of the species (Lind & Morrison, 1974). The seeds must usually be carried away from the parent site, as the seedlings will not develop in a dense shade or in a humus layer on the soil. Open sites at the forest edge or artificial clearings (by fires for example) are the places where *Juniperus* can be expected to regenerate. Such conditions impede quick regeneration of *Juniperus* in nature and less demanding species often repel *Juniperus* (Gardner, 1926).

As *Juniperus* often grows on steep mountain-sides and on sites with unfavourable climate, it is valuable for soil conservation.

Huffnagel (1961) estimated the total area of natural *Juniperus* forests in Ethiopia at 200 000 ha, or ca 3% of the total forested area of Ethiopia. The quality and the amount of wood varies considerably with the different growing conditions or habitats. In the most arid areas the trees are stunted, low branched, knotty and stag-headed and often useless as timber. In other regions, stands of 300–400 m^3 per ha occur, but often with irregular shaped boles or heartrot in old trees. Regardless of the timber usefulness of the trees, they are important for the conservation of soil and water on steep slopes in most areas in Ethiopia where the Junipers grow (Huffnagel, 1961).

J. procera is easily propagated by seed. The seed is sometimes damaged by borers, but is usually viable. About 2000 seedlings can be obtained per kg of fruits (Gardner, 1926). Sowing can be done either with cleaned seed or with whole fruits. If well stored (dry, cool), the seeds remain viable for at least one year, probably much longer. The seed is sown in prepared beds in the nursery, usually in April or May. It germinates in ca 4–6 weeks (rate ca 40%). After ca one year the plants should be hardened off by gradually reducing the shade. When the seedlings are two years old, they are ca 15–25 cm high and ready for planting out. As soon as the rains begin in April, they are usually planted in holes dug beforehand. The plants have proved to be very hardy and there are few losses, even in the driest seasons. In wetter areas, it is perhaps possible to transplant after one year. If *Juniperus* is planted in pure stands, the planting distance is ca 1.20–2 × 1.20–2 m, very dense, to promote self-cleaning in the extreme thicket stage. It is desirable to obtain trees with a clean stem from the very beginning, as prunings result in wounds which increase the risk of fungal attack. Usually, however, the trees are planted mixed with a broad-leaved species. Various species are used, each with their own advantages and disadvantages. Usual advantages are that the soil is in a better condition by the production of a mixed humus and that the risks of fire and diseases are lessened. Quicker growing species have the advantage of producing wood earlier, but the disadvantage that they outgrow the Junipers too early and that when they are cut the Junipers are often damaged. *Olea africana* is considered one of the best companions of *J. procera.* It is planted in alternate rows with *Juniperus,* with a planting distance of 1.50 × 1.50 m. Raising *Olea* seedlings, however, is much more difficult than those of *Juniperus.* It is unknown whether *Olea* cuttings grow easier. Sometimes, if the area to be planted has a scrub cover without high trees, planting lines for *Juniperus* are cut in the scrub 1.80 m apart and 60 cm wide and *Juniperus* seedlings are planted 1.50 m apart in the rows. This method has the advantage that weeding is not needed, only the scrub should be cut back occasionally. In Kenya, this last method gave excellent results (Gardner, 1926; Breitenbach, 1963).

A very serious disease in *J. procera* is caused by the fungus *Fomes juniperinus* (V. Schr.) Sacc. & Syd. The fungus enters the tree through wounds, caused by game, fire or human agency. It is a heartwood disease and it can start very early in the life of the tree, causing large holes, often resulting in almost hollow old trees. The fungus cannot live in dead trees (Gardner, 1926). Stewart & Dagnatchew (1967) reported the following less serious diseases of *J. procera* in Ethiopia: *Capnodium juniperinum*

Bacc., sooty mould, in Eritrea and Hararge; *Ceratostoma juniperinum* Ell. & Ev. on branches in Eritrea and Shoa; *Lenzites abietina* (Bull.) Fr. in Eritrea; *Stereum hirsutum* var. *amplexicaulis* Bacc. on trunk in Begemdir and Eritrea; *Stereum lignosum* Bacc. on trunk in Eritrea; *Tubercularia schweinfurthii* Bres. on the bark in Eritrea.

Mature specimens of the tall highland form of *J. procera* may yield 3–5 m^3 of roundwood. Frequent heartrot and deep bolegrooves however decrease the lumber cut out by about half on average (Breitenbach, 1963).

Uses

1. Medicinal uses

In Ethiopia, the following medicinal uses of *J. procera* are reported;
– A decoction of the fruits is used as a sudoriferum and as an emmenagogue (Cufodontis, 1953);
– The resin is used as a stimulant and as a medicine against ulcers (Baldrati, 1946; Lemordant, 1960);
– The smoke of (fruiting) branches is believed to relieve rheumatic pains (Baldrati, 1946; Lemordant, 1960);
– Ground twigs and buds are used in a treatment against intestinal worms (Amare, 1976);
– Chopped and finely ground leaves, mixed with water, are used as a drench for horses and mules, suffering from stomach disorders (Siegenthaler, 1963).
– Dry powdered leaf parts are used on wounds of humans and animals.
– A decoction of dry young branches is used as medicine against itch of camels (Baldrati, 1946).
– The fruits are used in a mixture with other fruits as a medicine against headaches (Gelahun, 1975, pers. comm.).
– The resin, mixed with honey, is used as a medicine against liver diseases (Gelahun, 1975, pers. comm.).

From elsewhere the following additional uses are reported:
– The heartwood is used as a medicine by the Masai (Watt & Breyer-Brandwijk, 1962).
– Oil from the wood has been used to induce abortion (Watt & Breyer-Brandwijk, 1962);
– The leaves are said to produce a contact dermatitis (Watt & Breyer-Brandwijk, 1962).
– Leaves, browsed in large amounts, may harm to stock, but are unpalatable on account of a resinous flavour (Watt & Breyer-Brandwijk, 1962).
– A cold aqueous extract of the leaf is active against *Mycobacterium tuberculosis* (Watt & Breyer-Brandwijk, 1962).
– The podophyllotoxin (antibiotic), present in *Juniperus* leaves is active against tumours (Lewis, 1977).

2. *Miscellaneous uses*

In Ethiopia (and also in other parts of East Africa), *J. procera* is mainly appraised as a timber tree. In Ethiopia it is one of the major forest species for timber production. Since ancient times, its wood has been used for building and any other indoor or outdoor wood construction (Schweinfurth, 1867; Fiori, 1912; Breitenbach, 1963; and many other authors). In the past, it was considered a sacred tree, used also in church construction and planted around churches and cemeteries. At funerals, the corpse is often strewn with its twigs, before the grave is filled (Harris, 1844; Logan, 1946).

The sapwood is white, limited to a narrow band in mature trees but in poles under 0.5 m diam., it may comprise nearly half the diameter. The sapwood is perishable in the ground and rapidly destroyed by termites. The heartwood varies in colour from pale yellow-brown to deep purple-red, the variations often giving a streaky effect to freshly sawn timber, which, however, turns on seasoning to a more uniform reddish-brown colour. It has a characteristic fragrant smell. The wood is light (air-dry ca 550 kg per m^3), straight-grained with not plainly marked growth zones. It is fissile, it whittles well and works easily, but is rather brittle at the edges and apt to split in nailing. It takes a good polish. In seasoning, the wood is liable to surface checks and end-splitting and it should not be allowed to dry out rapidly in the early stages. As the wood is not attacked by mould fungi there is no danger of stain or decay from preventing rapid initial drying. The wood retains internal moisture and scantlings or baulks are difficult to season properly within a reasonable time. Kiln drying is preferable for this timber. It is a very stable wood once seasoned. The sound heartwood is extremely resistant to termites and is a very durable wood in the ground. It is also resistent to impregnation with oils, and only very thin material, such as the slats used in pencil manufacture, can be satisfactorily impregnated (Dale & Greenway, 1961).

Although the wood is resistant to moisture and termites, it is not recommended for large constructions, because it tends to split (Giordano, 1948). For all constructions that need no nailing, the wood is excellent. From Kenya, the use of the wood for pencils is known worldwide. In many areas of East Africa a lot of wood from *Juniperus* is wasted, because simple tools are used to cut and work trees (Giordano, 1948).

Chemical composition

The bark of *J. procera* contains ca 3.5% of tannin (Watt & Breyer-Brandwijk, 1962). The wood contains ca 2–3% of oil, called 'cedar oil or cedar wood oil', which is usually liquid, with a colour, more or less as the wood and also with a characteristic smell. The most important component of the oil is cedrol (23–76%), which is used in microscopy, in soap and in perfume industries (De Philippis, 1940; Giordano, 1948; Hegnauer, 1962; Watt & Breyer-Brandwijk, 1962).

3.10 Lepidium sativum L. **Fig. 25**

'Lepidium': derived from the Greek 'lepidion', which is a diminutive of 'lepis' ('lepidos') = 'small scale', probably referring to the form of the fruits.
'sativum': derived from Latin 'serere' = 'to sow, to plant, to cultivate'; the grammatical root of 'serere' is 'sat', so the meaning is 'sown, planted cultivated'.

Linnaeus, Sp. Pl., ed. 1: p. 644 (1753).
Type: 'Habitat . . . . [unknown]'. '*Lepidium* floribus tetradynamis, foliis oblongis multifidis'. Specimen LINN 824.11 (lecto.!).

Synonyms

Lepidium hortense Forsk., Fl. Aeg.-Arabica: p. 69 (1775).
Lepidium sativum L. var. *trivalve* A. Braun, Flora 24: p. 266 (1841).
Lepidium sativum L. ssp. *eu-sativum* Thell. var. *silvestre* Thell., Denkschr. Allg. Schweiz. Gesell. Naturw. 41: p. 122–123 (1906).
Lepidium sativum L. ssp. *eu-sativum* Thell. f. *trivalve* Thell., Vierteljahresschr. Zürich. Naturf. Gesellsch. 51: p. 160 (1906).
For more synonyms see Thellung (1906, Die Gattung *Lepidium).*

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1977: Kloos, Preliminary studies of medicinal plants and plant products in markets of central Ethiopia, Ethnomedicine 4(1/2): p. 84–85. (use)

Local names: feto, fetto (Amarinia); circufa, fecio, shimfi (Gallinia); kotto, shimfa, schemfa, sumfa (Tigrinia); shimp (Kaffinia); chifu, shufu (Harar).
Trade names: garden cress, peppergrass (English); cresson alénois, passerage cultivée, nasitort (French); Garten-Kresse, Kresse (German).

Geographic distribution

The true geographic origin of *L. sativum* is not known. Thellung (1906) believed that it originated from NE Africa and SW Asia. Baccarini (1909) mentioned only Iran as country of origin. Stchenkova (1932) stated that a primary centre exists in Ethiopia and a secondary one in Europe and W Asia. Jonsell (1975) cited Schwanitz who considered it to have gene centres in the Ethiopian, as well as in the Mediterranean, Near East and Central Asian regions.

At present *L. sativum* is cultivated all over the world, mainly as a salad plant (seedlings). It is likely that the plants were distributed initially as weeds in flax fields (Thellung, 1906; Stchenkova, 1932).

In Ethiopia, seeds of *L. sativum* are offered for sale on almost every market and the plants are grown in gardens and fields in most provinces (Cufodontis, 1954; Herb. WAG).

Description

An erect, annual herb, ca 20–80 cm high, all green parts usually more or less glaucous; taproot up to 6 mm diam., with many side-roots, whitish to pale-brown.

Stem terete or finely striate, up to 6 mm diam., profusely branched at all heights, glabrous.

Leaves alternate, thin, light-green, usually sparsely villose above, glabrous beneath; basal leaves with petiole of 4 cm length or more, blade ovate or obovate in outline, up to 12 × 9 cm, irregularly pinnate, with ca 5–11 leaflets, in outline ovate or obovate lyrately pinnatisect, the ultimate lobes usually irregularly toothed; the leaflets of the subsequent leaves gradually becoming linear to sublinear, sometimes irregularly toothed; the upper leaves usually simple and linear, sometimes lobed or with teeth, ca 5–10 × 0.2–0.5 cm, attenuate at base, acute at top.

Inflorescence: axillary and terminal racemes, short (ca 1–3 cm) and corymb-like when flowering starts, elongated (up to 25 cm long) at fruiting stage; peduncle and rhachis glabrous, light-green, usually subterete; pedicel terete, ca 1.5–4.5 mm long, glabrous, light-green, making an angle of 20–30° with the rhachis; receptacle slightly thickened.

Calyx: sepals 4, ovate to oblong-ovate, 1–2 × 0.5–1 mm, entire, usually with white scarious margins, light-green, sparsely villose outside, the lateral pair usually concave.

Corolla: petals 4, spatulate, ca 2–3.2 × 0.5–1 mm, usually with a claw ca 1 mm long, glabrous, entire, white or pale-pink.

Androecium: stamens 6, tetradynamous; filaments linear, sometimes narrowly triangular, white, glabrous, the 4 median ones ca 1.5–2.2 mm long, the 2 laterals ca 1.2–2 mm long; anthers basifixed, subellipsoid in outline, ca 0.5 × 0.3 mm, usually violet, dehiscing introrsely by longitudinal slits; glands usually 6, alternating with the filaments, minute, fleshy, pyramidal, white.

Gynoecium: ovary ovate, flattened dorsal-ventrally, ca 1–3 × 1–2 mm, emarginate at apex, the lateral margins wing-like; style terete, up to 0.5 mm long, usually shorter or about as long as the incision in the ovary-top (notch); stigma capitate, finely papillate.

Fruit usually a 2-seeded silicle, orbiculate or ovoid, rather flat, ca 4–6 × 3–5.5 mm, light-green to yellow, sometimes a little pinkish, glabrous, with wing-like margins, emarginate at top, dehiscing by 2 valves, leaving the replum with the white, thin, septum on the pedicel (seldom 3-winged fruits with 3 seeds are produced).

Seeds subovoid, ca 2.5–3 × 1–1.5 × 0.5–1 mm, glabrous, colour varying from light-brown to almost black; embryo pale-yellow, sometimes a bit purplish, with a large radicle and trifoliate incumbent cotyledons which are more or less visible through the seedcoat, endosperm absent.

Seedling: germination epigeal; glabrous, usually light-green; hypocotyl 2–4.5 cm long, sometimes light-violet; cotyledons opposite, petiole ca 1–3 cm long, blade trifoliolate, lobes spatulate, up to 15 × 5 mm, at apex acute or rounded, the lateral lobes usually smaller than the central one; epicotyl 0–4 mm long.

Taxonomic notes

(1) Linnaeus described *L. sativum* in Vir. Cliff. (p. 63, 1737) as '*Lepidium* foliis oblongis multifidis'. In Hort. Cliff. (p. 331, 1738) he changed the description into '*Lepidium* foliis varie divisis incisisque', in Hort. Ups. (p. 183, 1748) and Mat. Med. (p. 322, 1749) into '*Lepidium* foliis oblongis incisis'. Van Royen (Roy. lugbd., p. 335, 1740) copied the description of Vir. Cliff. In 1753 finally, Linnaeus described *L. sativum* in Sp. Pl. (p. 644) as '*Lepidium* floribus tetradynamis, foliis oblongis multifidis'.

As Linnaeus changed the description of this species several times, I prefer to designate as lectotype of the species *Lepidium sativum* L. the only specimen present in the LINN herbarium, No 824.11. This is a specimen with leaves, flowers and fruits. It fits the description well and the sheet bears the inscription '6 *sativum*' in Linnaeus' handwriting, the number 6 corresponding with the order in Sp. Pl. (1753).

(2) De Candolle (1824) distinguished two varieties of *L. sativum*: var. *crispum*, with much divided curled leaves and var. *latifolium*, with flat, hardly divided leaves.

On the basis of colour and form of the leaves, Alefeld (1866) distinguished 6 varieties of *L. sativum*, but his descriptions of these varieties are rather indistinctive.

Thellung (1906), in the latest monographic survey of the genus *Lepidium*, subdivided *L. sativum* into two subspecies: a). subsp. *eu-sativum*, with apex of raceme-axis not spinescent, and b). subsp. *spinescens* (DC) Thell., with apex of raceme-axis spinescent. Within subsp. *eu-sativum*, Thellung distinguished 5 varieties, based on

Fig. 25. *Lepidium sativum* L. – 1. habit upper plant-part ($\frac{2}{3}\times$); 2. basal leaf ($\frac{2}{3}\times$); 3. intermediate leaf ($\frac{2}{3}\times$); 4. intermediate leaf, higher situated ($\frac{2}{3}\times$); 5. flower, one sepal and two petals turned down ($6\times$); 6. sepal ($10\times$); 7. petal ($10\times$); 8. branch with fruit and remaining septum ($4\times$); 9. trivalved fruit ($4\times$); 9a. trivalved fruit, top view ($4\times$); 10. seed ($8\times$); 11. seedling ($\frac{2}{3}\times$). – 1. WP 6636; 2–3. SL 1580; 4. SL 1587; 5–7. WP 7500 (spirit mat.); 8. PJ 4013; 9. PJ 4012; 10. SL 1753; 11. WP 7511 (spirit mat.).

silicle-length and leaf-form, 3 of them being cultivated. In 1913 (in Hegi), Thellung stated that all the cultivated taxa of *L. sativum* belong to var. *vulgare* Alef. (senso ampl. em. Thell.) and within this taxon he distinguished 3 subvarieties. In the second, revised edition of Hegi (1963), this view is still accepted, but the nomenclature was aligned to the Code. Thus the cultivated taxa of *L. sativum* belong, according to Markgraf (in Hegi, 1963), to subsp. *sativum* var. *sativum*. In var. *sativum* 3 subvarieties are distinguished:

a). subvar. *sativum:* cauline leaves pinnately divided or incised, with narrow-apexed, not curled lobes;

b). subvar. *crispum* (DC) Thell.: cauline leaves widened at apex and pinnately incised, especially at apex, with short curled lobes, together forming half a circle;

c). subvar. *latifolium* (DC) Thell.: cauline leaves 1–3 cm wide, entire, toothed or slightly lobate.

In Thellung's classification, the Ethiopian cultivated *L. sativum* specimens would fit into *L. sativum* L. subsp. *sativum* var. *sativum* subvar. *sativum*.

The two subspecies of Thellung are difficult to distinguish. Thellung (1906, p. 126) stated for subsp. *spinescens* 'von der vorigen subsp. nur in ± vorgerückten Reifestadien sicher zu unterscheiden'. Hedge (1965) stated: 'some specimens are intermediate between the two subspecies'. Moreover, their areas of distribution are not separated. Most authors do not accept these two subspecies.

In 1932, Stchenkova rejected the views of Alefeld and Thellung and made a new classification of *Lepidium*, based on the shape of the lower leaves. She distinguished a primary centre of forms of *L. sativum* in Ethiopia ('Abyssinia & Eritrea'), characterized by the presence of a large number of dominant characters (e.g. much divided leaf-blades, dark colour of the seeds), and a secondary centre in Western Asia and Europe, characterized by the presence of recessive characters (e.g. less divided leaf-blades, yellow-brown to pinkish-grey seeds). She distinguished 4 varieties and 4 subvarieties for the Ethiopian centre and 7 varieties for the Eurasian one. Although this classification is based on the shape of the lower leaves and 21 types are distinguished and depicted, the shape of the lower leaf of *L. sativum* of the studied Ethiopian material could not be found among the leaf-shapes considered by Stchenkova. In my opinion, this classification is, on one hand, too detailed, and on the other hand incomplete. It is not followed by any author, not even by Bush (1970) in the Flora of the USSR.

In 1958, Franchetti gave a detailed taxonomic treatment of *L. sativum* taxa of Ethiopia (without descriptions, but with cited specimens). According to her, all *L. sativum* specimens of Ethiopia belong to subsp. *sativum* (= subsp. *eu-sativum* Thell.) and to var. *sativum* (= var. *typicum* Thell.). Within var. *sativum* she distinguished 2 forms: forma *sativum* and forma *trivalve* (A. Br.) Thell.

(3) The Ethiopian *L. sativum* material studied here does not allow a subdivision into varieties or forms. I consider the often distinguished form with 3-valved fruits as an abnormality, not meriting separate taxonomic status, as specimens with 3-valved fruits always had some 2-valved fruits too (PJ 4012, SL 1700, SL 1701, SL 1702). The 3-valved form, however, may be of interest for plant-breeders.

The colour of the seeds ranges from very light-brown or red-brown to almost black. On the markets of Ethiopia samples with a mixture of coloured seeds are usually offered for sale and no distinction is made in name or use of the seeds of different colour. It seems likely that, after selection, the Ethiopian *L. sativum* material may prove to contain several cultivars.

(4) No noteworthy differences were observed between plants raised in Ethiopia and plants from Ethiopian seed raised at Wageningen.

(5) Jonsell (1975) mentioned 4 other *Lepidium* species for Ethiopia. For their distinction from *L. sativum* see Jonsell (1975: p. 40).

(6) The description is based on the following specimens:

Arussi	47 km from Asella, road to Bekoji, in barley field: WP 1611.
Bale	Goba market: SL 1217; Goro market: SL 1265–1266.
Begemdir	Between Geech and Jinbar Wanz, Semien mountains national park: V. Magda 397; Gondar market: WP 4995, SL 925.
Eritrea	Adi Caier market: SL 895.
Gojam	5 km E of Bahar Dar, road to Blue-Nile falls:J. J. F. E. de Wilde 5786.
Hararge	Alemaya, cultivated at College of Agriculture: Taddessa Ebba 718, PJ 1479–1480, PJ 1592, PJ 1895–1901, PJ 2787, PJ 3082–3086, PJ 3411–3413, PJ 4012–4013; Alemaya, cultivated in garden: WP 238, WP 283, WP 341–342, WP 733, WP 749, WP 758, WP 1059, WP 1068, WP 1076–1077, WP 1806, WP 1826, WP 2192, WP 3007; Alemaya market: WP 23, SL 22, SL 236, Bos 8065, PJ 7029; Asbe Tefari market: SL 10, SL 543; Assebot market: SL 709–710; Bedeno market: SL 324; Chelenko market: SL 275; Dire Dawa market: WP 111, Bos 8364, Bos 8370; Feddis market: SL 169, SL 174, SL 183; Gelemso market: SL 643; Harar market: WP 80, WP 109, Bos 8061; Jijiga market: SL 338; Lange market SL 278, SL 291; Moulu market: SL 428, SL 430, SL 448; Wotter market: SL 212.
Illubabor	Burre market: SL 1509; Metu market SL 1498.
Kefa	Agaro market: SL 75, SL 79, SL 103; Bonga market: SL 1418; Chena market: SL 1425; Jebu market: SL 64; Jimma market: WP 3298, Bos 8635.
Shoa	West side valley of Akaki river, 17 km S of Addis Ababa: F. G. Meyer 8585; Debre Zeit market: WP 2982; 170 km from Modjo, road to Shashemene, near threshing place: WP 1685; Nazareth market: WP 2995; Shashemene market: SL 1299, SL 1307; Wonji market: WP 3065.
Sidamo	Awassa market: SL 1318; Dilla market: WP 2815; Wondo market: WP 2810.
Tigre	Axum market: SL 939.
Wollega	Dembidollo market: SL 1534.
Wollo	Bati market: SL 1038–1039; Dessie market: SL 1096–1098; Kombolcha market: SL 961, SL 990.
Grown at Wageningen	F. van Gogh s.n., WP 5680–5683, WP 5864–5868, WP 6001–6005, WP 6009–6013, WP 6237–6238, WP 6635–6637, WP 6819–6822, WP 6884–6885, WP 6999, WP 7495–7513, SL 1578–1582, SL 1586–1592, SL 1594, SL 1695–1699, SL 1703–1709, SL 1750–1760, SL 1812, SL 1816–1817.

Ecology

According to Baldrati (1950), *L. sativum* will grow on both poor and rich soils and is rather drought-resistant. On poor soils, however, the plants remain small (20–40 cm high), on rich soils they may reach 80 cm.

In Ethiopia, *L. sativum* is seldom cultivated as a field crop. It is usually grown as a garden crop or in the field mixed with 'tef' or flax. It will grow at altitudes between 750 and 2900 m, but is usually found in cool places at ca 2400 m (Franchetti, 1958).

At flowering (if the weather is sunny), the stamens turn away from the stigma. This probably promotes cross-pollination. The flowers have a rather strong odour and are much visited by insects. Towards the end of the flowering period, the anthers return to their original position near to the stigma, probably effectuating self-pollination if cross-pollination failed. The flowers are slightly protogynous (Thellung, 1906; Markgraf, 1963).

The seeds become covered in slime if soaked in water.

Husbandry

L. sativum is propagated by seed. In 'tef' fields, *L. sativum* is sown when the 'tef' is weeded for the first time, some weeks after the beginning of the rainy season. It is sown thin and germination starts very quickly (often within 24 hours). At Wageningen, full germination took ca 2–3 weeks. It is a quick-growing plant and because of its profuse branching, it can support the 'tef' plants (Baldrati, 1950).

At Wageningen the plants flowered 1.5–2 months after sowing and seed could be harvested 1–1.5 month after flowering. Seeds sown at the beginning of the summer at Wageningen (around June 21) germinated but grew very poorly and died before they had flowered. Perhaps the temperatures were too high.

According to Bush (1970), the plants grow best in moist soils in the shade.

Baldrati (1950) reported that *L. sativum* has few diseases or pests, if any, in Ethiopia. Stewart & Dagnatchew (1967) observed the white rust *Albugo candida* (Pers. ex Chev.) Kuntze in Shoa Province and a leaf spot caused by *Alternaria brassicae* (Berk) Sacc. in Kaffa Province. Markgraf (1963) reported that *L. sativum* may suffer from the following pests: *Baridium lepidii* Germ. (in the stem), *Athalia rosae* L. (on flowers and fruits), *Plutella maculipennis* Curt. (leaves and young fruits).

Uses

1. Culinary uses

In Europe and many other parts of the world seedlings of *L. sativum* are used as a salad or to season salads, because of their pungent taste.

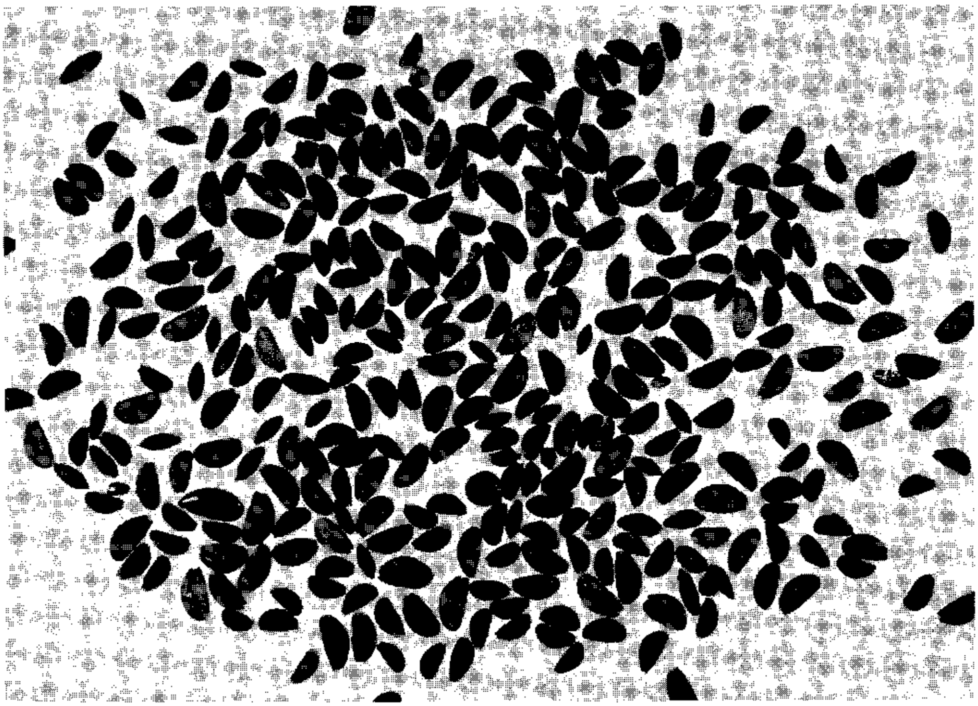
In Ethiopia, *L. sativum* is cultivated for its seeds, which are primarily used medicinally. Franchetti (1958) reported that the oil from the seeds is used as an edible oil in Ethiopia, but Baldrati (1950) remarked that the odour of the oil makes it unsuitable for this purpose. According to Chiovenda (1912) the oil is used as a condiment.

In many parts of Ethiopia a mixture of ground seeds with 'injera' and water constitutes a dish called 'fetto fitfit', which is eaten early in the morning or on special occasions to increase the appetite (Siegenthaler, 1963; Amare, 1976).

2. Medicinal uses

L. sativum is considered as one of the better medicinal plants in Ethiopia. The following uses are reported:

– A paste of seed flour mixed with water is used on chapped lips, against sunburn and other skin disorders. It is put on the skin also as an insect repellent and as a medicine against sciatica and fever, and in Shoa as a plaster against eye diseases (Siegenthaler, 1963; Franchetti, 1958). In Harar it is massaged also on diseased udders of cows (Amare, 1976).
– Seed-flour mixed with honey is taken against amoebic dysentery (Siegenthaler, 1963).
– A mixture of *L. sativa* seeds, *Nigella sativa* seeds, water and salt is ground and the resulting thick dough is allowed to ferment for 7 days. Against stomach cramps (such as caused by overeating), one teaspoon of this mixture is taken once a day (Siegenthaler, 1963; Amare, 1976; Kloos, 1976–1977).
– Seeds are used to induce abortion (Watt & Breyer-Brandwijk, 1962; Lemordant, 1971).
– Seeds are chewed to cure throat diseases, asthma (Baldrati, 1946), and headache (Kloos, 1976–1977).
– Ground seeds mixed with water are given to livestock with stomach disorders and to relieve pains of animals in labour (Baldrati, 1946; Siegenthaler, 1963).
– The Habab people use the seeds against a camel disease called 'zagag' (Cufodontis, 1954).
– The Ancient Greeks believed that the fresh herb had antiscorbutic and diuretic properties, and the seeds were used as an expectorant and emmenagogue. The plant now has no medicinal use in Europe (Markgraf, 1963).



Photograph 35. *Lepidium sativum,* seeds (3×), PJ 7029.

– By the Hausa, seeds of a red cultivar are crushed and mixed with water and used as a draught against rheumatic pains and swelling in humans, and also on sores of camels and horses. They eat the seeds against diarrhoea and dysentery (Dalziel, 1955; Watt & Breyer-Brandwijk, 1962).
– According to Watt & Breyer-Brandwijk (1962), bruised leaves yield a very active volatile antibiotic which inhibits growth of e.g. *Bacillus subtilis* and *Staphylococcus aureus.*

Chemical composition

The herb contains 0.115% volatile oil, known as cress-oil, of which the main substances are phenylacetonitrile and benzylisothiocyanate (Watt & Breyer-Brandwijk, 1962).

The seedlings contain glutamin and vitamin C.

The seeds contain: 20–60% of a brown, fixed oil (poor in erucic acid, rich in oleic and linoleic acid), uric acid (0.108 g/kg), sinapin, glucotropaeolin (benzylglucosinolate) which in water produces the 4 components benzylcyanide, benzylthiocyanate, benzyllisothiocyanate, benzylamine (Watt & Breyer-Brandwijk, 1962; Hegnauer, 1964; Saarivirta, 1973). The oil is suitable for illumination (Bush, 1970).

The slime cover of the seed in water consists of cellulose 18% and after hydrolysis it produces arabinose, rhamnose, galactose and galacturonic acid (Hegnauer, 1964). The benzylisothiocyanate of the seeds is a promising antibiotic against fungi and bacteria (Gessner & Orzechowski, 1974)

3.11 Myrsine africana L. — Fig. 26

'Myrsine': Latin transcription of the Greek 'mursine' = 'myrtle'; the leaves of *Myrsine* slightly resemble those of *Myrtus.*
'africana': derived from Latin 'Africa' = 'the land of the Afri's', the Africans.

Linnaeus, Sp. Pl. ed. 1: p. 196 (1753).
Type: 'Habitat in Aethiopia' (South Africa). Specimen LINN 267.1 (!, lectotypified by Dyer, 1963 ?).

Synonyms

Buxus dioica Forsk., Fl. Aeg.-Arab.: p. 159 (1775).
Myrsine glabra Gaertn., Fruct. 1: p. 282 (1788).
Myrsine scabra Gaertn., Fruct. 1: p. 282 (1788).
Myrsine rotundifolia Lam., Encycl. 4: p. 194 (1797).
Myrsine africana L. var. *retusa* (Ait.) DC, Trans. Linn. Soc. 17: p. 105 (1834).
Myrsine dioica (Forsk.) Asch. & Schwfth., Verh. Berl. Ges. Erdk. 18: p. 549 (1891).
For more synonyms see Mez (1902).

Literature

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1969: Hegnauer, Chemotax. der Pfl. 5: p. 154–163. (chem.)
1974: Shah, Pharmacobotanical studies of *M. africana,* a substitute of vidanga, Indian J. Pharm. 36(6): p. 164–165. (use).
1976: Taton, Distr. géogr. en Afrique de *M. africana,* Bull. Jard. Bot. Nat. Belg. 46: p. 449–453. (tax.)
1976: Kokwaro, Medicinal plants East Afr.: p. 164. (use)
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1976–
1977: Kloos, Preliminary studies of medicinal plants and plant products in markets of central Ethiopia. Ethnomedicine 4(1/2): p. 72. (use)

Local names: kechemo, kachamo, katchamu, katchamo geso, cajem, cajiem, (Amarinia); kachu, katsama, gujamo, fealfej (Gallinia); tatze, zadse, zosso, saso, zareh (Tigrinia); katam (Arabic); uaramole (Somali).
Trade names: Kurjan seed (English).

Geographic distribution

In Ethiopia *M. africana* grows in the wild in the mountainous regions of all provinces. Elsewhere it is reported from: Afghanistan, Angola, Arabia, the Azores, Baluchistan, China, the Himalayas, Kashmir, Kenya, Malawi, Mozambique, Socotra, Somalia, South Africa, Sudan, Tanzania, Uganda, Zaire, Zambia, Zimbabwe-Rhodesia (Pax, 1897; Mez, 1902; Cufodontis, 1960; Dyer, 1963; Taton, 1976; Herb. WAG).

Description

An erect, densely branched, evergreen shrub, usually 1–3 m high, with grey or grey-brown, (sub)terete, glabrous branches and densely glandular pubescent, red-brown to light-green twigs.

Leaves alternate, petiolate, estipulate; petiole terete, up to 2 mm long, glandular pubescent, light-green, basal part decurrent and long persistent on branch; blade usually elliptic or obovate to narrowly so, more rarely orbicular or ovate, 5–30 × 3–13 mm, (1–)2–3(–4) times as long as wide, usually leathery, dull or shiny dark-green above, pale-green beneath, with orange-brown gland-dots, in older leaves often only visible along the margin, margin sparsely provided with teeth in the upper $\frac{2}{3}$ part, midrib prominent beneath, usually densely puberulous in the lower half both sides.

Inflorescence: axillary fascicular, few to many flowered; bracts ca obovate in outline, ca 0.5–1 × 0.3–0.8 mm, usually with a claw-like basal part and a cuculliform fimbriate to ciliate margined upper part, rather densely brownish glandular-punctate, light-green to brownish-green; pedicel subterete, 0.3–1 mm long, glabrous or glandular-puberulous, light-green; flowers ca 1.5–3.5 mm long, usually 4-merous, seldom 3-merous, unisexual.

Calyx: very shortly tubular at base, with 4 obovate to obtrullate or orbicular, ca 0.5–1.3 × 0.3–1 mm, free lobes, fimbriate or ciliate in upper half, pale-green to pale-brown, dotted with orange-brown glands, usually persistent in fruit.

Corolla tubular, 4-lobed; tube 0.5–1 mm long, lobes usually narrowly obovate or oblong, ca 0.6–1.5 × 0.5–1 mm, fimbriate or ciliate, pale-green to pale-brown, dotted with orange-brown glands.

Androecium: stamens 4, opposite the corolla lobes, basally united and adnate to the corolla tube.

In male flowers: stamens always longer than the corolla; filaments at base forming a membranous, ca 0.3–1.5 mm long tube, which is adnate from the base to ca halfway the corolla tube, usually ending in small teeth which alternate with the filaments; filaments filiform, ca 0.3–1 mm long; anthers ca narrow-ovoid to subconical, ca 1.2–2 × 0.6–1 mm, basi- to dorsifixed, with glandular dotted, acuminate apex, usually purplish red; filaments (tube part included) usually glandular puberulous.

In female flowers: as in male flowers but always staminodial; staminodes usually shorter than the corolla; filament tube 0.3–0.8 mm long, free filament parts 0.3–0.5 mm long; anthers subconical, 0.6–1.3 × 0.3–0.5 mm.

Gynoecium: In female flowers: pistil 1; ovary globose to obovoid, ca 1 mm diam., glabrous and usually dotted with orange-brown glands, pale-green, unilocular; placenta subglobose, basal, ca 0.5 mm diam., with 3–5, ca globose ovules, which are partly embedded; style conical, 0.5–1 mm long, pale-green, usually persistent in fruit; stigma disciform in outline, ca 1 mm diam., irregularly incised into fimbriate lobes, whitish to pale-green.

In male flowers: as in the female flowers but always pistillodial; ovary ca 0.3 mm diam., style ca 0.3 mm long, stigma very small.

Fruit a globose drupe, ca 2.5–5 mm diam.; exocarp and endocarp slightly fleshy, pale-green, turning blue-purplish or red-purplish at maturity; endocarp crustaceous, enclosing one seed, which is totally or partly surrounded (like a grey-brown outer skin) by remnants of the placenta and not developed ovules.

Seed subglobose, slightly flattened; testa thin, brown; endosperm copious, ruminate, horny; embryo small, cylindrical, slightly curved, situated in a ca transverse horizontal position; the folds in the testa (ruminate endosperm !) are filled externally with an orange-brown, powdery to long cristal-like substance.

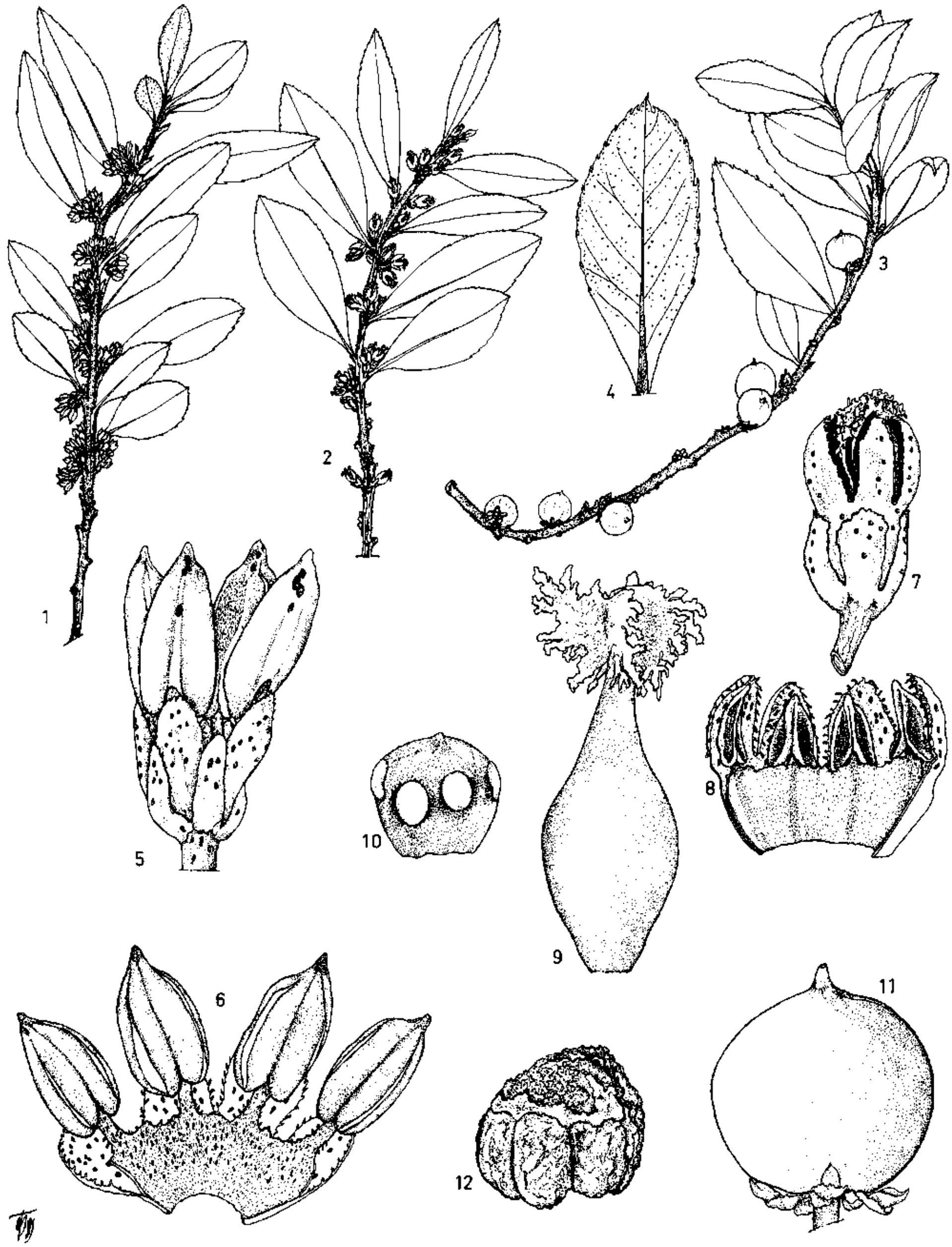


Fig. 26. *Myrsine africana* L. – 1. habit male flowering branch (1⅓×); 2. habit female flowering branch (1⅓×); 3. habit branch with fruits (1⅓×); 4. leaf (2×); 5. male flower (13⅓×); 6. opened corolla with stamens, male flower (13⅓×); 7. female flower (13⅓×); 8. opened corolla with staminodes, female flower (13⅓×); 9. pistil of female flower (33⅓×); 10. placenta with ovulae of female flower (33⅓×); 11. dried fruit (6⅔×); 12. seed (6⅔×). – 1, 5, 6. W. de Wilde c.s. 6566; 2, 7, 8, 9, 10. W.de Wilde c.s. 6565; 3–4. PJ 7196 (spirit mat.); 11–12. PJ 7090.

Taxonomic notes

(1) In Sp. Pl. ed. 1, p. 196, Linnaeus did not describe *Myrsine africana*, but referred with an asterisk to his description in Hort. Cliff. p. 72 (1738). In the Linnaean herbarium and in the Hort. Cliff. herbarium, a male flowering specimen of *M. africana* is present. The most logical choice as lectotype for the species is the specimen present in the Hort. Cliff. herbarium. Unfortunately the specimen in the LINN herbarium, No 267.1, has been designated as lectotype of *M. africana* (by Dyer, 1963 ?).

(2) De Candolle (1844) distinguished two varieties of *M. africana:* var. *retusa:* 'foliis patentibus semper obtusis' and var. *microphylla:*' 'foliis obtusis minoribus'. Although the form and the size of the leaves of this species may vary considerably, I do not consider the varieties described by De Candolle as meriting a special taxonomic status.

(3) The description is based on the following specimens:

Arussi	Asella, ca 175 km SSE of Addis Ababa, lower slopes of Mt. Cilalo, alt. 2500 m, 6-5-1965: W. de Wilde c.s. 6565 (f), 6566 (m); about 25 km SE of Asella, W. slope of Mt. Boruluccu, alt. 3800 m, 11-9-1965: W. de Wilde c.s. 8130 (m).
Bale	38 km W of Dinshu (Gurie), along the road to Adaba, alt. 2900 m, 10-1-1971: J. J. F. E. de Wilde 7365 (f).
Begemdir	Semian mountains, Sanboker, ca 1 km from wardens house on track to Addis-Gey, alt. 3150, 24-9-1969: J. J. F. E. de Wilde & M. G. Gilbert 216 (f); Semien mountains National park, between Saha & Dirne, alt. 3185 m, 12-9-1974: V. Magda 282 (f).
Eritrea	Ca 17 km on the road Asmara to Massawa, 15°20'N × 39°3'E, alt. 1800 m, 5-2-1969: J. F. F. E. de Wilde 4569 (f + m).
Hararge	Alemaya market, 9-9-1976: PJ 7090 (only fruits); about 65 km from Asbe Tefari, along the road to Kulubi, alt.2430 m, 16-5-1975: PJ 1315 (m); ca 88 km from Asbe Tefari on road to Kulubi, alt. 2120 m, 2-8-1975: PJ 2521 (m); 4 km out of Bati (near the gate of the College of Agriculture) on road to Kombolcha, 19-9-1974, alt. 2000 m: J. J. Bos & Amare Getahun 9101 (f); road to Feddis, ca 5 km from Harar, alt. 1870 m, 30-10-1975: PJ 4453 (f); Gara Ades, ca 100 km from Alemaya on road to Asbe Tefari, alt. 2500 m, 28-9-1976: PJ 7196 (f); Harar market, 22-3-1976: PJ 5918 (only fruits); ca 4 km past Kulubi on the highroad Addis Ababa to Harar, ca 9°25'N × 41°41'E, alt. 2400–2500 m, 14-12-1968: J. J. F. E. de Wilde 4215 (f); ca 3 km W of Kulubi, 9°25' × 41°40'E, alt. 2300 m, 15-1-1969: J. J. F. E. de Wilde 4427 (m).
Kefa	W side of upper Godeb gorge, alt. 3000 m, 30-8-1957: J. R. Flenley & R. G. Hiller 260 (m); at road between Jimma and Bonga, ca 5 km SW of Jimma, 7°38'N × 36°48'E, alt. 1750 m: I. Friis, A. Hounde & K. Jacobsen 123 (m); Magi, 6°11'N × 35°35'E, alt. 2400 m, 8-5-1967: E. F. Gilbert 352 (f, ETH); ca 1 hour walking distance NW of Maji, 6°12'N × 35°34'E, alt. 2200 m, 16-1-1970: J. J. F. E. de Wilde 6200 (f).
Shoa	About 40 km W of Ambo, about 160 km W of Addis Ababa, alt. 2400 m, 14-4-1965: W. de Wilde c.s. 6241 (m); Mt. Entotto, about 5 km N of Addis Ababa, alt. 2600 m,12-2-1966: W. de Wilde c.s. 9980 (f); about 10 km W of Gheddo, on Lekemti road, alt. 2000 m, 17-4-1965: W. de Wilde c.s. 6369 (f); about 10 km W of Gheddo, alt. 2000 m, 30-6-1965: W. de Wilde c.s. 7145 (f); about 10 km W of Guder, W of Ambo, alt. 2400 m, 18-4-1965: W. de Wilde c.s. 6377 (m); near Guder waterfall, alt. 2000 m, 10-5-1975: J. J. Bos & P. C. M. Jansen 10235 (m); about 5 km NW of Güder, alt. 1750 m, 21-3-1966: W. de Wilde c.s. 10395 (m).

Note: (m) = male plant.
(f) = female plant.

The following specimens, originating from Ethiopia, were seen: J. W. Ash 291 (K), 635 (K), 962 (K); G. Aweke 586 (WAG); I. Baldrati 989 (FT); P. R. O. Bally 3094 (K), 9137 (K), 10311 (K); Beccari s.n. (FT); A. de Benedictis 109 (FT); Bota 96 (P); Bourg de Bozas s.n. (1901) (P); R. Bricchetti 124 (FT); W. Burger 1530 (ACD, FT, K), 1644 (ACD, FT, K), 2260 (ACD, K); L. Buscalioni 1112 (FT), 1327 (FT), 1402 (FT), 1620 (FT), 2054 (FT), 2102 (FT); E. Chiovenda 261 (FT); R. Corradi 7411–7415 (FT), 7409 (FT); G. Cufodontis 647 (FT); A. Fiori 328 (FT), 562–563 (FT); J. R. Flenley & R. G. Hiller 260 (FT); E. F. Gilbert 352 (K); J. B. Gillett 4867 (K), 5143 (FT, K), 14226 (BM, FT, K, P),14264 (FT, K); G. Giordano 322 (FT), 398 (FT); P. E. Glover & Gilliland 1151 (K), 1204 (K); M. Gutetta 1056 (K); Hiller & Flenley 260 (K); Hort. Cliff. p. 72 (BM); Jecama RS 190 (ACD, K); Maurel s.n. (P); F. G. Meyer 7709 (K); R. Milchersich 1993 (FT); H. F. Mooney 4819 (FT, K), 5552 (FT, K), 6122 (FT, K), 7014 (FT, K); V. Nastasi 257 (FT); G. Negri 248 (FT); A. Pappi 88–89 (K), 1617 (FT), 2850 (FT), 4167 (FT, P), 4168 (FT), 5004 (FT); R. E. Perdue 6439 (K); R. Pichi-Sermolli 1101–1105 (FT), 1106 (FT, K), 1107–1109 (FT); F. G. Piovano 454 (FT); Plowden s.n. (K); Quartin-Dillon 25 (P); Quartin-Dillon & Petit s.n.(FT), s.n. (Ouadgerate) (P), s.n. (ex herb. A. de Franqueville 122) (K, P), s.n. (ex herb. A. de Franqueville 120) (P), s.n. (ex herb. A. de Franqueville s.n.) (P), s.n. (dernier envoi 1844) (P); Rochet d'Hericourt 3 (P), 36 (P); Ruspoli & Riva 1199 (FT); D. Saccardo s.n. (Dec. 1936) (FT); Schimperi iter Abyss. coll. 372 (BM, K, P), 557 (BM, P); Schimper 913 (Plantae Abyss. ex Tigre v Beg.) (BM, K); W. Schimper s.n. (1-11-1850) (P), 673 (P), 1039 (6-11-1852, 20-11-1852, 8-10-52, 1853) (P); G. Schweinfurth & D. Riva 995 (FT, K, P), 1206 (FT, K, P); H. Scott 79 (BM, K); L. Senni 1128 (FT), 1309 (FT); H. Smeds 132 (FT); Sollazzo 230 (FT); Steudner 1294 (K), 1457 (K); E. Taschdjian 362 (FT); A. Terracciano & A. Pappi 223 (FT), 595 (FT), 688 (FT), 1759 (FT); A. C. B. Thomerson, 563 (K); A. Vatova 635 (FT), 1653 (FT), 2483 (FT); W. de Wilde c.s. 8130 (K).

Ecology

In Ethiopia, *M. africana* can be found on often steep mountain slopes, forest borders, along (small) mountain rivers or gullies or in shrubby grassland, at altitudes of 1750–3800 m. Flowers can be found the whole year round, but the main flowering period is from April to September (rainy season) (herb. WAG).

Taton (1976), who studied the distribution of this species in Africa, reported that it grows in savannas, rocky areas, lava areas, temporary lakes on hard soils, poor mountain forests and in the *Ericaceae* belt, at altitudes of 1500–3800 m.

As the flowers are (functionally) unisexual, cross-pollination will be normal.

Mez (1902) reported that the position of the leaves can change with the environment. In some places, the leaves are spirally arranged; in other places a distichous leaf arrangement occurs.

Husbandry

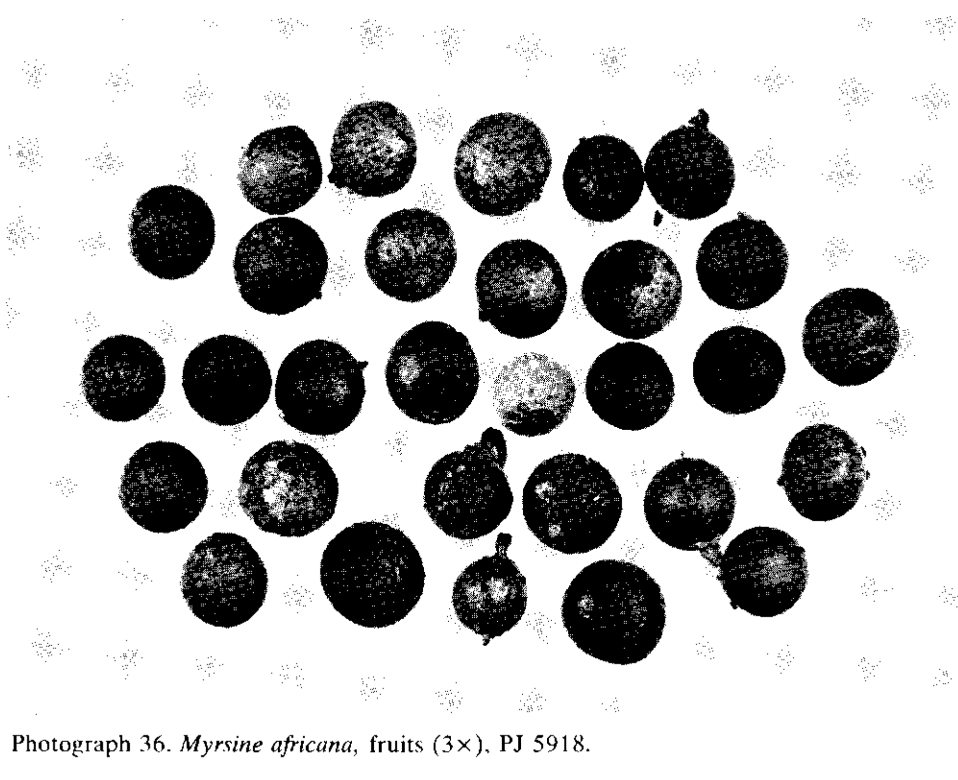
M. africana is not cultivated in Ethiopia. The fruits are gathered from plants growing in the wild state, and offered for sale on markets, where they can be found the whole year round.

In other parts of the world the plant is cultivated in (botanic) gardens (Mez, 1902).

Uses

1. Medicinal uses

The following medicinal uses of *M. africana* are reported from Ethiopia:
– The fruits are a common medicine against tapeworm and roundworm (also in East Africa and the Azores). Fruits are dried and powdered and drunk with water or eaten with food (ca 2–3 handfuls or 15–20 g per treatment). No food or drink is taken for 12 hours after a worm treatment. Some time after the medicine has been taken the patient has a burning feeling in his throat. The worms are evacuated with the faeces. The medicine temporarily colours the urine very dark-yellow (Fournier, 1861; Pax, 1897; Mex, 1902; Fiori, 1910; Gelahun, pers. comm., 1975). Sometimes the fruits are used together with kosso *(Hagenia)* (Cufodontis, 1960) or with fat from animal bones. Kokwaro (1976) reported that no harm comes from eating too many fruits, but Verdcourt & Trump (1969) reported a death because of eating too many fruits, and Fournier (1861) stated that patients abhorred this medicine.
– Fresh roots are eaten by women to relieve menstruation pains and to stop bleeding (Gelahun, pers. comm., 1975).
– Leaves are given to cows if they suffer from an eye disease (Gelahun, pers. comm., 1975).
– Lions are believed to feed on *M. africana* if they suffer from internal parasites (Amare, 1976).



Photograph 36. *Myrsine africana,* fruits (3×), PJ 5918.

The following uses are reported from other areas:
– The fruits are used in East Africa as a remedy for chest pains and stiff joints. Ripe fruits are dried and ground. A tablespoon of fine powder is taken in milk or cold water once a day. Sometimes also diarrhoea may result, as the fruits act as a purgative (Kokwaro, 1976). According to Fournier (1861), however, their purgative effect is not constant.
– In East Africa, the fruits are also used as a remedy for general stomach troubles (Verdcourt & Trump, 1969; Kokwaro, 1976).
– In India, the fruits are used against ringworm and other skin diseases (Watt & Breyer-Brandwijk, 1962).
– Shah (1974) stated that the fruits are a valuable substitute for fruits of vidanga (= *Embelia ribes* and *E. robusta*) in India, where these fruits are used to produce 'a new oral contraceptive tablet for family planning'. Like *Embelia, Myrsine* also contains the active principle embelin.
– Pax (1897) reported that the leaves are used as a purgative.
– The Tswana and Kwena in South Africa use a decoction of the leaf as a 'blood purifier' (against syphilis?) (Watt & Breyer-Brandwijk, 1962).

2. Miscellaneous uses

– According to Richard (1851), fruits mixed with barley are given as food to donkeys and mules in Ethiopia. Like Fournier (1861), I doubt if this statement is true. Baldrati (1946), however, reported that he was told that the fruits were edible.
– Sometimes the fruits are found as an adulterant in powdered pepper (Watt & Breyer-Brandwijk, 1962). In Ethiopia, the fruits are sometimes mistaken for those of *Maesa lanceolata.*
– The Sotho in South Africa administer *M. africana* to rams to prevent them from serving ewes before the proper time (Watt & Breyer-Brandwijk, 1962).
– The Manyika in S. Africa use the leaves as a charm to ward off thunder and witchcraft, by washing the body with leaves while standing in a river and allowing them to float away (Watt & Breyer-Brandwijk, 1962).
– According to Cufodontis (1960), the wood is very hard, termite resistant, used in building houses and for cleaning teeth.

Chemical composition

Embelin (= embelic acid) is considered to be the active principle for the anthelmintic properties of *M. africana.* The content in the whole plant is ca 2%, in the fruits alone up to 5%. The fruits also contain ca 1% quercitol. The endosperm contains amyloid. Cyanogenetic glucosides, saponins and alkaloids are absent.

Myricitin has been extracted from the leaves (Watt & Breyer-Brandwijk, 1962; Hegnauer, 1969).

3.12 Phytolacca dodecandra L'Hér. — Fig. 27

'Phytolacca': derived from the Greek word 'phuton' = 'plant' and the Neolatin (Italian) word 'lacca' = 'sealing wax'; plant of which the fruits contain a (sealing wax) red sap.

'dodecandra': derived from the Greek words 'dodeka' = 'twelve', and 'andros' = 'man'; with 12 male organs, stamens.

L'Héritier, C. L., Stirpes novae aut minus cognitae 6: p. 143–144, tab. 69 (1791).
Type: 'Habitat in Abyssinia. Bruce. H. P.' (cultivated in the botanical garden of Paris from seed collected by J. Bruce in Ethiopia). Specimen in G-DC herbarium, with the label: '*Phytolacca dodecandra* H. B. Paris. 162 h. DC' (also the label: '*Pircunia abyssinica* Moq. DC. Prodr. vol. 13 part 2. p. 30 no 4' is present on the same sheet) (holo., microfiche !).

Synonyms

Phytolacca abyssinica Hoffm., Comm. Gotting. 12: p. 25–26 (1796).
Phytolacca elongata Salisb., Prodr.: p. 345 (1796).
Phytolacca lutea Marsigl. ex Steud., Nom. ed. 1: p. 618 (1821).
Phytolacca scandens Hilsenb. & Boj. ex Moq., in DC, Prodr. 13, 2: p. 30 (1849).
Pircunia abyssinica (Hoffm.) Moq., in DC, Prodr. 13, 2: p. 30 (1849).
Pircunia abyssinica (Hoffm.) Moq. var *latifolia* Rich., Tent. fl. Abyss. 2: p. 222 (1851).
Phytolacca abyssinica Hoffm. var *apiculata* Engl., Pflanzenw. Ost Afrikas C: p. 175 (1895).
Phytolacca abyssinica Hoffm. var *macrophylla* De Wild. & Th. Dur., Pl. Thonn. Congol.: p. 15 (1900).
Phytolacca dodecandra L'Hér. var. *apiculata* (Engl.) Bak. & Wright, Fl. trop. Afr. 6(1): p. 97 (March, 1909).
Phytolacca dodecandra L'Hér. var. *brevipedicellata* H. Walt., Das Pflanzenreich 4.83: p. 44 (June, 1909).
Phytolacca nutans H. Walt., Das Pflanzenreich 4.83: p. 45 (June, 1909).
Phytolacca dodecandra L'Hér. var. *typica* Fiori and var. *pubescens* Fiori, Boschi e pian. legn. Er., Agricolt. Colon. 4: p. 43 (1910).
Phytolacca abyssinica Hoffm. var. *latifolia* De Wild. & Th. Dur., Et. Fl. Bang. Ub.: p. 56 (1911).

Literature

1849: Moquin, *Phytolaccaceae,* in DC, Prodr. 13, 2: p. 30. (tax.)
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1960: Lemordant, Les plantes éthiopiennes: p. 23–24. (use)
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1974–
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1976–
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Local names: endod, indot, andot, endoda (Amarinia); handode, endoda, endodu, haranga, aranca (Gallinia); endot, shebeti, shipti, sobet, sebbet, thobet (Tigrinia); sibit, sibil (Saho); gonnofai (Bilin).
Trade names: endod, soap-berry (English).

Geographic distribution

In Ethiopia, *P. dodecandra* is a common plant in all provinces, usually occurring at higher altitudes.

Outside Ethiopia, the plant is common and widespread in tropical Africa, South Africa and in Madagascar (Walter, 1909; Balle, 1951; Cufodontis, 1953; Polhill, 1971; Herb. WAG).

Description

A lianescent shrub; branches up to 10 m long and up to 5 cm diam., the older ones subcylindric, pale-brown and usually glabrous, usually slightly fissured and provided with more or less prominent, grey-brown, elliptic lenticels; the younger branches subangular, light- to dark-green, sometimes with purplish or reddish spots, usually slightly pubescent, often hollow after drying.

Leaves simple, petiolate, alternate, estipulate, subsucculent; petiole subterete, flattened, towards the blade slightly grooved above, (0.5–)1–3(–4) cm long, light-green or often reddish or purplish, glabrous or scarcely pubescent; blade ovate, narrowly ovate or elliptic, up to 14 × 8 cm; apex usually recurved, mucronate; base cuneate or obtuse, usually slightly oblique; margin entire, often slightly scarious; dull or bright-green above, lighter-green to greyish, with prominent midrib and main veins beneath; usually glabrous or scarcely pubescent both sides, provided with numerous crystal-like whitish dots or short lines (raphides), which are hardly visible in the fresh leaves.

Inflorescence a usually densely flowered raceme, ca 5–40 cm long, usually shortly pedunculate; rhachis (sub)terete, pubescent to glandular-pilose, light-green; bracts and bracteoles linear-triangular, ca 1–6 × 0.5–1 mm, glandular-pilose outside, usually subglabrous inside, light-green; pedicel subterete, 1.5–8(–14) mm long, usually longest in male flowers, pubescent to glandular-pilose, light-green, usually provided with two bracteoles in the upper half; flowers odoriferous, polymorphic, up to 8 × 8 mm in outline; most probably the sex is physiologically determined, resulting in functionally male, female, or bisexual flowers, all of them sometimes on the same plant, sometimes on different individuals.

Calyx usually with 5, basally slightly connate lobes; lobes subovate to oblong in outline, 2.5–5 × 1.5–4 mm, usually fleshy, with scarious, strongly recurved margin and rounded subacute apex, pubescent outside, especially so at base, sometimes nearly glabrous or only with ciliate margin, glabrous inside, pale-greenish-yellow, sometimes a bit reddish-brown outside, with crystal-like whitish dots, strongly reflexed in older flowers, persistent in fruit.

Corolla: absent.

Androecium: stamens ca 12–20, equal or very unequal in length, inserted at base of or slightly below the disc, in two or three whorls, usually best developed in functional male flowers, often staminodial in functional pure female flowers; filaments long triangular, ca 1–7 × 0.3–1 mm, thin, white to creamy-white, glabrous, with whitish crystals; anthers subellipsoid, ca 1–2.5 × 0.5–1 mm, yellow, dorsifixed, dehiscing by two longitudinal slits, the thecas usually unequal in length.

Disc: thin, fleshy, whitish, adnate to the base of the pistil.

Gynoecium: pistil 1, well developed in functional female and bisexual flowers, pistillodial in functional pure male flowers, (3–)5(–7)-carpelled; ovary depressed globose in outline, ca 1–4 mm diam., lobed; carpels slightly connate basally, each 1-ovuled, pale-green to whitish, glabrous or pubescent at base; styles as many as carpels, linear, 0.5–2 mm long, white, usually strongly recurved and/or slightly twisted in functional female and bisexual flowers, erect when pistillodial; the styles are totally papillately stigmatic, or, more often, only so at the inner surface.

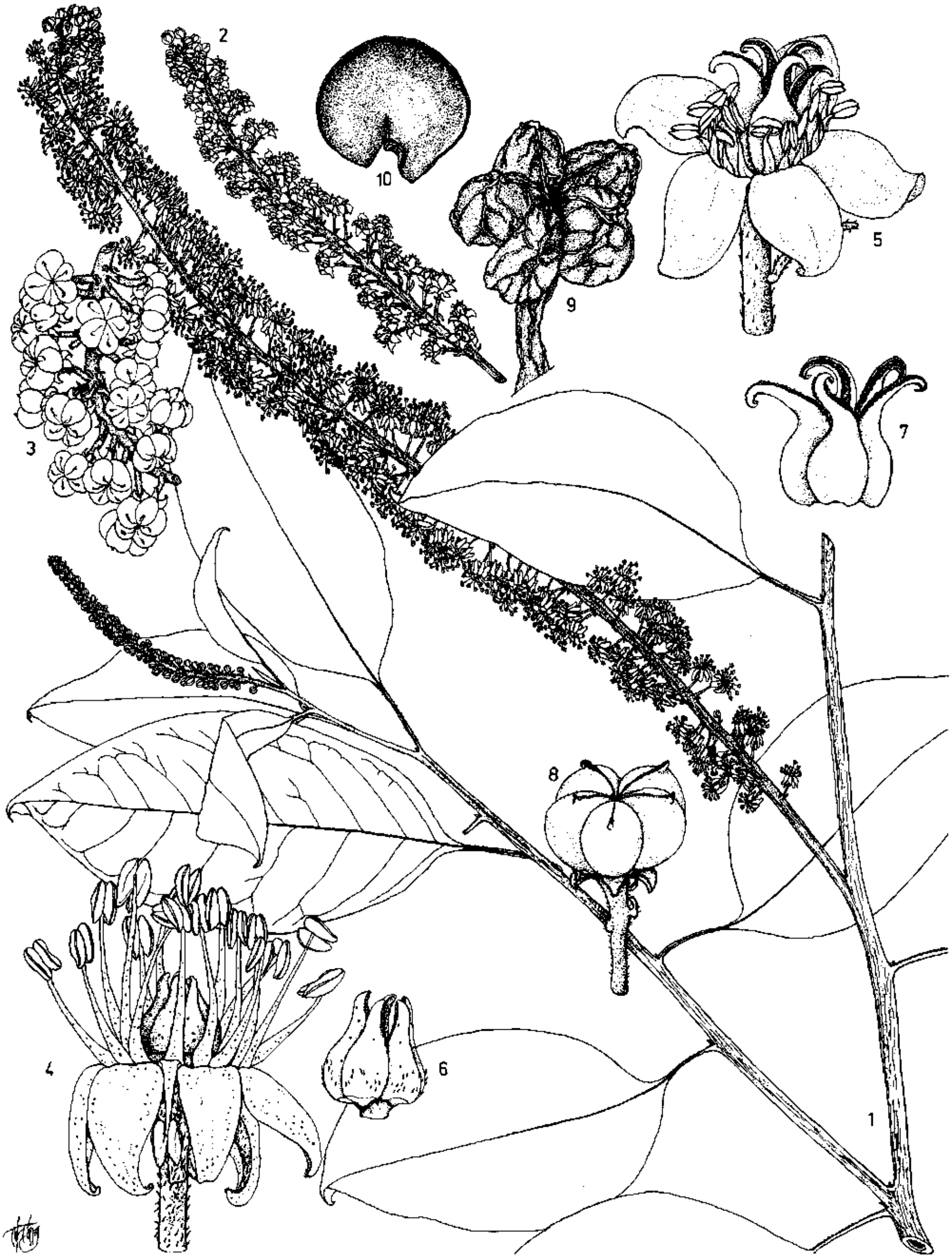


Fig. 27. *Phytolacca dodecandra* L'Hér. – 1. habit male flowering branch ($\frac{2}{3}\times$); 2. habit female inflorescence ($\frac{2}{3}\times$); 3. habit part of fruiting raceme ($\frac{2}{3}\times$); 4. male flower ($5\frac{1}{3}\times$); 5. female flower ($5\frac{1}{3}\times$); 6. ovary of male flower ($6\frac{2}{3}\times$); 7. ovary of female flower ($6\frac{2}{3}\times$); 8. fruitstalk with fruit ($2\times$); 9. fruitstalk with dried fruit ($4\times$); 10. seed ($6\frac{2}{3}\times$).– 1. J. J. F. E. de Wilde 4689; 2, 5, 7. W.deWilde c.s. 9594; 3, 8. J. J. F. E. de Wilde 5095 (spirit mat.); 4, 6. PJ 5182 (spirit mat.); 9, 10. PJ 1171.

Fruit: a deeply (3–)5(–7) lobed and seeded, in outline bluntly star-shaped, flattened berry, up to 13 mm in diam., 7 mm thick, with style-remnants on each carpel, usually glabrous, orange to purplish-red at maturity; in dried fruits the carpels are more prominent and have a wrinkled, blackish to brownish surface.

Seeds: sublenticular, up to 3.5 mm diam., ca 1–2 mm thick, slightly ridged; testa glossy black, hilum whitish; embryo subcylindrical, curved around the white, centrally situated endosperm.

Taxonomic notes

(1) L'Héritier described *P. dodecandra* from a plant grown in the botanic garden at Paris from seeds collected by J. Bruce in Ethiopia. It is known that L'Héritier's herbarium was bought by De Candolle (see Stafleu, Sertum Anglicum facs. ed. p. xxxv, 1963) and must be consulted at Geneva. In G-DC only one specimen is present with a label: '*Phytolacca dodecandra* H. B. Paris, 162 h. DC' (besides the label: '*Pircunia abyssinica* Moq. DC, Prodr. vol. 13 part 2, p. 30. no 4'). The words '*Phytolacca dodecandra*' are hardly visible on the microfiche of this sheet. It is a specimen with leaves and one inflorescence. The plant on this sheet I consider as the holotype of the species *Phytolacca dodecandra* L'Hér.

A second specimen at G-DC with a label '*Phytolacca abyssinica* hort. Par.' h. DC 99, might also originate from L'Héritier's herbarium but, if so, one would expect the name *Phytolacca dodecandra* on the label.

(2) Cavaco (1963) typified this species as 'la planche LXIX qui accompagne la description originale en l'absence de spécimen-type'. Polhill (1971) typified it as: 'plant cultivated in Paris from seeds collected by Bruce in Ethiopia (P, holo)'. At P however, I could not find the holotype; neither could Cavaco (1963) and Hepper and Friis (pers. comm., 1979). I doubt whether Polhill saw the holotype at P, as L'Héritier's herbarium went to G-DC.

(3) In my opinion, the flowers of *P. dodecandra* (endod) are essentially bisexual. Although certain plants may produce only unisexual flowers, the many herbarium sheets with both male and female flowers collected under the same number (e.g. J. F. F. E. de Wilde 4363, WP 2667, WP 3162, PJ 5182, Mooney 6882) and in addition the occasional presence of fully bisexual flowers (Bos 9692) support this view.

Polhill (1971) described the flowers as being dimorphic: long staminate or short staminate. The Ethiopian specimens show more variation. Besides specimens with long and short stamens, specimens can be found with both long and short stamens in one flower.

(4) Several varieties have been described of *P. dodecandra* (or of the synonyms *P. abyssinica* Hoffm. and *Pircunia abyssinica* (Hoffm.) Moq.):

- Richard (1851): var. *latifolia,* all Ethiopian specimens.
- Engler (1895): var. *apiculata,* 'foliis minoribus apiculatis, floribus 3–5 carpidiatis'.
- De Wildeman & Durand (1900): var. *macrophylla,* leaves 6–13 × 4–10 cm, with a 3 mm long mucro; stamens shorter than the sepals; sepals up to 2 × 1.5 mm.
- Walter (1909): var. *brevipedicellata,* 'flores pedicellis brevissimis, ca 1.5 mm longis, bracteolisque minutissimis'.
- Fiori (1911): var. *typica,* 'ramoscelli e foglie glabre'.

– Fiori (1911): var. *pubescens,* 'ramoscelli, foglie ed infiorescenze pubescenti'.

I consider all these varieties as falling within the variation pattern of the species, not deserving a separate taxonomic status.

(5) At Addis Ababa, a considerable collection of *Phytolacca,* originating from various parts of Ethiopia, was grown in an experimental garden. The specimens showed a very wide variability in habit (size, colour etc.) and for a satisfactory subspecific systematy of *Phytolacca dodecandra* it is necessary to study the specimens grown under experimental conditions and in nature. The notes on its possible applications stress the desirability of a taxonomic revision in conjunction with chemical and karyological research.

(6) The description is based on the following specimens:

Bale	7 km from Goro on road to Robi, alt. 1950 m, 15-2-1973: SL 3115.
Begemdir	83 km on road from Gondar to Bahar Dar, ca 12°07'N × 37°40'E, alt. 2100 m, 12-2-1969: J. J. F. E. de Wilde 4689; 2 km on road from Worata to Debre Tabor, alt. 1900 m, 29-12-1972: SL 3020.
Eritrea	About 15 km E of Asmara on the main road to Massawa 15°20'N × 39°02'E, alt. 2100 m, 1-2-1969: J. J. F. E. de Wilde 4468.
Hararge	On road from Alemaya to Asbe Tefari, about 20 km from Kobbo, alt. 2300 m, 16-8-1967: WP 1240; Alemaya, campus College of Agriculture, alt. 2000 m, 25-3-1974: Bos 7552; Alemaya, campus College of Agriculture, alt. 2000 m, 5-4-1974: Bos 7605; Alemaya, near to College of Agriculture, road to Awalle, alt. 2000 m, 24-2-1976: PJ 5182; Alemaya market, 30-4-1975: PJ 1171 (fruits only); 80 km before Asbe Tefari on road Kulubi-Asbe Tefari, alt. 2450 m, 24-9-1975: PJ 3522; 5½ km from Bati on Kombolcha road (near to College of Agriculture) alt. 2100 m, 8-11-1971: SL 2883; around Bati village, near College of Agriculture, alt. 2000 m, 5-3-1976: PJ 5205; near Bedenno, 9°17'N × 41°37'E, alt. 2400 m, 19-2-1962: W. Burger 1491; Road Bedeno-Langhe, 24 km from Bedeno, alt. 2490 m, 26-10-1967: WP 2443A; road to hospital Deder (side-road from main road), alt. 2300 m, 23-11-1972: SL 2934; mt. Gara Mulatta, about 20 km W of Alemaya, alt. 2800 m, 3-2-1966: W. de Wilde c.s. 9927; foothills S of Gara Mulatta, ca 9°08'N × 41°39'E, in between Gara Mulatta proper and village of Bedenno, alt. 2300 m, 8-1-1969: J. J. F. E. de Wilde 4363; NE slopes of Gara Mulatta, 45 km from the Dire Dawa-Harar highway on the Curfacelli road, alt. 2400 m, 15-1-1975: Bos 9692; village Gende Boneja, ca 7 km from College of Agriculture on road to Awalle valley, alt. 2000 m, 9-2-1976: PJ 5149; between Hirna & Deder, along Harar-Addis highway, alt. 2500 m, 15-8-1974: Bos 8342; ca 15 km SW of Kulubi, along highway to Addis Ababa, alt. 2300 m; Taddessa Ebba 525; along road from Kulubi to Asbe Tefari, about 63 km from Alemaya, alt. 2200 m, 21-7-1967: WP 861.
Kefa	7 km past Agaro, on the road from Jimma-Agaro-Dembi, 7°52'N × 36°36'E, alt. 1800 m, 10-1-1970: J. J. F. E. de Wilde 6132; Bonga, catholic mission, alt. 1900 m, 17-3-1973: SL 3228; Bonga, between catholic mission and waterfall, 12-12-1974: Bos 9416; Bonga, catholic mission, alt. 1750 m, 22-7-1975: PJ 2216; 28 km from Jimma, on road to Agaro, alt. 1825 m, 31-8-1972: SL 2569; road Jimma-Bonga, alt. 1500 m, 18-3-1976: PJ 5273.
Shoa	About 35 km S of Addis Ababa, alt. 2000 m, 1-4-1965: W. de Wilde c.s. 6072; about 50 km SE of Addis Ababa, near Debre Zeit, alt. 1900 m, 6-4-1965: W. de Wilde c.s. 6125; along road Ambo-Nekemt, alt. 1700–2100 m, 17-11-1975: PJ 4619; W slope of Mt. Uociacia, about 15 km W of Addis Ababa, alt. 3000 m, 4-1-1966: W. de Wilde c.s. 9594; Mt. Zuquala, about 60 km S of Addis Ababa, alt. 2800 m, 30-10-1965: W. de Wilde c.s. 8615.
Sidamo	18 km N of Agere Selam on the Wondo-Kebre Mengist road, alt. 2700 m, 15-2-

1974: Bos 9794; 22 km from Bore on road to Kebre Mengist, alt. 2775 m, 20-2-1973: SL 3137; road Wondo-Agere Selam, 5 km from Wondo, along road, alt. 2060 m, 17-11-1967: WP 2667; road Wondo-Agere Selam, 13 km from Wondo, along road, alt. 2400 m, 24-1-1968: WP 3162.

Wollega Anfilo, 34°40'E × 8°35'N, near Dembidollo, alt. 1925 m, 5-3-1957: H. F. Mooney 6882 (ETH); about 20 km E of Lekemti, alt. 2200 m, 15-4-1965: W. de Wilde c.s. 6257.

Wollo 2 km E of Dessie, along road to Gondar, alt. 2550 m, 30-11-1971: SL 2126.

The following specimens, originating from Ethiopia, were seen: J. W. Ash 246 (K), 670 (K); I. Baldrati 36 (FT), 309 (FT), 767 (FT), 987–988 (FT), 4661 (FT); P. R. O. Bally 3046 (K), 3131 (K), 3140 (K), 7114 (K); G. Bartolommei-Gioli 59 (FT); E. Beals 433 (K); N. Beccari 257 (FT); A. Bellini 289 (FT); P. Benedetto 209 (FT); A. de Benedictis 405 (FT), 437 (FT); Bourg de Bozas (Sorbonne 182, 1901) (P); W. Burger 530 (ACD, K), 1180 (ACD, FT, K), 1524 (ACD, K); L. Buscalioni 310 (FT), 467 (FT), 998 (FT), 1062 (FT), 1149 (FT), 1163 (FT), 1770 (FT), 2004 (FT), 2105 (FT); F. Cappelletti & V. Nastasi 205 (FT); A. S. Cheke 9 (K); E. Chiovenda 171 (FT); G. Dainelli & O. Marinelli 309 (FT); DRC 370 (K); I. M. Evans 60 (K); A. Fiori 445 (FT), 498 (FT), 53 (FT); I. Friis c.s. 27 (K), 556 (K), 1203 (K), 1489 (K); Gatti 356 (FT), 361 (FT); E. F. Gilbert 430 (K); M. G. Gilbert & J. J. Lavranos 2248–2249 (K); J. B. Gillett 5165 (FT, K, P), 14648 (K), 14697 (K), 14724 (FT, K), 14948 (FT, K); Bota 68 (Griaule) (P); R. Guidotti 767 (FT); Hemming 6521 (K); Hildebrandt 530 (BM); M. G. Jaboli 62 (FT), 169 (FT); J. A. D. Jackson 696 (K); J. L. Last Com. 3/1885 (K); F. G. Meyer 7450 (FT, K), 7526 (K), 7935 (K); R. Milchersich 35 (P); H. F. Mooney 5063 (FT, K), 5378 (K), 5655 (FT, K), 6231 (K), 6692 (K), 6882 (K); Moquin s.n. (1849) (P); G. Negri 81 (FT); A. Pappi 10 (FT), 12 (FT), 3397 (FT), 3429 (FT), 3536 (FT), 3930 (FT), 4909 (BM, FT), 5019 (BM, FT), 185 (K); R. E. Perdue 6324 (K); R. Pichi-Sermolli 1566 (FT, K), 1567–1569 (FT), 1570 (FT, K), 1571–1577 (FT); Piffard 80 (K); G. Piovano 12 (FT), 86 (FT); Quartin-Dillon & Petit s.n. (A. de Franqueville) (K, P), s.n. (dernier envoi 1844) (P), s.n. (2 Memsa) (P), s.n. (Richard) (P), s.n. (Etchelicote) (P), s.n. (P), s.n. (Massouah à Adowa) (P); Roth s.n. (Ankober 25-11-1841) (K); Rochet d'Hericourt 2 (P), 5 (P), s.n. (1842) (P), s.n. (Gondar) (P); P. Rovesti 102 (FT); Russel 229 (P), s.n. (1859–1860) (P); D. Saccardo s.n. (FT); Salt, Abyssinia 1 (1808) (BM); Schimperi iter Abyss. coll. 131 (BM, K, P), 1541 (BM, K, P); Schimper 534 (BM), 537 (FT), 986 (P), s.n. (P); G. Schweinfurth 1793 (K); G. Schweinfurth & D. Riva 842 (FT, K, P), 1084 (FT); H. Scott 331 (K); L. Senni 48 (FT), 139 (FT), 147 (FT), 223 (FT), 768 (FT); Siegenthaler X-21 (K); H. Smeds 751 (FT); Sollazzo s.n. (FT); Steudner 557 (K); R. B. Stewart E18 (K); Taddesse Ebba 525 (K, ACD); E. Taschdjian 149 (FT), 256 (FT); Tekle H. Hagos 39 (K); A. Tellini 606 (FT), 814 (FT); A. Terracciano & A. Pappi 177 (FT), 271 (FT), 926 (FT), 1596 (FT), 4630 (FT); M. Thulin 1561 (K); A. Vatova 17 (FT), 640 (FT), 1180 (FT), 1626 (FT), 1816 (FT), 2100 (FT), 2431 (FT); O. West 5794 (K); W. de Wilde c.s. 8615 (K), 9594 (K).

Ecology

P. dodecandra grows in a wide range of habitats in Ethiopia: in forests, forest borders, among shrubs in grassy fields, in fences along cultivated lands and houses, on mountain slopes and in open fields. In Ethiopia it is found as a very common, usually straggling plant, between the altitudes of 1500–3000 m.

The plant can be found flowering or fruiting in all months of the year, but the main flowering period is in the dry season, from October to April (Herb. WAG).

For East Africa, Polhill (1971) described the plant's habitat as a 'catholic, occurring in a wide range of forest, woodland, bushland, thicket and grassland communities, commonly riparian, generally perhaps on old forest land, limited only by extremes of altitude and rainfall: 500–2400 m'.

Photograph 37. *Phytolacca dodecandra* in fruit near Alemaya, PJ 5182.

In South Africa the plant is reported to grow also at sea level (Walter, 1909).

Lugt (1977) reported that female flowers open some weeks later than the male ones.

Where the berries are collected by people, the distribution of the plant is certainly influenced. The seeds are also distributed by animals eating the fruits (e.g. monkeys, birds). Once a plant is established, its rooting system is strong and widespread, and is very difficult to eradicate (Verdcourt & Trump, 1969).

Husbandry

Until recently, endod was not cultivated in Ethiopia. People collected the used parts from plants growing in the wild, perhaps only allowing the growth of the plants in fences and borders around houses and fields.

Since 1965, the plant has become well known, as it was discovered that its berries were molluscicidal (Lemma, 1965). In order to obtain a rather cheap product to kill snails transmitting bilharzia and a product that could be produced on the spots where bilharzia occurred, trials to cultivate endod on a large scale were started in Ethiopia in 1976. It was discovered that endod can be propagated easily both from seed and from cuttings. Endod may occur as an erect shrub, as a climbing or straggling shrub or as a creeper. For cultivation the erect shrub type is preferred and, if this character proves to be determined genetically in the plant, vegetative propagation might result in a homogenous plantation of shrubs. Woody cuttings, ca 10–15 cm long, are taken. Treatment with a root-promoting substance has proved advisable. Protection against the sun, a high relative humidity and a not too wet soil are advised for newly planted cuttings. If planted directly in the field, it is set out on small ridges to prevent waterlogging. The planting distance varies from 1 × 2 m to 3 × 3 m, according to the growth type of the shrub.

The plants produce berries for ca 1–3 months of the year. The yield of fruits per year per ha is estimated to be up to 2500 kg (dried product ca 1500 kg). Selection and breeding should considerably increase yield. An unsolved problem is still the nature of the functional unisexuality in endod.

Three insect stem-borers are reported as severe pests:

– *Gitona pauliani* Séguy: particularly active in the dry season, it prefers the young stems;

– *Gitona* sp.: also most active in the dry season, it prefers the older, thicker stems, situated in the shade;

– An unidentified secondary parasite of the order *Hymenoptera*, particularly active during the lesser rainy season.

The insects are most active towards sunset and they operate mostly not above the height of 80 cm. The adult borer (fly) oviposites on young shoots. The larva mines in the leaf to the midrib. It feeds especially on the phloem, which results in wilting tips. Spraying with Lebaycid (1.8 g/L water) + Buminal (2.2 g/L) every 2–3 weeks in

Photograph 38. *Phytolacca dodecandra* in flower near Alemaya, PJ 5182.

times of attacks gave good results. Buminal is an attractant, it keeps the insects away from new shoots after spraying. Some plants seem to have some natural resistance to the borer. The hairiness of the plants, the presence of raphid crystals in the tissue, or the saponin content of the plants might contribute to this resistance (Lugt, 1977; Lugt & Lemma, unpublished reports 1975–1977).

Stewart & Dagnatchew (1967) observed a leaf spot on endod in Hararge, caused by *Cercospora phytolaccae* Hansford.

Based on the colour of the berries, two types of endod are distinguished in Ethiopia:
- 'Arabe' (= from Arabia ?), with pinkish to red berries;
- 'Ahiyo' (= donkey), with yellow-green to green berries.

The 'arabe' type has a higher saponin content and a better molluscicidal activity than the 'ahiyo' type (Lugt, 1977).

According to Gelahun (pers. comm., 1975) 5 types of endod are present in Ethiopia, all with about the same activity. However, only one type can be used in either fresh or dried state, the other 4 types losing their activity if they are dried.

Uses

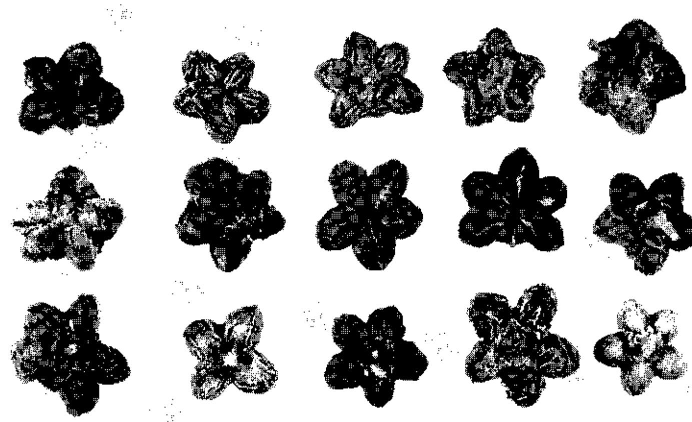
1. Medicinal uses

In Ethiopia, the following medicinal uses of endod have been observed or reported:
- As a remedy for venereal diseases (root-decoction, seed) (Cufodontis, 1953; Lemordant, 1960; Watt & Breyer-Brandwijk, 1962; Siegenthaler, 1963; Amare, 1976; Gelahun, pers. comm., 1975). A similar use also reported from East Africa (roots: Kerharo, 1976) and South Africa (roots and leaves: Watt & Breyer-Brandwijk, 1962).
- To induce abortion in women and animals (roots) (Lemordant, 1960; Amare, 1976; pers. inf., 1975–1977). A similar use is reported from Zaire (ground roots with bark of *Piptadenia africana* Hook. f.: Balle, 1951), and South Africa (a cheekful of leaves and young shoots is chewed and the juice swallowed, abortion starting ca 10 hours later. A large lump of butter is taken to stop further effects. A very dangerous treatment: Watt & Breyer-Brandwijk, 1962).
- To heal wounds and restore diseased skin (roots, leaves, fruits: Walter, 1909; Cufodontis, 1953; Lemordant, 1960; Gelahun, pers. comm., 1975; Amare, 1976). Such use is also reported from South Africa (leaf sap on wounds produces a marked burning sensation: Watt & Breyer-Brandwijk, 1962), Zaire (fresh, dried or powdered leaves: Balle, 1951), and Central Africa (warm leaf rubbed on the skin: Watt & Breyer-Brandwijk, 1962).
- As a purgative for humans and animals, as an anthelmintic, as a medicine against many internal diseases (roots, leaves, fruits, seeds) (Walter, 1909; Cufodontis, 1953; Lemordant, 1960; Watt & Breyer-Brandwijk, 1962; Siegenthaler, 1963; Gelahun, pers. comm., 1975). Reported also from S. & E. Africa (roots, leaves: Watt & Breyer-Brandwijk, 1962; Verdcourt & Trump, 1969; Kerharo, 1976).
- As a treatment against rabies (chewing of fresh roots: Siegenthaler, 1963).

Watt & Breyer-Brandwijk (1962) and Haerdi (1964) reported that macerated leaves or the bark of the roots are used in a medicine against epilepsy in Tanzania. In Uganda, root extracts are used to treat generalized oedema and Anokbonggo (1974–1975) confirmed the diuretic capacities of such extracts.

The plant is highly poisonous and the right dosages in the medicinal applications are essential. Particularly the bark and the root are very poisonous for people and animals, leaves less so and ripe fruits hardly at all. According to Hudson (1944) and Verdcourt and Trump (1969) the symptoms of poisoning in animals are: depression and quivering of the muscles and later increased urination and foetid diarrhoea. Acute poisoning results in frothing at the mouth, profuse diarrhoea and dysentery, intense congestion and distension of the stomach, congestion of the intestines, large haemorrhages in the left ventricle of the heart; lungs, liver, kidneys and spleen are usually congested too. In people there are symptoms like nausea, pressure in the stomach region, vomiting, persistant thirst, sensation of weakness, bloody diarrhoea, coldness and cyanosis of the skin, small and irregular pulse, dilated pupils, swelling of the oral mucous membrane and stupor. Death may occur within a few days. Recovery may occur quickly by taking ice in the mouth, mucilaginous gums and stimulants.

In the near future, endod may become a very useful plant in the eradication of bilharzia in Ethiopia and elsewhere.



Photograph 39. *Phytolacca dodecandra,* dry fruits (3×), PJ 1171.

2. *Miscellaneous uses*

– In Ethiopia the roots and leaves, but particularly the berries are widely used as soap to wash clothes. The dried berries are sold on most markets.
– In 1964, Lemma discovered in Ethiopia that downstream of washing places in rivers, many dead snails were present. He found that they were killed by substances present in the water, introduced from berries of endod by the washing people.

He discovered that sun-dried, crude, ground endod berries, suspended in an aqueous solution, killed snails transmitting bilharzia at concentrations of 15–30 ppm within 24 hours. This molluscicidal poetency of endod remains stable over a wide range of pH (5-9), in the presence of various concentrations of organic and inorganic matter and also after irradiation with ultraviolet light. Its toxicity for mammals and plants is rather low (LD_{50} is 6.5 g/kg body weight for sheep), but it is lethal to fish, lice, ticks, leeches, mosquito larvae, other stages of the bilharzia life-cycle (Miracidia and cercariae) at concentrations killing snails. Moreover it has fungicidal properties and it is rapidly broken down in water (in a few days). Research is going on to find a more active and easily produced solvent for extraction. Butanol extraction of an aqueous solution of the berries gives a light tan powder, with ca 20% of the original berry weight and its killing potency is 7 to 10 times as much as of the raw berries. Experiments are under way to find methods of cultivating desirable endod clones on a large scale. Lemma (1965–1970) showed in a 5 year project at Adwa (Ethiopia), that endod application to the water that was present, indeed considerably reduced the incidence of bilharzia in the village. In the future endod may perhaps become very important in the struggle against bilharzia, as its believed potencies are more promising than of longer known molluscicides.
– Endod extract may be useful for more purposes than killing snails transmitting bilharzia. Spielman & Lemma (1973) reported that it is highly toxic for second and third instars of mosquito larvae. Stolzenberg et al. reported that it may be useful as an antifertility drug and possibly to induce abortion.
– In Ethiopia, endod extracts are sometimes added to drinks and foods as a stimulant (Amare, 1976), and to milk to curdle it (Baldrati, 1946). These practices are very dangerous, since Watt & Breyer-Brandwijk (1962) reported similar, but often homicidal, use of the plant in South, Central and East Africa. They mentioned milk and butter as antidotes.
– In Ethiopia, a yellow dye is extracted from endod (Walter, 1909; Lemordant, 1960).
– Although the plant is often recorded as being very poisonous, use of the (boiled) leaves as food is recorded from Ethiopia, Ivory Coast, Nigeria and Zaire (Chiovenda, 1912; Balle, 1951; Dalziel, 1955; Irvine, 1961).
– In Tanzania, the fruits are used as a fish poison (Watt & Breyer-Brandwijk, 1962).
– In Zaire, a decoction of the roots is given to cattle in order to increase the milk production (Balle, 1951).
– As in Ethiopia, the plant is used as soap in Nigeria (ash from the burned plant), Uganda (berries), and Angola (leaves and berries) (Dalziel, 1955).
– In Ghana, the leaves are used to clean brass pans (Irvine, 1961).

Chemical composition

The roots contain 1.75% oil, soluble in petroleum-ether, 0.16% unknown alkaloid, 0.8% volatile oil and 0.21% potassium nitrate. There are also reports that the toxic principle of the root is not an alkaloid but a steroid saponin, which is a powerful convulsant, haemolytic, hypnotic and which causes severe irritation of the respiratory and gastro-intestinal tracts. The roots also yield a red pigment (Watt & Breyer-Brandwijk, 1962). Anokbonggo (1975) reported, without name, that the roots contain only one pharmacologically active principle, which is heat-resistant. Fresh roots contain 12.5–20% of this substance.

The fresh leaves contain 0.07% glucoside (of which 0.024% is ombuoside (= 7: 4′-dimethylrutin) and ombuiside (= a 3-rhamnoglucoside of 7: 4′-dimethylquercetin)) (Watt & Breyer-Brandwijk, 1962).

The fruits contain a mixture of 10 saponin acetates, together comprising 20–25% of the dry weight. Three saponin acetates have proved to be molluscicidal:

– Oleanoglycotoxin-A: ca 18% of the mixture. Its molecule contains 3 glucose residues and its LD_{90} for the snail *Biomphalaria glabrata* is 3 μmol/mol in 24 h.

– Lemmatoxin: ca 16% of the mixture. It is a derivative of oleanolic acid, with 2 glucose residues and 1 galactose residue. It is ca twice as active biologically as oleanoglycotoxin-A.

– Lemmatoxin-C: ca 17% of the mixture. It is a mixture of two closely related oleanic acid derivatives, with 2 glucose residues and 1 rhamnose residue. It has about half the biological activity of lemmatoxin (Parkhurst et al., 1973, 1974; Lugt, 1977).

3.13 Tamarindus indica L. — Fig. 28

'*Tamarindus*': most probably a latinization of the Italian, Portuguese or Spanish 'tamarindo', which in turn has been derived from the Arabic 'tamare-hindi' = 'Indian date', so called because of the dark-brown fruit pulp, which resembled a bit the dates known by the Arabs. '*indica*': from Latin 'Indus' = 'Indian', so from India.

Linnaeus, Sp. Pl., ed. 1: p. 34 (1753).
Type: 'Habitat in India, America, Aegypto, Arabia'. Specimen LINN 49.2 (lecto.!).

Synonyms

Tamarindus occidentalis Gaertn., Fruct. 2: p. 310–311 (1791).
Tamarindus umbrosa Salisb., Prodr.: p. 323 (1796).
Tamarindus officinalis Hook., Bot. Mag.: t. 4563 (1851).
Tamarindus somalensis Mattei, Bull. Orto Bot. Palermo 7: p. 94 (1908).
Tamarindus erythraeus Mattei, l. c.: p. 95 (1908).
Tamarindus indica L. var. *emarginata* Chiov., Fl. Som. 2: p. 178 (1932).

Literature

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Local names: hamar, hemor, homor, humar, komar, tommar (Amarinia); aradeb (Tigrinia); roka, rokka, rucagn, boka, darejo, dinkie, ghroma, gianko, omar (Gallinia).
Trade names: tamarind, Indian tamarind (English); tamarin, tamarinier (French); Tamarind, Tamarindenbaum (German).

Geographic distribution

The origin of *T. indica* (tamarind) is unknown. The tree is reported to be indigenous in Africa, India and Indonesia, but it is difficult to determine whether the tree is an escape from an old (introduced) cultivation or whether it is really indigenous. In tropical America it has certainly been introduced. Most authors believe that it is indigenous to the drier savannas of tropical Africa. At present the tree is widespread in the tropics, but, except in India, seldom cultivated on a plantation scale (Flückiger & Hanbury, 1874; Engler, 1915; Hepper, 1958; Brenan, 1967; and many other authors).

In Ethiopia, tamarind grows in all provinces, and it now certainly belongs to the wild flora. The fruits and other used parts are gathered from the wild plants and the fruits are often offered for sale on markets (Cufodontis, 1955; Roti-Michelozzi, 1957).

Description

A large evergreen tree, up to 30 m high; crown densely foliaged, widely spreading, rounded.

Stem: bole usually short, ca 1–2 m high, diam. at breast height up to 2 m; bark rough, fissured, thick, grey to dark grey-brown; slash whitish to light-brown; wood very hard; younger branches light-brown, yellow-brown pubescent or puberulous, gradually becoming grey and glabrous; youngest twigs light-green, whitish pubescent or puberulous.

Leaves alternate, stipulate, petiolate, compound; stipules lanceolate to narrowly triangular, up to 15 × 2 mm, caducous, whitish-green with darker green veins and glandular-ciliate margin; petiole up to 1.5 cm long, subterete, slightly grooved above, pulvinate at base, light-green, pubescent to puberulous, leaving a prominent scar on the branch after falling; blade suboblong in outline, up to 13 × 5 cm, paripinnate, with ca 8–16 pairs of leaflets; rhachis subterete, slightly grooved above, light-green, pubescent to puberulous, often provided with some globular excretion droplets near the leaflet-attachment; petiolules less than 1 mm long, thickened, ribbed, light-green, with a tuft of rather long, yellowish hairs at base; leaflet-limb narrowly oblong, ca 1–3.5 × 0.5–1 cm, entire, oblique and rounded at base, rounded to slightly emarginate or mucronulate at top, glabrous but sometimes midrib and margin hairy at base, blue-green, with prominent, reticulate venation both surfaces (best visible in dried specimens).

Inflorescence: lax lateral and terminal racemes, up to 13 cm long; peduncle and rhachis subterete, nearly glabrous to densely pubescent, light-green; bracts (up to 8 × 5 mm) and bracteoles (ca 5–8 × 2–4 mm) subovate, cucullate, caducous, subglabrous or puberulous, villously margined, red-brown; pedicel subterete, 0.5–1.5 cm long, light-green, subglabrous to pubescent; flowers ca 3 cm long, fragrant.

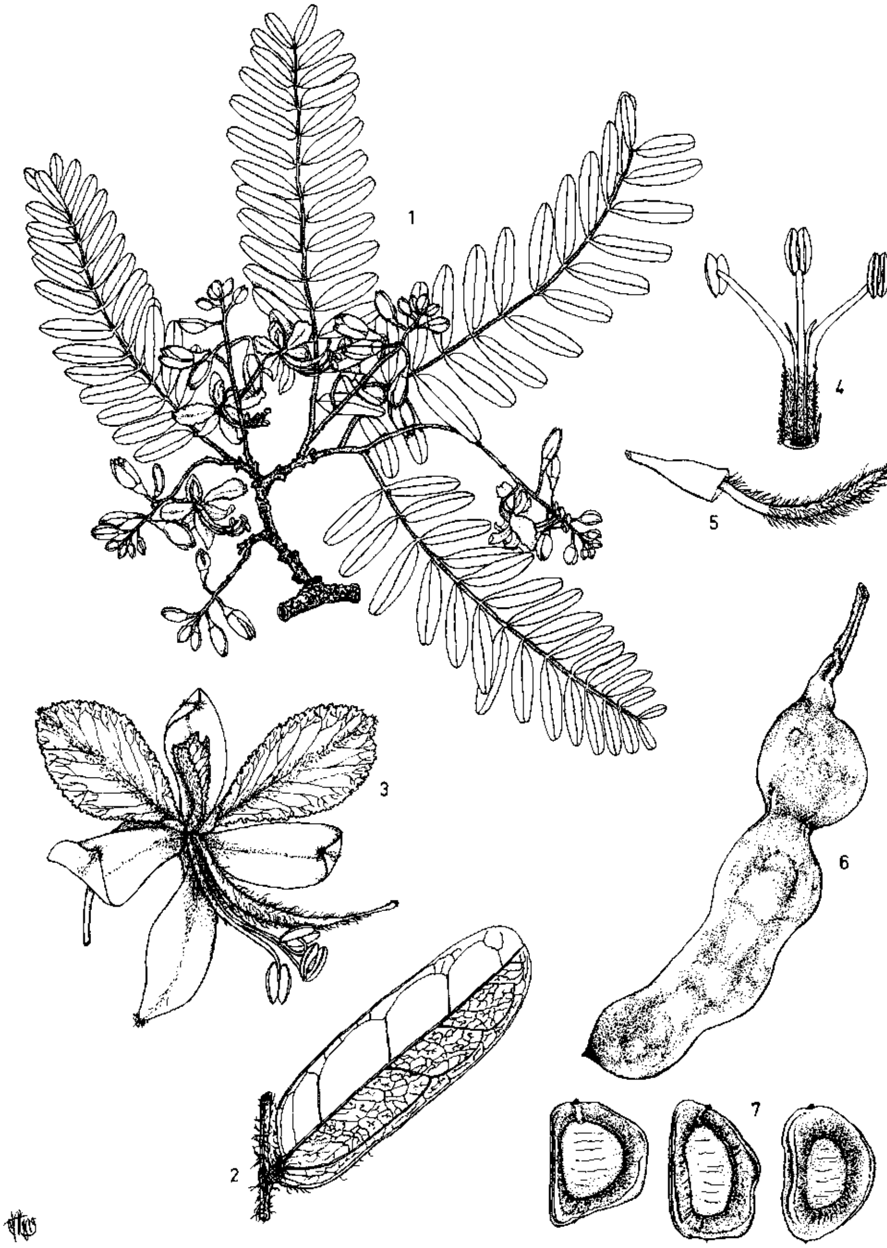

Fig. 28. *Tamarindus indica* L. – 1. habit flowering branchlet ($\frac{2}{3}\times$); 2. one leaflet with part of rhachis ($2\frac{2}{3}\times$); 3. flower ($2\frac{2}{3}\times$); 4. androecium ($2\frac{2}{3}\times$); 5. gynoecium ($2\frac{2}{3}\times$); 6. fruit ($\frac{2}{3}\times$); 7. three seeds ($1\frac{1}{3}\times$). – 1–5. J. J. F. E. de Wilde & M. G. Gilbert 358; 6. PJ 4937; 7. PJ 5926.

Hypanthium ca funnel-shaped, ca 5–8 × 2–4 mm, puberulous at base, light-green.

Calyx: sepals 4, unequal, usually spreading reflexed, ovate to lanceolate, ca 7.5–15 × 2.5–6 mm, apex acuminate or obtuse, anterior one usually the largest, subglabrous to pubescent and reddish outside, subglabrous to scarcely puberulous and whitish-green inside, both sides usually most hairy at base and at apex, margin scarious.

Corolla: petals 5, the posterior and lateral ones large and showy, the 2 anterior ones much reduced, linear, ca 1–2 mm long, acute, white, puberulous; posterior petal suboblong to ovate in outline, 7–14 × 3–5 mm, with strongly incurved to nearly folded sides; lateral petals subovate to oblong or obovate in outline, 7–17 × 4–8 mm, apices acuminate, margin incurved; the 3 large petals more or less clawed, (claw geniculate, pubescent), fleshy, with strongly undulating to folded margin, cream coloured with conspicuous brown-red veins, scarcely puberulous outside, usually densely pubescent centrally inside.

Androecium: stamens 3, united at base into a 5–7 × 1–2 mm, usually basally puberulous staminal band, bearing at top 3–4 small teeth which alternate with the filaments, the lateral one(s) usually situated lower; filaments filiform, 5–9 mm long, light-green, glabrous; anthers dorsifixed, ovoid, flattened, ca 2.5–3.5 × 1–2 mm, yellow-brown, glabrous, dehiscing by 2 longitudinal slits.

Gynoecium: pistil 1, stipitate; stipe ca terete, at base adnate to the anterior side of the hypanthium, free part 3–4 mm long, puberulous, light-green; ovary subcylindrical, 4–8 mm long, ca 1 mm diam., puberulous at the anterior side, light-green, up to 18-ovuled; style subterete, 4–6.5 mm long, puberulous, light-green, ending in a capitate, white to reddish finely papillate stigma.

Fruit subcylindrical, straight or curved, indehiscent, with rounded ends, up to 14 cm long and 4 cm diam., up to 10-seeded, often irregularly constricted between the seeds; exocarp crustaceous, greyish or, more usually, scurfy brown, with some strong brown fibrous threads inside; mesocarp thick-syrupy, blackish-brown; endocarp thin, leathery.

Seeds irregular in shape, flattened rhomboid to trapezoid, up to 18 × 12 × 7 mm, very hard; testa shiny, light to dark-brown, with a subelliptical, usually darker brown, large areola in the center of each of the two large flat sides; embryo white with two large cotyledons and a small, ca cylindrical radicle and a smaller flat, thin plumule, already bearing pinnate leaves.

Taxonomic notes

(1) In Sp. Pl. ed. 1 (1753), Linnaeus did not describe *T. indica.* He described the monospecific genus *Tamarindus* in 1737 in Gen. Pl. (p. 9), but he slightly changed the description in the 5th edition of 1754 (p. 20). The first reference in Sp. Pl. (1753) is to Hort. Cliff. p. 18 (1738). It seems preferable to designate as lectotype of the species a specimen from the Hort. Cliff. herbarium. In this herbarium, however, only a sterile specimen is present. In the LINN herbarium, 3 sheets of *T. indica* are present, with the numbers:

49.1: a poor specimen, with leaves, one (loose) flower and one (loose) fruit;

49.2: a rich specimen with flowers and leaves, no fruits; on the sheet the inscription

'*indica* 1' (from Linnaeus), refers to the order in Sp. Pl.;
49.3: a sterile branch, originating from the Hort. Cliff. herbarium.

I designate as lectotype of the species *Tamarindus indica* L. specimen LINN 49.2. The inscription on its sheet makes it likely that it was present in Linnaeus's herbarium in 1753. Unfortunately it bears no fruit.

(2) In 1791, Gaertner separated *Tamarindus* from the West Indies as a distinct species, *T. occidentalis,* differing from *T. indica* (from the East Indies) in its shorter pod (length up to 3 times as long as wide; in *T. indica* 6 times or more) and its fewer seeds (1–4 seeds; *T. indica* 6–12 seeds). De Candolle (1825) followed this distinction, but later authors considered *T. occidentalis* Gaertn. as synonymous with *T. indica* L.

(3) In 1908, Mattei described two other *Tamarindus* species: *T. erythraeus* and *T. somalensis. T. erythraeus* has elongate, falcate fruits, 15–20 cm long and 3 cm wide, with long triangular seeds. *T. somalensis* has short and ca straight, 10 cm long, 2–3 cm wide fruits, with elliptic or rounded seeds. These two species really fall within the variation pattern of *T. indica* and even distinction as varieties would be rather artificial, as believed also Roti-Michelozzi (1957) and Brenan (1967).

(4) In 1932, Chiovenda distinguished a variety with emarginate leaflets within *T. indica* and called it var. *emarginata* (Type: R. Confalone 13 (FT)!) As almost every tree has younger leaflets with rounded apices and older leaflets often with a slightly emarginate apex, this varietal distinction is not considered useful either.

(5) The description is based on the following specimens:

Gemu-Gofa	Road Arba-Minch-Soddo, 80 km from Arba-Minch, alt. 1210 m, 30-9-1975: PJ 3862; road Soddo-Arba-Minch, 25 km before Arba-Minch, alt. 1240 m, 28-9-1975: PJ 3774.
Hararge	Alemaya market, 11-5-1967: WP 34 (fruits only); Alemaya in garden, 1-1-1968: WP 3037 (seedling of WP 34); Alemaya market: 1-4-1976: PJ 5926 (fruits only); Dakata valley, farm area of College of Agriculture (along road Harar-Jijiga), alt. 1270 m, 13-4-1976: PJ 5972; Dire Dawa, grown in garden near the square on the way to the cement factory, alt. 1200 m, 26-3-1968: Taddesse Ebba 721; Road Dire Dawa-Erer-Gota, alt. 1200 m, 12-7-1976: PJ 6778; 24 km W of Erer hotel near Erer-Gota, alt. 1275 m, 19-10-1972: SL 2761; along river near Erer-Gota, alt. 1200 m, 29-6-1975: PJ 1794; about 25 km along the road Harar-Jijiga, 9°13'N × 42°17'E, alt. 1500 m, 22-3-1970: J. J. F. E. de Wilde 6396.
Illubabor	Gambela, around aeroport, alt. 540 m, 18-1-1976: PJ 4937.
Shoa	Awash national park, about 225 km E of Addis Ababa, on the road to Asbe Tefari and Harar, 8°50'N × 40°02'E, alt. 1050 m, 13-4-1969: J. J. F. E. de Wilde 4895; 8°15'N × 37°34'E, edge of great Gibbie river, turnoff from Addis Ababa-Jimma road to West at km 181, alt. 3500 ft, 28-4-1967: E. F. Gilbert 313 (ETH).
Sidamo	Sideroad from Abella to lake Abeya, 14 km from main road, alt. 1300 m, 12-5-1968: WP 4051; about 100 km along track Negelli to Wachille, near bridge crossing Dawa Parma river, alt. 800 m, 4°47'N × 39°19'E, 24-2-1971: J. J. F. E. de Wilde & M. G. Gilbert 358; Road from Soddo to Arba Minch, 31 km from Soddo, left, through the Abella community development project, 18 km along shore of lake Abaya, alt. 1200 m, 3-12-1967: WP 2969.

The following specimens, originating from Ethiopia, were seen: I. Baldrati 11 (FT), 2293 (FT), 2420 (FT), 4125 (FT), 4973 (FT); N. Beccari 12 (FT), 77 (FT); Beccari 9 (FT, K); W. Burger 1427 (ACD, K), 1621 (ACD, K); L. Buscalioni 1284 (FT); A. Chinderi 396 (FT), 438

(FT); E. Chiovenda 321 (III) (FT); N. C. Cockburn s.n. (K); R. Corradi 4205 (FT), 4259 (FT), 4312 (FT), 4350 (FT), 4451 (FT), 4455 (FT), 4473 (FT), 4501 (FT), 4510–4512 (FT); A. Fiori 128–130 (FT); D. G. Greathead 13 (BM), 102 (BM); R. Guidotte 556 (FT); C. F. Hemming 1162 (BM, K); Hohenack. Arznei & Handelspfl. 3 (P); F. B. Hummel 49 (K), 59 (K); Jecama I-17 (ACD, K); Kralik s.n. (june 1840 Tacazé) (P); Neuville 281 (P); A. Pappi 380 (BM, P), 2599 (FT), 3296 (FT), 4497 (BM, FT, K), 6758 (FT, P), 6843 (FT), 7723 (FT), 8395 (FT), 8964 (FT), 9061 (FT); A. Petit 424 (4ᵉ envoi) (P); Quartin-Dillon 31 (P); Quartin-Dillon & Petit 424 (1ᵉ envoi) (P), 6 (3ᵉ envoi) (P), 459 (3ᵉ envoi) (P), s.n. (dernier envoi 1844 (P), s.n. (A. de Franqueville 109) (K, P), s.n. (A. de Franqueville s.n.) (K, P); Rochet d'Hericourt 1 (P), 35 (P), 39 (P), 79 ? (P); Ruspoli-Riva 1141 (FT); Schimperi iter Abyss. coll. 635 (BM, K, P), 882 (BM, K, P); Schimper pl. Abyss. 528 (FT, P); Schimper 1136 (flora Abyss.) (P); W. Schimper 1136 (P); G. Schweinfurth & D. Riva 2181 (FT, K); Taddesse Ebba 579 (K), 721 (K); A. Terracciano 576 (FT), 873 (FT); A. Terracciano & A. Pappi 1932 (K), 2616 (K); A. Vatova 319 (FT), 1287 (FT), 1336 (FT); T. C. Wrigley 255 (BM).

Ecology

T. indica is a beautiful evergreen tree, particularly well adapted to semi-arid tropical regions. It is often found growing alone, rarely in small groups together, along rivers (which are often temporarily dry) or lakes, in dry, open, often rocky lowland-woodland.

In Ethiopia it occurs at altitudes from sea-level up to 1300 (–2000) m (Herb. WAG; Roti-Michelozzi, 1957).

In the area of the Flora of Tropical East Africa, its altitudinal range is from sea-level up to 1520 m (Brenan, 1967).

The tree is not found in very arid nor in very humid climates. In Ethiopia, it usually grows in areas with an annual rainfall of ca 300–400 mm, in one or two rainy seasons per year (Roti-Michelozzi, 1957). Provided that the soil is well-drained, the tree can stand a rainfall of up to 4000 mm per year (Duke & Turrell, 1974). The tree grows on many kinds of soils, but seems to prefer water-rich sandy soils near water-courses. It is often observed that the tree grows near termite hills, perhaps preferring the slightly concentrated lime. Its occurrence together with the baobab *(Adansonia digitata)* is also observed frequently. According to Aubréville (1950), the seedlings prefer soils relatively rich in organic matter in the shadow of the baobab. At the same time they profit from the relatively humid soil after rains. During its growth and development, it can push over the baobab and finally take its place. The tree is reported to be hurricane resistant (N.A.S., 1979).

The seeds are dispersed by animals which eat the fruits.

In Ethiopia tamarind is often accompanied by common plants of the genera: *Commiphora, Acacia, Delonix, Terminalia, Gyrocarpus,* and sometimes *Hyphaene* and *Dobera* (Roti-Michelozzi, 1957).

Flowering and fruiting trees of tamarind in Ethiopia can be found during the whole year. The main flowering period is from March to July (small rainy and dry season). Fruits were mainly observed from September to April (dry season) (Herb. WAG).

In India the tree usually flowers in the dry season (Roxburgh, 1874).

Flowers are probably pollinated by insects (Prasad, 1963), although the flower structure does not exclude the possibility of self-pollination. Prasad (1963) reported that pollen grains germinated well in a solution with 6–12% sucrose (in a 8%

solution, 51.5% of the pollen germinated); addition of 1% agar to the medium resulted in 66.7% germination.

According to Dalziel (1955) the tree has an abundant leaf-fall and usually has no undergrowth. Although the tree is often planted for its pleasant shadow in villages, people in India object to sleep under the tree as they fear its 'harmful acid exhalations'. The leaves bear acid exudation droplets indeed, which refresh the air at the hot times of the day.

Husbandry

The tamarind tree is normally grown from seed, but it can be propagated vegetatively as well (Purseglove, 1968; Lefèvre, 1971). The seeds keep their viability for a very long time. After sowing, germination starts after one week and in general the germination percentage is high.

Young plants are very sensitive to cold. Full-grown trees, however, are resistant to some frost (−2°C, Florida). Planting distances vary from 10 × 12 m in Thailand, 12 × 12 m in Venezuela to 20 × 20 m in Madagascar (Lefèvre, 1971). Tamarind, however, is seldom grown as a plantation (Purseglove, 1968). It is more often planted as a shadow tree in villages. Its popularity in India has grown recently, especially because all parts of the plant are useful.

In Ethiopia the tree is not cultivated in plantations. Its fruits are mainly collected from trees growing in the wild.

The tree grows slowly and resists wind very well.

In Madagascar, plants start flowering 4 years after sowing, being ca 3 m high. In India the worthwhile production of fruits starts after 10–12 years. The tree reaches its maximum yield after 80–100 years. One tree produces ca 150–200 kg fruits per year (ca 15 000 kg/ha). One fruit weighs ca 10–15 g, and ca 40% of it is the desired pulp. India is the largest producer of fruits: ca 250 000 tons per year, of which ca 3000 tons is exported to Arab countries, Ceylon, Europe and the USA (Lefèvre, 1971).

Several ways have been reported of preparing fruits before transport. In America, the pods, deprived of the exocarp, are placed in layers in a cask and boiling syrup is poured over them till the cask is filled. When cooled the cask is closed and is ready for sale. Sometimes layers of fruit are alternated with layers of sugar before the hot syrup is added. East Indian fruits are usually exported without sugar. The exocarp is removed and the pulp is pressed together. In the Upper Nile regions and in Arabia the pulp is kneaded into flattened round cakes, 10–20 cm in diam., 2–5 cm thick, which are dried in the sun. They are firm in consistency and quite black, externally covered with impurities. The American product is called 'brown or red tamarind', the East Indian product 'black tamarind' (Flückiger & Hanbury, 1874).

In Ethiopia, only whole fruits are offered for sale on markets.

The pulp of the Indian fruits is usually better developed and more juicy than of African fruits (Purseglove, 1968).

The tree certainly deserves more attention in Ethiopia. Lefèvre (1971) reviewed the literature on diseases and pests of tamarind. The most important ones were caused by the following:

— *Alphitobius laevigatus* F. ('black fungus beetle'), which feeds on the fruit pulp before and after harvest;
– *Longidorus elongatus*, a nematode present in the roots in India;
– *Sitophilus linearis* Herbst ('tamarind seed borer'), which attacks the fruit before and after harvest and whose larva feeds on the seeds.

Uses

1. Medicinal uses

The medicinal properties of tamarind are probably not very impressive, but, with its pantropic distribution, many uses have been reported. Some of its uses, arranged according to the part of the plant used, are as follows.

a) The roots

– They are used in a remedy against sleeping sickness, and they are a component of a poison antidote (Irvine, 1961).
– In Nigeria, they are an ingredient of a remedy for leprosy (Irvine, 1961; Watt & Breyer-Brandwijk, 1962; Haerdi, 1964).
– In Tanzania, they are used against heart pain (Haerdi, 1964).
– In East Africa and Sudan, a decoction is used against coughs and fevers (Irvine, 1961; Kokwaro, 1976).

b) The bark

– In East Africa, a decoction is used against sore throat (Kokwaro, 1976), and in Mauritius and Madagascar against asthma (Watt & Breyer-Brandwijk, 1962).
– It is used as a remedy against eye diseases (Irvine, 1961), in Sudan against fevers (Irvine, 1961), in Madagascar to cure wounds, ulcers and abscesses (Watt & Breyer-Brandwijk, 1962), in Malawi as a remedy for a fowl-sickness (Irvine, 1961).
– In Nigeria, a decoction of bark and pod-husks, together with the bark and leaves of *Diospyros mespiliformis*, is used as a medicine against leprosy (Irvine, 1961).
– Pulped bark with lemon is used against diarrhoea (Irvine, 1961). A similar drink is taken by women after childbirth (Heyne, 1927; Irvine, 1961).

c) The wood

– A decoction is used as a purgative (Watt & Breyer-Brandwijk, 1962).
– The ash is used against gonorrhoea (Watt & Breyer-Brandwijk, 1962).

d) The leaves

– A decoction is taken against fevers in Madagascar and Zaire (Irvine, 1961; Watt & Breyer-Brandwijk, 1962).
– A decoction or sap is used as a medicine against many intestinal complaints (diarrhoea, dysentery, worms) (Irvine, 1961; Watt & Breyer-Brandwijk, 1962; Haerdi, 1964; Kokwaro, 1976).
– A decoction or warmed sap is used against eye diseases (eye-drops) in Cambodia (Watt & Breyer-Brandwijk, 1962), Ghana (Irvine, 1961), and Senegal (Kerharo & Adam, 1964).
– A decoction or fresh or dry powdered leaves are used as a medicine against wounds and abscesses (De Wildeman, 1906; Heyne, 1927; Irvine, 1961; Watt & Breyer-Brandwijk, 1962; Amare,1976).

– In Tanzania fresh leaves are chewed and the pulp is placed on wounds caused by snake-bites (Watt & Breyer-Brandwijk, 1962).
– Leaves are used as a medicine against rheumatism (Watt & Breyer-Brandwijk, 1962), and against bronchitis and coughs (Irvine, 1961).
e) The flowers
– They are used as a medicine against jaundice, eye diseases, wounds and intestinal complaints (Watt & Breyer-Brandwijk, 1962).
f) The fruits (pulp)
– Best known are uses as a laxative and as a fever medicine (almost all authors on the subject, including those writing about Ethiopia). According to Watt & Breyer-Brandwijk (1962) the purgative effect of the pulp disappears after cooking.
– In Ethiopia the pulp is used against diarrhoea, dysentery and malaria (Watt & Breyer-Brandwijk, 1962), and on wounds and haemorrhoids (also in Brazil and Zaire) (De Wildeman, 1906).
– In Mauritius the pulp is used against rheumatism (Watt & Breyer-Brandwijk, 1962), in India as an antiscorbutic (Irvine, 1961) and in Indonesia old pulp as an abortivum (Heyne, 1927).
g) The seeds
– Powdered seeds are used against dysentery in Ethiopia, India and Senegal (Watt & Breyer-Brandwijk, 1962; Kerharo & Adam, 1964; Amare, 1976), In India against rheumatism (Forest research, 1955), in Ceylon and Sudan on wounds, ulcers and furuncles (Irvine, 1961).

2. *Miscellaneous uses*

a) The wood
The heartwood is dark-brown to purplish, tough, hard, cross-grained, difficult to work and liable to crack on seasoning. It bends easily, is strong, and takes a good polish. It is used for furniture and boats. The wood is not durable out of doors, but is resistant to worms and termites. It weighs (air-dry) ca 627–964 kg/m^3 (De Wildeman, 1906; Dale & Greenway, 1961). Canes made from the stem or root are very strong (Engler, 1915). Wood-ash is used in dehairing hides (Irvine, 1961) and the wood produces an excellent charcoal (Dale & Greenway, 1961).
b) The bark
– In Indonesia it is considered as a dainty to chew on tamarind bark and it is used together with or as a substitute for betel (Ochse, 1931);
– On Java, Indonesia, an ink is prepared from the burned bark of old trees (Watt & Breyer-Brandwijk, 1962);
– The bark is used to tan hides (Irvine, 1961);
– The tree yields a dark, reddish gum. This occurs in clear transparent 'tears' on the bark and it is quite insoluble, but in water it swells to make a jelly (Watt & Breyer-Brandwijk, 1962).
c) The leaves
– They are used in salads, curries and soups (also seedlings) (Purseglove, 1968; many other authors);

– They are used to dye leather (yellow) and to bleach leaves of *Corypha elata,* which are used to make hats (Engler, 1915; Lefèvre, 1971; many other authors);
– They are used as food for cattle (Irvine, 1961);
– The tree is the host of the silkworm *Hypsoides vuilletii* Joannis, which feeds on the leaves. The silk is occasionally made into fabrics, but, in Sudan, more often into thread to embroider Hausa gowns (Irvine, 1961).

d) The flowers

– They are used in salads, curries and soups (Purseglove, 1968; many other authors);
– If many trees grow together, tamarind honey production can be interesting (Lefèvre, 1971).

e) The fruits

– The rather acid, brown pulp of the fruits is eaten fresh. Mixed with sugar, it makes a sweetmeat. It is used to season foods, curries, preserves, chutneys and sauces, and to prepare jams and syrups. A refreshing acid drink and sherbet are made with it (Purseglove, 1968; many other authors);
– Overripe fruits can be used to clean copper and brass (Purseglove, 1968);
– The 'black' tamarind has been used in the manufacture of tobacco (Flückiger & Hanbury, 1874);
– In W. Africa the fruits are sometimes used as a detoxicator by placing them in water, in which tubers of poisonous yams *(Dioscorea* spp.) are soaked before cooking (Watt & Breyer-Brandwijk, 1962).

f) The seeds

– The seeds are eaten roasted or boiled after removing the testa (Purseglove, 1968; many other authors);
– Ground into a flour and boiled, they are a food for the poor in India (Roxburgh, 1874; Bhandari, 1974);
– In India, the seeds are used as a source of carbohydrate for sizing cloth, paper and jute products and for vegetable gum in the food processing industry (Purseglove, 1968; many other authors);
– A hard insoluble and durable material can be made from the seed kernel powder together with magnesium oxide or with gum (Engler, 1915; Watt & Breyer-Brandwijk, 1962);
– The testa is used in India to dye wool and to colour paper (Forest research, 1955).

Chemical composition

a) The fruit-pulp

Ranges of data for the composition of the fruit-pulp are given in Table 8.

According to Lefèvre (1971), tamarind is the most acid and at the same time the most sweet fruit. During ripening, the acidity of the fruit does not decrease (as happens in most other fruits). The sweet taste is caused by the synthesis and hydrolysis of amylose as this results in a production of many sugars. Lee et al. (1975) identified 61 volatile components in tamarind fruit-pulp. They described the overall aroma of tamarind as consisting of citrus notes and a warm spice-like flavour with some roasted character.

Table 8. Composition of tamarind fruit-pulp (g/kg), according to Lefèvre (1971).

moisture	150–180
protein	750–2400
fat	1.1–2
carbohydrate (mainly sugars)	160–700
cellulose	10–50
pectin	10–24
free tartaric acid	50–180
fixed tartaric acid	67
tryptophan	0.0002
methionine	0.00016
lysine	0.00155
ash	8–30
Ca	0.07–1
P	0.72–1.2
Fe	0.006–0.028
Na	0.51
K	7.81
S	0.09
Mg	0.21
Mn	0.024
active carotenoids	0.001
thiamine (vitamin B-1)	0.003–0.006
riboflavin (vitamin B-2)	0.001–0.002
ascorbic acid (vitamin C)	0.02–0.2
niacin	0.011–0.0214
vitamin A (International Units)	30–50

b) The leaves

The composition of the leaves is given in Table 9.

According to Busson (1965), the most abundant amino acids in the leaves are glutamic acid, leucine, and aspartic acid.

c) The bark

The bark contains ca 7% tannin (Irvine, 1961).

d) The seed

According to Purseglove, (1968) the seed contains starch 63%, proteins 16% and semi-drying oil 5.5%.

Table 9. Composition of the leaves of tamarind (percentage of dry material), according to Irvine (1961).

moisture content of fresh leaves (%)	64.2–70.2
crude protein	14.7–16.6
ether extract	3.7–4.3
crude fibre	17.9–24.4
N-free extract	50.3–51.0
ash	6.9–10.1
Ca	1.76–2.42
P	0.19–0.22

According to Pitke et al. (1977), the fatty acid composition (mass fractions) of tamarind kernel oil is as follows (determined by gas-liquid chromatography): lauric acid a trace, myristic acid a trace, palmitic acid 14.8%, stearic acid 5.9%, arachidic acid 4.5%, behenic acid 12.2%, lignoceric acid 22.3%, oleic acid 27.0%, linoleic acid 7.5%, linolenic acid 5.6%. The lignoceric acid is noteworthy. The only other oil reported to contain substantial amounts of this saturated fatty acid comes from the seeds of coral wood *(Adenanthera pavonina* L. *Leguminosae).* Since the oil of tamarind contains a large proportion of saturated fatty acids and its melting point is relatively high, it can be classed under the vegetable butter group. In sizing of cotton yarns with tamarind kernel powder, the fatty component acts as an internal lubricant.

4 List of Ethiopian spices, condiments and medicinal plants

In Ethiopia, many more plants are used as a spice (condiment) or as a medicine than have been treated in detail in this book. Table 10 lists numerous taxa, arranged alphabetically by their generic and specific names. The nomenclature is mainly based on Cufodontis's Enumeratio (1953–1972).

Each entry is accompanied by the name of the family to which the species belongs. Only a few local names are given. The Gallinia (G) names include many new ones that I noted, mainly in Hararge Province. The uses are mentioned briefly only. The name of the part used is followed by its activity or by the complaint(s) against which it is used. The table does not mention (or briefly only) methods of preparation or use, which may be found in the literature cited.

The information is based on personal collections and observations, as well as on the literature. Personal observations have not been distinguished.

The list is not complete. It could, however, form a basis for detailed treatment of other spices and medicinal plants in Ethiopia.

The following abbreviations are used for the vernacular names:

A = Amarinia	G = Gallinia	T = Tigrinia (Tigre)
Ar = Arabic	S = Somali	

Most pharmacological and medicinal terms can be found in the glossary (p. 298).

The literature is indicated by numbers as follows:

1. Amare Getahun, 1976. Some common medicinal and poisonous plants used in Ethiopian folk medicine.
2. I. Baldrati, 1946. Piante officinali dell'Africa orientale. Centro Studi Colon. 32.
3. F. von Breitenbach, 1963. The indigenous trees of Ethiopia. 2nd ed.
4. E. Chiovenda, 1912. Osservazioni botaniche, agrarie ed industriali. Monog. rapp. colon. 24.
   E. Chiovenda, 1931. Vegetali utilizzati nella medicina indigena dell' Eritrea, Somalia e regione vicine. Atti del primo congresso di studi coloniali.
5. G. Cufodontis, 1953–1972. Enumeratio plantarum aethiopiae, Spermatophyta. Bull. Jard. Bot. État Brux. Supplements.
   G. Cufodontis, 1957. Bemerkenswerte Nutz- und Kulturpflanzen Aethiopiens. Senck. Biol. 38: 405–415.
6. T. Fossi Innamorati, 1973. Notizie di medicina populare africana nell'Erbario tropicale di Firenze. Webbia 28: 81–134.
7. P. N. E. Fournier, 1861. Des ténifuges employés en Abyssinie.
8. H. Kloos, 1976. Preliminary studies of medicinal plants and plant products in Ethiopian markets. J. Ethiop. Pharm. Assoc. 2: 18–28.
   H. Kloos, 1976–1977. Preliminary studies of medicinal plants and plant products in markets of Central Ethiopia. Ethnomedicine 4(1/2): 63–104.

H. Kloos et al.. 1978. Preliminary studies of traditional medicinal plants in nineteen markets in Ethiopia: use patterns and public health aspects. Ethiop. Med. J. 16: 33–43.

9. D. Lemordant, 1960. Les plantes ethiopiennes.
D. Lemordant, 1971. Contribution à l'ethnobotanique Ethiopienne. J. Agric. Trop. Bot. Appl. 18(1–3): 1–35; 18(4–6): 142–179.
10. I. E. Siegenthaler, 1963?. Useful plants of Ethiopia. Exp. Stn. Bull. 14.
11. E. Westphal, 1975. Agricultural systems in Ethiopia.

Table 10. List of Ethiopian spices, condiments and medicinal plants.

Scientific name	Family	Vernacular names	Uses		Sources
Abrus precatorius (L.) L.	Papilionaceae	luhllo, suaua (T)	seed	eye disease	2, 4, 5
Abutilon bidentatum Hochst. ex A.Rich.	Malvaceae	oyo (G), balumbal (S)	root	dysentery	
Abutilon pannosum (Forster f.) Webb	Malvaceae	balambal (S)	root	dysentery	2, 4, 5
Acacia nilotica (L.) Del. var. nilotica	Mimosaceae	marah (S), tcia (T)	bark	dysentery	3, 4, 5
Acacia nilotica (L.) Del. var. adansonii (G. & P.) O.Ktze	Mimosaceae	mara (S)	bark	febrifuge, haemorrhoids, lactogenic, leucorrhoea	3, 4, 5
Acacia senegal (L.) Willd.	Mimosaceae	konetter (A), kantab (T)	gum arabic	panacea	2, 3, 4
Acacia spp.	Mimosaceae	ged mass (G)	bark	snake bites	
		karo (G)	leaves	wound dressing	
		lafto (G), wachu (G)	root	anthelmintic for sheep	
		grar (A)		leprosy, astringent	9
Achyranthes aspera L.	Amaranthaceae	talenge (A), maccello (T), dargu (G), matanne (G)	herb	wound dressing, venereal diseases, haemostatic, eye diseases	2, 6, 9
			root	against vomiting	
Adansonia digitata L.	Bombacaceae	baobab, dima, hummer (T), jag (S)	leaf	febrifuge	2, 9
Adenia venenata Forsk.	Passifloraceae	giavara (T), modacca (T)	leaf wood	wound dressing	2, 5
Adhatoda schimperiana (Hochst.) Nees	Acanthaceae	see p. 132			
Aerva persica (Burm. f.) Merrill var. bovei (Webb) Chiov.	Amaranthaceae	ansala (A), gennaffer (T)	herb	snake and insect bites	5
Aframomum corrorima (Braun) Jansen	Zingiberaceae	see p. 10			
Ageratum conyzoides L.	Compositae	arema (A), adda, gunyato, tefo (G)	herb	wound dressing	1, 2, 10

Table 10 (continued)

Scientific name	Family	Vernacular names	Uses		Sources
Ajuga integrifolia Ham.-Buch. var. canescens (Benth.) Cuf.	Labiatae	madanit, armagusa (A), ungo-quasot (T)	herb	dysentery, swollen legs, high blood pressure, diabetes	1, 8
Albizzia anthelmintica (Rich.) A. Brongn.	Mimosaceae	bessena (A, T)	bark	anthelmintic, syphilis	2, 4, 5, 7
Allium ampeloprasum L.	Amaryllidaceae	egzier choagoura (A)	bulb	spice	
Allium cepa L.	Amaryllidaceae	shingurt (A, T)	bulb	spice	
Allium sativum L.	Amaryllidaceae	netch-shinkurt (A), kullubi-adi (G)	bulb	spice	
Allophylus abyssinicus (Hochst.) Radlk.	Sapindaceae	umbus (A), azamara (T)	leaf, fruit	anthelmintic, venereal diseases	2, 9
Aloe spp.	Liliaceae	eret, seteret (A), alge, hargeisa (G)	sap	earache, eye disease, laxative, febrifuge, spleen and liver complaints, skin diseases, malaria	1, 2, 8, 9
			leaf	wound dressing	
Amaranthus angustifolius Lam.	Amaranthaceae	aluma (A), bernaheo (T)	leaf	perfume	2, 5, 6
			fruit	anthelmintic	
Amaranthus caudatus L.	Amaranthaceae	cifogot, lishalisho (A), iyaso (G), taffi (G), zelal-enno-mariam (T)	root	laxative	1, 5, 10
			seed	taenifuge, eye disease, amoebic dysentery	
Amaranthus gracilis (Desf.) Poir.	Amaranthaceae		herb	perfume	5
Amaranthus sylvestris Vill.	Amaranthaceae	aluma (A), birnaheo (T)	herb	perfume	1, 5
			seed	taenifuge	
Anacardium occidentale L.	Anacardiaceae	bibbo (S)	bark, leaf	astringent	2
Andrachne aspera Spreng.	Euphorbiaceae		root	against vomiting	5
Anethum foeniculum L.	Umbelliferae	see p. 20			
Anethum graveolens L.	Umbelliferae	see p. 29			
Anogeissus leiocarpus (DC) Guill. & Perr.	Combretaceae	hanse, kirkira (T)	fruit	dysentery	2
Apium graveolens L.	Umbelliferae		herb	condiment	5
Argemone mexicana L.	Papaveraceae	madafé (A, T)	sap	eye diseases, diuretic, narcotic	2, 4, 5
			seed	emetic, purgative	

Table 10 (continued)

Scientific name	Family	Vernacular names	Uses		Sources
Aristolochia bracteata Retz.	Aristolochiaceae	ghaga (Ar), boro (S)	herb	aphrodisiac, itch	1, 5
Artemisia abyssinica Schtz.-Bip. ex Richard	Compositae	chikoyi (A), jukun (G)	herb	constipation, cold, rheumatism	9
Artemisia afra Jacq.ex Willd.	Compositae	arrity, aretia (A), chukon, sakajo (G), kodo (G)	leaf	smallpox, perfume, stomach ache	1, 8, 10
Artemisia rehan Chiov.	Compositae	necc-rehan (A), zada-rihan (G)	herb	perfume, malaria, vermifuge, emmenagogue, insect repellent	2, 4, 5, 9
Arundinaria alpina K. Schum.	Gramineae	karkaha, meka, shenbeko (A), lemen, gobensa (G)	root	skin disease on head	
Asparagus asiaticus L.	Liliaceae	kest (A), sariti, hida sare (G)	leaf	paralysis	1, 9
			root	gonorrhoea, febrifuge	
			ash	warts	
Astragalus boeticus L.	Papilionaceae		seed	stimulant	5
Athroisma lobatum (Kl. in Schz.) Mattfeld	Compositae	furbunole (S)	herb	wound dressing	5
Balanites aegyptiaca (L.) Del.	Agialidaceae	djemo, muttcha (A), gouasa (T)	bark	disinfectant	2, 5, 9
			leaf	wound dressing	
			fruit	anthelmintic, laxative	
Becium grandiflorum (Lam.) Pichi-Sermolli	Labiatae	tabab (T)	herb	malaria	6
Bersama abyssinica Fres.	Melianthaceae	asamer (A), bersama (T), lolchissa (G)	leaf	dysentery, roundworm	1, 6
			sap	purgative	
Bidens borianiana (Schtz.-Bip. ex Schwfth.) Cuf.	Compositae	ababa-maskal (A), kelo (G)	flower	insect repellent	10
Bidens macrantha (Schtz.-Bip.) Cuf.	Compositae	addi-ababa (A), gellgellem (T)	leaf	wound dressing	4, 6
Bidens pilosa L.	Compositae	chugogot (A), jugogid (G)	leaf	intestinal inflammations	2
Bidens prestinariaeformis (Vatke) Cuf.	Compositae	maskal-abeba (A), hada maskala (G), kello (G)	sap	haemostatic	

Table 10 (continued)

Scientific name	Family	Vernacular names	Uses		Sources
Bixa orellana L.	Bixaceae		leaf	wound dressing	2
			fruit	dysentery	
			sap	anthelmintic	
			seed	catarrh, asthma	
Blepharispermum fruticosum Klatt in Schinz	Compositae		herb	diaphoretic	5
Boerhavia coccinea Mill.	Nyctaginaceae	deg-deg (S)	root	diuretic	5
Boswellia papyrifera (Del.) Hochst.	Burseraceae	etan, macher (A), libanot (G), angouah (T)	resin	frankincense, febrifuge	1, 2, 5
Boswellia pirottae Chiov.	Burseraceae		resin	frankincense	5
Brassica integrifolia (West) Rupr.	Cruciferae	gomanza (A), adri (T), rafu (G)	seed	stomach ache	6
Brassica nigra L. var. abyssinica A. Br.	Cruciferae	senafitch (A, T), midan rafu, rafu, senaficcia (G)	seed	condiment, abscess dressing, amoebic dysentery, stomach ache, constipation, bloat, abortifacient, rheumatism	2, 5, 9
Brucea antidysenterica J. F. Mill.	Simaroubaceae	see p. 140			
Buddleja polystachya Fresen.	Loganiaceae	amfar (A), mattere (T), bal addi, muca adi (G)	all parts	anthelmintic, purgative, skin diseases, wound dressing for animals	2, 4, 5, 7, 9
Cadaba farinosa Forsk.	Capparidaceae	astan (T), galangal (S)	leaf	dressing rheumatism	6
Cadaba rotundifolia Forsk.	Capparidaceae	laegiab (T), anagalli (Danakil)	leaf	anthelmintic, toothache	2, 5
Caesalpinia decapetala (Roth) Alst.	Caesalpiniaceae	kajima (G)	root	taenifuge, coughs	
Calotropis procera (Ait.) Dry. in Ait.	Asclepiadaceae	ginda, tobbeya (A), akalo (T)	sap	nose inflammation, leprosy, venereal diseases	1, 2, 4, 5, 9
			leaf	dressing swellings	
			root	emetic, tonic, diaphoretic	
Calpurnia aurea (Ait.) Benth.	Papilionaceae	see p. 148			
Camellia sinensis (L.) O.Ktze.	Theaceae	shay (A)	leaf	tea	
Capparis cartilaginea Decne	Capparidaceae	ajehada (T)	leaf	laxative	5

Table 10 (continued)

Scientific name	Family	Vernacular names	Uses		Sources
Capparis tomentosa Lam.	Capparidaceae	gamaro (A), andal (T)	leaf	dressing eye diseases	2, 4, 5, 9
Capsella bursa-pastoris (L.) Med.	Cruciferae	hamli-grat (T)	herb	abortifacient	9
Capsicum annuum L.	Solanaceae	see p. 38			
Cardiospermum helicacabum L.	Sapindaceae	samak (A), schuelet (T)	seed	febrifuge, common cold	1, 6
Carica papaja L.	Caricaceae	papaja (A, G), maffafai (S)	fruit	stomach ache	2
Carissa edulis (Forsk.) Vahl	Apocynaceae	agam (A), agamsa (T)	root	snake-bites, toothache, stomach ache	3, 5, 9
Carissa schimperi DC.	Apocynaceae	gararo (A), makteh (T), wabi (S)	leaf, bark root	dressing scabies aphrodisiac, blenorrhagia	2, 9
Carthamus tinctorius L.	Compositae	suf (A), sufi (G)	seed	stomach ache	
Carum carvi L.	Umbelliferae		seed	condiment	11
Cassia absus L.	Caesalpiniaceae	darur (A, T)	seed	venereal and eye diseases	2, 4, 5
Cassia adenensis Benth.	Caesalpiniaceae	galelo (S)	fruit, leaf	laxative	5
Cassia alexandrina (Gars., Mill.) Thell.	Caesalpiniaceae	senna-mekki (T)	leaf	laxative	5
Cassia angustifolia Vahl	Caesalpiniaceae	utekki (T), sanu (Danakil)	fruit, leaf	laxative	2, 4, 5, 6
Cassia bicapsularis L.	Caesalpiniaceae	muca dada (G)	seed	skin disease animals	
Cassia holosericea Fresen.	Caesalpiniaceae	gellelo (S)	leaf, fruit	laxative	5
Cassia italica (Mill.) Lam. ex Steud.	Caesalpiniaceae	senamaki (A), enteentaro (T)	leaf, fruit	laxative, febrifuge	4, 5, 6
Cassia occidentalis L.	Caesalpiniaceae	senamaki (A)	leaf	febrifuge	2, 4, 5
Casuarina equisetifolia Forst.	Casuarinaceae	arselebanos (A), show-showeye (G)	bark	astringent	3
Catha edulis (Vahl) Endl.	Celastraceae	see p. 156			
Celosia anthelmintica Asch. ap. Schwfth.	Amaranthaceae	belbilda (A), bilbilla (T)	herb	taenifuge	5, 6, 9
Celosia argentea L.	Amaranthaceae		flower seed	dysentery, menstruation pains diarrhoea	1, 4, 5
Celosia populifolia Moq.	Amaranthaceae	belbelta (A), angas (S)	herb	anthelmintic	7
Celosia trigyna L.	Amaranthaceae	belbelta (A), bilbilla (T)	herb	taenifuge	4, 5, 6, 7
Chenopodium album L.	Chenopodiaceae	amedmadoo, nechillo (A)	seed	anthelmintic	1

Table 10 (continued)

Scientific name	Family	Vernacular names	Uses		Sources
Chenopodium ambrosioides L.	Chenopodiaceae	gimmy (A)	herb	anthelmintic	5
Chenopodium schraderianum Roem. & Sch.	Chenopodiaceae	senakna (T)	seed	vermifuge	2
Chenopodium sp.	Chenopodiaceae	damakasse (A, G)	sap	eye disease	
Chrozophora plicata (Vahl) Juss.	Euphorbiaceae		seed, leaf	laxative	5
Cineraria lyratipartita (Schtz.-Bip. ex Rich.) Cuf.	Compositae	haschascha (T)	herb	syphilis	5
Cinnamomum zeylanicum Garc. ex Bl.	Lauraceae	qarafa (A), carafu (G), crefté (T)	bark	spice	5
Cirsium vulgare (Savi) Tenore	Compositae	kore hare (G), dender (T)	root	gonorrhoea	
Cissampelos pareira L.	Menispermaceae	hida losho (G)	leaf	diaphoretic, diuretic, wound dressing	1, 5
			root	snake bites	
Cissus adenantha Fres.	Vitaceae	asserkush, tebette-bkush (A)	leaf	wound dressing on head and swellings	2, 4, 5, 9
			root	rabies	
Cissus adenocaulis Steud. ex Rich.	Vitaceae	baltaki (G)	leaf	wound dressing	2, 4, 5
		kurrho (T)	root	ulcers, heart complaints	
Cissus cornifolia (Bak.) Planch.	Vitaceae	mahué (S)	leaf	scabies	2, 5
Cissus cyphopetala Fres.	Vitaceae	halenke-temen (T), buri bala shani (G), buri gura shani (G)	root	constipation, bloat, lactogogum (cows)	
Cissus mollis (Bak.) Planch.	Vitaceae	ucini-quasot (T), hidda refa (G)	herb	rabies	6
Cissus quadrangula L.	Vitaceae	amma (T)	herb	emetic, wound dressing animals	2, 5, 6
Cissus rotundifolia (Forsk.) Vahl	Vitaceae	tchambé (A), buri sartu, buri gura sadihi (G)	herb	laxative	2, 5
			root	cough, bloat	
Cissus stefaniniana Chiov.	Vitaceae	armo (S)	root	malaria	2
Citrullis colocynthis (L.) Schrader	Cucurbitaceae	anguille-baita (T)	sap	laxative	2, 5
Citrus sinensis (L.) Osbeck	Rutaceae	birtukan (A), burtukana, tuto, toto (G)	fruit	skin diseases, bloat	

Table 10 (continued)

Scientific name	Family	Vernacular names	Uses		Sources
Clausenia anisata (Willd.) Hook. f. ex Benth.	Rutaceae	limich (A), ulmae, wolmaye (G)	herb	disinfectant	1, 10
Clematis hirsuta Perr. & Guill.	Ranunculaceae	haso (A), kemida (T)	leaf	wound dressing	6
Clematis simensis Fres.	Ranunculaceae	hasso (A), harrak (T), tillo (G), fiti, elaydeea (G)	leaf	wound dressing	1, 2, 4, 5, 9
			sap	febrifuge, bloat	
			seed	rheumatic pains	
Clerodendrum myricoides (Hochst.) R.Br. ex Vatke	Verbenaceae	sulthé (A), surbatri (T), muserich, harmal adi, misrich, tirro (G)	bark	snake bites	1, 2, 9
			leaf	wound dressing, skin diseases, eye diseases, malaria, vermifuge	
			root	heart complaints, bloat	
Clutia kilimandscharica Engl.	Euphorbiaceae	feyel fedj (A)	leaf	diarrhoea	9
			smoke	eye diseases	
Coffea arabica L.	Rubiaceae	bunna (A, G)	leaf, fruit	coffee	10
Coffea canephora Pierre ex Fröhner	Rubiaceae			coffee	5
Coleus edulis Vatke	Labiatae	dinish (A), donike, barbarash (G)	sap	bloat	
Coleus lanuginosus Hochst. ex Benth.	Labiatae	zommer (T), damacse (G)	sap	headache	6
Combretum aculeatum Vent.	Combretaceae	ungoi (A), kato (T)	leaf	anthelmintic	6
Combretum ghasalense Engl. & Diels	Combretaceae	tenchelleba (T)	leaf, bark	malaria	2
Combretum paniculatum Vent.	Combretaceae	baye, gabai, shaga (G)	flower	eye diseases	1, 10
			herb	leprosy	
Commelina benghalensis L.	Commelinaceae	holagabis, holegbic (G), bar (S)	leaf	abscess dressing, skin diseases	
Commicarpus africanus (Lour.) Cuf.	Nyctaginaceae	hamla gila (T), koko-bala, kontoma (G)	sap	constipation, bloat	2, 4, 5
			leaf	wound dressing	
Commiphora africana (Rich.) Engl.	Burseraceae	oanka (A), ankoa (T)	resin	incense, panacea	5
Commiphora crenulata (Terrac.) Chiov.	Burseraceae	karbe (A), gowlello (S)	resin	disinfectant	8
Commiphora hodai Sprague	Burseraceae	kumb, karabee (G), hodeh (S)	resin	placenta expulsion	1, 9

Table 10 (continued)

Scientific name	Family	Vernacular names	Uses		Sources
Commiphora schimperi (Berg.) Engl.	Burseraceae	anka (A, T)	resin	incense, panacea	5
Conyza gouanii (L.) Willd.	Compositae	kaskasa (A), kasch-kascho (T)	herb	panacea	9
Cordia africana Lam.	Boraginaceae	see p. 170			
Cordia gharaf (Forsk.) Aschers.	Boraginaceae	auhi (T)	root	eye disease	5
Coriandrum sativum L.	Umbelliferae	see p. 56			
Crassocephalum macropappum (Schtz-Bip. ex Rich.) S. Moore	Compositae	jegallatiit (A)	flower	wound dressing	4, 6
Craterostigma plantagineum Hochst.	Scrophulariaceae	fosi-angrebit (T)	herb	snake, insect, scorpion bites	4, 5
Crotalaria natalitia Meisn. var. rutshuruensis De Wild.	Papilionaceae	may mako, muka guracha (G)	leaf, seed	dressing for scabies	
			root	boil dressing, toothache, diarrhoea of animals	
Crotalaria retusa L.	Papilionaceae	sciahsciahta (T), farowle, fororre (G)	leaf	wound dressing	
			root	bloat	
Croton macrostachyus Hochst.	Euphorbiaceae	see p. 178			
Cucumis ficifolius A. Rich.	Cucurbitaceae	umbai (A), duba hare, haragoge, duba hargeyssa (G), enkeuftehag (T)	leaf	against vomiting	4
			fruit	insect bites	
			root	rabies, bloat	
Cucumis laevigatus Chiov.	Cucurbitaceae	umbai (G)	fruit	condiment in tedj	4, 5
Cucumis prophetarum Jusl.	Cucurbitaceae	yender-inbuyi (A)	fruit	abortifacient, rabies	1, 8
			root	venereal and liver diseases, stomach ache, rabies	
Cucumis pustulatus Hook.f.	Cucurbitaceae	haftoh (T), curari (S)	root	purgative	4
Cucurbita maxima Duch. in Lam.	Cucurbitaceae	doba firay (A), arabe, firi duba (G)	seed	taenifuge	5, 8, 9
Cucurbita pepo L.	Cucurbitaceae	doba firay (A), arabe, firi duba (G)	seed	taenifuge	5, 8, 9
Cuminum cyminum L.	Umbelliferae	see p. 67			
Curcuma longa L.	Zingiberaceae	urt (A), hard (G)	rhizome	condiment	5
Cussonia holstii Harms ex Engl.	Araliaceae	habrate (G), waharu-gu (S)	bark	against vomiting, diarrhoea of animals	

Table 10 (continued)

Scientific name	Family	Vernacular names	Uses		Sources
Cymbopogon citratus (DC ex Nees) Stapf	Gramineae	tej-sar (A), chita sheka hussen (G)	leaf	perfume, heart, chest and stomach complaints	5, 8
Cynara scolymus L.	Compositae	kerchofe (G)	leaf	liver disease	1
Cynoglossum lanceolatum Forsk.	Boraginaceae	chigogit (A), matanni (G), bagé (T)	herb	febrifuge	6
Cyperus rigidifolius Steud.	Cyperaceae	ghichia (A), matrass-antschoa (T)	bulb	fever, diarrhoea, stomach ache	1
Datura metel L. var. metel	Solanaceae	atafaris (A), asangher (G)	leaf	narcotic (smoke)	4, 5
			seed	pain killing massage, rheumatism (oil)	
Datura stramomium L. var. stramonium	Solanaceae	atafarris, asinnakurt (A), asangher, kimatari (G)	leaf	narcotic, headache, wound dressing for animals	2, 4, 5, 6, 9, 10
			seed	rheumatism, head fungus, toothache, headache	
Daucus sp.	Umbelliferae	karot hare, shuf (G)	leaf	bloat, internal parasites animals	
			seed	taenifuge	
Delonix elata (Torner) Gamble	Caesalpiniaceae	debi (S)	seed	laxative	3, 5
Delphinium dasycaulon Fres.	Ranunculaceae	ilili hurdy (G), zellim-dobossom (T)	sap	coughs	
Dichrocephala chrysanthemifolia (Blume) DC.	Compositae	tabbaghiddi (A, G), kullegal (T)	herb	vermifuge	6
Dichrocephala integrifolia (L. f.) O.Ktze.	Compositae	tabbagiddi (A, G), kullegab (T)	herb	anthelmintic	5, 9
Dichrostachys glomerata (Forsk.) Chiov.	Mimosaceae	ergett-dimo (A), adi (G), kono (T)	bark	wound dressing	4
Dodonaea viscosa (L.) Jacq.	Sapindaceae	kitkita (A), kirtita (G), tasos (T)	leaf	wound dressing, febrifuge, sore throat	9
Dolichos formosus Rich.	Papilionaceae	wodal-asfes (A), adagora-quasot (T)	herb	wound dressing, venereal diseases	5
Dolichos oliveri Schwfth.	Papilionaceae	harmal, mucandi (G)	leaf	headache	
			root	headache, heart complaints, bloat	

Table 10 (continued)

Scientific name	Family	Vernacular names	Uses		Sources
Dovyalis abyssinica (Rich.) Warburg	Flacourtiaceae	koshum (A), koshumo (G), aihada (T)	fruit	swelling of throat	
Ecbolium linnaeanum Kurz	Acanthaceae	alen-medu (S)	herb	bites, epilepsy	5
Echinops sp.	Compositae	kabricho (A)	root	bilharzia, abscess dressing, stomach ache, common cold	2, 8, 9
Ehretia cymosa Thonn.	Boraginaceae	gammeh, karmamissa (A), aulaga, ulaga, karmamissa (G)	leaf	wound dressing, eye disease, abortifacient	
Eleusine coracan (L.) Asch. & Gräbn.	Gramineae	dagussa, dagiessa (A)	seed	dysentery	9
Embelia schimperi Vatke	Myrsinaceae	see p. 187			
Eragrostis tef (Zucc.) Trotter	Gramineae	tef (A), taffi (G)	seed	coughs	9
Erica arborea L.	Ericaceae	asta (A), schakto (T)	smoke	contagious diseases	9
Eriosema scioanum Avetta	Papilionaceae	embwatcho (A)	herb	wound dressing, venereal diseases	6, 9
Erythrina abyssinica Lam.	Papilionaceae	gurgad, kortch (A), soari (T)	bark	wound dressing	9
Erythrina burana Chiov.	Papilionaceae	burana (A, G), walensu, wollensu (G)	leaf, bark	dysentery and internal diseases of animals	
Erythrochlamys spectabilis Guerke	Labiatae	daidup (S)	herb	neuralgia	5
Eucalyptus globulus Labill.	Myrtaceae	bahar-zaf (A), acca-chilti (G), baharzafi addi (G)	leaf, branch, fruit	febrifuge, common cold, headache, coughs, insect repellent	1, 2, 9, 10
Euclea schimperi (DC) Dandy	Ebenaceae	miesa (A, G), dubis (G), kellao (T), dedo (A)	leaf	gonorrhoea, constipation, eczema	1, 6, 9
			root	taenifuge, purgative	
Euphorbia abyssinica Gmel.	Euphorbiaceae	kolqual (A), hadami (G)	sap	disinfectant, rabies, skin diseases, febrifuge	2, 9
Euphorbia depauperata Hochst. ex Rich.	Euphorbiaceae	adandash, abandasch (T)	leaf	anthelmintic	4, 5, 7, 9
			root	purgative, vermifuge	
Euphorbia hirta L.	Euphorbiaceae		sap	asthma	1
Euphorbia obovalifolia Rich.	Euphorbiaceae	kulgwal (A)	sap	taenifuge	5
Euphorbia peplus L.	Euphorbiaceae		herb	purgative, expectorant, asthma	2

Table 10 (continued)

Scientific name	Family	Vernacular names	Uses		Sources
Euphorbia petitiana Rich.	Euphorbiaceae	handukduk (A, T), endor-dorhen (T)	herb	anthelmintic	7
Euphorbia schimperiana Hochst. ex Scheele	Euphorbiaceae	handukduk (A, T)	leaf, flower, fruit	anthelmintic, purgative, venereal diseases	5, 7, 9
Euphorbia scordifolia Jacq.	Euphorbiaceae	rummid (Ar)	sap	laxative	5
Euphorbia tirucalli L.	Euphorbiaceae	kanchab (A), kinchiba (K), danno (S)	sap	disinfectant	
Evolvulus alsinoides L.	Convolvulaceae	eriraio (T)	herb	tonic, vermifuge	1
Ficus mallotocarpa Wardburg	Moraceae	harbu (G)	sap	gonorrhoea	
Ficus palmata Forsk.	Moraceae	belas (A), lugo (G), belles (T)	sap	skin complaints, warts	
Ficus sycomorus L.	Moraceae	worka (A), sagla (T)	root	prophylactic against typhoid	
Ficus vasta Forsk.	Moraceae	worka (A), kiltu (G)	leaf	paralysis (smoke)	
Galinsoga parviflora Cavan.	Compositae	nekelken, yeshewa-arem (A)	herb	wound dressing	1
Gardenia lutea Fresen.	Rubiaceae	gambella (A), gambello (G), hatina (T)	leaf root	syphilis haemostatic, bloat	2, 4
Glinus lotoides L.	Aizoaceae	menitery (A), cosala (A, T)	seed, herb	anthelmintic	2, 4, 5, 8
Glycine wightii (Wight & Arn.) Verdc. var. longicauda Schwfth.	Papilionaceae	hida law law, hida sarra (G)	leaf	dressing for scabies	
Gnidia stenophylloides Gilg	Thymelaeaceae	arsa (G)	herb, root	gonorrhoea	5, 6
Gomphocarpus fruticosus (L.) R. Br.	Asclepiadaceae	tefreina (A), hario, tifirindo (G)	sap smoke root	ulcers, lactogogum stiffness bloat	5
Grewia ferruginea Hochst. ex Rich.	Tiliaceae	longata (A), doconnu (G), sauma (T)	root	anthelmintic	9
Grewia schweinfurthii Burret	Tiliaceae	muro-medu (S)	leaf	wound dressing	6
Guizotia abyssinica (L.f.) Cass.	Compositae	noog, nogi (A)	seed	common cold	
Guizotia sp.	Compositae	mech (G)	leaf	earache	
Gymnema sylvestre (Retz.) R. Brown ex Schultes	Asclepiadaceae	schangok (T)	leaf root	diabetes vomitive	2

Table 10 (continued)

Scientific name	Family	Vernacular names	Uses		Sources
Gynandropsis gynandra (L.) Briq.	Capparidaceae	bökhbeha (T)	leaf	perfume, renal calculus	1, 5
Hagenia abyssinica (Bruce) Gmelin	Rosaceae	see p. 194			
Helichrysum schimperi (Schzt.-Bip. ex Rich.) Moeser	Compositae	balci, sarka (G), markok (T)	sap	bloat	
Helinus mystacinus (Ait.) E. Mey. ex Steud.	Rhamnaceae	galima (T)	fruit	wound dressing	10
Heliotropium ovalifolium Forsk.	Boraginaceae	amamgemel (T), hadad, dubi-goreyalle (S)	herb	scorpion sting	1
Heliotropium sp.	Boraginaceae	matanne, desa (G), habak hid (S)	leaf	wound dressing, constipation, bloat	1
			sap	eye disease, placenta expulsion	
Helminthocarpon abyssinicum Rich.	Papilionaceae	fosi-korzet (T)	herb	constipation	6
Hibiscus crassinervius Hochst. ex Rich.	Malvaceae	abbai-negus (A)	herb	syphilis	6, 9
Hibiscus ludwigii Eckl. & Zeyh.	Malvaceae	sogot (T)	leaf	paralysis	6
Hibiscus micranthus L.f.	Malvaceae	jifor (G), rigatatolo (T)	root	wound dressing for animals	
Hibiscus sabdariffa L.	Malvaceae	karkadé (A)	seed	aphrodisiac	5, 9
			root	laxative	
Hydnora johannis Beccari	Hydnoraceae	lekke, likki (S)	herb	astringent	5
Hydrocotyle sp.	Umbelliferae		herb	leprosy, syphilis, skin diseases	2
Hyparrhenia pseudocymbaria (Steud.) Anders.	Gramineae	kwaya (A), oa (G)	root	toothache	6
Hypericum annulatum Moris	Guttiferae	khendugdug (T)	root	anthelmintic	6
Hypericum gnidiifolium Rich.	Guttiferae	amidia (A), gorgoro (G)	leaf	stomach complaints	9
Hypoëstes triflora (Forsk.) Roem. & Schult.	Acanthaceae	tekur-talange (A), dargu (G)	herb	wound dressing for animals	4, 6
Hypoxis obtusa Burchell ex Ker- Gawler	Hypoxidaceae	tasseta (T)	herb	stomach complaints children	6
Indigofera arrecta Hochst. ex A. Rich.	Papilionaceae	dikindik (T), riga gange (G), ellangin (S)	leaf	dressing itched mule skin	
Indigofera houer Forsk.	Papilionaceae	darko (S), houer (Ar)	leaf, root	wound dressing	1

Table 10 (continued)

Scientific name	Family	Vernacular names	Uses		Sources
Indigofera sp.	Papilionaceae	dida (K)	leaf	earache	
Ipomoea sinensis (Desr.) Choisy	Convolvulaceae	afaful (T), saar (S)	leaf	wound dressing	6
Jasminum abyssinicum Hochst. ex DC.	Oleaceae	messerik, taroharek (A), teo (G)	leaf	anthelmintic, condiment in drinks	1, 4, 5, 7
			root	tonsillitis, wound dressing animals	
Jasminum floribundum R. Br. ex Fresen.	Oleaceae	messeric (A), tembelel (A), bilu, kechachelu (G)	leaf	anthelmintic, condiment in drinks, abscess dressing	2, 4, 5, 6, 7, 9
			sap	stomach complaints, eye disease	
			fruit	vermifuge	
Jasminum humile L.	Oleaceae		herb	condiment	5
Jatropha curcas L.	Euphorbiaceae	andelmeluc (S)	seed	purgative	2, 5
Jatropha lobata (Forsk.) Müll. Arg.	Euphorbiaceae	mdjersche (Ar)	sap	astringent	6
Jatropha villosa (Forsk.) Müll. Arg.	Euphorbiaceae	deglo (S)	petiole	ulcers	5
Juniperus procera Hochst.	Cupressaceae	see p. 205			
Kalanchoë lanceolata (Forsk.) Pers.	Crassulaceae	pipi (A, G), endahulla (A), birbirti, jifu (G), dokata (T)	herb	bloat	9
			sap	earache, throat complaints	
			fruit	anthelmintic, abortifacient	
			root	wound dressing	
Kalanchoë sp.	Crassulaceae	indahula (A), chabi (G)	leaf	eye disease, earache, wound dressing, vermifuge, gonorrhoea, bloat	1, 10
Kigelia aethiopum (Fenzl) Dandy in Andrews	Bignoniaceae	selselè (T)	bark	dysentery	2, 4, 5
			fruit	aphrodisiac	
Kleinia longiflora DC.	Compositae	luco (G), barir (T), goddar (S)	sap	swellings, paralysis, dysentery of babies, pneumonia	
Laggera pterodonta (DC.) Schtz. –Bip.	Compositae	zagazela (T)	herb	disinfectant	6
Lantana trifolia L.	Verbenaceae	koschim (A), midani-bera, suke (G)	leaf	condiment in milk, colds, ringworm, udder inflammation	8

Table 10 (continued)

Scientific name	Family	Vernacular names	Uses		Sources
Lathyrus sativus L.	Papilionaceae	schimbera, gwaya (A), ater (T)	herb	painkiller for children	9, 10
Launea nudicaulis (L.) Hook.f.	Compositae	kablaror (S)	root	laxative	5
Lawsonia inermis L.	Lythraceae	hina (A), allan (S), hanna (Ar)	leaf	colds, cosmetic	2, 5
Lens culinaris Med.	Papilionaceae	messer (A), missera, misir (G)	seed	dysentery	
Leonotis raineriana De Visiani	Labiatae	faraseng, ras-kimmir (A), catator (T)	leaf	abdominal pains, purgative, anthelmintic, condiment in drinks	1, 2, 6, 8
			root	excessive menstruation	
Lepidium sativum L.	Cruciferae	see p. 216			
Leptadenia sp.	Asclepiadaceae	dunkar (G)	stem	toothache	
Leucas martinicensis (Jacq.) R. Br.	Labiatae	boccu-farda, indertow (G), ras kimir (A), takhater (T)	leaf	gonorrhoea, wound dressing, hookworms, headache	6, 10
Lightfootia abyssinica Hochst. ex Rich.	Campanulaceae	divorno (A), balcutal (G), sarsara (T)	herb	wound dressing	
Linum usitatissimum L.	Linaceae	talba, telba (A, G), kontar (G)	seed	diuretic, amoebic dysentery, stomach ache, wound dressing, laxative, itch	1, 2, 5, 9, 10
Lippia abyssinica (O. & D.) Cuf.	Verbenaceae	dama-kasse (A)	herb	condiment in wot and butter	2, 5
Lippia citriodora Kunth	Verbenaceae		herb	condiment in tea	11
Lippia javanica (Burm.f.)Sprengel	Verbenaceae	kassi (A)	herb	condiment in wot and butter	5
Lochnera rosea (L.) Reichbch.	Apocynaceae		leaf	diabetes	1
Lycopersicon esculentum Mill.	Solanaceae	tematem (A), timatim (G), gnagno (S)	leaf	haemostatic	
Maerua angolensis DC.	Capparidaceae	cuoromo (T)	leaf	dressing skin diseases, laxative	4, 5
Maerua oblongifolia (Forsk.) Rich.	Capparidaceae	koromo (T), burde (S)	leaf	wound dressing	6
Maesa lanceolata Forsk.	Myrsinaceae	kalawa (A), saoria (T)	fruit	anthelmintic	1, 2, 4, 5, 7
Majorana hortensis Moench	Labiatae	hassab (A)	herb	condiment	5

Table 10 (continued)

Scientific name	Family	Vernacular names	Uses		Sources
Malva parviflora Höjer in L.	Malvaceae	lut, lit (A), lekti (T)	leaf	wound dressing	2
			sap	taenifuge, laxative	
Malva verticillata L.	Malvaceae	adguar (A), liti (G)	leaf	wound dressing, anthelmintic	5, 6, 9
			fruit	anthelmintic	
Maytenus ovatus (Wall. ex W. & A.) Loesener	Celastraceae	adad (A)	root	anthelmintic, purgative	
			leaf	febrifuge, malaria	2, 4, 9
			fruit	condiment	
Maytenus senegalensis (Lam.) Exell	Celastraceae	kombolcha (G), argudi (T)	leaf	diarrhoea of animals	2, 4
Maytenus undatus (Thunb.) Blakelock	Celastraceae	addad (A), komboldj (A)	leaf	stimulant	2
Melia azedarach L.	Meliaceae		root	anthelmintic	2
Melilotus indicus (L.) All.	Papilionaceae	melan (A), jemamberi (T)	flower	cosmetic	2
			smoke	haemostatic	
Mentha longifolia (L.) Nath.	Labiatae	semhal (T)	herb	condiment in tea	2
Mentha piperita L.	Labiatae		herb	condiment in tea	2
Mentha sp.	Labiatae	anana (G)	herb	condiment in tea, common cold, headache	11
Meriandra bengalensis (König ex Roxb.) Bentham	Labiatae	nihba, mossogo (T)	leaf	perfume (camphor)	2
Millettia ferruginea (Hochst.) Baker	Papilionaceae	berbera (A, T), sotallo (G)	leaf	scabies	4
Mimusops kummel Bruce ex DC.	Sapotaceae	sci (A), colati (G), kummel (T)	seed	vermifuge	9
Mirabilis jalapa L.	Nyctaginaceae	harmele kobera (A), harmal dima, ilili dimtu (K)	seed	narcotic, bloat	
			root	constipation, fever, heart complaints	
Momordica foetida Schum.	Cucurbitaceae	markorra (A), hara-goge (G), anqaqokho (T)	fruit	stomach ache, constipation, earache, boils, skin diseases, gonorrhoea	2
Moringa peregrina (Forsk.) Fiori	Moringaceae	mokor (S)	root	anthelmintic, detergent	
			sap	astringent	2
			root	rubefacient, diuretic	

Table 10 (continued)

Scientific name	Family	Vernacular names	Uses		Sources
Portulaca oleracea L.	Portulacaceae	melhenna (T)	herb	diaphoretic	5
Premna resinosa Schauer in DC.	Verbenaceae	awalo (A)	herb	diaphoretic	5
Premna schimperi Engl.	Verbenaceae	tscho-tscho (A), totoke, aurgeyssa (G)	leaf	wound dressing	
			sap	earache, eye disease	
			petiole	toothache	
Psiadia punctulata (DC.) Vatke	Compositae	matane (G), alekha (T)	herb	malaria	6
Psidium guajava L.	Myrtaceae	zetun (A), zeytuna (G)	fruit	laxative	
Pteris abyssinica Hieron.	Polypodiaceae	mauccaba anabit (T)	herb	depurative for animals	6
Pterocephalus frutescens Hochst. ex A. Rich.	Dipsacaceae	henserase (A), bocatta hillo (K)	leaf	boil dressing	
Pterolobium stellatum (Forsk.) Chiov.	Mimosaceae	kantuffa (A), arangama (G)	leaf	tuberculosis	1
Pulicaria schimperi DC.	Compositae	kaddita-mu (T)	leaf	carminative	6
Pulicaria undulata (L.) C. A. Meyer	Compositae	hobba (T)	herb	haemorrhoids	5
Punica granatum L.	Punicaceae	rooma (A), rumana (K)	leaf	taenifuge, liver disorders	1, 7, 9, 10
			bark	taenifuge	
			root	anthelmintic	
			fruit	diarrhoea, wound dressing	
			seed	headache	
Pygeum africanum Hook.f.	Rosaceae	tekurancet (A), omi (G)	leaf	wound dressing	1
Ranunculus multifidus Forsk.	Ranunculaceae	makhrus (T), metmeti (T)	leaf	cough	6
Raphanus sativus L.	Cruciferae	fijul (G)	tuber	rheumatism, constipation, heart complaints	
Rhamnus prinoides L'Hér.	Rhamnaceae	see p. 96			
Rhamnus staddo Rich.	Rhamnaceae	sado (A), zoddo (G)	leaf, root	condiment in drinks	5
Rhoicissus tridentata (L.) Willd. & Drummond	Vitaceae	lalu, hida rafu (G)	leaf	rabies	1
			root	bloat	
Rhus abyssinica Hochst. ex Oliv.	Anacardiaceae	tateysa (G), hamus, sciamut (T)	leaf	influenza	10
			root	udder disease	
Rhus vulgaris Meikle	Anacardiaceae	kamo (A), auruba (G)	leaf	serious cough of animals	
Rhynchosia resinosa Hochst. (ex Rich.) ex Baker	Papilionaceae	essa-tacasu, hida losho (G)	leaf	wound dressing	

Table 10 (continued)

Scientific name	Family	Vernacular names	Uses		Sources
Ricinus communis L.	Euphorbiaceae	gulo, golo (A), kobo (G)	leaf	haemorrhoids	2, 5, 9
			seed	laxative, wound dressing, rheumatism, mental illnesses	
Rosa abyssinica R. Br. ex Lindl.	Rosaceae	gaga (A, T), gorra (G)	root	anthelmintic	
Rosmarinus officinalis L.	Labiatae	kora (G)	leaf	condiment	11
Rubia cordifolia L. var. discolor (Turcz.) Engler	Rubiaceae	moncierer (A), laleysa (G), zechnen (T)	herb	haemostatic, itches	4, 5, 8
			root	amoebic dysentery, haemostatic, cancer, cough	
Rubus steudneri Schwfth.	Rosaceae		fruits	diabetes	9
Rumex abyssinicus Jacq.	Polygonaceae	makmako (A), ala loni, dongisha (G)	leaf	gonorrhoea, abscesses	1, 2, 4, 5, 6, 7, 8, 9
			root	condiment in butter, purgative, liver disease, haemostatic, abscesses, depurative, wound dressing, stomach ache, neckache, low blood pressure	
Rumex bequartii De Wild.	Polygonaceae	kitela ragim (A), balder, mucha-arab (G)	leaf	wound dressing, stomach ache, rheumatism	1
			root	ulcers	
Rumex nervosus Vahl	Polygonaceae	embatcho (A), dangango (G), hahot (T)	leaf	haemostatic (nose), skin diseases	1, 5, 9
			root	stop vomiting, ulcers, condiment in butter	
			ash	dressing in skin burns	
Rumex steudelii Hochst. ex Rich.	Polygonaceae	tult (A), shomboba (T)	herb	antidote, laxative, cough, depurative	1, 2, 4, 5, 9
			root	astringent, colics in mules	
Ruta chalepensis L.	Rutaceae	see p. 104			
Salvadora persica L.	Salvadoraceae	garsa (A), adai (T)	bark	inflammations	1, 2, 6
			fruit	colds, stomach complaints	
Salvia grahami Benth.	Labiatae		herb	headache, fever	5, 6

Table 10 (continued)

Scientific name	Family	Vernacular names	Uses		Sources
Tephrosia uniflora Pers.	Papilionaceae	saga (T)	seed	scorpion bites	6
Terminalia brownii Fresen.	Combretaceae	houeba (A), weiba (T)	bark	purgative, jaundice	6, 9
			root	syphilis	
Thymus schimperi Ron.	Labiatae	tossigne (A)	herb	condiment, gonorrhoea, cough, liver disease	1
Thymus serrulatus Hochst. ex Benth.	Labiatae	tosing, tossine (A), tausi (A, T)	herb	condiment in wot, butter and bread; cough, stomach ache, headache, earache and gonorrhoea	2, 8, 9
			smoke	abortifacient	
Toddalia asiatica (L.) Lam.	Rutaceae	gumuro, kajima, arab berbere (G)	fruit	heart complaints	
Trachyspermum ammi (L.) Sprague ex Turrill	Umbelliferae	see p. 111			
Tragia benthami Baker	Euphorbiaceae	dobi (G)	leaf	wound dressing animals	
Tragia hildebrandtii Muell. Arg.	Euphorbiaceae	goubtinio (S)	leaf	pains in pregnancy	5
Trianthema pentandra L.	Aizoaceae	auwud-guilla, garmesada, kreskek (T)	sap	expectorant, throat diseases, febrifuge	2, 4, 5, 6
			root	intestinal complaints, emetic, fever, headache	
			smoke	headache	
Trichilia roka (Forsk.) Chiov.	Meliaceae	kota (T), roka (Ar)	root	relieve birth-pains, malaria, emetic	1, 2
Trifolium rueppellianum Fres.	Papilionaceae	nagad (A), kaddo (G)	leaf	dressing elephantiasis	
Trigonella foenum-graecum L.	Papilionaceae	abish (A), hulbata (G)	seed	condiment, rheumatism, wound dressing, stomach ache, leprosy, carminative	1, 2, 5, 9, 10
Vaccaria pyramidata Med.	Caryophyllaceae	bahar kemam (A)	herb	condiment?	11
Vangueria linearisepala K. Schum.	Rubiaceae	bururi (A, G)	root	hoof disease, scabies animals	
Verbascum schimperi Skan.	Scrophulariaceae	timbolone, bal cope, muca adi (G)	leaf	eye disease, headache	
			root	heart complaints, constipation, bloat	

Table 10 (continued)

Scientific name	Family	Vernacular names	Uses		Sources
Verbascum sinaiticum Benth. in DC.	Scrophulariaceae	aiaggioro (A), ternakha (T)	leaf root	haemostatic, scabies anthelmintic, cough	2, 4, 5, 7, 9
Verbena officinalis L.	Verbenaceae	akkoragag, attuch (A), serrufit (T)	herb	dysentery, throat inflammation, burns, vermifuge, respiratory complaints	2, 8
Vernonia amygdalina Del. in Caill.	Compositae	grawa (A), dumoga, ebicha (G)	leaf	menstruation pain, purgative, malaria, vermifuge, wound dressing, urinary inflammation	1, 2, 4, 5, 6, 8, 9
Vernonia campanea S. Moore	Compositae	difu (G)	leaf	itch horses and mules	
Vernonia leopoldi (Schtz.-Bip.) Vatke	Compositae	sukuale, marrat (T)	leaf, flower	wound dressing	4, 6
Vernonia myriantha Hook.f.	Compositae	ebecha (G)	leaf	wound dressing, bloat	
Vigna luteola (Jacq.) Benth.	Papilionaceae	wodal asfas (T)	herb	syphilis, wound dressing	4, 9
Vigna unguiculata (L.) Walp. cv. group biflora	Papilionaceae	atera kechene (A), atara babille (G)	seed	stomach ache	
Viscum tuberculatum Rich.	Loranthaceae	deglo (A), digalo (G), degala-aule (T)	leaf	taenifuge, dysentery, diuretic	2
Withania somnifera (L.) Dunal in DC.	Solanaceae	gizewa (A), sabbe-re-golla (A), hidi budawa (G), agol (T)	herb	narcotic, laxative, diuretic, headache, stomach ache	2, 4, 5, 8
Woodfordia uniflora (Rich.) Koehne	Lythraceae	tutano, baldima (G), balaldo (T)	leaf	headache	
Ximenia americana L.	Olacaceae	ankoi (A), mellau (T), huda (G)	fruit	vermifuge	1
Zehneria scabra (L.f.) Sonder	Cucurbitaceae	aregresa (A), hafa-felo (T)	leaf	purgative, skin diseases, anthelmintic, wound dressing, eye dressing	1, 6, 7, 9
Zingiber officinale Rosc.	Zingiberaceae	see p. 120			
Zizyphus mauritiana Lam.	Rhamnaceae	kurkura (G), gob (S)	root	astringent, scrophula	1
Zygophyllum album L.	Zygophyllaceae	durran-ad (S)	herb	vermifuge, purgative	2
Zygophyllum coccineum L.	Zygophyllaceae	rottraejt (Ar)	herb	vermifuge, purgative	2

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Glossary of pharmacological, medical and veterinary terms

abortifacient, abortive, (drug) causing abortion

abortion, expulsion of the contents of a pregnant womb to terminate further development of the embryo (or foetus); used technically when expulsion occurs within the first 3 months of pregnancy

abscess, a walled-off collection of pus in any part of the body

anaesthetize, producing insensibility

analgesic, relieving pain

anorexia, absence of appetite

antiseptic, with antisepsis activity

antisepsis, prevention of contamination with germs by stopping their growth or multiplication

anthelmintic, destroys or causes expulsion of worms

antibiotic, chemicals of biological origin with specific antibacterial actions

antidote, to counter poison or disease

antiscorbutic, against scurvy

antispasmodic, relieves spasms

asthma, usually refers to allergic asthma characterized by attacks of shortness of breath, coughing, wheezing, a thick phlegm, and a sense of oppression or constriction in the chest

astringent, contracts muscle-fibres and condenses tissues

biliousness, a condition due to digestive disorder, and marked by a general weakness, headache, loss of appetite, indigestion, constipation, coated tongue

bilharzia, disease caused by a genus of trematode worms *(Schistosoma)* or blood-flukes

blenorrhagia, (1) an excessive mucous discharge, (2) gonorrhoea

blister, thin bladder on the skin, containing watery matter or serum

bloat, swelled, inflated

boil, a furuncle, a localized abscess of the skin due to infection of a hair follicle or sweat gland by pus producing bacteria; discharges pus from one point only

bubonic, bubo, an inflammation and swelling of one or more of the glands in the groin or the armpit that usually results in pus formations

cancer, any tumour which by its own structure or properties threatens life

caries of bone, decay of the bones

carminative, carminativum, relieves flatulence

catarrh, inflammation of the lining tissue of various organs, particularly of the nose, throat, and air passages, and characterized by an outpouring of mucus

cholagogue, stimulating liver and increasing bile, producing greenish liquid motions
cholera, an acute, serious, infectious disease characterized by severe diarrhoea, with watery stools, vomiting, muscular cramps, lack of urination, and collapse
colic, pain in the abdomen coming in attacks caused by spasm of the intestinal muscles
constipation, sluggishness or inaction of the bowels
convulsant, causing convulsions, uncontrollable contractions of muscles over large areas of the body, either periodic or continuous
cyanosis, blue discoloration, due to circulation of imperfectly oxygenated blood

dermatitis, any inflammation of the skin
detergent, cleansing agent
diabetes, a disease characterized by the discharge of a large quantity of urine and by unusual thirst; the term includes *diabetes mellitus,* a disease whose chief characteristic is the failure of the body to use carbohydrates at a normal rate; there is a deficiency of insulin, and is characterized by an excess of sugar in the blood, the presence of sugar in the urine, thirst, loss of weight, and weakness
diaphoretic, promotes perspiration
diarrhoea, looseness of the bowels characterized by increased frequency and wateriness of the stools
diuretic, promotes flow of urine
dressing, bandage, ointment
dysentery, an inflammation of the large intestine; characterized by pain, intense diarrhoea with passage of small amounts of mucus and blood, and general, serious sickness

eczema, an inflammation of the skin that itches severely and lasts days or years; not contagious, it is characterized by various combinations of skin swelling with tiny blisters, pimples, or scaling of the skin
elephantiasis, a persistent, variably sized enlargement of the tissues immediately beneath the skin due to an obstruction of the lymph-vessels by worms; the legs and arms become enormous and in the male, the scrotum may enlarge to the size of a water-melon
emetic, causes vomiting
emmenagogue, substance promoting flow of menstrual discharge
epigastric, of the part of the abdomen immediately over the stomach
epilepsy, a nervous system condition manifesting episodes of unconsciousness with or without convulsions, and more or less violent
expectorans, expectorant, aids expectoration (spitting) and facilitates removal of secretions from air passages

febrifuge, to reduce fever
fit, sudden attack of hysteria, with loss of consciousness and violent movements

galactogogue, inducing a flow of milk

gastritis, inflammation of the stomach as a result of poisoning by mouth, infection, or allergy

gastro-enteritis, inflammation of the stomach and intestine

gonorrhoea, an infection contracted by intimate contact with another human being, characterized by an inflammation of the lining membrane of the urethra and the cavities that are near it, accompanied by pain, burning on urination, and a copious discharge of pus; complications may be inflammation of the prostrate, abscesses about the urethra, inflammation of the bladder, and inflammation of the eyes

gout, a condition in which there is a decrease in the excretion of one of the endproducts of food breakdown (uric acid); characterized by attacks of acute, painful inflammation of usually one joint, most often the great toe

griping, see colic

haemolytic, haemolysis, the destruction of the red corpuscles with liberation of haemoglobin into the surrounding fluid, caused by the presence of hemolysins

haemorrhage, bleeding; an escape of blood from blood-vessels

haemorrhoids (piles), a varicose vein condition (enlargement and excessive widening of the veins) of the lower part of the rectum and the anus

haemostatic, procedure or substance controlling loss of blood

hepatotoxic, toxic for the liver

hookworm, (Necator), the egg of the worm enters the skin through the webs of the fingers and toes, and once in the blood-stream finds its way into the small intestine and may do damage here and in the lungs

hysteria, a condition, the result of deep emotional conflict, characterized by extreme emotionalism and often disturbances of the muscle system, as paralysis of various organs

inflammation, the reaction of tissue to injury, consisting of certain observable findings; heat at the area of injury, redness, swelling, and pain

influenza, and epidemic disease characterized by inflammation of the lining tissue of the nose, throat, bronchial tubes, accompanied by cough, phlegm, discharge from the nose, fever, pain in the muscles and prostration; caused by various types of virus

insomnia, sleeplessness, disturbed sleep, inability to sleep

itch, (1) an irritating sensation in the skin relieved by scratching, (2) any of various skin diseases accompanied by itching, particularly scabies

jaundice, yellowness of the skin, lining tissues, and secretions due to bile pigments in the blood

lactogenic, lactogogum, promoting the secretion of milk

laxative, gentle stimulating influence on bowel muscles

leprosy, a disease of mostly tropical and subtropical countries, caused by *Myobacterium leprae*, and characterized by affection of the skin and nerves

leucorrhoea, a discharge of whitish mucus and pus from the female genitals

liniment, liquid used in rubbing the body

maggot, larva especially of the cheese-fly and bluebottle
malaria, an infectious disease caused by *Plasmodium* sp. and transmitted by infected mosquitoes of the genus *Anopheles*
mammary, related to the milk secreting organ of mammals
mastitis, inflammation of the breast
mumps, acute infectious inflammation of the parotid gland near ear, caused by a virus

narcotic, producing sleep or stupor; any drug producing sleep or stupor and relieving pain at the same time
nausea, an uncomfortable feeling in and about the stomach associated with aversion to food and a need to vomit
neuralgia, severe attacks of sharp, stabbing pain of short duration and tenderness along the course of a nerve in any part of the body

oedema, an excessive accumulation of fluid in the tissues, locally or generally

panacea, universal remedy
paralysis, the inability of muscles to perform, caused by injury to the nerve or nerve-cells
pellagra, a disease caused by a deficiency in food intake, and characterized by loss of strength, digestive disturbances, pain up and down the spine, and a redness, drying and peeling of the skin; spasms, paralysis and mental deficiency may also arise
pleuritis, disease characterized by the inflammation of the pleura (membranes lining the thorax), usually caused by chill and marked by pain in chest or side, fever, etc.
pneumonia, inflammation of the lung
prophylactic, medicine or measure tending to prevent disease
prostration, state of extreme physical weakness, complete exhaustion
purgative, increased movement of intestines, mildly stimulating glands; drastic purgatives increase intestinal fluid and cause painful fluid motions

rabies, a virus disease transmitted to man by the bite of infected dogs
renal calculus, a nodule of solid matter formed in the excretory passages of the kidneys
repellent, substance repulsive or distasteful to, for example, insects
rheumatism, generally indicates diseases of nerves, bones, joints, muscles and tendons accompanied by discomfort and physical incapacity
ringworm, the skin manifestation produced by certain moulds
rubefacient, stimulating to redness

scabies, a contagious infestation of the skin by an insect *Sarcoptes scabici*
sciatica, a disease characterized by pain, numbness, tingling, tenderness to the touch along the course of the sciatic nerve, which runs down the whole length of the back of the leg
scrophula, scrofula, tuberculosis of the lymph-glands in the neck
sedative, tending to soothe

smallpox, a serious, often fatal, contagious disease that comes on suddenly with high fever; in several days an eruption of small pimples appears all over the body, which increase in size, blister, form pus, crust, and leave pock marks

spasmolyticum, medicine against cramps

sprain, wrench violently so as to cause pain and swelling (and sometimes inflammation)

stomachic, substance that stimulates appetite

sudoriferum, causing perspiration

syphilis, a disease communicated by sexual contact, or innocently from blood or bite of infected person, or from infected mother to foetus; caused by *Treponema pallidum*

taenifuge, a deterrent to tapeworm

tapeworm (Taenia), long, flat, segmented, ribbon-like worms that are parasites on man and animals

tonic, medicinal preparation believed to have the power of restoring normal tone or activity

tonsillitis, inflammation of the tonsils

tuberculosis, disease affecting most tissues of the body, marked by tubercles and the presence of a characteristic bacillus

tumour, a new growth of cells or tissue, of unknown cause, that is independent of the laws of growth of the individual upon which it arises; it may kill the host

typhoid, an acute infectious disease caused by an organism *Eberthella typhosa,* that enters the body in food and water and is found in the intestines and in the bowel discharge

ulcer, an excavated sore, the base of which is inflamed

varicose veins, veins that are knotted, swollen or tortuous

venereal disease, relating to, or caused by sexual intercourse

vermifuge, expels intestinal worms

vesicant, raising blisters

vomitive, causes vomiting

wart, a horney overgrown projection of the skin

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Synonyms are in italics. Page numbers of principal entries are in bold. Names of Table 10 (p. 259–281) have not been included.