A Catalogue of the Wild Relatives of Cultivated Plants Native to Europe

An enumeration of the wild genetic resources of native European plants that are grown in Europe for food, forage, ornament, timber and other purposes

Prepared by

Vernon H. Heywood & Daniel Zohary

Introduction

Europe has a long history of plant domestication and a rich heritage of crops cultivated for a diversity of purposes. The number of plants involved is remarkably high yet much of this heritage has been surprisingly neglected. No systematic account of the crop plants developed in Europe and the genetic resources present in their wild relatives has been produced up to the present. This Catalogue aims to fill that gap.

Approximately 10% of the species of the European flora are regarded as being threatened to some degree. Amongst these are wild relatives of numerous cultivated plants, some of which are already facing serious genetic erosion, and in a few cases, a risk of their extinction. The development of new priorities for the conservation of threatened plants is urgently needed in Europe. In these priorities, some of the plants listed here should figure prominently if the continent is not to lose much of the wild genetic basis of economic plants which have had their origins here.

This Catalogue provides a survey of the wild genetic resources of cultivated plants in Europe as circumscribed by *Flora Europaea* (Tutin, Heywood et al. 1964-1980, Tutin et al. 1993). (See also Fig. 1). In addition, Cyprus and the Canary Islands are also included because they are member states (or part of a member state) of the Council of Europe. Although Turkey is a member state, it was decided not to include Anatolian Turkey in this survey, as its flora is almost as diverse as that of Europe as a whole; and it has such a large number of species (c. 8,000) that it deserves a separate treatment.

The Catalogue enumerates the various cultivated plants (grain crops, fruit trees, vegetables, oil and fibre crops, pot herbs and condiments, medicinal plants, fodder plants, timber trees, and ornamentals) grown in Europe which also have their close wild relatives growing on this continent. For each cultigen the Catalogue specifies, as far as can be ascertained, which are its close wild relatives (the primary wild gene pool); and where they occur in Europe. The survey of the food crops is more exhaustive than that of the other groups, and contains several minor or relict crops. The list of the other cultivated plants is less comprehensive: only the main timber trees, fodder crops, medicinals, and ornamentals have been included.

The total number of wild relatives of cultivated plants of economic importance in Europe is larger than one might suspect. Europe harbours rich wild gene pools of several

cereals, particularly oats *(Avena)* and rye *(Secale)*, several food legumes such as pea *(Pisum)* and lupins *(Lupinus)*. The wild inventory is even richer when it comes to fruit crops, such as apple *(Malus)*, pear *(Pyrus)*, plums and cherries *(Prunus)*, grape vine *(Vitis)*, raspberries and blackberries *(Rubus)*, olive *(Olea)* and fig *(Ficus)*, and for vegetables — including lettuce *(Lactuca)*, carrot *(Daucus)*, cabbage and other brassicas *(Brassica)*, beet *(Beta)*, celery *(Apium)*, asparagus *(Asparagus)* and artichoke *(Cynara)*. Also very rich is the assemblage of pot herbs, condiments, and aromatic plants, such as mints *(Mentha)*, marjoram *(Origanum)*, lavender *(Lavandula)*, thyme *(Thymus)*, rosemary *(Rosmarinus)*, mustards *(Sinapis, Brassica)*, horseradish *(Armoracia)*, or chives and leek *(Allium)*, which have their close wild relatives here; as well as a very large number of ornamentals. Indeed, many of these ornamental plants have been taken into cultivation in Europe itself and represent a significant part of its cultural heritage. Finally, Europe is also rich in forestry resources such as pine *(Pinus)*, fir *(Abies)*, spruce *(Picea)*, oak *(Quercus)*, and poplar *(Populus)*, and in fodder plants: rye grass *(Lolium)*, cock's foot grass *(Dactylis)*, clover *(Trifolium)*, alfalfa *(Medicago)*, etc. Again many of the cultivars of these trees, grasses and legumes have been derived from wild forms that are native to this continent.

Preparation of the Catalogue

Professor W. Greuter, on behalf of OPTIMA, and representatives of the Nature Reserve Authority, Israel were the first to report to the Council of Europe on the urgent need for conservation of the wild progenitors of cultivated plants native to Europe. The Council authorities responded by establishing a Group of Specialists on Biodiversity and Biosubsistence (with Prof. W. Greuter as its chairman and Mr. J.-P. Ribeau as its organizer). The Group first met in Strasbourg in 1991, and decided that a preparation of this Catalogue would be part of its activities. Three Workshops, on the wild progenitors of cultivated plants native to Europe and their conservation needs have been organized by this Group. Two were held under the auspices of the Council of Europe: the first in Faro, Portugal in November 1992, and the second in Neuchâtel in October 1993. The third Workshop was held under the auspices of the Dipartimento di Scienze Botaniche e Giardino Botanico dell'Università di Palermo, in Gibilmanna Sicily, in September 1994.

The Catalogue was initially commissioned by the Council of Europe to Botanic Gardens Conservation International (BGCI), who asked Dr David Bramwell to prepare a draft. This initial list was added to by Dr Etelka Leadley of BGCI. The list was later substantially modified by the Group of Experts and a new version was prepared by Professor Vernon Heywood, incorporating numerous alterations and changes that had been suggested. The new version of the Catalogue was then successively revised following detailed scrutiny both by the Group of Specialists and by participants of the three Workshops. Finally Professor D. Zohary and Professor V. Heywood systematically revised and modified the Catalogue, adding further taxa and information on origin, genetic affinities, domestication and breeding, and references to key literature. The contributions of the following colleagues were especially valuable: Professor F. Mangas Catarino, Dr M. Chauvet, Professor F. Ehrendorfer, Dr I. Hagemann, Dr K. Hammer, Dr P. Hanelt, Professor G. Kamari, Professor J. van der Maesen, Professor G. Müller-Starck, Professor F. M. Raimondo, Professor M. Tigerstedt, and Professor B. Valdés. We are also grateful to the staff of the Secretariat of the Council of Europe — M. Hector Hacourt and Mme Marie-Aude L'Hyver Yesou — for organizing the work of the Group and making

preparations for the first two Workshops.

Much information was also provided through the papers presented to the Workshops, some of which dealt specifically with the wild genetic resources of crops included in the Catalogue. In particular, Professors Mangas Catarino, Ph. Küpfer and F. M. Raimondo and their colleagues provided us not only with information, but also with the opportunity to visit several of the wild relatives in the field during the Workshops.

Publication of this Catalogue has been made possible through the generous support of the Orto Botanico di Palermo, Università degli Studi di Palermo (Director Professor Francesco M. Raimondo).

Taxonomy and Geographical Distribution

In general, the taxonomy and nomenclature in this Catalogue follow those in *Flora Europaea* vols. 1-5 (Tutin, Heywood *et al.* 1964-1988) and *Flora Europaea* vol. 1, ed. 2 (Tutin *et al.* 1993); but some adjustments have been made and synonyms added where needed for clarification. Also the information on the distribution of the wild relatives follows the style used in *Flora Europaea*. Each country (or territory) in which a given wild plant occurs is indicated by the following two-letter abbreviations (see also Fig. 1).

In addition, an initial letter is sometimes used for each of the Canary Islands (C,T,P,G,H,L), and the code for Cyprus is **Cy** as used by *Med-Checklist: a critical inventory of vascular plants of the circum-mediterranean countries* (Greuter et al. 1981→).

Symbols for countries:

Al Albania
Au Austria, with Liechtenstein
Az Açores
Be Belgium, with Luxembourg
Bl Islas Baleares
Br Britain, including Orkney, Zetland and Isle of Man; excluding Channel Islands and Northern Ireland
Bu Bulgaria
Co Corse
Cr Kriti (Crete), with Karpathos, Kasos and Gavdhos
Cy Cyprus
Cz Former Czechoslovakia
Da Denmark (Dania), including Bornholm
Fa Færöer
Fe Finland (Fennia), including Ahvenanmaa (Åland Islands)
Ga France (Gallia), with the Channel Islands (Îles Normandes) and Monaco; excluding Corse
Ge Germany
Gr Greece, excluding those islands included under Kriti (Cr) and those which are outside Europe as defined for Flora Europaea
Hb Ireland (Hibernia); both the Republic of Ireland and Northern Ireland
He Switzerland (Helvetia)

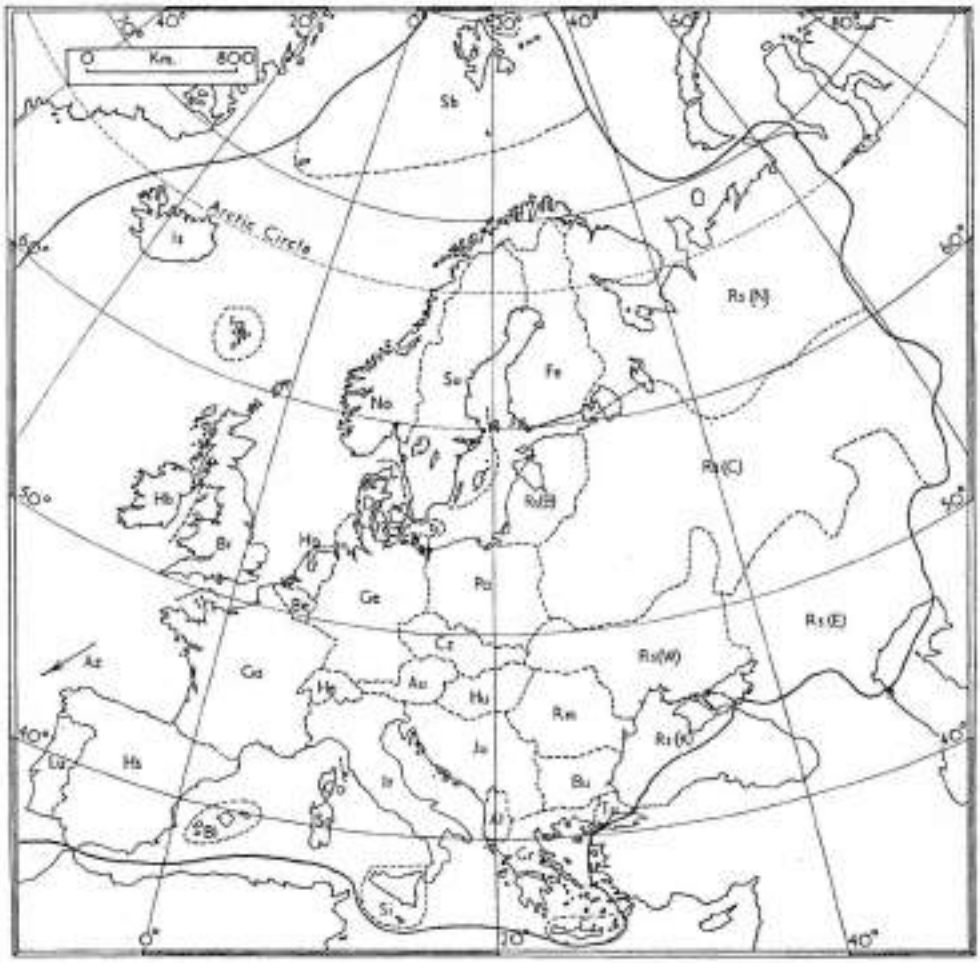

Fig. 1. The countries and territories of Europe, as recognized in *Flora Europaea* and followed in this Catalogue.

Ho Netherlands (Hollandia)
Hs Spain (Hispania), with Gibraltar and Andorra; excluding Islas Baleares
Hu Hungary
Is Iceland (Islandia)
It Italy, including the Arcipelago Toscano; excluding Sardegna and Sicilia
Ju Former Jugoslavia
Lu Portugal (Lusitania)
No Norway
Po Poland
Rm Romania
Rs Former territories of U.S.S.R.
Rs(N) Northern division: Arctic Europe, Karelo-Lapland, Dvina-Pecora

Rs(B) Baltic division: Estonia, Latvia, Lithunia, Kaliningradskaja Oblast'
Rs(C) Central division: Ladoga-Ilmen, Upper Volga, Volga-Kama, Upper Dnepr, Volga-Don, Ural
Rs(W) South-western division: Moldavia, Middle Dnepr, Black Sea, Upper Dnestr
Rs(K) Krym (Crimea)
Rs(E) South-eastern division: Lower Don, Lower Volga, Transvolga

Sa Sardegna
Sb Svalbard, comprising Spitsbergen, Björnöya (Bear Island) and Jan Mayen
Si Sicilia, with Pantelleria, Isole Pelagie, Isole Lipari and Ustica; also the Malta archipelago
Su Sweden (Suecia), including Öland and Gotland
Tu Turkey (European part), including Gökçeada (Imroz)

Note: Square brackets [ ] indicate the naturalized occurence of the taxon. An asterisk * before the area symbol indicates doubt as to the native status of the taxon concerned.

References

(1) *Key references for individual species or genera*: An attempt was made to select a small number of key references for each species (or group of species) surveyed, especially those referring to further literature. Publications were chosen that review (a) the taxonomy of the cultivated plants and their wild relatives, (b) the genetic affinities between the cultivated and the wild taxa, and (c) the variability, ecology and distribution of the wild relatives. For the ornamentals and aromatic plants, the literature cited is rather sparse, reflecting the fact that much of the information is either not recorded or not reported in the mainstream literature.

(2) *General sources*: The following Floras and botanical handbooks contain a wealth of botanical, genetic and cultural information on many of the species and genera listed in the Catalogue.

Bois, D. 1927-1937: Les plantes alimentaires chez tous les peuples et à travers les âges. 4 vols. — Lechevalier, Paris.

Craker, L. & Simon, J. (ed.) 1986: Herbs, spices and medicinal plants: recent advances in botany, horticulture and pharmacology. — Oryx Press, Phoenix, AZ.

Griffiths, M. 1994: Index of garden plants. — Macmillan, London.

Hay, R. K. M. & Waterman, P. G. (ed.) 1993: Volatile oil crops: their biology, biochemistry and production. — Longman, Harlow.

Hegi, G. 1906-1931: Illustrierte Flora von Mittel-Europa, 7 vols. — J. F. Lehmanns, München.

— 1936→: Illustrierte Flora von Mittel-Europa, ed. 2. — Paul, Parey, Berlin.

— 1966→: Illustrierte Flora von Mittel-Europa, ed. 3. — Paul, Parey, Berlin.

Heywood, V. H. & Chant, S. R. (ed.) 1982: Popular encyclopaedia of plants. — Cambridge University Press, Cambridge.

Hora, B. (ed.) 1986: The Oxford encyclopaedia of trees, ed. 2. — Oxford University Press, Oxford.

Huxley, A., Griffiths, M. & Levy, M. (ed.) 1992: The new Royal Horticultural Society dictionary of gardening. 4 vols. — Macmillan, London.

Jalas, J. & Suominen, J. 1972 →: Atlas Florae Europaeae: Distribution of vascular plants in Europe. Fascicles 1-10. — Helsinki University Printing House, Helsinki; fascicles 1-7 also published in three volumes by Cambridge University Press, Cambridge, 1988.

Krüssmann, G. 1984-1986: Manual of cultivated broad-leaved trees and shrubs, 3 vols. — Timber Press, Portland, Oregon. [English translation of Handbuch der Laubgehölze. Paul Parey Verlag, Berlin & Hamburg 1976].

Mabberley, D.J. 1987: The Plant Book, ed. 2. — Cambridge University Press, Cambridge.

Meusel, H., Jäger, E. J, & Weinert, E. 1965-1992: Vergleichende Chorologie der Zentraleuropäischen Flora, 3 vols. — Gustav Fischer Verlag, Jena.

Moore, J. N. & Ballington, J. R. (ed.), 1991: Genetic resources of temperate fruits and nut crops. — International Society for Horticultural Science (ISHS), Wageningen.

Schultze-Motel, J. (ed.) 1986: Rudolf Mansfelds Verzeichnis landwirtschaflicher und gärtnerischer Kulturplanzen (ohne Zierpflanzen), 4 vols. — Akademie-Verlag, Berlin.

Smartt, J. & Simmonds, N. W. (ed.), 1995: Evolution of crop plants, ed. 2. — Longman, Harlow.

Tutin, T. G., Heywood, V. H., Burges, N. A., Valentine, D. H., Walters, S. M. & Webb, D. A. (ed.) 1964-1988: Flora Europaea, 5 vols. — Cambridge University Press, Cambridge.

—, Burges, N. A., Chater, A. O., Edmondson, J. R., Heywood, V. H., Moore, D. M., Valentine, D. H., Walters, S. M. & Webb, D. A. (ed.), 1993: Flora Europaea **1**, ed. 2. — Cambridge University Press, Cambridge.

Zohary, D. & Hopf, M. 1993: Domestication of plants in the Old World, ed. 2. — Clarendon Press, Oxford.

Catalogue of the plants

PINACEAE

Abies alba Miller — silver fir. A tall tree forming forests in the mountains of C. Europe extending to the Pyrenees, S. Italy, Macedonia and E. Poland (Al Au Bu Co Cz Ga Ge He Hs Hu It Ju Po Rm) and used for timber production. Recently in decline in much of its natural range. Seed orchards have been established to produce relatively more pollution-tolerant strains. $2n = 24$. Closely related to the silver fir are ***A. nebrodensis*** (Lojac.) Mattei, surviving as small relict population the Madonie mountains of Sicily, ***A. cephalonica*** Loudon, native to Greece and ***A. borisii-regis*** Mattf., native to Bulgaria, N. Greece and S. Albania.

Knorpel, S., Paule, L., & Laffers, A. 1982: Genetics and breeding of the silver fir (*Abies alba* Mill.). — Academia Scientiarium et Artium Slavorum Meridionalium, Zagreb 9/5: 151-184.

Wolf, H. (ed.) 1994: Weisstannen-Herkunfte (Provenances of silver fir). — Ecomed Verlagsgesellschaft, Landsberg am Lech.

Picea abies (L.) Karsten — common or Norway spruce. A leading tall forest tree, native to N. Europe, the Alps and the Carpathians extending southwards in the mountains to the S. Alps and Bulgaria (Al Au Bu Cz Fe Ga Ge He It Ju No Rm Rs(N,B,C) Su).

Recently cultivars have been bred and selected populations produced by seed orchards are now planted in Europe. Extensively used for timber production. $2n = 24$.

Schmidt-Vogt, H. 1986: Die Fichte (Norway spruce) II/1. — Paul Parey, Hamburg & Berlin.

Pinus nigra Arnold — black pine. A tall and variable forest tree, native to S. Europe (Al Au Bu Co Cr Cy Gr Hs It Ju Rm Rs(K) Si Tu), N.W. Africa and S.W. Asia, very widely planted for timber and shelter. Five ecogeographical subspecies are recognized: subsp. ***nigra*** growing mainly in the W. Balkan peninsula; subsp. ***pallasiana*** (Lamb.) Holmboe, native to the E. Balkan peninsula; subsp. ***dalmatica*** (Vis.) Franco, restricted to a small area on the Adriatic coast of Croatia; subsp. ***laricio*** (Poiret) Maire, native to Calabria, Sicily and Corsica; and subsp. ***salzmannii*** (Dunal) Franco, native to Spain and S. France. Planted trees are mainly recent selections from the wild. $2n = 24$.

Lee, C. 1968: Geographic variation in European Black Pine. — Silvae Genet. **17(5/6)**.
Rohrig, E. 1964: Black Pine (*Pinus nigra* Arnold) and its varieties. Part 1. Natural stands. — Forest Comm., London. No. 144.

Pinus pinea L. — stone pine. A tree, native and naturalized throughout the northern coasts of the Mediterranean (Co Ga Gr Hs It Lu Sa Si) and N.W. Africa, extending to S. Anatolia and Lebanon. Widely planted and extensively exploited since classical times for its edible seeds and timber. Special forms with thin shells have been selected; and recently clones have been developed to be grafted on seedlings prepared for planting. $2n = 24$

Kislev, M. E. 1988: *Pinus pinea* in agriculture, culture and cult. — Pp. 73-79 in: Küster, H. (ed.) Der prähistorische Mensch und seine Umwelt. — Konard Theiss Verlag, Stuttgart.

Pinus pinaster — maritime pine. A forest tree, widespread in the W. Mediterranean (Co Ga Hs It Lu Ju Sa Si), extending to N.W. Africa. Widely cultivated in southern Europe for its timber and resin. Recently cultivars have been bred, especially in France, and selected populations produced by seed orchards are extensively planted. $2n = 24$.

Baradat, P. & Patuszka, P. 1992: Le pin maritime. — Pp. 695-709 in: Amélioration des espèces végétales cultivées. — INRA Editions, Paris.

Pinus sylvestris L. — Scots pine. A leading forest tree of temperate Europe (Al Au Br Bu Cz Fe Ga Ge He Hs Hu It Ju Lu No Po Rm Rs(N,B,C,W,K) Su as well as N. Asia (Siberia), extending to S. Spain (subsp. ***nevadensis*** (Christ) Heywood, Sierra Nevada). An extraordinarily variable species with a very wide distribution and altitudinal range, with numerous races and ecotypes, selected and recently bred for timber production. Selected populations produced in seed orchards are now extensively planted over its range in Europe. $2n = 24$.

Bialobok, S. *et al.* (ed.) 1973: International symposium on the genetics of Scots Pine. 8th to 18th October 1973. Warszawa-Kórnik, Poland. — Institute of Dendrology and Kornik Arboretum, Committee of Forest Sciences, Polish Academy of Sciences, Forestry Research Institute, Poznan.
Giertych, M. & Mátyás, C. (ed.), 1991: Genetics of Scots Pine. Developments in Plant Genetics and Breeding **3**. — Elsevier Science Publishers, Amsterdam.

Additional references for *Pinus* species

Critchfield, W. B. & Little, E. L. 1966: Geographic distribution of the pines of the World. — U.S. Department of Agriculture Misc. Publ. 991. Washington DC.

Hora, F. B. 1986: Pines (genus *Pinus*). — Pp. 67-68 in: Hora, F. B. (ed.), The Oxford encyclopedia of trees of the World, ed. 2. — Oxford Univ. Press, Oxford.

Mirov, N. T. 1967: The genus *Pinus*. — Ronald Press, New York.

SALICACEAE

Salix alba L. — white willow. A deciduous tree, the coppiced shoots of which have been extensively used in basketry and the wood for carpentry, tools and lumber. Selected clones are often planted for coppicing. Clones of subsp. ***caerulea*** (Sm.) Rech. fil. are extensively planted in Britain where it is used in the manufacture of cricket bats and in the Netherlands for the manufacture of clogs. Selected forms are also grown for ornament. Along with other *Salix* species, *S. alba* is the original natural source of aspirin. Native in most of Europe but mainly an introduction in the north (Al Au Be *Br Bu Co *Cr Cz Ga Ge Gr He Ho Hs *Hu It Ju Lu Po Rm Rs(*N,B,C,W,K,E) Sa Si Tu [Da Fe Hb No Su]).

Several other widespread, European willow species, especially ***S. fragilis*** L., ***S. caprea*** L., ***S. triandra*** L., ***S. viminalis*** L., and ***S. purpurea*** L., are also planted and used for basketry. Clones of other species (and hybrids involving them), such as ***S. caprea*** L., ***S. cinerea*** L., ***S. hastata*** L. and ***S. repens*** L., are grown for ornament.

Meikle, R. D. 1984: Willows and poplars of Great Britain and Ireland. — Botanical Society of the British Isles Handbook No. 4, London.

Populus nigra L. — black poplar. Deciduous tree, widely grown over Europe for its timber. Intensive breeding programmes have led to production of superior clones, many of them of hybrid origin. Wild forms of the black poplar are native to S.C. and E. Europe (Al Au Bu Co Cz Ge Gr He Ho Hu It Ju Po Rm Rs(C,W,K,E) Tu). $2n = 38$.

Bisoffi, S., Gernignani, G., Gras, M. A., May, S. & Mughini, G. 1987: Establishment of *Populus nigra* genetic resources in Italy. — Genetica Agraria **41**: 105-114.

Jobling, J. 1990: Poplars for wood production and amenity. — Forestry Commission Bulletin **92**. Her Majesty's Stationary Office, London.

Rajora, O. P. 1989: Characterization of 43 *Populus nigra* L. clones, representing selections, cultivars and botanical varieties based on their multilocus allozyme genotypes. — Euphytica **43**: 197-206.

Steenackers, V. 1970: La populiculture actuelle. — Bull. Soc. Roy. For. Belge 1-38.

JUGLANDACEAE

Juglans regia L. — walnut. Deciduous tree, apparently native to parts of the Balkan peninsula and possibly Italy; widely cultivated for its fruits and timber and naturalized in S. and W. Europe (Al *Au Bu Gr *It Ju Rm *Si [Br Co Ga He Hs Hu Lu Rs(W,K,E) Tu]).

McGranahan, G. & Leslie, C. 1991: Walnuts (*Juglans*). — Pp. 907-951 in: Moore, J. N. & Ballington, J. R. (ed.), Genetic resources of temperate fruit trees and nut crops. — ISHS,

Wageningen.
Zohary, D. & Hopf, M. 1993: Domestication of plants in the Old World, ed. 2, Pp. 177-178. — Clarendon Press, Oxford.

CORYLACEAE

Corylus avellana L. — hazel. Deciduous shrub or small tree, native and widely distributed over temperate Europe (all except Bl Cr Fa Is Sb), as well as north Turkey and the Caucasus region. Widely cultivated for its nuts since classical times. Cultivars are selected clones. Many of the modern ones are the result of hybridization with other *Corylus* species. $2n = 28$.

Corylus maxima Miller — filbert. Deciduous tree, native to S.E. Europe (Gr Ju) and N. Anatolia. Cultivated in parts of Europe for its edible nuts. Closely related to and interfertile with *C. avellana* (some authors consider it only a subspecies of the latter). Numerous modern cultivars are of hybrid origin between *C. avellana* and *C. maxima*. $2n=28$.

Corylus colurna L. — Turkish hazel. Deciduous tree, native to S.E. Europe (Al Bu Gr Ju Rm Tu), N.W. Anatolia and the Caucasus region. Long cultivated, both as an ornamental and for its nuts. Recently used in crosses with other species. $2n = 28$.

References for *Corylus*

Krüssmann, G. 1984: Manual of cultivated broad-leaved trees and shrubs **1**, Pp. 377-379. — Timber Press, Portland, Oregon.
Mehlenbacher, S. A. 1991: Hazelnuts *(Corylus)*. — Pp. 771-835 in: Moore, J. N. & Ballington, J. R. (ed.), Genetic resources of temperate fruit and nut crops. ISHS Wageningen.
Wright, W. W. 1986: Hazels (genus *Corylus*). — Pp. 143-144 in: Hora, B. (ed.), The Oxford Encyclopaedia of Trees of the World, ed. 2. — Oxford University Press, Oxford.
Zohary, D. & Hopf, M. 1993: Domestication of plants in the New World, ed. 2, Pp. 179-180. — Clarendon Press, Oxford.

FAGACEAE

Castanea sativa Miller — sweet chestnut. A deciduous tree grown for its nuts since classical times. Selected clones are usually grafted on wild stocks. Possibly native to S. Europe, from Italy eastwards (Al Bu Gr Hu It Ju Sa Si Tu) to Turkey and Caucasia, and naturalized mainly in W. Europe. $2n = 24$.

Richardson, I. B. K. 1986: Chestnuts (genus *Castanea*). — Pp. 133-135 in: Hora, B. (ed.). The Oxford encyclopedia of trees of the World, ed. 2. — Oxford Univ. Press, Oxford.
Rutter, P. A., Miller, G. & Payne, J. A. 1991: Chestnuts *(Castanea)*. — Pp. 761-788 in: Moore, J. N. & Ballington, J. R. (ed.), Genetics resources of temperate fruit trees and nut crops **2**. — ISHS, Wageningen.
Zohary, D. & Hopf, M. 1993: Domestication of plants in the Old World, ed. 2, Pp. 178-179. — Clarendon Press, Oxford.

Quercus suber L. — cork oak. A deciduous tree, native to S. Europe (Co Ga Hs It Ju Lu Sa Si) and N.W. Africa. Both wild and planted trees have been extensively exploited since classical times for commercial production of cork. Planted trees are selections from the wild. $2n = 24$.

Quercus robur L. — English or pedunculate oak. A deciduous tree, native to most of temperate parts of Europe, except the north-east and parts of the Mediterranean region (all except Az Bl Cr Fa Is Sa Sb Tu). Widely planted as a forest tree in temperate parts of Europe. Planted trees are mainly selections from the wild. Extensive introgression with ***Q. petraea*** (Mattuschka) Liebl. occurs in Britain, and probably elsewhere in N.W. Europe. $2n = 24$.

MORACEAE

Ficus carica L. — fig. A small, functionally dioecious tree, and a characteristic fruit crop of Mediterranean horticulture since Bronze Age times, with many local, vegetatively propagated cultivars. Native to and naturalized in the Mediterranean belt of south Europe (*Al *Bl Co Cr Cy *Ga Gr Hs It Lu Rs(K) Sa Si *Tu), extending to N.W. Africa, the Near East and the south coasts of the Caspian and the Black Seas. $2n = 26$.

Zohary, D. 1995: Fig. — Pp. 366-370 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.

CANNABACEAE

Humulus lupulus L. — hop. Dioecious climber, widely cultivated for its infructescences which are used to flavour beer. Grows spontaneously over most of Europe (all except Az Bl Cr Fa Is Sb), and often naturalized so that its original distribution is obscured.

De Lyser, D. W. & Kasper, W. J. 1994: Hopped beer: the case for cultivation. — Economic Botany **48**: 166-170.
Neve, R. A. 1995: Hops. — Pp. 33-40 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.
Small, E. 1980: The relationships of hop cultivars and wild variants of *Humulus lupulus*. — Canad. Jour. Bot. **58**: 676-686.

Cannabis sativa L. — hemp. Dioecious herb cutlivated for its fibres (subsp. ***sativa***) and for its narcotic resin (subsp. ***indica*** (Lam.) Small & Cronq.). Wild forms (subsp. ***spontanea*** (Vavilov) Serebr. ex Serebr. & Sizov.) are native to C. Asia and extend to the Caucasus region and S.E. Europe. Naturalized or casual in much of Europe [Au Be Bu Co Cz Ga Ge Gr He Hs Hu It Ju Po Rm Rs(C) Sa Si].

Small, E. 1995: Hemp. — Pp. 28-32 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.
— & Cronquist, A. 1976: A practical and natural taxonomy for *Cannabis*. — Taxon **25**: 405-435.

POLYGONACEAE

Rumex rugosus Campd. — sorrel. Dioecious herb cultivated as a vegetable. Of uncertain origin but closely resembles wild ***R. acetosa*** L., which is widely distributed over most of Europe (all except Az Bl Cr Gr Sb) and which is regarded by some authors as its progenitor, although with some features more similar to ***R. thyrsiflorus*** Finger. which is native to E. and C. Europe, extending westwards to Norway and France, Spain and Portugal. All three with $2n = 14$ (female), $2n = 15$ (male).

CHENOPODIACEAE

Beta vulgaris L. — beet. An annual or biennial herb, extensively cultivated for sugar, fodder and for the edible leaves, hypocotyl and root. The cultivars are closely related and fully interfertile with a variable group of wild types centered in the Mediterranean basin and placed in *Beta* Sect. *Beta*. The following members of this group, sometimes treated as separate species, grow wild in Europe: (i) subsp. ***maritima*** (L.) Arc. (= *B. maritima* L.), apparently the progenitor of most cultivars and and native to the coasts of W. and S. Europe (Al Az Be Bl Br Bu Co Cr Cy Da Ga Ge Gr H Ho Hs It Ju Lu Sa Si Su Tu) as well as other and coastal regions of the Mediterranean basin; (ii) subsp. ***macrocarpa*** (Guss.) Thell. (=*B. macrocarpa* Guss.), native to more xeric niches in the south parts of the Mediterranean region in Europe (Bl Cr Gr Hs It Lu Sa Si), the Canary Islands, N.W. Africa and Near East; and (iii) subsp. ***patula*** (Ait.) Ford-Lloyd & Williams (=*B. patula* Ait.) native to Madeira and S.E. Spain. All have $2n = 18$ chromosomes..

More distant wild species of beet, which belong to the three other sections recognized in *Beta*, cross with the crop only with considerable difficulties. They are represented in Europe by: ***B. patellaris*** Moq. (S.E. Spain, Canary Islands), ***B. webbiana*** Moq. (Canary islands), ***B. trigyna*** Waldst. & Kit. (Bu Ju Rm Rs(K,W)), ***B. nana*** Boiss. & Heldr. (mountains of S. Greece).

Ford-Lloyd, B. V. 1995: Sugarbeet, and other cultivated beets. — Pp. 35-40 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.

— & Williams, J. J. 1975: A revision of *Beta* section *Vulgares (Chenopodiaceae)*, with new light on the origin of cultivated beets. — Bot. Jour. Linn. Soc. **71**: 89-102.

Letschert, J. P. W. 1993: *Beta* section *Beta*: biogeographical patterns of variation and taxonomy. — Wageningen Agricult. Univ. Papers No. 93-1.

Atriplex hortensis L. — orache. An annual herb cultivated since Roman times for its leaves, eaten as a boiled vegetable. Possibly wild and obviously naturalized forms of orache occur in C. and S. Europe [Au Bu Cz Ge Hu It Ju Po Rm Rs (C,W,K,E)] and are is certainly native in S.W. Asia.

Hammer, K. 1986: Chenopodiaceae. — Pp. 145-170 in: Schultze-Motel, J. (ed.), Rudolf Mansfelds Verzeichnis landwirtschaflicher und gärtnerischer Kulturpflanzen (ohne Zierpflanzen). — Akademie-Verlag, Berlin.

PORTULACACEAE

Portulaca oleracea L. polyploid complex — purslane. Cultivated as a vegetable (subsp. ***sativa*** (Haw) Celak in S. & C. Europe. Weedy forms of hexaploid ($2n = 54$)

subsp. ***oleracea***), as well as the less common hexaploid subsp. ***stellata*** Danin & H. G. Baker are widespread in S. & C. Europe. They have been reported from Al Au Az Be Bl Br Bu Co Cz Ga Ge Gr He Ho Hs Hu It Ju Lu Po Rm Rs(C,W,K,E) Sa Si Tu and the Canary Islands. *P. oleracea* complex is apparently of Meso-American origin; and it is in that part of the World in that most of its subspecies occur, including diploid ($2n = 18$) and tetraploid ($2n = 36$) forms. It however seems to have arrived to teh Old World in pre-Columbian times.

Danin, A., Baker, I. & Baker, H. G. 1979: Cytogeography and taxonomy of the *Portulaca oleracea* L. polyploid complex. — Israel Jour. Botany **27**: 177-211.

CARYOPHYLLACEAE

Dianthus barbatus L. — sweet william. Extensively grown as an ornamental and naturalized in several countries. Wild forms occur from the Pyrenees to the Balcan peninsula (Au Bu Cz Ga Hs Hu It Ju Po Rm Rs Tu [Fe Ga Ge Rs(B,C,E)]). $2n = 30$.

Dianthus caryophyllus L. — pink. Apparently native to some Mediterranean countries ([Ga] Gr Hs It *Ju Sa Si) and occasionally naturalized. Probably the main ancestor of the widely cultivated carnation. $2n = 30$ (30, 60 and 90 in cultivated forms). Closely related to *D. sylvestris* Wulfen. from S. and S.C. Europe.

RANUNCULACEAE

Nigella sativa L. — black cummin, fennel flower. Annual herb, grown for its seeds. Nattive to S.W. Asia, and naturalized and probably also native in S.E. Europe (Bu Cr Cy Cz Gr Hu It Ju To Rm Rs Tu). Cultivated since Bronze Age for its aromatic seeds used as a condiment. $2n = 12$.

Delphinium elatum L. — delphinium. Perennial herbs, cultivated for ornament. Native from C. Europe to Russia (Au Cz Ga He It Ju Po Rm Rs(N,C,W,E)). Under cultivation *D. elatum* has been crossed with Asiatic ***D. grandiflorum*** L. to produce a wide range of garden hybrids. Tetraploid, $2n = 32$.

Bassett, S. E. 1990: Modern garden delphiniums. — Collectanea Botanica (Barcelona) **19**: 153-160.

Blanché, C. 1990: *Delphinium* 2. subgen. *Delphinium*: origin and evolutionary trends. — Collectanea Botanica (Barcelona) **19**: 75-96.

Consolida orientalis (Gay) Schrd. and ***C. ajacis*** (L.) Schur. (=*C. ambigua* (L.) P. W. Ball & Heywood) — larkspur. Annual herbs, widely used as garden ornamentals. Many cultivars have been derived from these two species and crossed between them. *C. orientalis* ($2n = 16$) is native to N.C. and E. Spain, S.E. Europe snd S.W. Asia, andlocally naturalized elsewhere in Europe (Al Bu Gr Hs *Hu Ju Rm Rs(W,K,E) Tu [Au Cz Ga Ge He *It Si]). *C. ajacis* ($2n = 16$) is native to teh mediterranean region (Al Co Cr Ga Gr Hs It Ju Tu).

Anenome coronaria L. — anemone. A perennial herbs with corms, grown for its flowers. Native mainly to S.W. Asia but extending into the Mediterranean region of

Europe (Bl Co Gr Cy Ga Gr It Sa Si Tu). Cultivated forms have been selected for flower size and colour patterns. Diploid, $2n = 16$.

Horovitz, A., Galil, J. & Zohary, D. 1975: Biological flora of Israel. 6: *Anemone coronaria* L. — Israel Jour. Botany **24**: 26-41.

Aquilegia — columbine. Perennial herbs, grown as ornamentals. Most cultivars have been derived from ***A. vulgaris*** L., native to W. and C. Europe (Al Au Be Br Co Cz Ga Ge Gr Hb He Ho Hs Hu It Ju Lu Po *Rm Rs(B,C) Si), and from crosses between it and N. American species. Most of the other 15 European species are sometimes cultivated for ornament and are easily crossable with the commercial cultivars. $2n = 14$.

BERBERIDACEAE

Berberis vulgaris L. — barberry. Spiny shrub, native to most of Europe except the islands and the extreme north (Al Au Be Bu Cz Ga Ge Gr He Ho Hs Hu It Ju Lu Po Rm Rs(B,C,W,K,E) and extending to S.W. Asia. Grown for its fruit and for ornament. It is also the intermediate host for the wheat rust *Puccinia graminis* and has been eradicated in some areas. A distinct wild race, subsp. ***australis*** (Boiss.) Heywood, occurs in Spain, and hybridises with typical *B. vulgaris*. $2n = 28$.

Ahrendt, L. W. S. 1961: *Berberis* and *Mahonia*: a taxonomic revision. — Bot. Jour. Linn. Soc. **57**: 1-41.

LAURACEAE

Laurus nobilis L. — bay, bay laurel. Evergreen shrub or small tree, native to the Mediterranean Europe (Al Bl Co Cr Cy Ga Gr Hs Lu Ju Sa Tu) and other parts of the Mediterranean basin. Cultivated as an ornamental shrub, and for its leaves which have been widely used since classical times as a condiment. Contains diploid ($2n = 24$) and tetraploid ($2n = 48$) forms.

PAPAVERACEAE

Papaver somniferum L. — opium poppy. An annual, diploid ($2n = 22$) herb, cultivated since ancient times for its seeds which are used as a condiment and for oil; and for its narcotic opium-containing latex (now illegal in Europe). Large- and frequently double-flowered forms are now grown also for ornament. The cultivars, grouped in subsp. ***somniferum***, are apparently derived from wild subsp. ***setigerum*** (DC.) Arcangeli (=*P. setigerum* DC.). The latter is native to the W. and C. Mediterranean belt of Europe (Bl Co Ga Hs It Lu Sa Si), the Canary Islands and N.W. Africa. It contains both diploid ($2n = 22$) and tetraploid ($2n = 44$) forms. The cultivars are obviously related to the diploid *setigerum* wild forms.

Grey-Wilson, C. 1993: Poppies, a guide to the Poppy family in the wild and in cultivation. — Timber Press, Portland, Oregon.

Hammer, K. & Fritsch, R. 1977: Zur Frage nach der Ursprungsart des Kulturmohns (*Papaver somniferum* L.). — Kulturpflanze **25**: 113-124.

Kadereit, J. W. 1986: A revision of *Papaver* L. Sect. *Papaver* (*Papaveraceae*). — Botan. Jahrb. Syst. **108**: 1-16.

Zohary, D. & Hopf, M. 1993: Domestication of plants in the Old World, ed. 2, Pp. 128-131.— Clarendon Press, Oxford.

CAPPARIDACEAE

Capparis spinosa L. (incl. ***C. ovata*** Desf. and ***C. sicula*** L.) — caper. A variable shrub cultivated for its flower buds which are used as a condiment, especially in S. Europe. Non-spiny, large-flowered clonal cultivars have been selected. Wild forms are native to Mediterranean Europe (Al Bl Co Cr Cy Ga Gr Hs It Ju Rs(K) Sa Si) and other parts of the Mediterranean basin and S.W. Asia. $2n = 38$.

Barbera, G. & Lorenzo, R. D. 1984: The caper culture in Italy. — Acta Hortic. **144**: 167-171.
Higton, R. N. & Akeroyd, J. R. 1991: Variation in *Capparis spinosa* L. in Europe. — Bot. Jour. Linn. Soc. **106**: 104-112.

CRUCIFERAE

Isatis tinctoria L. — woad. A biennial herb, cultivated since ancient times as a source of a blue dye (woad). Its cultivation collapsed with the introduction of synthetic dyes but it is now being grown again (on small scale) in some countries such as Germany. Native to S.W. Asia and parts of S.E. Europe, and widely naturalized elsewhere in Europe.

Hanelt, P. 1986: Cruciferae. — Pp. 272-332 in: Schultze-Motel, J. (ed.), Rudolf Mansfelds Verzeichnis landwirtschaftlicher und gärtnerischer Kulturpflanzen (ohne Zierpflanzen). — Akademie-Verlag, Berlin.
Harry, J. B. 1930: The woad plant and its dye, Pp. 328. — Oxford Univ. Press, Oxford.
Körber-Grohne, U. 1987: Nutzplanzen in Deutschland, Pp. 410-416. — Konrad Theiss, Stuttgart.

Erysimum cheiri (L.) Crantz — wallflower. A perennial herb cultivated for ornament, with numerous cultivars, many of hybrid origin, native to the Aegean region but naturalized throughout C., S. & W. Europe (Cr Gr).

Erysimum scoparium (Brouss.) Wetts. — a Canarian endemic perennial from the highest mountains of Tenerife and Gran Canaria, grown in Europe as an ornamental and locally for its medicinal value.

Matthiola incana R. Br. — stock. Herbs, grown for ornament in gardens for at least 400 years. Wild forms are short-lived perennials with woody base, native to sea cliffs on the coasts of S. & W. Europe (Az Bl Br Co Cr Cy Ga Gr Hs It Ju Lu Sa Si Tu), N. W. Africa and the Canary Islands, and widely naturalized in Europe. Cultivated forms are often annual or biennial.

Rich, T. C. G. 1991: Crucifers of Great Britain and Ireland, Pp. 182-183. — Botanical Society of the British Islands Handbook No. 6, London.

Barbarea verna (Miller) Ascherson — land cress. A biennial herb, usually grown as an annual as a salad and for the oil from its seeds. Formerly extensively cultivated in kitchen gardens; but now only grown in parts of W. and C. Europe as a local market vegetable. Native to S.W. Europe (Az Co Ga Hs It Lu Sa) and naturalized elsewhere [Au Br Ba Hb He Ho Rs(W)].

Rich, T. C. G. 1991: Crucifers of Great Britain and Ireland, Pp. 172-173. — Botanical Society of the British Islands Handbook No. 6. London.

Nasturtium officinale R. Br. (= *Rorippa nasturtium-aquaticum* (L.) Hayek) — green water-cress. Annual diploid ($2n = 32$) herbs, cultivated widely as a salad crop. Wild forms are found in wet places throughout Europe (except for Fa Fe Is No Rs(N) Sb); as well as in temperate Asia. It grows also in some tropical parts of Asia and Africa. Triploid hybrids (brown cress, $2n = 48$) are also used. They are crossing products between diploid *N. officinale* and wild tetraploid ($2n = 64$) ***N. microphyllum*** (Boenn.) Reichenb.

Hanelt, P. 1986: Cruciferae. — Pp. 272-332 in: Schultze-Motel, J. (ed.), Rudolf Mansfelds Verzeichnis landwirtschaftlicher und gärtnerischer Kulturpflanzen (ohne Zierpflanzen). — Akademie-Verlag, Berlin.
Rich, T. C. G. 1991: Crucifers of Great Britain and Ireland, Pp. 150-153. — Botanical Society of the British Islands Handbook No. 6. London.

Armoracia rusticana P. Gaertner, B. Meyer & Scherb. — horse-radish. Perennial herb, naturalized throughout much of Europe, and widely cultivated (by vegetative propagation) for its rhizomes which are used as a condiment. Origin unclear, but possibly native in S. Russia and the E. Ukraine and naturalized in other parts of Europe. [Al Au Be Br Bu Cz Da Fe Ga Ge Hb He Ho Hs Hu It Ju No Po Rm Rs(N,B,C,W,E) Si Su Tu].

Hanelt, P. 1986: Cruciferae. — Pp. 272-332 in: Schultze-Motel, J. (ed.), Rudolf Mansfelds Verzeichnis landwirtschaftlicher und gärtnerischer Kulturpflanzen (ohne Zierpflanzen). — Akademie-Verlag, Berlin.
Rich, T. C. G. 1991: Crucifers of Great Britain and Ireland, Pp. 246-247. — Botanical Society of the British Islands Handbook No. 6. London.

Camelina sativa (L.) Crantz. — false flax, gold of pleasure. An annual oil crop, extensively cultivated (particularly in C. Europe) in the past but only a relic crop today. One of the classical examples for the evolution of secondary crops form weeds. Today widespread in Europe mainly as a weed and often a casual. (Al Au Be Br Bu Co Cr Cz Da Fe Ga Ge Gr He Ho Hu It No Rm Rs(N,B,C,W,K,E) Sa Si Su). Non-weedy forms are apparently native only in S.E. Europe and in S.W. Asia. $2n = 40$.

Hanelt, P. 1986: Cruciferae. — Pp. 272-332 in: Schultze-Motel, J. (ed.), Rudolf Mansfelds Verzeichnis landwirtschaftlicher und gärtnerischer Kulturpflanzen (ohne Zierpflanzen). — Akademie-Verlag, Berlin.
Markgraf, F. 1975: *Camelina*. — Pp. 342-345 in: Gustav Hegi's Illustrierte Flora von Mitteleuropa, ed. 2, **4(1)**. — Paul Parey, Berlin.
Mirek, Z. 1981: The genus *Camelina* in Poland. — Fragmenta Floristica et Geobotanica **27**: 445-507.

Iberis semperflorens L. — candytuft. Small evergreen shrub native to Sicily and the W. coast of Italy (It Si) and sometimes naturalized. Cultivated as a garden plant. Related species include: ***I. sempervirens*** L. from Mediterranean Europe (Al Cr Ga Gr Hs It Ju), ***I. gibraltarica*** L. from Gibraltar (Hs) and ***I. umbellata*** L. from the Mediterranean region (Al Ga Gr It Ju).

Brassica oleracea L. — cabbage, cauliflower, kohlrabi, Brussels sprouts, etc. Widely cultivated as a vegetable in Europe, some forms since classical times. Recently

ornamental forms have also been bred. The crop is closely related to, and fully interfertile with, a varied aggregate of perennial, bushy, diploid ($2n = 18$; genome: CC), largely self-incompatible, wild cabbages (the *B. oleracea* "cytodeme") native to the Atlantic coast of Europe, the Mediterranean basin, and the Canary islands. The following closely related wild taxa have been recognized in this group. Many of them are narrow endemics. (1). Wild ***B. oleracea*** subsp. ***oleracea*** (sensu stricto), native to the Atlantic coast of Spain, France, U.K. and Heligoland; (2). ***B. montana*** Pourret (= *B. oleracea* subsp. *robertiana* (Gay) Bonnier & Layens) native to the coasts of N.E. Spain and the French and the Italian rivieras; (3). ***B. rupestris*** Rafin. and (4). ***B. villosa*** Biv. (sensu lato) both in W. Sicily; (5). ***B. incana*** Ten. in E. Sicily, the W. coast of Italy, and several Adriatic islands; (6). ***B. macrocarpa*** Guss. endemic to W. Sicily (Isole Egadi); (7). ***B. insularis*** Moris in Corsica, Sardinia, and Pantelleria; (8). ***B. cretica*** Lam. subsp. **cretica** in S.E. Greece, (9). ***B. cretica*** subsp. ***nivea*** (Boiss. & Spruner) M. Gustafsson in N.E. Peloponnisos and Kriti; (10). ***B. cretica*** subsp. ***laconica*** M. Gustafsson & Snogerup in S.E. Greece; (11). ***B. hilarionis*** Post in Cyprus; and (12). ***B. bourgeaui*** (Webb) Kuntze in the Canary Islands.

Hodgkin, T. 1995: Cabbages, kales, etc. — Pp. 76-82 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.

Raimondo, F. M. 1991: On the taxonomy and distribution of *Brassica* sect. *Brassica (Cruciferae)* in Sicily. — Flora Mediterranea **1**: 63-86.

Snogerup, S. 1980: The wild forms of the *Brassica oleracea* group ($2n = 18$) and their possible relations to cultivated ones. — Pp. 121-132 in: Tsunada, S., Hinata, K., & Gómez-Campo, C. (ed.), Brassica crops and wild allies. — Japan Scientific Societies Press, Tokyo.

—, Gustafsson, M. & Bothmer, R. von 1990: *Brassica* sect. *Brassica (Brassicaceae)* I. Taxonomy and variation. — Willdenowia **19**: 271-365.

Brassica rapa L. (= *B. campestris* L.) — turnip. Widely cultivated in Europe for its oil (turnip rape cultivars, subsp. ***oleifera*** (DC.) Metzger), and for its swollen roots and leaves (turnip cultivars, subsp. ***rapa***). Other groups of cultivars such as the Chinese cabbage (subsp. ***chinensis*** (L.) Hanelt), and Pekin cabbage (subsp. ***pekinensis*** (Lour.) Hanelt) have evolved in E. Asia. Also they are grown for their leaves and roots. Weedy and ruderal forms of turnip (subsp. ***sylvestris*** (Lam.) Janchen) are widespread over much of Europe (Al Bl Br Bu Co Cz Ba Fe Ge Gr Hb Ho Hs Hu Is It Ju No Rm Rs(K,E), Sa Si Su); as well as S.W. and E. Asia. All the above mentioned subspecies are interfertile, diploid ($2n = 20$, genome: AA) and largely self-incompatible.

Hanelt, P. 1986: Cruciferae. — Pp. 272-332 in: Schultze-Motel, J. (ed.), Rudolf Mansfelds Verzeichnis landwirtschaftlicher und gärtnerischer Kulturpflanzen (ohne Zierpflanzen). — Akademie-Verlag, Berlin.

McNaughton, I. H. 1995: Turnip and relatives. — Pp. 62-68 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.

Rich, T. C. G. 1991: Crucifers of Great Britain and Ireland, Pp. 88-89. — Botanical Society of the British Islands Handbook No. 6. London.

Brassica napus L. — rape, swede. Extensively cultivated in Europe for its oil-containing seeds; (oil seed rape, subsp. ***oleifera*** (DC.) Metzger) and for its swollen tap-root (swede or swedish turnip, subsp. ***rapifera*** Metzger). A tetraploid cultigen ($2n = 38$, genomes: AACC) probably originated in cultivation by hybridization (and chromosome doubling) between diploid ($2n = 18$) *B. oleracea* and diploid ($2n = 20$) *B. rapa*. Widely naturalized.

McNaughton, I. H. 1995: Swedes and rapes. — Pp. 68-75 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.
Rich, T. C. G. 1991: Crucifers of Great Britain and Ireland, Pp. 86-87. — Botanical Society of the British Islands Handbook No. 6. London.

Brassica nigra (L.) Koch — black mustard. Cultivated since classical times, mainly for its seeds used for preparation of mustard. A relict crop today, replaced by *B. juncea* (L.) Czern. from S. and E. Asia. Wild, weedy and feral forms of *B. nigra* occur over most of Europe (all except Bl Is Ns and Sb); and are widely distributed also in S.W. Asia. Diploid ($2n = 16$, genome: BB).

Hanelt, P. 1986: Cruciferae. — Pp. 277-332 in: Schultze-Motel, J. (ed.), Rudolf Mansfelds Verzeichnis landwirtschaflicher und gärtnerischer Kulturplanzen (ohne Zierpflanzen). — Akademie-Verlag, Berlin.
Hemingway, J. S. 1995: Mustards. — Pp. 82-86 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.
Heywood, V. H. 1982: Brassicas. — Pp. 62-63 in: Heywood, V. H. & Chant, S. R. (ed.), Popular Encyclopaedia of Plants. — Cambridge University Press, Cambridge.

Sinapis alba L. — white mustard. An annual herb widely cultivated both as a forage crop, and for its seeds which are either the sole or the main ingredient in the preparation of mustard. Wild and weedy forms occur over much of Europe (all except Sb); as well as in N. Africa and S.W. Asia. Also widespread as an alien in several other areas. Diploid ($2n = 24$) and largely self-incompatible.

Hanelt, P. 1986: Cruciferae. — Pp. 277-332 in: Schultze-Motel, J. (ed.), Rudolf Mansfelds Verzeichnis landwirtschaflicher und gärtnerischer Kulturplanzen (ohne Zierpflanzen). — Akademie-Verlag, Berlin.
Hemingway, J. S. 1995: Mustards. — Pp. 82-86 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.
Rich, T. C. G. 1991: Crucifers of Great Britain and Ireland, Pp. 86-87. — Botanical Society of the British Islands Handbook No. 6. London.

Eruca vesicaria (L.) Cav. subsp. ***sativa*** (Miller) Thell. (= *E. sativa* Miller). — garden or salad rocket. An annual diploid ($2n = 22$) herb, grown as a salad crop. Wild *sativa* forms are apparently native in the Mediterranean belt of Europe. Weedy and naturalized forms are spread over most Europe (Bl Bu Co Cr Ga He Hs Hu It Ju Lu Rm Rs(C,W,K,E) Sa Si Tu). A distinct wild race, subsp. ***vesicaria*** is native to Spain and the Balearic Islands (Hs Bl).

Bianco, V. V. 1995: Rocket, an ancient underutilized vegetable crop and its potential. — Pp. 35-57 in: Padulosi, S. (ed.), Rocket genetic resources network: report of the first meeting 13-15 November 1994, Lisbon, Portugal. — International Plant Genetic Resources Institute (IPGRI), Rome.
Rich, T. C. G. 1991: Crucifers of Great Britain and Ireland, Pp. 86-87. — Botanical Society of the British Islands Handbook No. 6. London.

Raphanus sativus L. — radish. An annual herb, widely cultivated in Europe for its roots. It is probably derived from ***R. raphanistrum*** L. with which it is fully interfertile. The latter is a highly variable species distributed over Europe (all except Sb), the Mediterranean basin and W. Asia. Diploid ($2n = 18$, genome RR). Self-incompatible.

Crisp, P. 1995: Radish — Pp. 86-88 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.
Hanelt, P. 1986: Cruciferae. — Pp. 277-332 in: Schultze-Motel, J. (ed.), Rudolf Mansfelds Verzeichnis landwirtschaftlicher und gärtnerischer Kulturpflanzen (ohne Zierpflanzen). — Akademie-Verlag, Berlin.

GROSSULARIACEAE

Ribes rubrum L. — white and red currants. Shrub, widely cultivated in W. Europe for its fruits. Wild forms occur in W. Europe (Be *Br Ga Ge Ho It). Also ***R. spicatum*** Robson from N. & E. Europe and other European species of *Ribes* have been involved in the derivation of red currant cultivars. Diploid ($2n = 16$).

Ribes nigrum L. — black currant. Widely cultivated in Europe and frequently naturalized so its original distribution is difficult to define but certainly native in C. & E. Europe (Au Be Br? Bu Cz Da Fe Ga Ge Ho Hu It Ju No? Po Rm Rs(N,B,C,W,E) Su.) Wild subsp. ***nigrum*** and Scandinavian and Russian races have been used in the formation of modern cultivars along with non-European species. Diploid ($2n = 16$).

Brennan, R. M. 1991: Currants and gooseberries. — Pp. 459-488 in: Moore, J. N. & Ballington, J. R. (ed.), Genetic resources of temperate fruit and nut crops. — ISHS, Wageningen.
Fitsch, R. 1986: Saxifragaceae. — Pp. 338-345 in: Schultze-Motel, J. (ed.), Rudolf Mansfelds Verzeichnis landwirtschaftlicher und gärtnerischer Kulturpflanzen (ohne Zierpflanzen). — Akademie-Verlag, Berlin.
Keep, E. 1995: Currant. — Pp. 235-239 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.

ROSACEAE

Spiraea salicifolia L. — Deciduous shrub, native to C. & E.C. Europe (Au Bu Cz Hu Po Rm Rs(B,C,W)) and often naturalized elsewhere. Cultivated as a garden ornamental.

Rubus idaeus L. — raspberry. A deciduous, diploid ($2n = 14$) and self-incompatible thorny shrub, extending through much of Europe but confined only to mountain regions in the south (all countries except Az Bl Cr Cy Fa Is Lu Sb Tu). Also widely spread in temperate Asia and N. America. Intensive selection and breeding has led to the development of a range of extensively cultivated clones grown for their edible fruits.

Rubus fruticosus L. complex. — blackberry, bramble. A taxonomically complex polyploid aggregate of scrambling thorny shrubs which comprise a large number of pseudogamous facultative apomicts (agamospecies) (2x, 3x, 4x, 5x, 6x) as well as the putative sexual progenitors (*R. plicatus* Weihe & Nees 4x; *R. ulmifolius* Schott 2x). The wild forms are massively distributed in Europe. Intensive selection and breeding resulted in high quality clones grown for their fruits, especially in N. Europe. It is also parent of several hybrid blackberry cultivars. $x = 7$.

Heslop-Harrison, Y. 1968: *Rubus* L. — Pp. 7-25 in: Tutin, T. G., Heywood, V. H., Burges, N. A., Moore, D. M., Valentine, D. H., Walters, S. M. & Webb, D. A. (ed.), Flora Europaea **2**. — Cambridge Univ. Press, Cambridge.

Jennings, D. L. 1995: Raspberries and blackberries. — Pp. 429-434 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.
—, Daubeny, H. A. & Moore, J. N. 1991: Blackberries and raspberries. *(Rubus)*. — Pp. 331-389 in: Moore, J. N. & Ballington, J. R. (ed.), Genetic resources of temperate fruit and nut crops. — ISHS, Wageningen.

Rosa gallica L. — A deciduous shrub which is native to S. & C. Europe (Al Au Be Bu Cz Ga Ge Gr He Hu It Ju Po Rm Rs(C,W,K) Tu). One of the wild ancestors of the modern rose cultivars. $2n = 28$.

Pyrus communis L. — pear. Deciduous tree, widely cultivated in Europe. Closely related to (and fully interfertile with) ***P. pyraster*** Borkh., a highly variable deciduous wild pear (sometimes split into several species) widespread over S., W. and C. Europe (Al Au Be Br Bu Cz Da Ga Ge Gr He Hs Hu It Ju Lu Po Rm Rs(C,W,E) Si) and extending (as a distinct geographic race: subsp. ***caucasica*** Fedorov), to the Caucasus and to N. Turkey. All these wild pears are diploid ($2n = 34$), self-incompatible trees. They represent the main wild source from which the fruit crop has been derived.
Several additional *Pyrus* species growing wild in Europe are also fully interfertile with the fruit crop and very probably also contributed to the cultivated gene pool: ***P. eleagnifolia*** Pallas, native to Turkey and the Black Sea belt of Europe (Bu Rm Rs(K) Tu); ***P. spinosa*** Forssk. (= *P. amygdaliformis* Vill.), native to the Mediterranean vegetation belt of south Europe (Al Bu Co Cr Ga Gr Hs It Ju Sa Si Tu); and ***P. nivalis*** Jacq., in the W. Alps, as well as some other sites in S. and S.E. Europe (Au Bu Cz Ga He Hu It Ju Rm). All European wild pears have also been traditionally used as host stocks for grafting cultivars.

Bell, R. L. 1991: Pears *(Pyrus)*. — Pp. 657-697 in: Moore, J. N. & Ballington,. J. R. (ed.), Genetic resources of temperate fruit and nut crops. — ISHS, Wageningen.
Browicz, K. 1993: Conspect and chorology of the genus *Pyrus* L. — Arboretum Kórnickie **38**: 17-33.
Zohary, D. & Hopf, M. 1993: Domestication of plants in the Old World, ed. 2, Pp. 167-169. — Clarendon Press, Oxford.

Malus pumila Miller (= *M. domestica* Borkh.) — apple. Deciduous tree, extensively cultivated in Europe and closely related to (and fully interfertile with) the European wild crab apple ***M. sylvestris*** (L.) Miller subsp. ***sylvestris***. This wild apple is widespread in temperate Europe (all except Bl Is Sb); and its more eastern wild race subsp. ***orientalis*** (Uglitzkich) Browicz, (= *M. orientalis* Uglitzkich) grows in N. Turkey and the Caucasus region. All these wild apples are self-incompatible and diploid ($2n = 34$). They represent the main source from which the cultivated apples have been derived.

Zohary, M. & Hopf, M. 1993: Domestication of plants in the Old World, ed. 2, Pp. 162-166. — Clarendon Press, Oxford.

Sorbus domestica L. — rowan, mountain ash. A deciduous tree, grown as an ornamental and occasionally for its fruits. Wild forms occur in S. Europe (Al Bu Co Ga Ge Gr He Hs Hu It Ju Rm Rs(K) Sa Si Tu). $2n = 34$.

Sorbus aucuparia L. — Mountain ash. A small, deciduous tree with attractive red fruits, widely planted as an ornamental. Wild forms occur in most of Europe (all except

Az Bl Cr Fa Sa Sb Tu). $2n = 34$.

McAllister, H. A. 1986: The rowan and its relatives (*Sorbus* spp.). — Ness Series I, Ness Gardens (University of Liverpoool Botanic Gardens). Carwood Printing & Stationery Ltd., Liverpool.

Ohle, H. 1986: Rosaceae. — Pp. 346-426 in: Schultze-Motel, J. (ed.), Rudolf Mansfelds Verziechnis landwirtschaflicher und gärtnerischer Kulturplanzen (ohne Zierpflanzen). — Akademie-Verlag, Berlin.

Mespilus germanica L. — medlar. A deciduous tree, sometimes cultivated in C. and S. Europe for its fruit. Wild forms occur in S. and S.E. Europe (Bu Ga Gr *It Rs(K) *Sa *Si).

Crataegus azarolus L. — azarole. A shrub or small tree cultivated (on a small scale) since ancient times in S. Europe for its small apple-like fruits used for making jams and as a flavouring in liqueurs. Selections have been made for fruit colour, size and taste. Probably originated in the Eastern Mediterranean. Wild and naturalized in parts of S. Europe (Cr Cy Ga Hs It Si), and in the Near East.

Hammer, K. & Perrino, P. 1985: Azzeruolo (*Crataegus azarolus* L.) — a rare fruit tree in South Italy. — Gleditschia **13**: 107-111

Prunus dulcis (Miller) D. A. Webb (= *Amygdalus communis* L.) — almond. A deciduous tree, extensively cultivated for its edible fruits and occasionally naturalised in the Mediterranean belt of Europe. A largely self-incompatible, diploid ($2n = 16$) nut crop. Wild forms of this species are native to the Levant. Yet ***P. webbii*** (Spach) Vierh., native to the Aegean region and S. Italy (Al Bu Cr Gr It Ju) is also interfertile with the crop, and is being used in almond breeding programmes. $2n = 16$.

Browicz, K. & Zohary, D. 1995: The genus *Amygdalus* L. *(Rosacese):* species relationships, distribution and evolution under domestication. — Genetic Resources and Crop Evolution, (in press).

Prunus spinosa L. — sloe or blackthorn. A tetraploid ($2n = 32$) spiny shrub, widely distributed over Europe (all except Az Cr Fa Is Rs(N) Sb) is locally cultivated in C. Europe for its fruits which are used in the preparation of jams. It is distantly related to the cultivated plum but can still be crossed with it, although the hybrids are almost sterile.

Prunus domestica L. — plum. Deciduous tree, extensively cultivated for its fruits, comprising the hexaploid ($2n = 48$) European or garden plum (subsp. ***domestica***) and the damsons and bullaces (subsp. ***insititia*** (L.) C.K. Schneider. Naturalized forms of this fruit tree grow over most of Europe. The origin of the cultivars is still uncertain. Some workers have suggested that 6x *P. domestica* is a product of hybridization between 2x *P. cerasifera* and 4x *P. spinosa* but there is no evidence to support this. The crop is, however, closely related to and easy to cross with the diploid, tetraploid and hexaploid ($2n = 16, 32, 48$) wild forms of the cherry plum ***P. cerasifera*** Ehr. (= *P. divaricata* Ledeb.) native to the Balkan Peninsula and Krym (Al Bu Gr Ju Rs(K) Tu), the Caucasus and the Near East.

The European plum and the cherry plum are also closely related to another diploid ($2n = 16$) wild plum ***P. cocomilia*** Ten., native to the S. Balkan, the Aegean region, S. Italy

and Sicily (Al Gr It Ju Si); and to diploid ($2n = 16$) ***P. brigantina*** Vill. which closely resembles the former and is restricted to a small area in the western Alps (Ga It).

References for plums

Ohle, H. 1986: Rosaceae. — Pp. 346-426 in: Schultze-Motel, J. (ed.), Rudolf Mansfelds Verzeichnis landwirtschaflicher und gärtnerischer Kulturpflanzen (ohne Zierpflanzen). — Akademie-Verlag, Berlin.

Ramming, D. W. & Cociu, V. 1991: Plums (*Prunus*). — Pp. 235-287 in: Moore, J. N. & Ballington, J. R. (ed.), Genetic resources of temperate fruit and nut crops. — ISHS, Wageningen.

Zohary, D. 1992: Is the European plum, *Prunus domestica* L., a *P. cerasifera* Ehrh. x *P. spinosa* L. allopolyploid? — Euphytica **60**: 75-77.

Prunus avium L. — sweet cherry. A deciduous, diploid ($2n = 16$) tree, extensively cultivated over most of Europe for its fleshy fruits. Wild forms, fully interfertile with the cultivars, are native to N.,W., C. and higher parts of South Europe. It is also very widely naturalized in Europe (Al Au Be Br Bu ?Co Cz Da Ga Ge Gr Hb He Ho Hs Hu It Ju Lu No Po Rm Rs(C,W,K) Sa Su Tu [Bl]).

Prunus cerasus L. — sour cherry, morello. A deciduous, tetraploid ($2n = 32$), small tree which probably arose from hybridization between the sweet cherry *P. avium* L. and *P. fruticosa* Pallas. Widely cultivated in the Balkan Peninsula, and less extensively in other parts of W. and C. Europe. Also frequently naturalized in these areas (Al Au Br Bu Cz Da Fe Ga Ge Gr Hb He Ho Hs Hu It Ju Lu No Po Rm Rs(B,C,W,K) Su).

Prunus fruticosa Pallas. — A wild, deciduous, tetraploid ($2n = 32$) small tree. One of the alleged parents of the cultivated sour cherry, it is native to E., S.E. and C. Europe (Au Bu Cz Ge Hu It Po Rm Rs(C,W,E), the Caucasus and Turkey.

References on cherries

Iezzoni, A., Schmidt, H. & Albertini, A. 1991: Cherries (*Prunus*). — Pp. 111-173 in: Moore, J. N. & Ballington, J. R. (ed.), Genetic resources of temperate fruit and nut crops. — ISHS, Wageningen.

Oldén, E. J. & Nybom, N. 1968: On the origin of *Prunus cerasus* L. — Hereditas **56**: 327-345.

Prunus lusitanica L. — Portuguese cherry laurel. Tree or shrub, grown as an ornamental in milder regions of Europe. It is native to the Iberian peninsula and S.W. France (Az Ga Hs Lu). Other wild subspecies occur in the Azores (subsp. ***azorica*** (Mouillefort) Franco) and in the Canary Islands (subsp. ***hixa*** (Willd.) Franco).

Prunus laurocerasus L. — cherry laurel. Tree or shrub, extensively cultivated as an ornamental in S. & W. Europe. Native to the Balkan peninsula (Bu Ju Tu).

Zohary, D. & Hopf, M. 1993: Domestication of plants in the Old World, ed. 2. Pp. 173-177. — Clarendon Press, Oxford.

LEGUMINOSAE

Ceratonia siliqua L. — Carob, locust bean. Evergreen dioecious tree, cultivated since

ancient times in S. Europe for its sweet pods; and more recently for its seeds which contain galactomanans (carob bean gum) used by the food industry. Wild forms are a characteristic constituent of Mediterranean vegetation of S. Europe (Al Bl Cr Cy Ga Gr Hs It Ju Lu Sa Si), N.W. Africa and the Near East. $2n = 14$. Cultivation is based on grafting of selected clones.

Catarino, F. (ed.) 1981: International symposium on *Ceratonia siliqua* L. — Centro de Engenharia Biológica das Universidades de Lisboa, Lisboa.
— 1993: The carob tree. — Naturopa **73**: 14-15.

Chamaecytisus proliferus (L.) Link subsp. ***palmensis*** (Christ) Bramwell (= *C. palmensis* Christ). A shrub used locally as a fodder plant with considerable potential for warmer climates. Endemic to the W. & C. Canary Islands (C, T, P, G, H).

Lupinus luteus L. — Yellow lupin. Annual legume, recently introduced into cultivation, mainly for animal feed and green manure. Wild forms are native to the Mediterranean belt of Europe (Co Hs It Lu Sa Si) and the Levant.

Lupinus albus L. — White lupin. Annual legume, cultivated since classical times mainly for its edible seeds and as fodder. Wild forms (subsp. ***graecus*** (Boiss. & Spruner) Franco & P. Silva) are native to the Balkan peninsula, the Aegean region and S. Italy (Al Bu Cr Gr It Ju Tu).

Lupinus angustifolius L. — blue or narrow-leaved lupin. Annual legume cultivated for green manure, forage and the seeds. Wild and naturalized forms of this lupin occur mainly in the Mediterranean region of Europe and S.W. France. (Bu Co Cr Ga Gr Hs It ?Ju Lu Sa Si Tu [Au Az Cz Ge He Hu Po Rm Rs(C,W)])

Haq, N. 1993: Lupins (*Lupinus* species). — Pp. 103-130 in: Williams, J. T. (ed.), Pulses and Vegetables. — Chapman and Hall, London.
Plitman, U. & Heyn, C. C. 1984: Old World *Lupinus*: taxonomy, evolutionary relationships and links with the New World species, Pp. 55-56. — Proc. 3rd Int. Lupin Conference. La Rochelle, June 1984.
Smartt, J. 1990: Grain legumes: evolution and genetic resources, Pp. 271-277. — Cambridge University Press, Cambridge.

Galega officinalis L. — goats rue. Perennial herb, cultivated as fodder and for ornament. Wild types occur in E., C. & S. Europe (Al Au Bu Cz Ga Ge Gr Hs Hu It Ju Po Rm Rs(W,K,E) Tu).

Glycyrrhiza glabra L. — liquorice. Perennial herb, cultivated since ancient times for its woody rhizomes which are used as a source of liquorice. Formerly rather widely cultivated in Europe but today the main growers are Spain, Italy, and parts of the the Balkan peninsula. Mainly a southwest Asiatic plant; but wild forms are also found in S. & E. Europe (Al Bu Cr Ga Gr Hs It Ju Rm Rs(C,W,K,E) Sa Si Tu). Frequently naturalized. $2n = 16$.

Duke, J. A. 1981: Handbook of Legumes of World economic importance, Pp. 90-92. — Plenum Press, New York.
Hanelt, P. 1986: Leguminosae. — Pp. 430-699 in: Schultze-Motel, J. (ed.), Rudolf Mansfelds

Verzeichnis landwirtschaflicher und gärtnerischer Kulturplanzen (ohne Zierpflanzen). — Akademie-Verlag, Berlin.

Vicia villosa Roth. — vetch. Annual herb, occasionally cultivated for fodder. Wild forms occur in much of Europe (Al Au Bl Bu Co Cr Cy Cz Ga Ge Gr He Hs Hu It Ju Lu Po Rm Rs(N,B) Sa Si Tu).

Vicia sativa L. — Common vetch. An annual legume, extensively grown as a fodder crop and also frequently naturalized. The wild forms of this vetch are extraordinarily variable both morphologically and chromosomally. Their centre of diversity is in the Mediterranean basin. Some forms extend, mainly as weeds, far into temperate Europe (all except Fa Is Sb). subsp. ***nigra*** (L.) Ehrh., throughout the range; subsp. ***amphicarpa*** (Dor.) Asch. & Graebn., in S. Europe; subsp. ***cordata*** (Wulfen) Asch. & Graebn., in S. Europe; subsp. ***incisa*** (Bieb.) Arcangeli in Krym; subsp. ***sativa*** throughout the range; and subsp. ***macrocarpa*** (Moris) Arcangeli, in the Mediterranean region. All wild forms are predominantly self-pollinated. $2n = 10, 12, 14$.

Maxted, N. 1995: An ecogeographical study of *Vicia* subgenus *Vicia*. — International Plant Genetic Resources Institute, Rome.

Zohary, D. & Plitman, U. 1979: Chromosome polymorphism, hybridization and colonization in the *Vicia sativa* group *(Fabaceae)*. — Plant Syst. Evol. **131**: 143-156.

Lens culinaris Medicus — lentil. An annual grain legume, extensively cultivated in Europe since Neolithic times. Interfertile with, and apparently derived from ***L. orientalis*** (Boiss.) Schmalh., a small, self-pollinated diploid ($2n = 14$) wild lentil, native to S.W. Asia and extending to Cyprus and probably to some of the Aegean islands.

Smartt, J. 1990: Grain legumes: evolution and genetic resources, Pp. 190-198. — Cambridge University Press, Cambridge.

Zohary, D. 1995: Lentil. — Pp. 271-274 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.

Lathyrus odoratus L. — sweet pea. An annual legume widely grown as an ornamental. Wild forms are restricted to S. Italy and Sicily.

Lathyrus sativus L. — grass pea. An annual pulse, cultivated since Neolithic times in the Mediterranean basin and S.W. Asia but not known with certainty from the wild. Closely related to wild and weedy ***L. cicera*** L. from which it may have been derived. The latter is a diploid ($2n = 18$), predominately self-pollinating plant, widely distributed over the Mediterranean basin (Al Bl Bu Co Cr Cy Ga Gr He Hs It Ju Lu Rm Rs(K,E) Sa Si Tu) and S.W. Asia.

Kearney, J. & Smartt, J. 1995: — Pp. 266-270 in: *Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.*

Smartt, J. 1990: Grain Legumes: evolution and genetic resources, Pp. 190-198. — Cambridge University Press, Cambridge.

Pisum sativum L. (including ***P. arvense*** L.) — garden and field peas. An annual legume extensively cultivated for its seeds and pods in Europe and west Asia since Neolithic times. Closely related to (and interfertile with) several wild races native to the

Near East and the Mediterranean basin. One of these wild peas, subsp. ***elatius*** (Bieb.) Ascherson & Graebner (= *P. elatius* Bieb.) is native to the Mediterranean vegetation belt of Europe (Al Bu Co Cy Ga Gr Hs It Ju Lu Rm Rs(W,K) Sa Si Tu) and other parts of the Mediterranean basin. Another wild race, var. ***pumilio*** Meikle (= *P. humile* Boiss. & Noë) is a Near-East element extending to Cyprus. All wild forms of the pea are predominantly self-pollinated and diploid ($2n = 14$).

Smartt, J. 1990: Grain Legumes: evolution and genetic resources, Pp. 176-190. — Cambridge University Press, Cambridge.

Zohary, D. & Hopf, M. 1993: Domestication of plants in the Old World, ed. 2, Pp. 99-101. — Clarendon Press, Oxford.

Trigonella caerulea (L.) Ser. — Annual legume, widely cultivated in Europe for fodder. Origin unknown but apparently derived from ***T. procumbens*** (Besser) Reichenb. which is native to E.C. & S.E. Europe (Au Bu Cz Gr Hu Ju Rm Rs(?C,W,K,E) Tu).

Medicago sativa L. — alfalfa or lucerne. A perennial legume, intensively cultivated (subsp. ***sativa***, tetraploid $2n = 32$) for fodder and the food industry throughout Europe and also naturalized in some places. The crop is closely related to a variable aggregate of diploid ($2n = 16$) and tetraploid ($2n = 32$) wild types native to Europe and W. Asia which are all placed within the *Medicago sativa* L. polyploid complex. The wild forms present in Europe (all except Az Fa Is Sb) fall into the following subspecies: subsp. ***sativa*** and subsp. ***falcata*** (L.) Arcangeli (the more widespread wild types); as well as subsp. ***glomerata*** (Balbis) Tutin and subsp. ***coerulea*** (Less. ex Ledeb.) Schmalh. (which are more restricted in their distribution). Wild forms are largely cross-pollinated.

Hanelt, P. 1986: Leguminosae. — Pp. 430-699 in: Schultze-Motel, J. (ed.), Rudolf Mansfelds Verzeichnis landwirtschaftlicher und gärtnerischer Kulturpflanzen (ohne Zierpflanzen). — Akademie-Verlag, Berlin.

Hanson, A. A., Barnes D. K. & Hill, R. R. Jr. (ed.) 1987: Alfalfa and alfalfa improvement. — Amer. Soc. Agronomy, Madison, Wisconsin.

Small, E. & Jomphe, M. 1989: A synopsis of the genus *Medicago (Leguminosae)*. — Canadian Jour. Bot. **67**: 3260-3292.

Trifolium repens L. — white clover. Perennial tetraploid ($2n = 32$), self-incompatible clover. One of the most widely cultivated forage legumes in Europe. Wild forms, infertile with the cultivars, are widespread throughout Europe (all except Sb); and fall into a number of distinct varieties or subspecies centred in the Mediterranean region: Var. ***repens*** (growing over the Mediterranean basin, temperate Europe and S.W. Asia); var. ***giganteum*** Lagrèze-Fossat (a giant form scattered in the Mediterranean basin); var. ***orphanideum*** (Boiss.) Boiss.(= subsp. *orphanideum* (Boiss.) Coombe) (Greece and Crete); var. ***biasolettii*** (Steud. & Hochst.) Aschers. & Graeb. (= subsp. *prostratum* Biasol. (France and Corsica to Albania); var. ***nevadense*** (Boiss.) C. Vicioso (= subsp. *nevadense* (Boiss.) D.E. Coombe) (Spain, Portugal); var. ***ochranthum*** Maly ex Aschers. & Graebn. (= subsp. *ochranthum* (Maly) Nyar.) (Romania); and var. ***orbelicum*** (Velen) Fritsch (= subsp. *orbelicum* (Velen) Pawl.) (Carpatians and mountains of the Balkan peninsula). In addition, diploid ($2n = 16$) ***T. occidentale*** D.E. Combe (S.W. England and N.W. France) and ***T. nigrescens*** Viv., (S. Europe), are closely related to ***T. repens*** and might have been involved in the origin of some cultivars.

Baker, M. J. & Williams, W. M. (ed.) 1987: White Clover. — C.A.B. International,

Wallingford, Oxon.
Caradus, J. R. 1995: White clover. — Pp. 306-308 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.

Trifolium hybridum L. — alsike clover. A perennial, diploid ($2n = 16$), self-incompatible legume, widely grown for fodder. Widely naturalized. Origin still uncertain. Wild forms occur apparently in C. and S. Europe (*Au Bu Cr *Cz Ga Gr *He Hs *Hu It Ju *Rm Rs(N,B,C) Tu). In addition to these wild forms, ***T. ambiguum*** Bieb., native to S.E. Europe (?Rm Rs (W, K, E) may also have been involved in the ancestry of the cultivars.

Trifolium incarnatum L. — crimson clover. An annual, diploid ($2n = 16$) legume, extensively cultivated as a fodder crop. Native to S. & W. Europe, and widely naturalized over most of Europe (Al Au Be Br Bu Co Cr Cz De Fe Ga Ge Gr He Hs Ho Hu It Ju Lu No Po Rm Rs(W,K,E) Sa Si Su Tu).

Trifolium pratense L. — red clover. A very variable, self-incompatible, diploid ($2n = 14$) short lived perennial clover widely grown for fodder. Numerous infraspecific wild taxa of this clover have been described. They are widely distributed throughout Europe (all except Bl Cr Sb); as well as temperate Asia.

Trifolium subterraneum L. — subterranean clover. Annual legume extensively cultivated in Australia as a self-seeding pasture plant. More recently introduced into cultivation in Portugal and several other European countries. Wild forms of this variable species are native to the Mediterranean vegetation belt of Europe and extend, particularly in the west , into the temperate belt. (Al Az Be Bl Br Bu Co Cr Ga Gr Hb Hs Hu It Ju Lu Rm Rs(W,K) Sa Si Tu). A self-pollinating, diploid ($2n = 16$) species.

Additional references on clovers

Caradus, J. R. & Williams, W. M. 1995: Other temperate forage legumes. — Pp. 332-343 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants ed. 2. — Longman, Harlow.
Hanelt, P. 1986: Leguminosae. — Pp. 430-699 in: Schultze-Motel, J. (ed.), Rudolf Mansfelds Verzeichnis landwirtschaftlicher und gärtnerischer Kulturpflanzen (ohne Zierpflanzen). — Akademie-Verlag, Berlin.
Zohary, M. & Heller, D. 1984: The genus *Trifolium*. — Israel Academy of Sciences and Humanities, Jerusalem.

Lotus berthelotii Masf. — An ornamental trailing perennial, grown locally in many Mediterranean and subtropical countries. Wild only in Tenerife, Canary Islands, where it is on the point of extinction.

Ornithopus sativus Brot. — An annual legume, grown for fodder in most of Europe and sometimes naturalized outside its original native range of S.W. Europe (Az Ga Hs Lu).

Duke, J. A. 1981: Handbook of Legumes of World economic importance, Pp. 180-181. — Plenum Press, New York.
Hanelt, P. 1986: Leguminosae. — Pp. 430-699 in: Schultze-Motel, J. (ed.), Rudolf Mansfelds Verzeichnis landwirtschaftlicher und gärtnerischer Kulturpflanzen (ohne Zierpflanzen). — Akademie-Verlag, Berlin.

Hedysarum coronarium L. — sulla or sulla sweetvetch. A perennial legume sometimes grown for fodder. Wild forms occur in the C. & W. Mediterranean region (Hs It Sa Si). $2n = 16$.

Duke, J. A. 1981: Handbook of Legumes of World economic importance, Pp. 9-94. — Plenum Press, New York.
Hammer, K., Cifarelli, S. & Perrino, P. 1986: Collection of land-races of cultivated plants in South Italy 1985. — Kulturpflanze **34**: 261-273.
Hanelt, P. 1986: Leguminosae. — Pp. 430-699 in: Schultze-Motel, J. (ed.), Rudolf Mansfelds Verzeichnis landwirtschaflicher und gärtnerischer Kulturplanzen (ohne Zierpflanzen). — Akademie-Verlag, Berlin.

Onobrychis viciifolia Scop. — sainfoin. A perennial, tetraploid ($2n = 28$) legume, widely grown for fodder.Wild forms occur in C. Europe (Al Au Cz Hu Ju Rm) which are possibly derived from hybridization between ***O. montana*** DC. (S. Europe) and ***O. arenaria*** (Kit) DC. (sub-Mediterranean).

Duke, J. A. 1981: Handbook of Legumes of World economic importance, Pp. 177-180. — Plenum Press, New York.
Hanelt, P. 1986: Leguminosae. — Pp. 430-699 in: Schultze-Motel, J. (ed.), Rudolf Mansfelds Verzeichnis landwirtschaflicher und gärtnerischer Kulturplanzen (ohne Zierpflanzen). — Akademie-Verlag, Berlin.

LINACEAE

Linum usitatissimum L. — flax, linseed. An annual herb cultivated for its fibres and oil-bearing seeds since Neolithic times. Closely related to and interfertile with ***L. bienne*** Miller which is native in S. and W. Europe (Al Bu Br Bu Co Cr Cy Ga Gr Hb Hs It Ju Lu Rs(K) Sa Si Tu) and S.W. Asia. Wild forms are predominantly self-pollinating. $2n = 30$.

Körber-Grohne, U. 1987: Nutpflanzen in Deutschland, Pp. 366-376. — Konard Theiss Verlag, Stuttgart.
Zohary, D. & Hopf, M. 1993 — Domestication of plants in the Old World, ed. 2, Pp. 118-126. — Clarendon Press, Oxford.

VITACEAE

Vitis vinifera L. — grape vine. A woody climber grown extensively in Europe and the Mediterranean basin for table grapes and for wine production. The cultivars (subsp. **vinifera**) are derived from wild subsp. ***sylvestris*** (C. C. Gmelin) Hegi, a dioecious vine which grows wild in S. and S. E. Europe and extends also into C. Europe (Al Au Bu Co Cz Ga Ge Gr He Hu It Ju Rm Rs(W,K) Sa Si Tu). Wild *sylvestris* forms are native also in S.W. Asia.

Mullins, M. G., Bouquet, A. & Williams, L. E. 1992: Biology of the grape vine. — Cambridge University Press, Cambridge.
Zohary, D. & Hopf, M. 1993: Domestication of Plants in the Old World, ed. 2, Pp. 143-150. — Clarendon Press, Oxford.

BUXACEAE

Buxus sempervirens L. — box. Shrub or small tree, widely grown for ornament and for its wood used to make fine tools and instruments. Many ornamental cultivars have been produced. Wild forms are native to S.W. and W.C. Europe. (Al Au Be Br Co Ga Ge Gr Hs It Ju Lu Sa *Tu).

VIOLACEAE

Viola odorata L. — sweet violet, garden violet. Perennial herb, widely cultivated as an ornamental and in S. France also for its essential oil. Wild types occur throughout Europe (all except Bl Fa Fe Is Rs(N) Sb ?Tu. Some violet cultivars are probably derived from the closely related ***V. alba*** Besser which is native to C. and S. Europe (Al Au Bu Co Cr Cz Ga Gr He Hs Hu It Ju ?Lu Po Rm Rs(W,K) Su Tu). $2n = 20$.

Viola tricolor L. — pansy. Annual to perennial herb, widely cultivated as an ornamental. Wild forms are native to most of Europe (all except Az Bl Cr Cy Lu Sa Sb Si) and the Caucasus, $2n = 26$. *V. tricolor* is also one of the parents of the garden pansy ***V. × wittrockiana*** Gams. Other species which have contributed to its make up are: ***V. lutea*** Hudson ($2n = 48$), native to W. and C. Europe (Au Be Br Cz Ga Ge Hb He Ho Hs Po); and ***V. altaica*** Ker-Gawler ($2n = 48$), native to C. Asia.

PUNICACEAE

Punica granatum L. — pomegranate. A bush or small tree, cultivated for its fruits since the Bronze Age. Wild forms of this fruit tree are native to S.W. Asia and extend also to the Balkan peninsula (Al Bu Gr Ju).

Levin, G. M. 1994: Pomegranate *(Punica granatum)* plant genetic resources in Turkmenistan. — Plant Genetic Resources Newsletter **97**: 31-36.

CUCURBITACEAE

Citrullus lanatus (Thunb.) Mats. & Nakai — watermelon. A trailing annual herb, cultivated for its large fruits. Closely related to and fully interfertile with ***C. colocynthis*** (L.) Schrader, a wild perennial watermelon with very bitter fruits, which is found in several dry areas of S. Europe (Gr Hs It Si) and widely distributed in the deserts of N. Africa and S.W. Asia.

Zohary, D. & Hopf, M. 1993: Domestication of plants in the Old World, ed. 2, Pp. 181-182. — Clarendon Press, Oxford.

ARALIACEAE

Hedera helix L. — ivy. Woody climber or creeper, extensively cultivated for ornament. Numerous cultivars have been selected for ground cover, wall climbing, and pot plants, and for habit, leaf shape, and colour. Wild forms occur in W. and S. Europe, northwards to Norway (all except Fa Fe Is Sb Rs(N,E).

UMBELLIFERAE

Foeniculum vulgare Miller — fennel. Biennial or perennial herb, widely cultivated for its fruits and leaves used for flavouring. In some parts of Europe cultivars with swollen leaf-bases (var. ***azoricum*** (Miller) Thell.) are grown as a vegetable. Wild forms of fennel (subsp. ***piperitum*** (Ucria) Coutinho) are widely distributed especially in Mediterranean parts of Europe (Al Az Bl Br Bu Co Cr Cy Ga Gr Hb Hs It Ju Lu Sa Si Tu), as well as the Canary Islands, N.W. Africa and the Near East.

Tutin, T. G. 1980: Umbellifers of the British Islands, Pp. 100-111. — Botanical Society of the British Isles Handbook No. 2. London.

Apium graveolens L. — celery, celeriac. Biennial herb, widely cultivated since Roman times for its edible petioles (var. ***dulce*** (Miller) DC.), more rarely for its seeds (var. ***vulgare***) or for its turnip-like root (var. ***rapaceum*** (DC.) Gaudin). Wild forms are widespread in Europe, particularly in the coastal regions and the Mediterranean belt (Al Au Az Be Bl Br Bu Co Cr Cy Da Ga Ge Gr Hb Ho Hs It Ju Lu Po Rm Rs(W,K,E) Sa Si) as well as in temperate Asia and N. Africa. $2n = 22$.

Helm, J. 1972: *Apium graveolens* L. Geschichte der Kultur und Taxonomie. — Kulturpflanze **19**: 73-100.
Körber-Grohne, U. 1987: Nutpflanzen in Deutschland, Pp. 237-245. — Konard Theiss Verlag, Stuttgart.
Riggs, J. J. 1995: Umbelliferous minor crops. — Pp. 481-485 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.
Tutin, T. G. 1980: Umbellifers of the British Islands, Pp. 100-111. — Botanical Society of the British Isles Handbook No. 2. London.

Petroselinum crispum (Miller) A.W. Hill — parsley. Biennial or short lived perennial herb, cultivated for its leaves (var. ***neapolitanum*** Danert) and also for its swollen roots (var. ***tuberosum*** (Bernh.) Crov.). Wild forms grow in the rocky places on the coasts in S. Europe. Widely naturalized throughout Europe. Origin uncertain, but probably derived from wild types in S.E. Europe or W. Asia. $2n = 22$.

Maass, H. I. 1986: Umbelliferae. — Pp. 992-1032 in: Schultze-Motel, J. (ed.), Rudolf Mansfelds Verzeichnis landwirtschaflicher und gärtnerischer Kulturpflanzen (ohne Zierpflanzen). — Akademie-Verlag, Berlin.
Riggs, J. J. 1995: Umbelliferous minor crops. — Pp. 481-485 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.
Tutin, T. G. 1980: Umbellifers of the British Islands, Pp. 136-137. — Botanical Society of the British Isles Handbook No. 2. London.

Carum carvi L. — caraway. Perennial herb, widely cultivated since ancient times for its aromatic fruits used for flavouring. Wild forms occur in most of Europe, except the Mediterranean region ; widely naturalized. (Al Au Be Bu Cz Da Fe Ga Ho Hs Hu It Ju No Po Rm Rs(N,B,C,W,E) Su [*Br Fa Hb Is Sb]). $2n = 20$.

Tutin, T. G. 1980: Umbellifers of the British Islands, Pp. 148-149. — Botanical Society of the British Isles Handbook No. 2. London.

Pastinaca sativa L. — parsnip. Biennial herb, widely cultivated for its edible root

since classical times. Wild forms, in several subspecies, are variable, and widely distributed over much of Europe but in some parts, especially in the north, they are probably only escapes from cultivation (Al Au Be Br Bu Co Cz Ga Ge Gr He Ho Hs Hu It Ju Po Rm Rs(*B,C,W,K,E) Sa ?Si Tu [Da Fe Hb Lu No Rs(N) Su]. $2n = 22$.

Körber-Grohne, U. 1987: Nutpflanzen in Deutschland, Pp. 232-237. — Konard Theiss Verlag, Stuttgart.
Riggs, J. J. 1995: Umbelliferous minor crops. — Pp. 481-485 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.
Tutin, T. G. 1980: Umbellifers of the British Islands, Pp. 168-169. — Botanical Society of the British Isles Handbook No. 2. London.

Daucus carota L. — carrot. Annual or biennial herb, widely cultivated for its edible root (subsp. ***sativus*** (Hoffm.) Arcangeli). The primary wild gene-pool includes a highly variable and complex assemblage of wild subspecies and other taxa including : subsp. ***carota***, subsp. ***gummifer*** Hooker fil., subsp. ***commutatus*** (Paol.) Thell., subsp. ***hispanicus*** (Goaun) Thell., subsp. ***hispidus*** (Aracangeli) Heywood, subsp. ***gadecaei*** (Rouy & Camus) Heywood, subsp. ***drepanensis*** (Arcangeli) Heywood and subsp. ***rupestris*** (Guss.) Heywood. The wild assemblage occurs over most of Europe (except Fa Is Sb) and extends into N.W. Africa and W. Asia. Geitonogamous and cross-pollinated plants; $2n = 18$.

Heywood, V. H. 1983: Relationships and evolution in the *Daucus carota* complex. — Israel Jour. Bot. **32**: 52-65.
Riggs, T. J. 1995: Carrot. — Pp. 477-480 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.

ERICACEAE

Calluna vulgaris L. — heather. Small shrubs grown extensively for ornament. Wild forms occur as a dominant element of heaths, moors, bogs, open woods and fixed dunes throughout most of temperate Europe. Much rarer in the Mediterranean belt and in S.E. Europe (all except Al Bl Cr Gr Rs(K) Sa Sb Si). Numerous cultivars have been bred. $2n=16$.

PRIMULACEAE

Cyclamen L. — cyclamen. Valued garden plants, extensively grown and commercially produced in Europe. The cyclamen cultivars grown as pot plants are derived from ***C. persicum*** Miller which is native to the Aegean region and the Near East. Also widely grown are cultivars of ***C. hederifolium*** Aiton, wild types of which occur in S. Europe (Al Bu Co Ga Gr He It Ju Sa Si Tu). The following wild European species should be considered part of the primary gene-pool of the ornamental forms: ***C. graecum*** Link, native to Greece & Aegean region (Cr Cy Gr), ***C. purpurascens*** Miller, which grows from S.E. France to the Carpathians (Au Cz Ga Ge He Hu It Ju Po), ***C. creticum*** Hildebr. native to Crete (Cr), ***C. balearicum*** Willk. in S. France and the Balearic Isles (Bl Ga), ***C. coum*** Miller in S.E. Europe (Bu Rs Tu), and ***C. repandum*** Sibth. & Sm., which occurs in the C. & E. Mediterranean (Co Ga Gr It Ju Sa Si).

Grey-Wilson, C. 1988: The genus *Cyclamen*. — Royal Botanic Gardens, Kew / Christopher

Helm and Timber Press.

OLEACEAE

Syringa vulgaris L. — lilac. Deciduous shrub, widely cultivated for ornament in Europe. Many cultivars have been produced by slection or hybridization with other non-European species. Wild forms are native from N.C. Romania to C. Albania and N. E. Greece (Al Bu Gr Ju Rm.) and naturalized in W. and C. Europe.

Fiala, J. L. 1988: *Lilacs*: The genus *Syringa*. — Timber Press, Portland, Oregon.

Olea europaea L. — olive. An evergreen tree, and the principal fruit crop (subsp. ***europaea***) of the Mediterranean region since the Bronze Age, grown for its oil-bearing fruits and table olives. Wild forms (subsp. ***oleaster*** (Hoffm. & Link) Hegi (= *O. europaea* var. *sylvestris* (Miller) Lehr.) occur within the same climatic zone in which the cultivars are grown, and are a characteristic element of the native sclerophyllous Mediterranean scrub vegetation (Bl Cr Cy Gr Hs It Lu Sa Si). The wild forms are fully interfertile with the cultivars and often serve as stock for grafting domesticated clones. Wild subsp. ***cerasiformis*** (Webb & Berth.) Sunding, endemic to the Canary Islands, is another close wild relative of the cultivated olive but had nothing to do with its domestication.

Zohary, D. 1994: The wild genetic resources of the cultivated olive. — Pp. 62-65 in: Lavee, S. & Klein, I. (ed.), 2nd International Symposium on olive growing. — Acta Horticulturae **356**.

— 1995: Olive. — Pp. 379-382 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.

Fraxinus excelsior L. — European or common ash. A tall deciduous tree widespread over most of Europe except the northern, southern and eastern margins (Au Be Br Bu Cz Da Ga Ge Hb He Ho Hs Hu It Ju No Po Rm Rs(B,C,W,K) Su). Widely planted for timber production, and grown very locally in Sicily for extraction of sweet "manna". $2n$=46.

LABIATAE

Melissa officinalis L. — Lemon balm. A perennial herb, long cultivated for its aromatic foliage used as a pot-herb and for extraction of its essential oils. Wild forms are native to S. Europe (Al Bl Bu Co Cr Cy Ga Gr Hs It Ju Rm Sa Si) and it is also widely naturalized.

Satureja hortensis L. — Summer savory. An annual herb, widely cultivated as a pot-herb and for extraction of its essential oils. Wild types and related subspecies occur in Italy and the Balkan peninsula (Al Ga Gr Hs It Ju).

Origanum vulgare L. — marjoram, oregano. A perennial herb, widely grown as a pot herb and for its essential oils used by the food industry. Wild forms occur in most of Europe (all except Az Bl Cr Fa Is) and are extremely variable, with numerous variants described as distinct species or subspecies.

Thymus vulgaris L. — thyme. Dwarf shrub, widely grown as a pot-herb and for

extraction of its essential oils. Wild forms of this variable species occur in the W. Mediterranean region, extending to S.E. Italy (Co Ga Hs It). Closely related species include ***T. hyemalis*** Lange and ***T. glandulosus*** Lag. ex H. del Villar, both from S.E. Spain.

Several other native ***Thymus*** species, such as ***T. serpyllum*** L. and ***T. capitatus*** (L.) Hoffmanns. & Link are also cultivated in Europe as pot-herbs and for their essential oils.

Mentha L. — mint. A very variable group of perennial herbs extensively cultivated (by vegetative propagation) as root herbs for their essential oils which are widely used to flavour foods and drinks, and in medicine. The cultivated mints seem to have had a complex origin. Some cultivated mints were apparently directly derived from several wild species. Many other cultivars are hybrids (often polyploid) between various *Mentha* species. Many of the cultivated mints have also extensively naturalized, and/or hybridized with local wild taxa, complicating the delimitation of species and the taxonomy in this genus.

Mentha suaveolens Ehrh. — mint. Perennial herb, cultivated in most of Europe as a pot-herb and for extraction of essential oils. Widely naturalized. Wild forms are native to S. & W. Europe (Al Az Be Bl Br Co Cr Ga Ge Gr He Ho Hs It Lu Sa Si Tu). This mint is widely confused with ***M. x rotundifolia*** (L.) Hudson (*M. longifolia* x *M. suaveolens*).

Mentha spicata L. — spearmint. Perennial herb, widely cultivated as a pot-herb and for extraction of essential oils, and naturalized throughout a large part of Europe [Al Au Az Be Be Bl Br Bu Cr Cz Da Ga Ge Gr Hb He Ho Hs Hu It Ju Lu No Po Rm Rs(W,K) Su Tu]. It exact origin is unknown and it may have arisen in cultivation. Several hybrid taxa such as ***M. x gentilis*** L. (= *M. arvensis* L. x *M. spicata* L.) and the sterile **M. x *piperita*** L. (= *M. aquatica* L. x *M. spicata* L.), which originated in Great Britain in the 17th century, are also used and widely cultivated in Europe, especially the latter hybrid, which is the major source of peppermint oil.

Harley, R. M. & Brighton, C. A. 1977: Chromosome numbers in the genus *Mentha* L. — Bot. Jour. Linnean Soc. **74**: 71-96.

Ikoda, N. & Ono, S. 1991: Cytogenetics of the genus *Mentha*. — Pp. 565-580 in: Tsuchiya, T. & Gupta, P. K. (ed.), Chromosome engineering in plants: genetics, breeding, evolution. Part B. — Elsevier, Amsterdam.

Maass, H. I. 1986: *Labiatae*. — Pp. 1127-1179 in: Schultze-Motel, J. (ed.), Rudolf Mansfelds Verzeichnis landwirtschaftlicher und gärtnerischer Kulturpflanzen (ohne Zierpflanzen). — Akademie-Verlag, Berlin.

Rosmarinus officinalis L. — rosemary. A perennial shrub, extensively cultivated since Roman times for ornament, as a pot herb and for its aromatic oils. Wild forms are frequent in the Mediterranean belt of Europe (Bl Co Cr Cy Ga Gr Hs It Ju Lu Sa Si).

Lavandula angustifolia Miller — lavender. Small shrubs, extensively cultivated for ornament and for its essential oils used in perfumery and medicine. Wild forms are frequent in Mediterranean Europe (Co Ga Gr Hs It Ju Sa Si). Commercial production is largely based on selected clones of this species and on lavandins ***L. x intermedia*** which are

hybrids between *L. angustifolia* and *L. latifolia* Medicus.

Meunier, C. 1992: Lavandes et lavandins. — Edisud, Aix-en-Provence.
Tucker, A. O. & Hensen K. J. W. 1985: The cultivars of lavender and lavandin *(Labiatae)*. — Baileya **22**: 168-177.

Salvia officinalis L. — sage. Shrubs, widely grown in Europe, both as an ornamental and as a pot herb, and for its essential oils used in medicine. Wild forms occur in the Adriatic belt of the Balkan peninsula. They are doubtfully native and certainly naturalized in Spain and S. France (Al *Ga Gr *Hs Ju). $2n = 14$. The cultivated sage is also closely related to wild ***S. lavandulifolia*** Vahl, endemic to Spain, and to wild ***S. fruticosa*** Mill. (= *S. triloba* L. fil.) from C. & E. Mediterranean basin (Al Cr Gr It Si).

Rosúa,, J. L. & Blanca, J. 1986: Revision del género *Salvia* L. *(Lamiaceae)* en el Mediterráneo Occidental: la sección *Salvia*. — Acta Botánica Malacitana **11**: 227-271.
Tucker, A. O., Maciarello, M. J. & Howell, J. T. 1980: Botanical aspects of commercial sage. — Economic Botany **34**: 16-19.

S. sclarea — clary. A tall, biennial, native to S. Europe (Al Bl Bu Co Ga Gr Hs It Ju Lu Rm Rs(W,K), Sa Tu [Au Cz He]), and cultivated (mainly in E. Europe) for its essential oils. $2n = 22$.

SOLANACEAE

Atropa bella-donna L.. — deadly nightshade. Perennial herb, widely cultivated as a field crop for the pharmaceutical industry, for the extraction of alkaloids, mainly in E. Europe but also to some extent in the west.. Wild forms are native to the mountains of S., W. & C. Europe (Al Au Be Br Bu Co Cz Ga Ge Gr He Ho Hs Hu It Ju Lu Po Rm Rs(W,K) Sa Si Tu.)

SCROPHULARIACEAE

Antirrhinum majus L. — snapdragon. Perennial herb, extensively cultivated as a garden ornamental with numerous cultivars and widely naturalised. Wild forms are native in S.W. Europe where several wild subspecies and varieties occur (Bl Ga Hs Lu Si.).

Digitalis purpurea L. — foxglove. A biennial or perennial herb grown in Europe as an ornamental and long used as a medicinal plant. Wild forms of this species are very variable and are native to W., S.W. and W.C. Europe where a series of subspecies and other variants occur (Az Be Br Co Cz Ga Ge Hb Hs Lu No Sa Su). It is widely naturalized or casual further east in Europe. $2n = 56$.

D. lanata Ehrh. — foxglove. A perennial or biennial herb, grown as an ornamental and widely used as a medicinal plant. A major source of commercial cardiac glycosides such as digitoxin, and widely cultivated outside Europe. Native to the Balkan peninsula (Al Bu Gr Hu Ju Rm Tu).

VALERIANACEAE

Valerianella locusta (L.) Laterrade — lamb's lettuce, corn salad. An annual herb, grown as a salad crop, especially in W. and C. Europe. Wild forms are native to most of

Europe but rarer in the north (all except Az Bl ?Cr Fa Is Rs(N) Sb). $2n = 16$.

DIPSACACEAE

Dipsacus sativus (L.) Honck. — teasel. Tall perennial herb cultivated for the treatment of cloth particularly in hat-making; and as an ornamental. Its origin is uncertain but it is probably derived from ***D. ferox*** Loisel., native to Corsica, Sardinia and C. Italy (It Co Sa).

COMPOSITAE

Chamaemelum nobile (L.) All. — chamomile. Perennial herb cultivated for lawns, ornament, as a herbal tea and for medicinal infusions. Wild forms grow in Europe (Az Br Ga Hb Hs Lu). $2n = 18$. ***C. mixtum*** (L.) All. ($2n = 18$) and ***C. fuscatum*** (Brot.) Vasc. ($2n = 18$) from the Mediterranean basin are also closely related to the cultivars.

Chamomilla recutita (L.) Rauschert — wild chamomile. Annual herb, cultivated in parts of Europe as a medicinal plant and herbal infusion. Wild forms are probably native in E. and S. Europe, although it is natutalized over most of the continent (all except Az Fa Hb Is Rs(N,Sb)). $2n = 18$.

Tanacetum vulgare L. — tansy. Perennial herb, extensively cultivated for ornament and as a pot-herb. Wild forms occur throughout Europe (all except Az Bl Cr Cy Sb).

Tanacetum parthenium (L.) Sch. Bip. — feverfew. Perennial herb, long cultivated as an ornamental and as a medicinal plant; and widely naturalized. Wild forms grow in the Balkan peninsula in mountains and rocky places (Al Bu Gr Ju). $2n = 18$.

Tanacetum cinerariifolium (Trev.) Sch. Bip. — pyrethrum. Perennial herb, cultivated in S. Europe as an insecticide. Wild forms occur in W. Jugoslavia and Albania (Al Ju).

Artemisia absinthium L. — wormwood, absinthe. A perennial herb, widely cultivated for flavouring alcoholic beverages and for its volatile oils; formerly used as a vermifuge. Wild forms are native in most of Europe (all except Az Bl Cr Cy Fa Is Sa Sb Si Tu) and N.W. Asia. $2n = 18$.

Artemisia abrotanum L. — southernwood. Perennial herb, widely cultivated as an ornamental and for flavouring. Occurs in E. S. and S.C. Europe, but probably native only in the south [Au Cz Ga Ge He Hs Hu It Ju Rm Rs(N,C,W,E)]. $2n = 18$.

Artemisia dracunculus L. — tarragon. Perennial herb, widely cultivated since classical times for flavouring. Wilds forms are native to Russia (Rs) and widely distributed in N. and C. Asia. A polylpoid aggregate with diploid ($2n = 18$), tetraploid ($2n = 36$) and higher polyploid forms.
Sutton, S., Humphries, C. & Hopkins, J. 1985: Tarragon. — The Garden **110**: 237-250.

Pericallis hybrida Nordenstam — florist's cineraria. Ornamental herbs important in the horticultural industry which arose as hybrids of ***P. cruenta*** (L'Hérit.) Bolle and ***P.***

lanata (L'Hérit.) Nordenstam, both endemic to the Canary Islands. Several other related endemic species in the Canary Islands form an additional part of the wild gene-pool of the the ornamental cultivars.

Calendula officinalis L. — marigold. Annual or perennial herb, widely cultivated as an ornamental and a pot herb. Locally naturalized in S. and W. Europe. Its origin is still unclear but may be S.W. Europe. $2n = 32$.

Cynara cardunculus L. (incl. ***C. scolymus*** L.) — globe artichoke, cardoon. Perennial herb, widely cultivated in Europe for its fleshy heads (globe artichoke, subsp. ***scolymus*** (L.) Hayek) and also for its young leaves and roots (cardoon, subsp. ***cardunculus***). Wild forms of this vegetable (var. ***sylvestris*** (Lamk.) Fiori) are native to the Mediterranean region of Europe (Bl Co Ga Gr Hs It Lu Sa Si) as well as the coastal areas of N.W. Africa and the Canary Islands. All are cross-pollinated plants fully interfertile with the cultivars. $2n = 34$.

The following other wild *Cynara* species, native to S. Europe, are more distantly related to the crop and belong to its secndary gene pool: ***C. cornigera*** Lindley (= *C. sibthorpiana* Boiss. & Heldr.), native to Crete and the Aegean Islands, ***C. baetica*** (Sprengel) Pau (= *C.alba* Boiss. ex DC.), native to S. Spain, ***C. algarbiensis*** Cosson, native to S. Portugal and adjacent S.W. Spain and ***C. humilis*** L. from the Iberian peninsula. All have $2n = 34$ chromosomes.

Rottenberg, A. & Zohary, D. 1995: The wild ancestry of the cultivated artichoke. — Genetic Resources and Crop Evolution (in press).

Cichorium intybus L. — chicory, endive (gallice). A diploid ($2n = 18$) perennial herb. Some cultivars (var. ***sativum*** Lam. & DC) are grown for their large roots which when dried and roasted serve as a coffee substitute. Other cultivars (var. ***foliosum*** Hegi) are grown for their leaves and serve as salad plants or cooked vegetables ('witloof'). Wild forms are native throughout Europe, except for the far north (all except Fa Is Sb and probably also Fe, Hb, No Rs). They are also widepsread in S.W. Asia and N. Africa.

Cichorium endivia L. — endive (anglice), escarole. Annual or biennial ($2n = 18$) herb, widely cultivated as a salad plant (subsp. ***endivia***). Wild forms (subsp. ***divaricatum*** (Schousboe) P.D. Sell = *C. pumilum* Jacq.) are native to S. Europe (Al Bu Co Cr Cy Ga Gr Hs It Ju Lu Si Tu), as well as S.W. Asia and N.W. Africa.

Körber-Grohne, U. 1987: Nutpflanzen in Deutschland, Pp. 282-291. — Konard Theiss Verlag, Stuttgart.

Scorzonera hispanica L. — black salsify. Perennial herb, cultivated in parts of W. Europe for its taproots which are used as a vegetable. Wild forms are native to C. and S. Europe; occasionally naturalized further north (Al Au *Bl Bu Cz Ga Ge Gr Hs Hu It Ju Lu Rm Rs(C,W,K,E) [He ?Po]). $2n = 14$.

Körber-Grohne, U. 1987: Nutpflanzen in Deutschland, Pp. 245-249. — Konard Theiss Verlag, Stuttgart.

Nuez, F. & Hernández Bermejo, E. 1992: Hortícolas marginadas. — Pp. 303-332 in: Hernández Bermejo, E. & León, J. (ed.), Cultivos marginados. Otra perspectiva de 1992. — FAO,

Rome.

Tragopogon porrifolius L. — salsify. Biennial herb, cultivated in parts of W. Europe for its taproots which are used as a vegetable. Wild forms are native to the Mediterranean region, extending to E. Romania; naturalized in N.W. and C. Europe (Bl Bu Co Cr Ga Gr Hs It Ju Rm Sa Si Tu [Au Be Br Cz Da Ge Hb He Ho Su]). $2n = 12$.

Lactuca sativa L. — lettuce. An annual diploid ($2n = 18$), predominately self-pollinated herb, widely cultivated in Europe as a leading salad plant. The cultivars are closely related to and fully interfertile with wild ***L. serriola*** L., a weedy annual widespread over most of Europe (all except Fa Is Sb), as well as S.W. Asia and N.W. Africa. It was recently introduced also to several other parts of the world. The cultivars are also partially interfertile with ***L. saligna*** L., also a weedy, diploid ($2n = 18$) self-pollinated wild annual, native to S.W. & S.E. Europe (Al Be Bl Br Bu Co Cr Cz Ga Ge Gr Ho Hs Hu It Ju Lu Rm Rs(C,W,K,E) Sa Si Tu), S.W. Asia and N. Africa. The crop is probably interfertile also with ***L. altaica*** Fisch. & C.A. Mey., a central Asiatic wild lettuce that extends to E. Europe (the Lower Volga Plain).

Zohary, D. 1991: The wild genetic resources of cultivated lettuce (*Lactuca sativa* L.). — Euphytica **53**: 31-35.

LILIACEAE

Scilla siberica Haw. — Bulbous herb, widely cultivated for ornament. Wild forms occur in woods and scrub in Russia, Rs(C,W,K,E).

Hyacinthoides non-scripta (L.) Chouard — bluebell. Bulbous herb, widely cultivated as an ornamental and naturalized. Wild forms occur in W. Europe (Be Br Ga Hb Ho Hs Lu). It is closely related to and hybridises with ***H. hispanica*** (Miller) Rothmaler which is also cultivated, and native to S.W. Europe (Hs Lu) and N.W. Africa.

Allium schoenoprasum L. — chives. A bulbous herb, cultivated for its edible leaves. Wild forms are widespread in Europe but only on mountains in the South (Au Br Bu Co Cz Da Fe Ga Ge Gr Hb He Ho Hs It Ju Lu No Po Rm Rs Su); often naturalized. $2n = 16$.

Allium porrum L. — leek. A bulbous plant grown for its narrow bulbs and leaf-bases (leek cultivars, tetraploid $2n = 32$), for its leaves (kurrat cultivars, $2n = 32$) or for its large garlic-like cloves (great headed garlic, tetraploid $2n = 32$ or hexaploid $2n = 48$). These cultivated varieties are closely related and fully interfertile with tetraploid and hexaploid wild forms of ***A. ampeloprasum*** L., a variable polyploid complex ($2n = 16, 24, 32, 40, 48$), native to S. Europe (Al Bl Bu Cr Cy Ga Gr Hs It Ju Lu Rm Sa Si Tu) and other parts of the Mediterranean basin.

Brewster, J. K. 1994: Onion and other vegetable Alliums. — CAB International, Wallingford, Oxon.

Jones, H. A. & Mann, L. K. 1963: Onions and their allies, Pp. 199-214. — Leonard Hill, London.

Jones, R. N. 1990: Cytogenetics. — Pp. 199-214 in: Rabinowitch, H. D. & Brewster, J. L. (ed.), Onion and allied crops **1**. — CRC Press, Inc., Boca Raton, Florida.

Convallaria majalis L. — lily of the valley. Cultivated as a medicinal plant, for perfume and for ornament. Native in most of Europe where the wild forms are common (Al Au Be Br Bu Co Cz Da Fe Ga Ge Gr He Ho Hs Hu It Ju No Po Rm Rs(N,B,C,W,K,E) Su).

Asparagus officinalis L. — asparagus. Rhizomatous perennial, extensively cultivated for its young shoots as a vegetable. Naturalized in some areas. Wild forms ($2n$ = 20, 40) are common in most of Europe, except for the far north (Al Au Be Br Bu Co Cz Da Ga Ge Gr Hb He Ho Hs Hu It Ju Lu Po Rm Rs(C,W,K,E) Si Su Tu) and are sometimes also collected. The cultivars are diploid ($2n$ = 20); and apparently derived from wild diploid forms.

Körber-Grohne, U. 1987: Nutpflanzen in Deutschland, Pp. 249-255. — Konard Theiss Verlag, Stuttgart.

AMARYLLIDACEAE

Leucojum vernum L. — spring snowflake. A bulbous herb, frequently cultivated for ornament. Wild forms occur in Central Europe (Au Be Cz Ga Ge He Hs Hu It Ju Po Rm Rs(W)).

Leucojum aestivum L. — summer snowflake. A bulbous herb, widely cultivated for ornament. Wild forms are native to W. C. & S. Europe (Al Au Be Bl Br Bu Co Cz Ga Ge Gr Hb He Ho Hu It Ju Rm Rs(W,K) Sa Tu). Subsp. ***aestivum*** is widespread while subsp. ***pulchellum*** (Salisb.) Briquet is restricted to the W. Mediterranean and not commonly cultivated.

Galanthus nivalis L. — snowdrop. Bulbous herb, extensively cultivated and widely naturalized. Wild forms are widespread in Europe (Al Au Bu Cz Ga Ge Gr He Hs Hu It Ju Po Rm Rs(C,W,?K,E) Si Tu). The wild forms are variable and several variants have been described as independant taxa.

Narcissus tazetta L. — bunch flowered narcissi. A bulbous herb, long cultivated as an ornamental and recently also as a cut-flower crop. It is native to the Mediterranean region (Al Bl Co Cr Cy Ga Gr Hs It Ju Lu Sa Si.) and possibly also to the Canary Islands. Very polymorphic species but since the plant has been in cultivation for centuries some of the variation may have originated in cultivation. $2n$ = 22.

Narcissus jonquilla L. — jonquil. A bulbous herb, widely cultivated for its perfume. Wild forms are found in C. & S. Spain and Portugal (Hs Lu) and naturalized elsewhere in S. Europe. $2n$ = 14.

Narcissus pseudonarcissus L. — daffodil. A bulbous herb, cultivated as an ornamental, often on an industrial scale as a cut flower crop. Wild forms are native to W. Europe (Br Ga Ge He Ho Hs L).

Other *Narcissus* species native to Europe are cultivated in their wild form or have been used directly or through hybridization in the breeding of numerous cultivars.

References on *Narcissus* species

Blanchard, J. W. 1990: *Narcissus*. A guide to the wild daffodils. — Alpine Garden Society, Woking.

Cullen, J. 1986: *Narcissus*. — Pp. 301-309 in: Walters, S. M. et al. (ed.), The European Garden Flora, **1**. — Cambridge University Press, Cambridge.

IRIDACEAE

Iris germanica L. — bearded iris. A rhizomatous perennial, widely cultivated for ornament. Its origin is as yet unclear, but very likely it is derived from wild forms native to the E. Mediterranean. Several European species are apparently also involved in the origin of some of the cultivars: ***I. aphylla*** L. (Al Cz Ga Hu It Ju Po Rm Rs(C,W,E)), ***I. variegata*** L. (Au Bu Cz Ge Hu Ju Rm Rs(W)), ***I. pumila*** L. (Al Au Bu Cz Gr Hu Ju Rm Rs(C,W,K,E)), ***I. lutescens*** Lam. (Cr Ga Hs It Lu), and ***I. attica*** Boiss. & Heldr. from Greece.

Mathew, B. 1989: The *Iris*. — Batsford, London.

Crocus sativus L. — saffron crocus. A corm-bearing herb, cultivated since ancient times for its stigmas which are used as a spice, dye, perfume and medicament. Today it is cultivated in Spain and Turkey and still highly prized as a culinary spice and colorant. The cultivars are sterile triploids ($2n = 24$) propagated vegetatively and saffron is the richest known source of vitamin B2 or riboflavine. It is probably derived from ***C. cartwrightianus*** Herbert, a wild diploid ($2n = 16$) crocus growing in S. Greece.

Crocus flavus Weston — yellow crocus. Corm-bearing herb; an E. European plant and one of the parents of the ornamental crocus such as the Dutch or Golden Yellow cultivars. The other parent is ***C. angustifolius*** from S.W. Russia. ***C. vernus*** (L.) Hill from W. C. and S. Europe is ancestral to the Large Dutch Spring cultivars. ***C. chrysanthus*** (Herbert) Herbert from S.E. Europe and ***C. biflorus*** Miller from S. Europe produced hybrids from which the *C. chrysanthus* cultivars are derived. ***C. etruscus*** Parl. from N.W. Italy and ***C. tommasinianus*** Herbert from S. Yugoslavia and S. Hungary are regarded as ancestral to some of the large spring-flowering cultivars of ***C. vernus***.

References on *Crocus* species

Chichiricco, G. 1984: Karyotype and meiotic behaviour in triploid *Crocus sativus*. — Caryologia **37**: 233-239.

Mathew, B. 1977: *Crocus sativus* L. and its allies *(Iridaceae)*. — Plant Systematics and Evolution **128**: 89-103.

— 1982: The *Crocus*: A revision of the genus *Crocus (Iridaceae)*. — Timber Press, Portland, Oregon.

Gladiolus communis L. — gladiolus. A corm-bearing herb, frequently cultivated as an ornamental. Wild forms closely related to the cultivars occur in S. Europe where two subspecies have been recognised: subsp. ***communis*** (Al Bu Co Ga Gr Hs It Ju ?Rs(K) Sa S), and subsp. ***byzantinus*** (Miller) Hamilton from S. Spain and Sicily (Hs Si). However these wild forms differ from the cultivated varieties in chromosome number.

GRAMINEAE

Festuca pratensis Hudson — fescue. A variable perennial grass, extensively cultivated in Europe as a pasture grass. Wild forms are widely distributed over most of Europe but rarely in the Mediterranean region and the southwest, and probably naturalised in the north. (all except Bl Cr Lu Sb Tu). A distinct race subsp. ***apenina*** (De Not.) Hegi thrives on limestone bedrock in the Alps, Apennines, Sicily, N.W. Jugoslavia and E. & S. Carpathians. $2n = 14$.

Festuca rubra L. — red fescue. A perennial grass, widely cultivated in Europe (and worldwide) as a pasture grass. Wild forms occur almost throughout Europe and are highly variable, including several chromosome levels (all except Bl Cr Sa Tu) but only as an alien in the Azores and E. Russia.

Lolium multiflorum Lam. — Italian ryegrass. An annual to short-lived perennial grass, widely cultivated for forage. Wild forms occur in S. Europe (Al Az Bl Bu Co Cr Ga Gr Hs It Ju Lu Rm Sa Si Tu) and are widely naturalized in temperate Europe. $2n = 14$, it hybridizes quite freely with *L. perenne*, and also with *L. temulentum*.

Lolium perenne L. — perennial ryegrass. A perennial grass, extensively cultivated and an important pasture plant. It is wild in almost all of Europe (all except Sb) although probably often introduced in the north.

Loos, B. P. 1994: The genus *Lolium;* taxonomy and genetic resources. — Thesis, Wageningen Agricultural University. CPRO-DCO.

Dactylis glomerata L. — cock's-foot, orchard grass. A perennial, tetraploid ($2n = 28$) grass, one of the main cultivated forage plants of temperate Europe. It is closely related to (and fully interfertile with) the variable, tetraploid wild forms which are distributed over most of Europe (all except Sb) although probably introduced in parts of the north. Several diploid ($2n = 14$) subspecies that frequently grow side by side with morphologically similar tetraploid forms also occur in Europe: subsp. ***aschersoniana*** (Graebner) Thell. (=*D. aschersoniana* Graebner) in W. and C. Europe; subsp. ***lusitanica*** Stebbins & D. Zohary in Portugal; an un-named diploid from Galicia, Spain; subsp. ***juncinella*** (Bory) Stebbins and D. Zohary (= *D. juncinella* Bory) in Sierra Nevada, Spain; subsp. ***ibizensis*** Stebbins and D. Zohary in Ibiza; subsp. ***reichenbachii*** Hausm. ex Dalla Torre & Sarnth. in N. Italy; and subsp. ***smithii*** (Link) Stebbins and Zohary (= *D. smithii* Link) in the Canary Islands.

Lumaret, R. 1998: Cytology, genetics, and evolution in the genus *Dactylis*. — Critical Reviews in Plant Sciences 7: 55-91.

Mizianty, M. 1986: Biosystematic studies on *Dactylis* L. 1. Review of previous studies. 1.1.Systematics, variability, ecology, biology and cultivation problems. — Acta Societatis Botanicorum Poloniae **55**: 467-479.

— 1990: Biosystematic studies on *Dactylis* L. 1. Review of previous studies. 1.2. Cytology, genetics, experimental studies and evolution. — Acta Societatis Botanicorum Poloniae **59**: 104-118.

Bromus inermis Leysser — A rhizomatous grass, cultivated in E. & E.C. Europe for fodder. Wild forms occur in S.C. and W. Europe (Au ?Be Bu Cz Ga Ge Ho *Hs Hu It Ju

Po Rm Rs(N,B,C,W) Tu) and it is naturalized in the north.

Triticum L. (including ***Aegilops*** L.) — wheats. Annual self-pollinating cereals. The most important grain crop of Europe since Neolithic times. The main commercial wheats grown in Europe today are the *durum* cultivars of tetraploid ***T. turgidum*** L., ($2n = 28$, genomic constitution AABB) and hexaploid bread wheat ***T. aestivum*** L. ($2n = 42$, genomic constitution AABBDD). The direct wild ancestors of these cultivated wheats, namely wild emmer wheat *T. dicoccoides* (Körn.) Aaron. (genomic cocnstitution AABB), and *Aegilops squarrosa* L. (genomic constitution DD) are native to W. Asia and do not occur in Europe. However, two additional wild diploid species, each carrying chromosomes almost homologous to the A and to the B genomes found in the cultivars extend from the Near East to Europe: diploid ($2n = 14$) ***T. boeoticum*** Boiss. (containing genome A) grows wild in the S. Balkan peninsula (Al Bu Gr Ju Rs(K) Tu), and diploid ($2n = 14$) ***A. speltoides*** Tausch (with chromosome similar to the B genome), occurs in the S.E. part of the Balkan peninsula (Bu Gr Tu). All other nine species of *Aegilops* L. native to S. Europe are much more distant yet their gene pools can also be used in wheat breeding.

Feldman, M., Lupton, F. G. H. & Miller, T. E. 1995: Wheats. — Pp. 184-192 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. Longman, Harlow.

Miller, T. E. 1987: Systematics and evolution. — Pp. 1-30 in: Lupton, F. G. H. (ed.), Wheat Breeding. — Chapman and Hall, London.

Slageren, M. W. van 1994: Wild wheats: a monograph of *Aegilops* L. and *Amblyopyrum* (Jaub. et Spach) Eig *(Poaceae)*. — Wageningen Agricultural University Papers 94-6.

Secale cereale L. — rye. An annual, diploid ($2n = 14$), cross-pollinating cereal, commonly cultivated as a grain crop in N. Europe and sporadically throughout the rest of the continent. Wild and weedy forms (chromosomally homologous and fully interfertile with the crop), are widely distributed over the Near East and the Caucasus region, and some extend to the Balkan countries.

The crop is also related to ***S. montanum*** Guss., a perennial diploid ($2n = 14$), montane grass, native to the Mediterranean basin (Al Bu Gr Hs It Ju Rm Si) and to S.W. Asia. This species is only partly interfertile with the crop since it differs from it by two chromosomal translocations.

Sencer, H. A. & Hawkes, J. G. 1980: On the origin of cultivated rye. — Biol. Jour. Linn. Soc. **13**: 299-313.

Zohary, D. & Hopf, M. 1993: Domestication of Plants in the Old World, ed. 2, Pp. 64-73. — Clarendon Press, Oxford.

Hordeum vulgare L. — barley. An annual cereal, and a principle grain crop in Europe since Neolithic times. Two main types — two-rowed barley and six-row barley — which are separated by a single gene, are extensively cultivated in Europe. The cultivars are closely related to and fully interfertile with the wild progenitor of the crop, ***H. spontaneum*** C. Koch, an annual, predominantly self-pollinated diploid ($2n = 14$) wild barley, native to S.W. Asia and extending to Crete and Cyprus.

Other wild species of *Hordeum* native to Europe are much more distantly related to the crop. Almost all these wild relatives cannot be crossed with cultivated barley. The only

exception is ***H. bulbosum*** L. Interspecific hybrids between this species and the crop have been obtained yet they tend to be fully sterile.

Bothmer, R. von, Jacobsen, N., Jorgensen, R. B. & Linde-Laursen, I. 1991: An ecogeographical study of the genus *Hordeum*. — Systematic and Ecogeographic Studies on Crop Genepools 7. — IBPGR, Rome.
Zohary, D. & Hopf, M. 1993: Domestication of plants in the Old World, ed. 2, Pp. 54-64. — Clarendon Press, Oxford.

Avena sativa L. (incl. ***A. byzantina*** C. Koch). — common oats. Annual, hexaploid ($2n = 42$ genomic constitution AACCDD) cereal, and a major grain crop throughout Europe. Closely related to and fully interfertile with ***A. sterilis*** L. and ***A. fatua*** L., annual, weedy hexaploid ($2n = 42$) wild oats, widely distributed over the Mediterranean basin, and extending to C. and N. Europe, mainly as weeds in cultivated fields (all except Fa Gr Is Sb). Both these wild oats constitute the primary wild gene pool of the cultivated *A. sativa*.

In addition, ***A. murphyi*** Ladiz., a tetraploid oat ($2n = 28$; genomic constitution AACC) endemic to south Spain is also genomically related to the *sativa-sterilis-fatua* complex, i.e. belongs to the secondary gene pool of the crop. Other wild species of *Avena* native to Europe have widely diverged from the crop complex. It is very difficult or impossible to cross them with it.

Leggett, J. M. & Thomas, H. 1995: Oat evolution and cytogenetics. — Pp. 120-149 in: Welch, R. W. (ed.), The oat crop. — Chapman & Hall, London.
Rajhathy, T. & Thomas, A. 1974: Cytogenetics of oats (*Avena* L.). — Misc. Publ. Genet. Soc. Canada **2**.
Zohary, D. & Hopf, M. 1993: Domestication of plants in the Old World, ed. 2, Pp. 73-78. — Clarendon Press, Oxford.

Phleum pratense L. — timothy. A perennial grass, widely cultivated as a fodder grass in Europe. The distribution of the wild forms, is obscured by extensive naturalization (all countries except Bl Cr Sb).

Phalaris canariensis L. — canary grass. Annual grass, cultivated in S. Europe for its seeds and locally naturalized. It is native to the Canary Islands and N.W. Africa. $2n = 28$.

Cynodon dactylon (L.) Pers. — bermuda grass. A perennial grass, commonly cultivated as a lawn-grass in warmer regions. Wild forms occur from S. England to N. Ukraine, (Al Au Az Bl Br Bu Co Cr Cy Ga Gr He Ho Hs Hu It Ju Lu Rm Rs(C,W,K,E) Sa Si Tu Canaries).

Setaria italica (L.) Beauv. — foxtail, Italian millet. Annual grass, occasionally cultivated for fodder and bird-seed in S. Europe. Closely related to and interfertile with wild ***S. viridis*** (L.) Beauv., an annual self-pollinating grass which occurs in many European countries (all except Az Br Fa Hb Is Rs(B) Sb) and mainly as a weed.

DeWet, J. M. J. 1995: Foxtail millet. — Pp. 170-172 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, ed. 2. — Longman, Harlow.

PALMAE

Phoenix dactylifera L. — date palm. Date cultivation centers on the Middle East and N. Africa; and extends also to S. Spain. Wild forms of this species of fruit crop are not native to Europe. They occur only in the warmer parts of the Near East, Arabia and N. Africa. However the closely related ***P. theophrasti*** Greuter which is endemic to the coasts of Crete and adjacent Anatolia, is also interfertile with the cultivated date palm. Another wild relative which can be crossed with the date palm is ***P. canariensis*** Hort., endemic to the Canary islands and today widely planted in S. Europe as an ornamental.

CYPERACEAE

Cyperus esculentus L. — tiger or chufa nut. Cultivated in S. Europe for its edible tubers and for preparing a beverage. Wild and weedy forms occur in the Mediterranean region and S.W. Europe (Al Az Bu Co Ga It Lu Si).

Addresses of the authors:
Prof. Vernon H. Heywood, School of Plant Sciences, The University of Reading, Whiteknights, P O Box 221, Reading RG6 6AS, U.K.
Prof. Daniel Zohary, Department of Evolution, Systematics and Ecology, The Hebrew University, Jerusalem 91904, Israel.