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Wild relatives of food crops native to Armenia and Nakhichevan

Abstract

Gabrielian, E. & Zohary, D.: Wild relatives of food crops native to Armenia and Nakhichevan. — *Fl. Medit.* 14: 5-80. 2004. — ISSN 1120-4052.

The paper surveys the variability, ecology, and distribution of the wild relatives of food crops (cereals, legumes, oil and fiber plants, vegetables, condiments, fruits and nut trees) native to Armenia and Nakhichevan. It focuses on the close wild relatives, i.e., members of the primary wild gene pools (GP-1) of the crops. The wild relatives of about 80 crops were surveyed; and the available information on the distribution (in Armenia and Nakhichevan) of most of these relatives is also illustrated by 93 site distribution maps.

Introduction

The aim of this paper is to survey the wild relatives of cultivated food plants that occur in Armenia and Nakhichevan (South Trans-Caucasus). We focus on the *close wild relatives*, which are fully (or almost fully) cross compatible and inter-fertile with their related cultigens, and therefore most attractive to the breeders. In other words, this paper is concerned mainly with Armenia's primary wild gene pools (GP-1) of crops. Some of the more distant wild relatives, which according to Harlan and De Wet (1971) definition belong to the secondary and tertiary wild gene pools (GP-2 and GP-3) of their related crops are sometimes mentioned as well; but usually only in brief.

Armenia is a relatively small country. However, it is geo-morphologically and ecologically very varied. More over, it is situated on the cross roads between several phytogeographic regions. Consequently, in spite of its small size, it is exceptionally rich floristically. In addition, Armenia has a long history of agriculture, and it is situated in the midst of an area (The Caucasus and the Trans-Caucasus) that contributed significantly to domestication of plants, particularly fruit crops, vegetables and spices. It is therefore no wonder that it is also outstandingly rich in wild relatives of cultivated plants.

No attempt have been recently made to bring together what is already known floristically on the wild relatives of cultivated plants in Armenia; and combine this information with what has been already learned on the genetic affinities between the crops and their wild counterparts. This paper intends to close this gap. For each of the Old World's food crops that have close wild relatives in this country, we try to answer the following ques-

tions: Who are these wild relatives? Where do they occur? How common and how variable are they in Armenia? What is already known about their relationships with their domesticated counterparts.

Background information

General

The Republic of Armenia (total area 29,965 km²) is part of the Trans-Caucasus (= Minor Caucasus). It lies in the largely volcanic Armenian highlands between 38 (degrees) : 51 (minutes) and 41:20 latitude; and between 43:30 and 46:30 longitude. Armenia is a mountainous country, with elevations ranging from 450 m above sea level (in the Arax river valley) to 4096 m above sea level (in the highest peak of Mt. Aragatz). About 85% of the Armenia's area is above 1000 m altitude; and some 51% of its area is above 2000 m. As a result of intensive folding and powerful volcanism, high mountain ridges with numerous spurs occur all over the country. In addition, Armenia is rich in extinct volcanoes (with surviving craters) like the huge Aragatz massif (the highest mountain in the Minor Caucasus, with 4 peaks rising more than 4000 m above sea level), Zangezur range (with Mt. Kaputdjuh about 4000 m above sea level), or Mt. Arailer, Mt. Guthanasar, and many others. Several plateaus, such as Lori, Shirak, Aparan, and Ararat, occur between the mountain ridges. This is also the case of the large, elevated depression of Lake Sevan (the altitude of the lake itself is about 2000 m above sea level). Other, smaller lakes dot the country. Complex relief, sharp contrasts in altitude, remoteness from vast sea expanses, etc, contribute to a variable, and frequently harsh continental climate. Many high mountain ridges isolate parts of the adjacent land either by blocking or by enhancing precipitation and/or dry winds, forming a whole variety of particular local climates. Thus, because of the presence the huge longitudinal Zangezur mountain ridge, dry subtropical environments are created in the south; and in areas exposed to the moisture arriving from the Caspian Sea luxuriant, broad-leafed, temperate forests develop. Annual rainfall varies from 200 mm (even 150 mm) in the driest semi-desert areas, to 800 (1000) mm in the rainy parts of the country. The absolute minimum temperature is -37(-43) °C, while the maximum is as high as 42(44) °C. The hottest months are July and August. The coldest one is January (and rarely also February). Seasonally, the country is characterized by a very short spring and by a prolonged autumn (sometimes extending to mid-December). The marked geo-morphological and climatic diversity brings about also wide edaphic variability – from gray semi-desert soils to chernozem, mountain steppe, forest and meadow soils; as well as alluvial, saline, and swampy ones. Finally, Armenia lies at the meeting place of two completely different floristic provinces: (i) the mesophyllous Caucasian (Circumboreal) region, and (ii) the largely woodless, arid, Armeno-Iranian (Irano-Turanian) region. All these elements gave rise to very varied and contrasting environments that support an extremely rich flora (ca. 3500 species of vascular plants). This is indeed remarkable for such a small country. Particularly diverse are the xerophytic mountain formations. It is precisely on these arid and barren slopes (that from a distance look like an almost lifeless steppe or desert) that a large number of Armenia's useful wild plants grow, including wild relatives of numerous grain crops, fruit trees, vegetables, aromatic herbs, and ornamentals.

Floristic background

The following sources provide basic information about plant life in Armenia: (I) The ten published volumes of *Flora Armenii* edited by A. L. Takhtajan, as well as the manuscript of its 11th volume (the last volume) which covers the grasses and is now in an advanced stage of preparation. (II) The comprehensive collection of Armenian plants placed at the Herbarium of the Institute of Botany, The National Academy of Sciences of the Republic of Armenia, Erevan. (III) In addition, we relied heavily on *Flora Erevana* by A. L. Takhtajan and A. A. Fedorov (1972) that contains an excellent account on the flora and vegetation of the Ararat valley. (IV) The now classical 2nd edition of *Flora Kavkaza* by A. A. Grossheim (1939-1967) and his comprehensive treatments of the vegetation (Grossheim 1948) and of the plant resources of the Caucasus (Grossheim 1952) were found by us very valuable for general orientation. So was P. M. Zhukovsky's (1971) comprehensive review of the cultivated plants and their wild relatives. (V) We also wish to acknowledge the contribution of P. A. Gandilyan to our knowledge of the wild relatives of cultivated plants in Armenia, particularly his studies of the wild cereals. (VI) Finally, we thank Andreas Melikyan, of the Armenian Agriculture Academy, Erevan, for providing us with valued data on the distribution, variability and use (in Armenia) of the wild relatives of several vegetable crops and condiments, particularly *Beta*, *Spinacia*, *Coriandrum*, *Cucumis*, *Daucus* and *Satureja* (see also Melikyan 2001).

Distribution of the wild relatives of crops in Armenia

For sketching the distribution of the wild relatives of cultivated plants in Armenia and Nakhichevan, we adopted A. L. Takhtajan (1954-2001) subdivision of this area into "floristic regions" (Fig. 1). For most of the close wild relatives, i.e., plants that belong to the primary wild gene pools (GP-1) of the crops, we prepared site distribution maps that sum up the chorological information available on these plants. Such maps were compiled also for some more distant wild relatives,

Cereals

Wheats: *Triticum* L. and *Aegilops* L.

Four distinct biological species of the genus *Triticum* L. (*Tsoren* in Armenian) representing three ploidy levels (diploid $2n=2x=14$, tetraploid $2n=4x=28$ and hexaploid $2n=6x=42$) occur under domestication (Feldman & al. 1995; Zohary & Hopf 2000; Hanelt 2001). This paper is concerned primarily with the wild genetic resources of the two economically important wheat crops of today, namely the tetraploid (4x) hard wheat *T. turgidum* L. (genomic designation AABB) and the hexaploid (6x) bread wheat *T. aestivum* L. (genomic designation AABBDD). Two other wheat crops, namely diploid (2x) einkorn *T. monococcum* L. (genomic designation AmAm), and tetraploid (4x) *T. timopheevii* (Zhuk.) Zhuk. (genomic designation AmAmGG) survive today only as relics. Their close wild relatives are treated more briefly. The wild progenitors of all these four cultivated wheats are today well recognized.

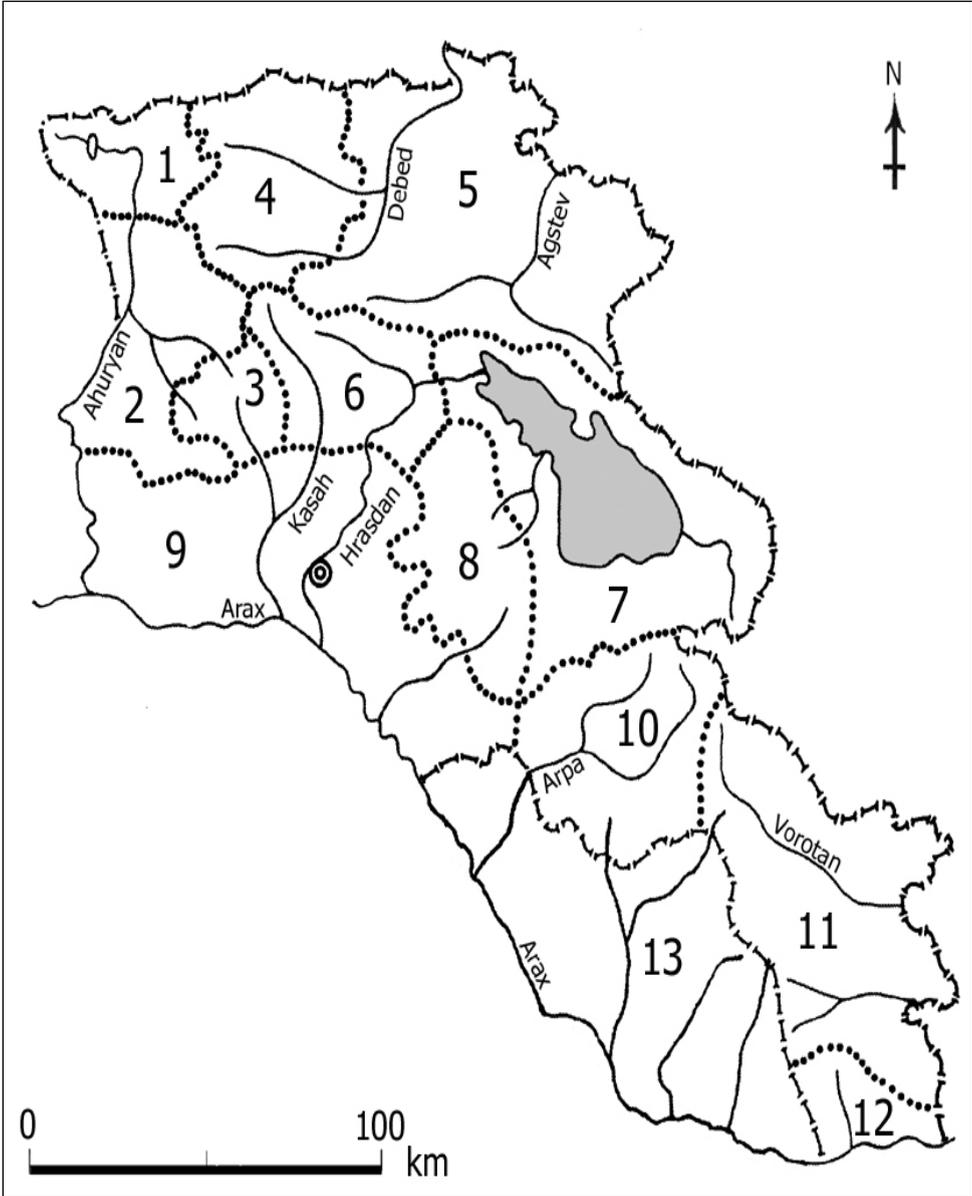


Fig. 1. Floristic regions of Armenia as defined by A. L. Takhtajan (1954-2001) in volumes 1-10 of *Flora Armenii*:

- | | | |
|--------------------|--------------|--------------------------|
| 1 - Upper Ahuryan; | 5 - Idjevan; | 9 - Erevan; |
| 2 - Shirak; | 6 - Aparan; | 10 - Darelegis (= Vaik); |
| 3 - Aragatz; | 7 - Sevan; | 11 - Zangezur; |
| 4 - Lori; | 8 - Gegham; | 12 - Meghri; |
| | | 13 - Nakhichevan. |

Armenia lies already outside the distribution range of wild emmer wheat *T. dicoccoides* (Körn. ex Aschers. & Graebn.) Schweinf. In other words, it does not harbor the direct wild progenitor that gave rise to the various 4x *T. turgidum* cultivars, and the wild source of the A and B genomes present in the 6x bread wheat *T. aestivum*. However, the following wild relatives of cultivated wheats do occur in this country (Gandilyan 1972, 1980, 1990; Gabrielian 1991). The gene pools of some of them are relatively easy-to-tap; and they have been already used in wheat breeding work.

(I) *Triticum urartu* Tumanian ex Gandilyan

This is a diploid ($2n=2x=14$), self-pollinated, wild wheat, that was never domesticated as such. However, its chromosomes (genomic designation AA or AuAu) closely correspond to the AA sets found in wild 4x AABB *T. dicoccoides* and in its domestic derivatives, namely the 4x (AABB) cultivars of hard wheat *T. turgidum*, and the 6x (AABBDD) cultivars of bread wheat *T. aestivum*. Because of this genomic similarity *T. urartu* is now identified (Dvořák & al. 1988, 1993; Jaaska 1997) as the closest diploid source of the A genome present in these polyploid wheat crops. *T. urartu* is a Near Eastern element. It is largely confined to the “Fertile Crescent” belt (Waines 1996; Valkoun & al. 1998) and it extends to Armenia and adjacent areas in North-West Iran. Morphologically, *T. urartu* closely resembles 2x wild einkorn *T. boeoticum* (see below). However, in spite of their morphological similarity, these two wild wheats are isolated from one other reproductively (Waines 1996); and *T. urartu* can be distinguished from *T. boeoticum* by several morphological traits (Gandilyan 1972; Dorofeev & al. 1979; Waines & Barnhart 1992; Waines 1996). Further more, also molecularly these two diploid wheats can be distinguished from one another by allozyme and DNA markers (Dvořák & al. 1988, 1993; Jaaska 1997).

T. urartu was first discovered in Armenia by M. G. Tumanian. He collected it near Erevan, and described it as a new wheat species (Tumanian 1934, 1937; Gandilyan 1972). Today this wild wheat is known to be (Gandilyan 1990; Gabrielian 1991) a component of the semi-arid, herbaceous vegetation in the Erebuni reserve for wild cereals South and South-East of Erevan (Fig. 2). It thrives on Tertiary red clays and on basalts, and often forms mixed stands with *T. boeoticum*, *T. araraticum*, *Aegilops tauschii*, and several other *Aegilops* species, in altitudes ranging from 1300 to 1400 m.

(II) Wild einkorn wheat, *Triticum boeoticum* Boiss.

Wild einkorn wheat, *T. boeoticum* Boiss. [= *T. monococcum* L. subsp. *boeoticum* (Boiss.) A. & D. Löve] is a diploid ($2n=2x=14$), self-pollinated, annual wheat (genomic designation AmAm) that is fully inter-fertile, and chromosomally homologous, with the cultivated 2x einkorn wheat, *T. monococcum* L. It is considered the direct wild progenitor of this domestic cereal. The AmAm chromosome sets found in *T. boeoticum* are fairly homologous (but not fully corresponding) with the AA sets found in 4x *T. turgidum* and 6x *T. aestivum* (Waines 1996); and transfer of useful genes from wild einkorn to the cultivated polyploid wheats is relatively a simple matter (Vardi & Zohary 1967). The center of distribution of wild *T. boeoticum* is in the Near East ‘arc’ and the adjacent Anatolian Plateau. From here this diploid wheat extends both to the south Balkan and to the Caucasus and Trans-Caucasus (Harlan and Zohary 1966; Valkoun & al. 1998; Zohary & Hopf 2000).

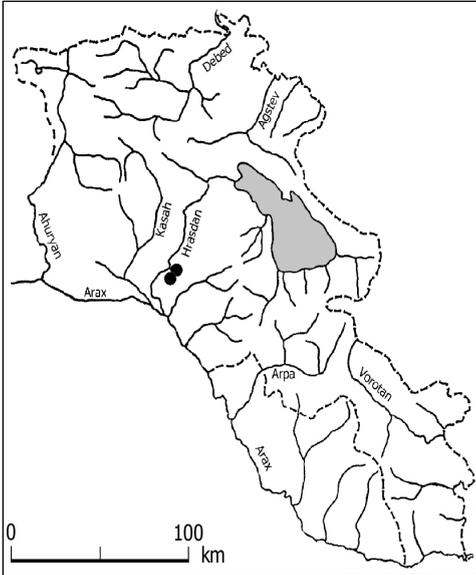


Fig. 2. Distribution of *Triticum urartu* Tumanian ex Gandilyan.

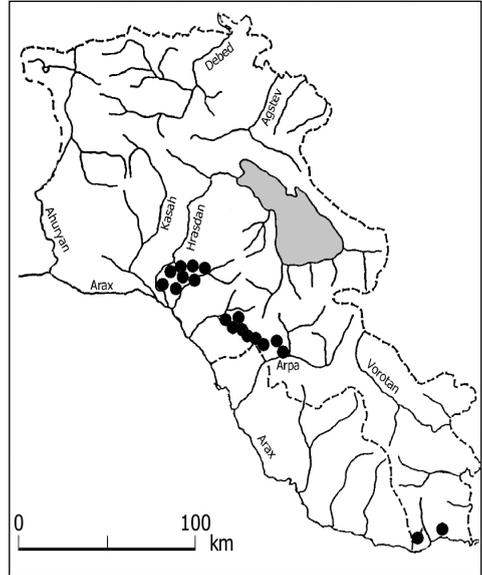


Fig. 3. Distribution of wild einkorn wheat, *Triticum boeoticum* Boiss. [= *T. monococcum* L. subsp. *boeoticum* (Boiss.) A. & D. Löve].

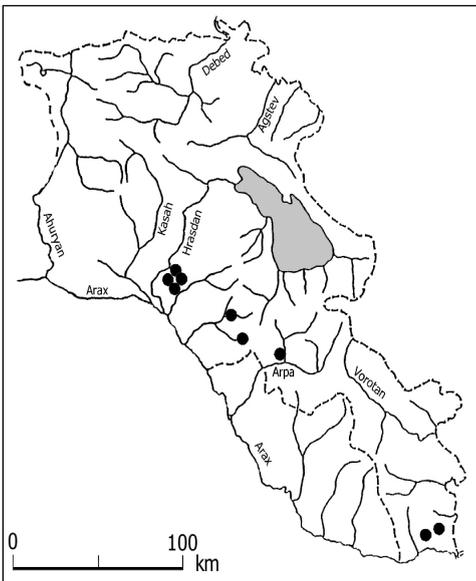


Fig. 4. Distribution of *Triticum araraticum* Jakubz. [= *T. timopheevii* Zhuk. subsp. *araraticum* (Jakubz.) MacKey].

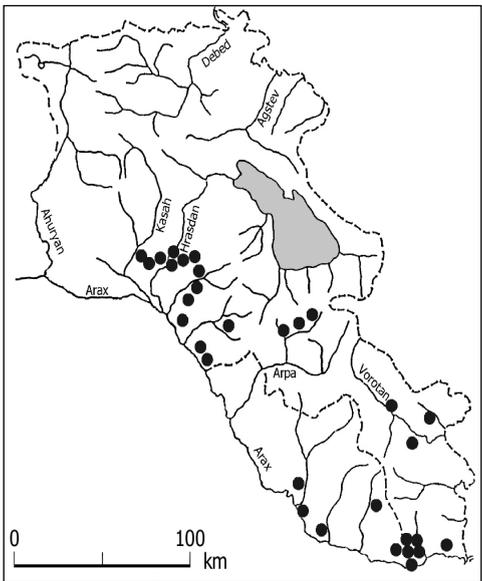


Fig. 5. Distribution of *Aegilops tauschii* Coss. [= *A. squarrosa* L.].

In Armenia, *T. boeoticum* occurs in Erevan floristic region, and it extends to adjacent parts of Gegham and Darelegis districts and reappears in Meghri region (Fig. 3). Its populations are protected in the Erebuni reserve for wild cereals near Erevan, where it is associated with *T. urartu*, *T. araraticum*, *A. tauschii* and several other *Aegilops* species.

(III) *Triticum araraticum* (Jakubz.) Jakubz. [= *T. timopheevii* Zhuk. subsp. *araraticum* (Jakubz.) MacKey]

This tetraploid ($2n=4x=28$) self-pollinated, wild wheat (genomic designation AmAmGG) is inter-fertile and chromosomally homologous with cultivated $4x$ *T. timopheevii* Zhuk. It is identified as the wild progenitor of this very rare (and geographically very localized) wheat crop. Morphologically, wild $4x$ *T. araraticum* resembles closely $4x$ wild emmer *T. dicoccoides*. However, reproductively it is strongly isolated from *T. dicoccoides* (and also from AABB *T. turgidum* cultivars) by strong hybrid sterility (Sears 1969; Maan 1973). The two are also molecularly distinct. Wild *T. araraticum* is native in the central and the eastern parts of the “fertile crescent” belt, and extends to the Trans-Caucasus (Valkoun & al. 1998; Zohary & Hopf 2000).

In Armenia *T. araraticum* occurs in Erevan floristic region, and extends to adjacent parts of Gegham and Darelegis districts. It reappears in Meghri region (Fig. 4). It is a rather common annual constituent in the Erebuni reserve for wild cereals near Erevan; and it grows in semi-desert and mountain steppe environments, frequently together with *T. urartu*, *T. boeoticum*, *A. tauschii* and several other *Aegilops* species.

(IV) *Aegilops tauschii* Coss.

This annual, self-pollinated, diploid ($2n=2x=14$) wild grass, is the donor of the D genome found in $6x$ bread wheat. It is widely distributed over central Asia and the south Caspian basin (Zohary *et al.* 1969; van Slageren 1994) where it occupies steppe-type, primary habitats, and colonizes disturbed environments such as roadsides, edges of cultivation, and even cereal cultivation. *A. tauschii* Coss. [= *A. squarrosa* L.] is a very variable species, and it appears in a multitude of forms - from slender types with rather narrow cylindrical spikes to more robust plants with thick, beaded spikes. The latter forms (subsp. *strangulata* Eig) are confined to the south Caspian basin. Molecularly, the DNA of some collections of subspecies *strangulata* were found to be closest to that present in the D genome in hexaploid AABBDD bread wheat (Dvořák & al. 1998).

In Armenia, *A. tauschii* is widely distributed in the central and southern parts of the country, namely in Erevan, Darelegis, Zangezur and Meghri floristic regions, as well as in Nakhichevan (Fig. 5) at altitudes ranging from 700 to 1300 m. It occupies primary steppe-type and semi-desert habitats, as well as roadsides and edges of cultivation. It also penetrates wheat and barley cultivation. In the latter places, spontaneous hybrids between *A. tauschii* and *T. turgidum* or *T. aestivum* cultivars were also detected. Both subsp. *tauschii* and subsp. *strangulata* occur in Armenia. However, the latter subspecies is less common than the first one.

(V) More distant *Aegilops* species

The following seven *Aegilops* species (*Aitsakn* in Armenian) also occur in Armenia

(Gandilyan 1980; van Slageren 1994): (I) 2x *A. umbellulata* Zhuk. (II) 4x *A. geniculata* Roth [= *A. ovata* L.], (III) 4x *A. biuncialis* Vis., (IV) 4x *A. triuncialis* L., (V) 4x *A. neglecta* Req. ex Bertol. [= *A. triaristata* Willd.] (VI) 4x *A. cylindrica* Host, and (VII) 4x and 6x *A. crassa* Boiss. All are well diverged from 4x *T. turgidum* and from 6x *T. aestivum*, and belong to the secondary wild gene pools (GP-2) of these wheat crops.

Barley: *Hordeum vulgare* L.

Cultivated barley *Hordeum vulgare* L. (*Gari* in Armenian) is one of the main cereals in the belt of Mediterranean agriculture. Also barley is a Near East founder crop. Together with emmer and einkorn wheats it started Neolithic agriculture in the Near East. Cultivated barley is fully inter-fertile (and chromosomally homologous) with wild *H. spontaneum* K. Koch [= *H. vulgare* L. subsp. *spontaneum* (K. Koch) Thell.] and this annual, diploid ($2n=2x=14$), predominately self-pollinated, wild barley, is now recognized as the wild progenitor of the crop (Harlan & Zohary 1966; Bothmer & al. 1991; Zohary & Hopf 2000). *H. spontaneum* is largely a Near East element, occupying both primary and disturbed habitats. Towards east, it extends deeply into the Trans-Caucasus and into Central Asia. In the center of its distribution (the “fertile crescent” belt of the Near East) *H. spontaneum* occupies a wide environmental range, and its populations are genetically highly variable (Nevo 1992). Crosses of cultivated barley with other members of the genus *Hordeum* (which contains some 30 species) mostly fail altogether. Moreover, in the few cases in which interspecific hybrids between the crop and some of these species were obtained, they turned out to be fully pollen and seed sterile (Bothmer & al. 1991).

In Armenia, *H. spontaneum* occurs in Idjevan, Erevan and Meghri floristic regions (Fig. 6) where it occupies relatively dry and warm places in the lower altitude zone. In the northern part of the country, near Airum, and in Erevan area, wild barley forms only small populations. However, in Meghri floristic region, between Ordubad (in Nakhichevan) and Agarak, and near Aldara or Shvanidzor in the Arax river gorge, *H. spontaneum* builds massive stands in gardens and orchards, particularly in vineyards.

Rye: *Secale cereale* L.

Cultivated rye (*Ashora* in Armenian) is a characteristic diploid ($2n=2x=14$), cross-pollinated cereal of the cooler parts of Europe and West Asia, much appreciated for its winter hardiness. Four biological species are commonly recognized in the genus *Secale* L. (Sencer & Hawkes 1980; Kobylanskyi 1989; Zohary & Hopf 2000). The crop is closely related to a group of wild and weedy taxa that are now frequently included in the crop's species complex. An additional wild rye namely *S. montanum* Guss. was also found to be closely related to the crop. The two other rye species (*S. iranicum* Kobyl. and *S. sylvestre* Host) are much more distant and largely inter-sterile with the crop. They clearly belong to its secondary (GP-2) wild gene pool.

Wild and weedy forms of *Secale cereale*

A varied aggregate of wild and weedy forms of rye is now included in the crop species *Secale cereale* L. (Sencer & Hawkes 1980; Kobylanskyi 1989; Zohary & Hopf 2000). All members of this complex (cultivars, wild forms, weeds) are annual, self-incompatible,

diploid ($2n=2x=14$), chromosomally homologous and fully inter-fertile with one another. They fall into the following groups (Zohary & Hopf 2000):

- (a) Non-shattering, obligatory weeds: These forms infest wheat and barley cultivation. They are harvested together with these cereals, and in grain size and weight they mimic the wheat kernels. They are commonly regarded by the farmers as “tolerated weeds”, and are characteristic contaminants of traditional wheat agriculture in South-West Asia, the Caucasus and the Balkan countries.
- (b) Semi-brittle weeds, commonly referred to as *Secale segetale* (Zhuk.) Roshev., or as *S. dighoricum* (Vavilov) Roshev. These forms frequently augment the obligatory non-shattering weeds in the Trans-Caucasus, North Iran and Central Asia.
- (c) Fully brittle weeds, commonly referred to as *Secale ancestrale* Zhuk., that infest cultivation in West Turkey.
- (d) Fully brittle wild forms, commonly referred to as *Secale vavilovii* Grossh. [= *S. cereale* subsp. *vavilovii* (Grossh.) Kobyl.] These occupy primary as well as some secondary habitats (particularly on basalt bedrock) in Armenia and East Turkey.

Armenia harbours the following weedy and wild forms of *S. cereale*: All over this country non-shattering, obligatory weeds frequently infest wheat and barley cultivation. Semi-shattering, weeds are less common. They infest mainly irrigated wheat and barley cultivation. Truly wild, fully shattering, self-incompatible, annual forms of *S. vavilovii* [= *S. cereale* L. subsp. *vavilovii*] occur in Aragatz, Aparan, Sevan, Erevan and Darelegis floristic regions, and they reappear in Meghri and in South Nakhichevan (Fig. 7). They thrive in *Artemisia fragrans* and *A. araxina* semi-deserts, in phrygana-type vegetation, and on dry stony slopes, and extend to roadsides and edges of cultivation. They show preference to basaltic bedrock, and to alluvial sediments derived from basalt mixed with volcanic ash and chalk, at altitudes ranging from 800 to 1700 m. *S. vavilovii* forms are rather common east of Erevan and on the road to Garni, sometimes forming massive stands.

Secale montanum Guss.

As already noted, in addition to wild rye taxa that now included in the crop complex also *Secale montanum* Guss. [= *S. strictum* (C. Presl) C. Presl] is closely related to the rye crop. *S. montanum* is a perennial, diploid ($2n=2x=14$), cross-pollinated, wild grass. It differs from *S. cereale* by two reciprocal chromosomal translocations. Yet, it crosses readily with the crop and the interspecific hybrids are only partly fertile (Stutz 1972; Sencer & Hawkes 1980; Zohary & Hopf 2000). Natural hybridization between these ryes have been detected in places in which they grow side by side. Mountain rye is a very variable species, widely distributed over the elevated plateaus and mountainous areas in South-West Asia and the south Balkan, with extensions to South Italy and Sicily.

Armenia harbors a rich variety of *S. montanum*. This wild rye occurs in Aragatz, Aparan, Sevan, Gegham, Erevan, Darelegis, Zangezour and Meghri floristic regions (Fig. 8) growing in the middle and upper mountain altitude belts (1200 to 2700 m). It thrives in mountain tragacanth vegetation, between rocks and on dry stony slopes, as well as along roadsides.

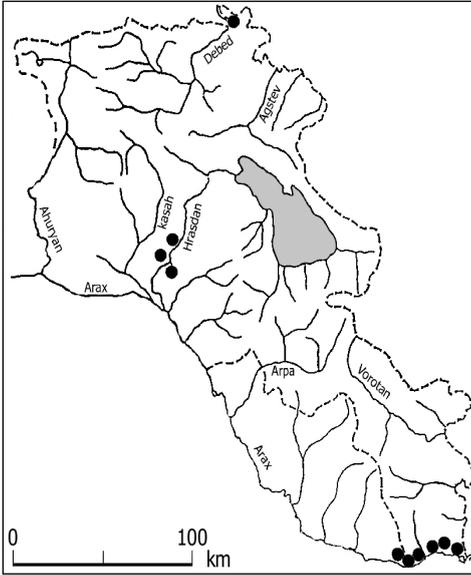


Fig. 6. Distribution of wild barley, *Hordeum spontaneum* K. Koch [= *H. vulgare* L. subsp. *spontaneum* (K. Koch) Thell.

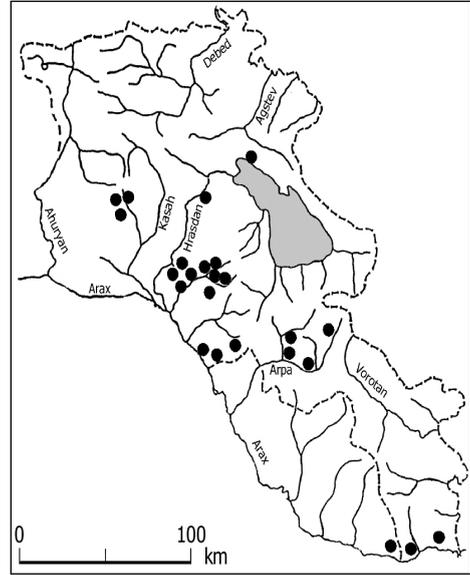


Fig. 7. Distribution of *Secale vavilovii* Grossh. [= *S. cereale* L. subsp. *vavilovii* (Grossh.) Kobyl.]

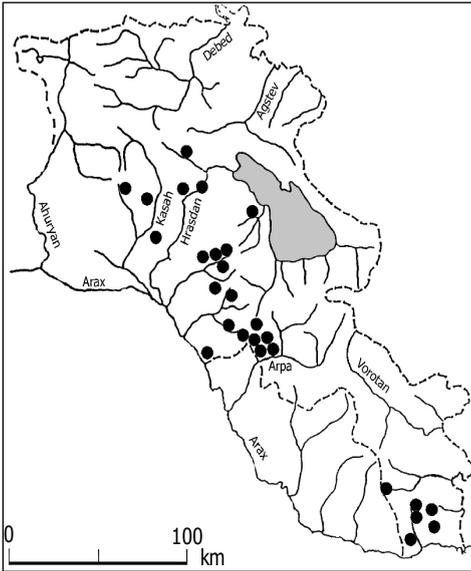


Fig. 8. Distribution of *Secale montanum* Guss.

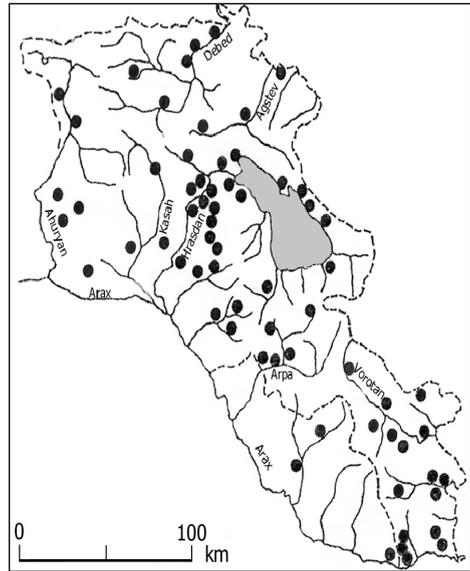


Fig. 9. Distribution of *Avena sterilis* L. [= *A. sativa* L. subsp. *sterilis* (L.) de Wet].

Common oat, *Avena sativa* L. [including *A. byzantina* K. Koch]

Common oat (*Varsak* in Armenian) is an annual, hexaploid ($2n=6x=42$) predominately self-pollinated cereal, extensively grown in the temperate parts of the World. The wild stock from which the crop could have evolved is now well recognized (Thomas 1995; Leggett & Thomas 1995; Zohary & Hopf 2000). Common oat cultivars are fully inter-fertile and chromosomally homologous with a variable aggregate of wild and weedy hexaploid ($2n=6x=42$) oat forms, which are commonly referred to as *A. sterilis* L. and *A. fatua* L. These wild oats are predominately self-pollinated, and chromosomally homologous with the $6x$ *A. sativa* cultivars. On basis of these close affinities, many crop plant evolutionists regard *A. sterilis* and *A. fatua* not as separate species but only as wild, intra-specific taxa of the *A. sativa* crop complex. Both *A. sterilis* [= *A. sativa* L. subsp. *sterilis* (L.) de Wet] and *A. fatua* [= *A. sativa* L. subsp. *fatua* (L.) de Wet] are aggressive colonizers. They are widely distributed over the Mediterranean basin and South-West Asia, occupying both primary and secondary habitats. As weeds and colonizers they penetrate deeply into the temperate parts of Europe and the Caucasus. They were also introduced, and successfully colonized, extensive territories in North and South America, Australia and South Africa. All other species grouped in the genus *Avena* are more distant, and hard to cross with the crop complex. Inter-specific hybrids (when obtained) are fully (or almost fully) pollen and seed sterile.

In Armenia wild *sterilis* and *fatua* oats are widely distributed all over the country (Figs 9 and 10) mostly as weeds in cultivation and as colonizers of abandoned agricultural sites, waste places, and other open, disturbed habitats. Both are morphologically variable. *A. sterilis* is represented in this country both by subsp. *trichophylla* (K. Koch) Maleev, and by subsp. *ludoviciana* (Durieu) Gill. & Magne.

Foxtail millet, *Setaria italica* (L.) P. Beauv.

Foxtail millet (*Khosanuk* in Armenian) is a founder crop of North China agriculture. It is an annual, predominately self-pollinated, diploid ($2n=2x=18$), warm-season cereal; still extensively grown in eastern Asia. It survives well under dry conditions and completes its life cycle in a relatively short time. The crop is closely related and inter-fertile with *S. viridis* (L.) P. Beauv., which is a common summer weed, widely distributed across temperate and subtropical Eurasia (De Wet 1995).

In Armenia, *S. viridis* is a common weed in orchards, vineyards and gardens, as well as a roadside colonizer in Shirak, Aragatz, Idjevan, Aparan, Sevan, Erevan, Darelegis, Zangezur and Meghri floristic regions (Fig. 11).

Legumes

Lentil, *Lens culinaris* Medik.

The cultivated lentil (*Vosp* in Armenian) belongs to the small group of founder crops that started Neolithic agriculture in the Near East (Smartt 1990; Zohary 1995). This domesticated pulse is closely related to wild *L. orientalis* (Boiss.) Schmalh. [= *L. culinaris* Medik. subsp. *orientalis* (Boiss.) Ponert]. The latter is an annual, diploid ($2n=2x=14$), self-pollinated, wild lentil, and the only wild taxon in the genus *Lens* that some of its forms are

fully inter-fertile and chromosomally fully homologous with the crop (Ladizinsky 1993). *L. orientalis* is a South-West Asian and Central Asian element. It usually grows on shallow, stony soils, and on gravelly hillsides.

In Armenia, *L. orientalis* occurs in the Ararat plain, and in central and southern Armenia (Fig. 12). It is recorded from numerous sites in the Erevan region, as well as from Aparan, Darelegis and Meghri floristic regions. It is also known from South Nakhichevan. Its distribution is rather patchy. Usually *L. orientalis* forms small, scattered stands on stony slopes, between rocks and on scree. It grows in the relatively dry semi-desert environments, in phrygana and shibliak formations, in mountain steppes, and in juniper or oak open forests, at altitudes ranging from 450 to 2000 m. Its close associates are *Artemisia fragrans*, *Vicia ervilia*, *Paliurus spina-christi*, *Amygdalus fenzliana*, *Cercis griffithii*, and *Rhamnus pallasii*.

Armenia also harbors the largely Mediterranean *L. ervoides* (Brign.) Grande. It is a rare plant in this country, recorded from only four sites in Zangezur floristic region (Fig. 12). Genetically, *L. ervoides* is already quite distant from the crop. Crosses between them (Ladizinsky 1993) result in hybrid embryo breakdown.

Pea, *Pisum sativum* L.

Pea (*Volor* in Armenian) is a diploid ($2n=2x=14$), self-pollinated, annual pulse. Similar to the lentil also pea is known today as a founder crop of the Neolithic agriculture in the Near East (Smartt 1990; Zohary & Hopf 2000). The wild forms of *P. sativum* are well recognized and can be grouped into two aggregates (Ben-Ze'ev & Zohary 1973; Hanelt 2001): (I) A "maquis-type" climber, historically called *P. elatius* M. Bieb., and now frequently referred to as *P. sativum* L. subsp. *elatius* (M. Bieb.) Aschers. & Graebn., native to the Mediterranean basin (including the Black Sea), the Caucasus and North Iran. (II) A shorter, more xeric "steppe-type" which was first treated as *P. humile* Boiss. & Noë [= *P. syriacum* (Berger) Lehm.] and which is now regarded as *P. sativum* L. subsp. *humile* (Holmb.) Greut., Matthäs & Risse [= *P. sativum* L. subsp. *syriacum* Berger; = *P. sativum* L. subsp. *elatius* (M. Bieb.) Aschers. & Graebn. var. *pumilio* Meikle]. This wild and weedy "steppe type" is native to the Near East and the Trans-Caucasus. Some of its wild forms were found to be chromosomally fully homologous to those present in the cultivars (Ben-Ze'ev and Zohary 1973). They seem to represent the direct wild progenitor of domestic pea. Other *humile*-type populations (as well as *elatius*-type ones) differ from the crop by a reciprocal chromosomal translocation. Yet, they too, are crossable with the cultivars.

In Armenia, the tall "maquis-type" forms occur in Lori, Idjevan, Sevan, Gegham, Erevan, Zangezur and Meghri floristic regions (Fig. 13). They are climbers in oak-hornbeam forests, in bush thickets, in meadows, in fields and at edges of cultivation; at the lower and middle mountain belts (800-1700 m). The shorter "steppe type" forms occur in Idjevan, Sevan, Darelegis and Meghri floristic regions (Fig. 13). They grow in oak or juniper open forests, in shibliak and phrygana formations, on dry stony slopes, scree, skeletal soils, and between rocks - from the lower to the upper mountain belts (700-2000 m). Both wild subspecies occur also in Nakhichevan.

Armenia also harbors a more distant wild relative of pea, namely *Vavilovia formosa* (Steven) Fed. This is a rare, insufficiently studied, alpine, perennial pea, sporadically distributed on mountain ranges in the Near East and in the Caucasus (Gabrielian 1962; Davis 1970). It is a rare plant that grows in Armenia on screes, volcanic slags and among rocks

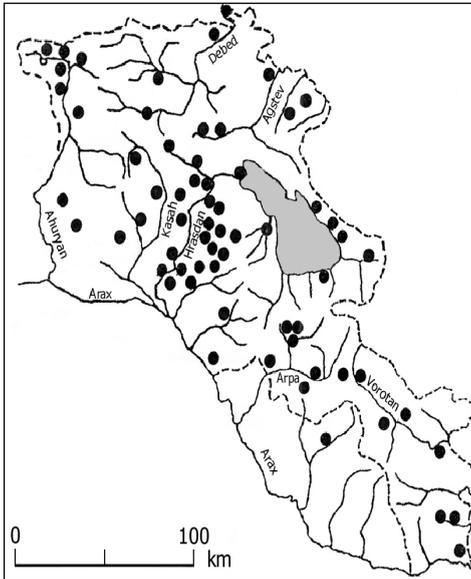


Fig. 10. Distribution of *Avena fatua* L. [= *A. sativa* L. subsp. *fatua* (L.) de Wet].

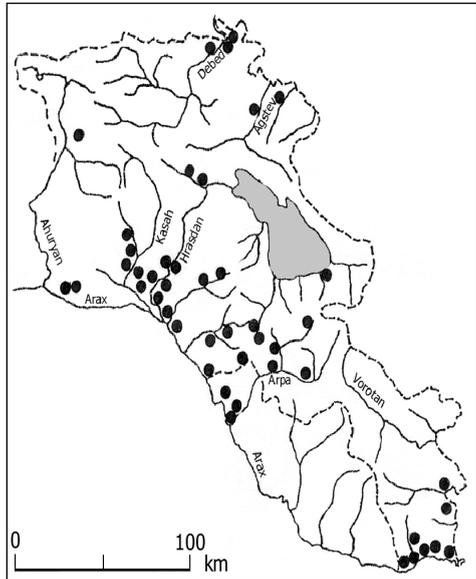


Fig. 11. Distribution of *Setaria viridis* (L.) P. Beauv.

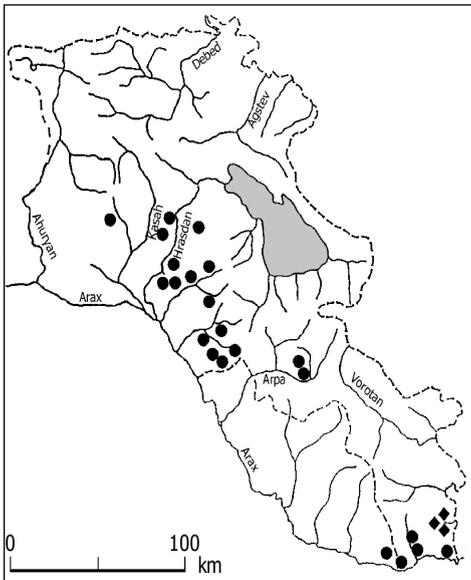


Fig. 12. Distribution of ● *Lens orientalis* (Boiss.) Schmalh. [= *L. culinaris* Medik. subsp. *orientalis* (Boiss.) Ponert] and ◆ *L. ervoides* (Brign.) Grande.

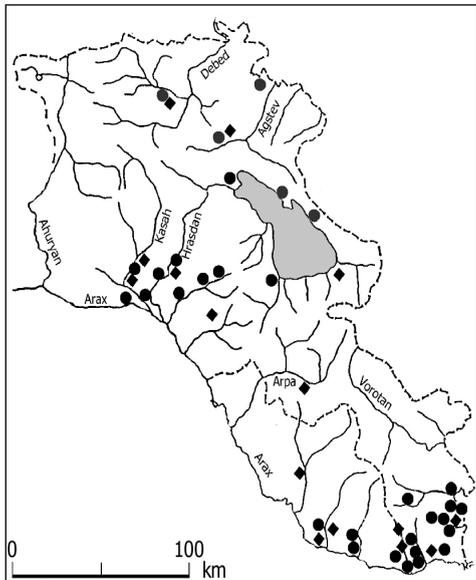


Fig. 13. Distribution of wild peas: ● "maquis type" *P. elatius* M. Bieb. [= *P. sativum* L. subsp. *elatius* (M. Bieb.) Aschers. & Graebn.] and ◆ "steppe type" *P. humile* Boiss. & Noë [= *P. sativum* L. subsp. *syriacum* Berger; = *P. sativum* L. subsp. *elatius* (M. Bieb.) Aschers. & Graebn. var. *pumilio* Meikle].

and stones in Gegham (near Aknalich and Mt. Sevsar) as well as in Zangezur (Kaputdjukh, Parakan and Mets Ishkhanasar mountains) floristic regions (Fig. 14), at altitudes ranging from 3100 to 3300 m. *V. formosa* had not been yet cross tested with the crop.

Grass pea, *Lathyrus sativus* L.

Grass pea (*Tapvolor* in Armenian) is an annual, diploid ($2n=2x=14$), self-pollinated pulse crop grown in the Mediterranean basin and in the Near East since Neolithic times. The cultivars show close morphological resemblance to a group of wild *Lathyrus* species distributed over the Mediterranean basin and South-West Asia (Smartt 1990; Kearney & Smartt 1995). The crop appears closest to *L. cicera* L., a variable wild and weedy annual legume that is widely distributed over the Mediterranean basin and the Near East. However, several other wild *Lathyrus* species closely resemble the crop as well. Critical crossing tests (both inter-specific and intra-specific) that could clarify the cyto-genetic affinities between the crop and its wild relatives are not available yet. However, they are essential for tracing the ancestry of the grass pea. More so since in *Lathyrus*, reproductive isolation barriers (such as cross-incompatibility, hybrid non-viability and hybrid sterility) seem to build up rather early in speciation. All we know (Kearney and Smartt 1995) is that some forms of *L. cicera* crossed with *L. sativus* produced partly fertile hybrids.

In Armenia, *L. cicera* is relatively common. It occurs in Aragatz, Idjevan, Aparan, Erevan, Darelegis, Zangezur and Meghri floristic regions, as well as in Nakhichevan (Fig. 15) growing on dry stony or clayish slopes, on scree and between rocks, at altitudes ranging from 700 to 2200 m. It also colonizes edges of agricultural lands, and frequently infests wheat and barley cultivation.

Bitter vetch, *Vicia ervilia* (L.) Willd.

Bitter vetch (*Kurushna* in Armenian) is a diploid ($2n=2x=14$) self-pollinated pulse with beaded pods and angular seeds, cultivated since Neolithic times (Zohary & Hopf 2000). Today it survives, in the East Mediterranean basin and the Near East, only as a minor crop used mainly as an animal feed. Wild forms of *V. ervilia*, fully inter-fertile with the crop (Ladizinsky & van Oss 1984) occur in the "Fertile Crescent" belt and Anatolia, and extend to the Trans-Caucasus.

In Armenia, wild forms of *V. ervilia* occur in Idjevan, Sevan, Erevan, Darelegis, Zangezur and Meghri floristic regions, as well as in Nakhichevan (Fig. 16). They grow between rocks, on scree, and in sandy places, in semi-desert sagebrush or in phrygana formations, at altitudes ranging from 1300 to 2000 m, frequently in association with *Lens orientalis*.

Liquorice, *Glycyrrhiza glabra* L.

A perennial, diploid ($2n=2x=16$) herb (*Matutak* in Armenian) cultivated for its rhizomes, used for extracting liquorice (Small 1997). Wild forms of *G. glabra* are widely distributed over the Mediterranean basin, the Balkan, the Caucasus, South West and Central Asia, colonizing alluvial valleys, and other sites with deep soils. Frequently this legume is also naturalized.

In Armenia, *G. glabra* is widely distributed in Shirak, Sevan, Erevan, Darelegis,

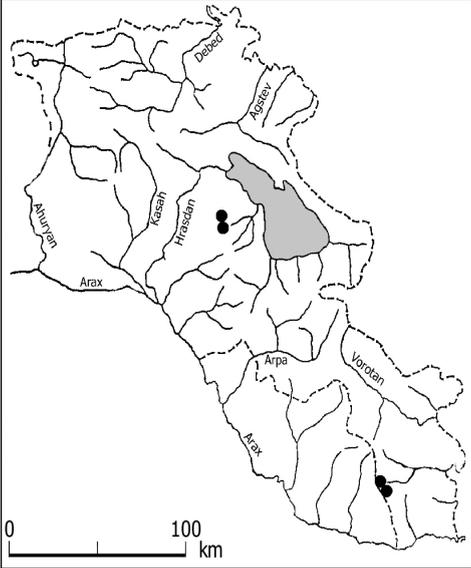


Fig. 14. Distribution of *Vavilovia formosa* (Steven) Fed.

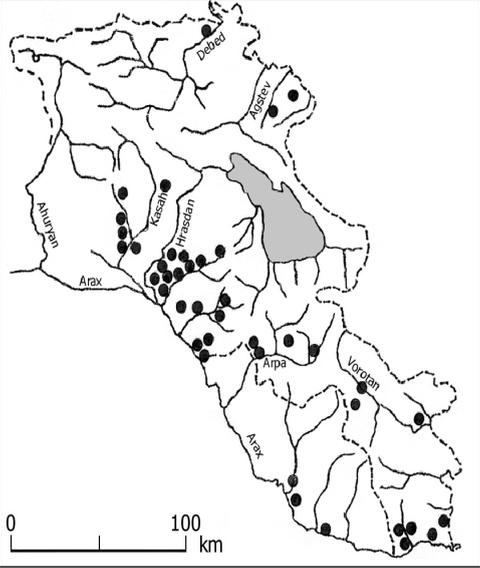


Fig. 15. Distribution of *Lathyrus cicera* L.

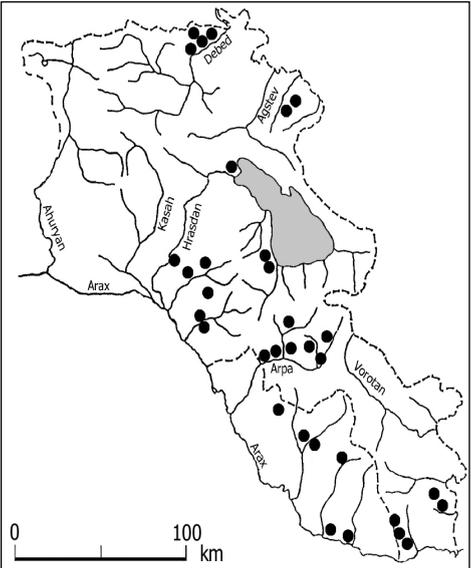


Fig. 16. Distribution of wild forms of bitter vetch, *Vicia ervilia* (L.) Willd.

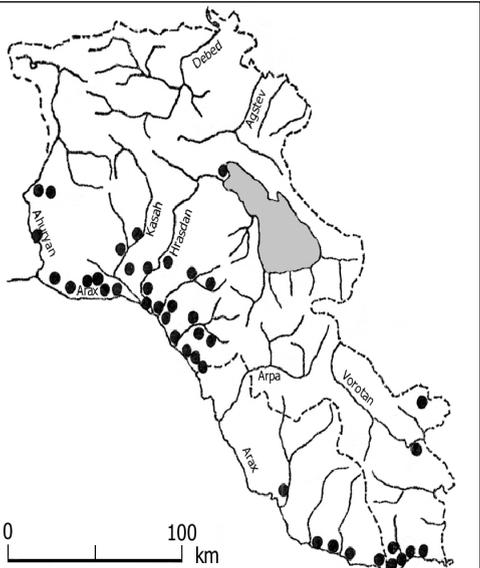


Fig. 17. Distribution of wild forms of liquorice, *Glycyrrhiza glabra* L.

Zangezur and Meghri floristic regions, as well as Nakhichevan (Fig. 17). It occupies swampy, high water table areas, and somewhat saline places. It also grows as a weed in agriculture, and along streams, rivers, canals and roadsides, at altitudes ranging between 500 and 1600 m. Another species of liquorice, namely *G. echinata* L., is known only from Erevan floristic region.

Oil and fiber crops

Flax, *Linum usitatissimum* L.

Flax (*Ktavat* or *Vush* in Armenian) is an annual, diploid ($2n=2x=30$) self-pollinated herb, cultivated since Neolithic times for its oil-bearing seeds and for its fibers. Closely related to the crop is an aggregate of wild and weedy forms, usually referred to as *L. bienne* Mill. [= *L. usitatissimum* L. subsp. *angustifolium* (Huds.) Thell.]. They are chromosomally homologous and fully inter-fertile with the flax cultivars, and regarded as the wild progenitor stock from which the crop has been derived (Diederichsen & Hammer 1995; Zohary & Hopf 2000). *Bienne* forms are self-pollinated, annual or short-lived perennials, widely distributed over the Mediterranean basin, West and South-East Europe, and South-West Asia. They show preference to heavy soils and slightly marshy habitats.

In Armenia, wild *bienne* forms occur in Shirak, Lori, Idjevan, Aparan and Sevan floristic regions (Fig. 18). They infest cultivation, and thrive in slightly wet roadsides and waste places, at altitudes ranging from 1000 to 2000 m.

Turnip, *Brassica rapa* L. [= *B. campestris* L.]

Turnip (*Shakhgam* in Armenian) is an annual or biennial, cross-pollinated, diploid ($2n=2x=20$) seed planted crop (McNaughton 1995; Diederichsen 2001). In Europe and South-West Asia turnip is cultivated for its swollen hypocotyle [root turnip, subsp. *rapa*] and for its oil-bearing seeds [oilseed turnip, subsp. *oleifera* (DC.) Metzger]. It has been grown in this area at least since the first millennium BC (Zohary & Hopf 2000). Other groups of *B. rapa* cultivars, such as Chinese cabbage [subsp. *chinensis* (L.) Hanelt], and Peking cabbage [subsp. *pekinensis* (Lour.) Hanelt] evolved independently in East Asia. Wild-growing weedy or ruderal populations of turnip [subsp. *sylvestris* (Lam.) Janchen] are widely spread over much of Europe, Siberia, the Caucasus, South-West Asia and East Asia. They are fully inter-fertile and chromosomally homologous with the cultivars. Much of this material seems to be introduced and naturalized (Jalas & al. 1996). The native distribution of wild turnip was not established yet with certainty.

In Armenia, weedy forms of *B. rapa* infest cultivation and colonize roadsides and waste places. They occur practically in all floristic regions, at altitudes ranging from 800 to 2700 m.

Rape or Swede, *Brassica napus* L.

Rape (*Gongegh* in Armenian) is an annual or biennial seed planted crop extensively cultivated (Rich 1991; McNaughton 1995; Diederichsen 2001) for its oil-containing seeds [oil seed rape or rutbaga, subsp. *oleifera* (DC.) Moench], or for its swollen root [rape, subsp. *rapifera* Metzger]. The crop is an allo-tetraploid ($2n=4x=38$) that very likely originated

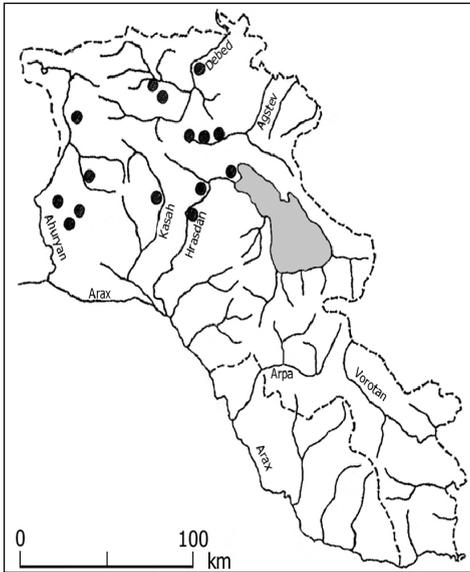


Fig. 18. Distribution of *Linum bienne* Mill. [= *L. usitatissimum* L. subsp. *angustifolium* (Huds.) Thell.].

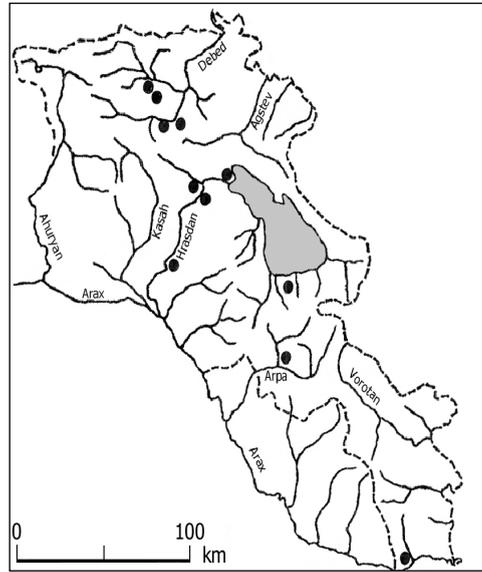


Fig. 19. Distribution of wild forms of rape, *Brassica napus* L.

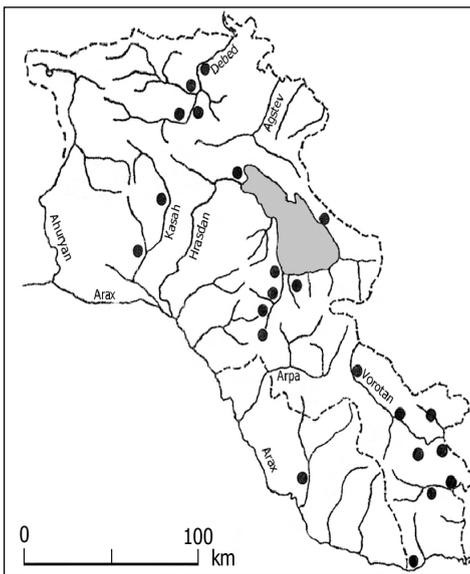


Fig. 20. Distribution of wild forms of gold of pleasure, *Camelina sativa* L.

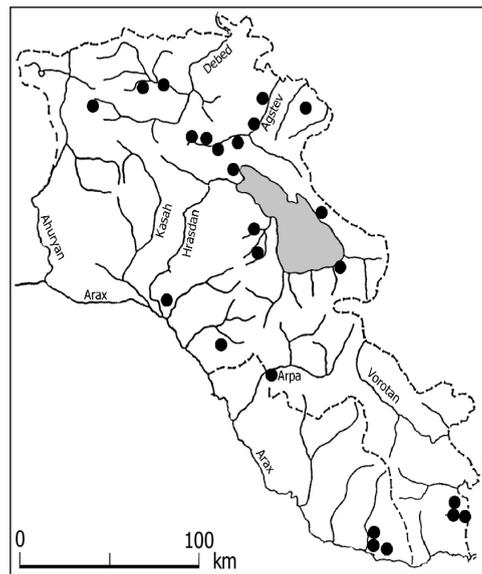


Fig. 21. Distribution of wild and weedy forms of hemp, *Cannabis sativa* L.

(under domestication) by hybridization between diploid ($2n=2x=20$) *B. rapa* and diploid ($2n=2x=18$) *B. oleracea*. Today, *B. napus* is widely naturalized in Europe, the Caucasus and Siberia.

In Armenia, wild-growing, weedy rape forms colonize waste places in Idjevan, Aparan and Erevan floristic regions (Fig. 19) in altitudes ranging from 600 to 1600 m.

Gold of pleasure, *Camelina sativa* L.

This is an annual, seed-planted oil crop (*Soruk* in Armenian) extensively cultivated in the past, particularly in Central Europe (Zohary & Hopf 2000). To day *C. sativa* survives only as a relic crop, and represents one of the better studied “secondary crops” i.e., plants which first evolved as weeds and only later were picked up as crops. The gold of pleasure cultivars are closely related to, and inter-fertile with, a variable aggregate of wild and weedy forms (Markgraf 1975). Weedy races of the *C. sativa* complex are widely distributed over most of temperate Europe, the Caucasus, Siberia and South-West Asia. Truly wild forms are more restricted, and apparently occur only in South-East Europe and some parts of South-West Asia.

In Armenia *C. sativa* is still locally grown in few places. Traditionally, its oil was used both for food and for lighting. Also its stem fibers were utilized for spinning. Wild and weedy forms of *C. sativa* occur in Idjevan, Aparan, Sevan, Gegham, Erevan, Zangezur and Meghri floristic regions, as well as in Nakhichevan (Fig. 20) at altitudes ranging from 700 to 2300 m. Weedy forms [*C. sativa* L. var. *caucasica* Sinsk.] commonly infest cereal cultivation and colonize edges of agriculture. What seem to be truly wild populations occupy less disturbed habitats, such as steppes or mountain meadows.

Hemp, *Cannabis sativa* L.

Hemp (*Kanep* in Armenian) is an annual, erect, dioecious, diploid ($2n=2x=20$) herb cultivated mainly for its fibers [subsp. *sativa*] or for its narcotic resin [subsp. *indica* (Lam.) Small & Cronquist]. Wild and weedy forms [subsp. *spontanea* (Vavilov) Serebr. ex Serebr. & Sizova] are native in Central Asia, the south Caspian basin, and the Himalayas; and they extend to the Caucasus and to South-East Europe. Naturalized or casual forms occur over much of Europe, as well as in several other parts of the World (Small & Cronquist 1976; Small 1995).

In Armenia, wild and weedy forms of *C. sativa* are quite common (Shkhijan 1962). They are recorded from Lori, Idjevan, Sevan, Erevan, Darelegis, Zangezur and Meghri and Nakhichevan floristic regions, as well as in Nakhichevan (Fig. 21), growing along streams and rivers, on herbaceous slopes, and even on dry stony or rocky hills, at altitudes ranging from 700 to 2000 m.

Safflower, *Carthamus tinctorius* L.

Safflower (*Kanchrak* or *Gathy tzaghik* in Armenian) with its characteristic orange-yellow flowers is today an oil crop (Knowles & Ashri 1995). Yet, until World War II it served primarily as a dye plant. *Carthamus* is basically an Irano-Turanian genus, comprising 13-14 annual species of thistles (Hanelt 1963). The crop is taxonomically closely related to a

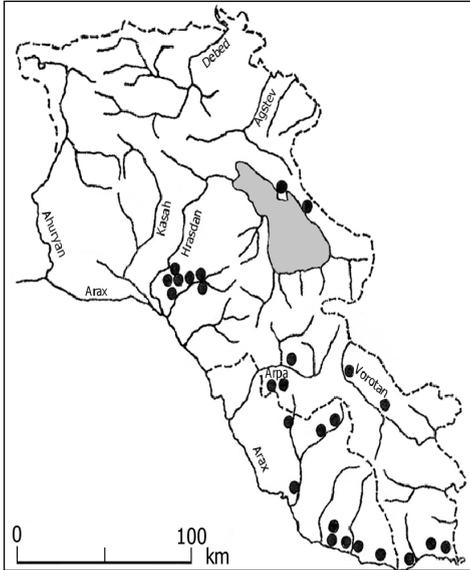


Fig. 22. Distribution of *Carthamus oxyacanthus* M. Bieb.

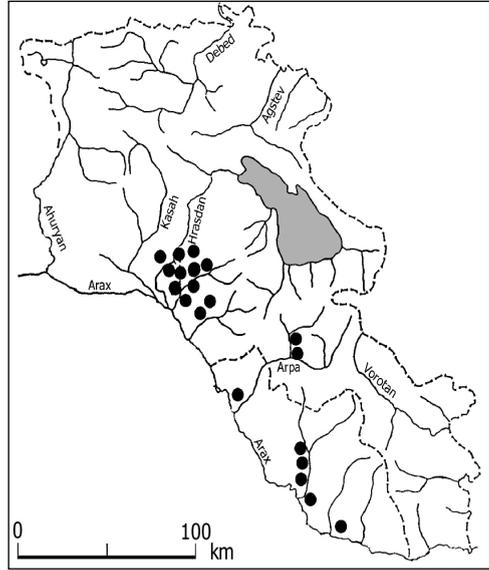


Fig. 23. Distribution of *Carthamus gypsicola* Iljin.

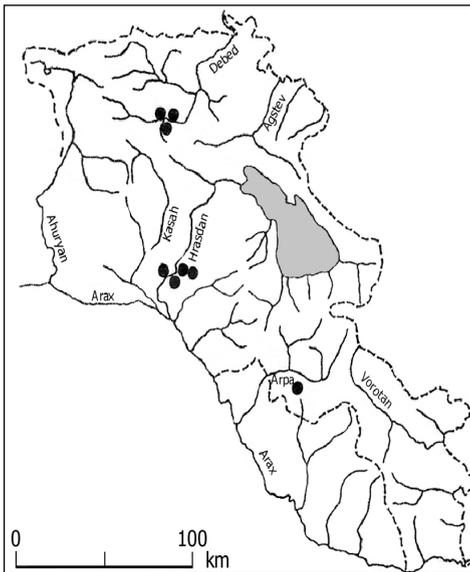


Fig. 24. Distribution of wild forms of beet, *Beta vulgaris* L. subsp. *maritima* (L.) Arcang.

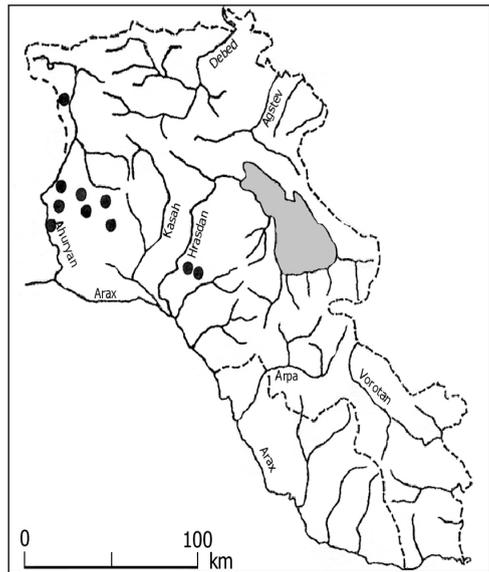


Fig. 25. Distribution of *Beta lamatogona* Fisch & C. A. Mey.

group of 3-4 diploid ($2n=2x=24$) wild species, placed in section *Carthamus* of the genus *Carthamus*, and native to South-West and Central Asia (Hanelt 1963; Knowles & Ashri 1995). *C. tinctorius* was already cross-tested with two wild and weedy members of this section, namely (I) *C. persicus* Willd. [= *C. flavescens* Willd.] that occurs in the Levant countries, the Syrian Desert, South Anatolia and Upper Mesopotamia; and (II) *C. oxyacanthus* M. Bieb., that grows in the Trans-Caucasus, Iran, Afghanistan and Central Asia. Both species were found to be inter-fertile and chromosomally homologous with the crop. *C. tinctorius* is very probably also inter-fertile with a third, diploid ($2n=2x=24$) wild member of this section, namely *C. gypsicola* Iljin, a geographically much more restricted species, which grows on gypsum-rich substrates in the southern Trans-Caucasus, the southern Caspian basin and in Middle Asia. In contrast, members of other taxonomic sections in *Carthamus* are far more distant, and hard or impossible to cross with the cultivated safflower.

Both *C. oxyacanthus* and *C. gypsicola* occur in Armenia (Gabrielian 1995). *C. oxyacanthus* is a rather common thistle. It is recorded from Sevan, Erevan, Darelegis, Zangezour and Meghri and floristic regions, as well as from Nakhichevan (Fig. 22). It grows in semi-desert environments, on stony or on Tertiary red clay slopes, on ancient mounds and as a weed in (and at the edges) of cultivated fields, at altitudes ranging from 450 to 2000 m. In comparison, *C. gypsicola*, with its characteristic fragile, shiny, white stem, is much less common. It is recorded from the vicinity of Erevan, from Darelegis and Meghri floristic regions and from Nakhichevan (Fig. 23). It is edaphically specific, occupying gypsum-rich clays, slightly saline sites, or dry stony slopes, at altitudes ranging from 450 to 1400 m.

Vegetables

Beet, *Beta vulgaris* L.

Beet (*Chakndegh*, *Bazuk* in Armenian) is a multi-purpose, annual or biennial, diploid ($2n=2x=18$) seed planted crop, comprising four principal types of cultivars: leaf beet, garden beetroot, fodder beet and sugar beet. The crop is closely related to a group of wild and weedy *Beta* taxa that together with the beet cultivars build Section *Beta* in this genus (Letschert 1993). Closest to the crop is an aggregate of annual and perennial wild forms that are fully inter-fertile and chromosomally homologous with the crop. In the past this wild aggregate was assumed to contain one or several wild species. Today these wild relatives are included (as "races" or subspecies) in the crop species *B. vulgaris* (Letschert 1993; Ford-Lloyds 1995; Hammer 2001). The most widespread wild "race" of this kind is *B. vulgaris* L. subsp. *maritima* (L.) Arcang. [= *B. maritima* L.; = *B. perennis* (L.) Freyn.]. Wild and weedy forms of this wild taxon are widely distributed over the Mediterranean basin, South-West Asia, the Caucasus, and the Atlantic coast of Europe (Meusel & al. 1965; Zeven & de Wet 1982). They are regarded as the wild stock from which the crop could have been derived. More restricted in its distribution (and more specific in its ecological requirements) is subsp. *adanensis* (Pamuk.) Ford-Lloyd & Williams [= *B. adanensis* Pamuk.] found in Greece, South-west Turkey and Syria. Two other members of Section *Beta*: (I) *B. macrocarpa* Guss. [= *B. vulgaris* L. subsp. *macrocarpa* (Guss.) Thell.], and (II) *B. patula* Aiton [= *B. vulgaris* L. subsp. *patula* (Aiton) Ford-Lloyd & Williams] are also

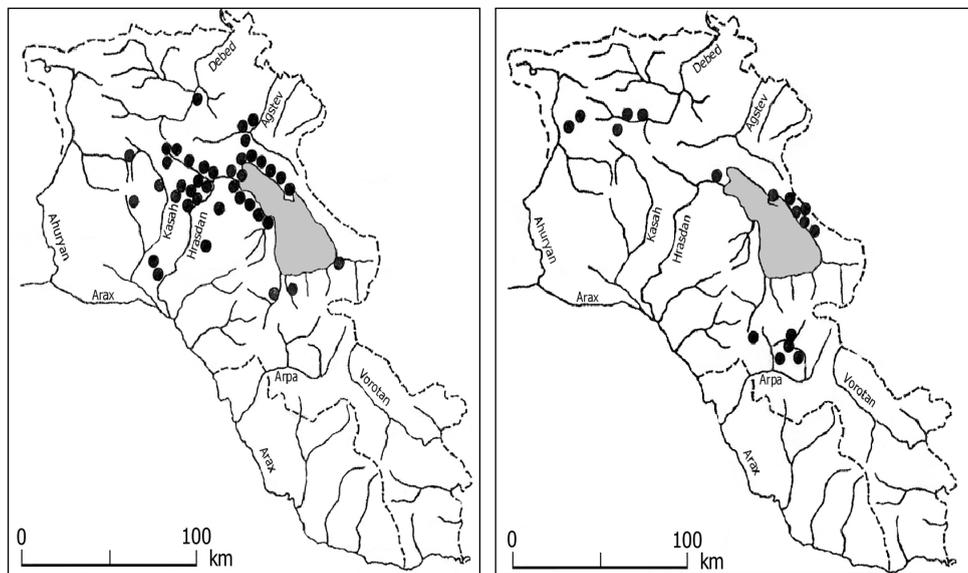


Fig. 26. Distribution of *Beta corolliflora* Zosimovicz ex Battler. Fig. 27. Distribution of *Beta macrorrhiza* Steven.

closely related to the crop and are, at least partly, inter-fertile with it (Letschert 1993). Indeed some workers (e.g. Ford-Lloyds 1995) regard them too as parts of the *B. vulgaris* crop complex. In contrast, the beet species grouped in the three other sections in the genus *Beta* are far more distant. They are hard or impossible to cross with *B. vulgaris* (Letschert 1993; Ford-Lloyds 1995). They belong to the secondary or the tertiary gene pools (GP-2, GP-3) of the crop.

In Armenia, wild and weedy forms of *B. vulgaris* subsp. *maritima* (L.) Arcang. [= *B. perennis* (L.) Freyn.] with their characteristic thick root, grow on Tertiary red clays or on stony slopes in Idjevan, Erevan and Darelegis floristic regions, at altitudes ranging from 800 to 1800 m (Fig. 24). They occur in the Ararat valley, where they sometimes occupy slightly saline ground.

Other *Beta* species

In addition to *B. vulgaris* subsp. *maritima*, Armenia harbors also the following three wild *Beta* species (Takhtajan & Mulkidjanyan 1956; Melikyan 1989; Gandilyan & Melikyan 1999). All three are members of section *Corollinae*, that according to Ford-Lloyds (1995) are strongly reproductively isolated from the crop,

(I) Diploid ($2n=2x=18$) *B. lomatogona* Fisch. & C. A. Mey., native to the Trans-Caucasus, Asia Minor and North-West Iran. In Armenia it occurs in Shirak and Erevan floristic regions (Fig. 25) growing on dry rocky slopes in mountain steppes, at altitudes ranging from 1500 to 1800 m.

(II). Tetraploid ($2n=4x=36$) *B. corolliflora* Zosimovicz ex Battler. This beet too is a

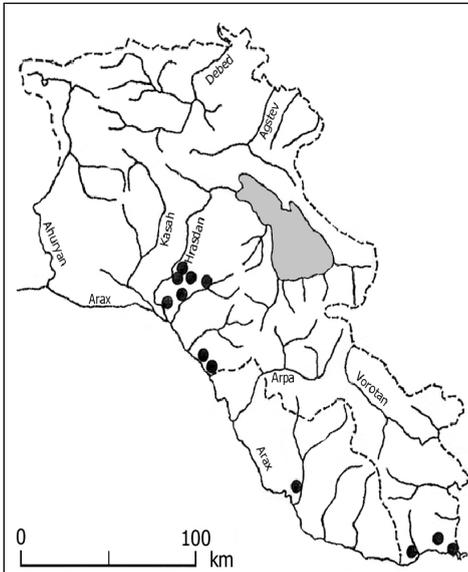


Fig. 28. Distribution of *Atriplex micrantha* Ledeb. [= *A. heterosperma* Bunge].

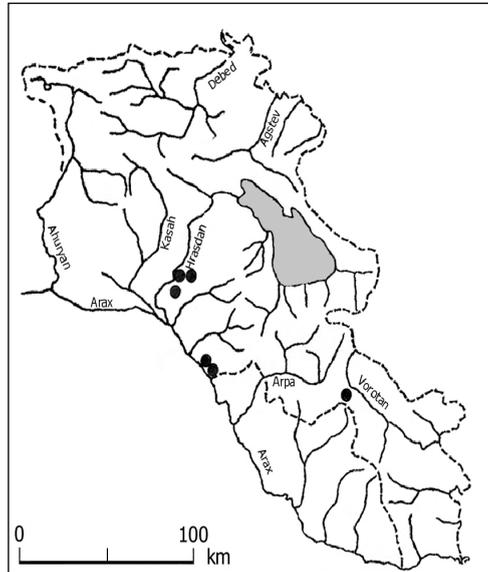


Fig. 29. Distribution of *Atriplex aucheri* Moq.

Trans-Caucasus, East Turkey and North-West Iran element. In Armenia it is recorded from Lori, Idjevan, Sevan, Aparan and Darelegis floristic regions (Fig. 26) occurring in the Middle and the Upper Mountain zones (1500 to 2100 m), growing on slopes, meadows, edges of forests and ruderal sites.

(III) Diploid ($2n=2x=18$) *B. macrorrhiza* Steven, native to Dagestan, the Southern and Eastern Caucasus, Eastern Turkey and North-West Iran, occurs in Armenia in Sevan and Darelegis floristic regions (Fig. 27). It occupies wet places, banks of lakes and fallow fields at altitudes ranging from 1400 to 2100 m. It is worth noticing that Burenin & Pivovarov (1998) report that the hybrids between *B. vulgaris* and *B. macrorrhiza* that they tested were fertile and produced seeds.

Orache, *Atriplex hortensis* L.

Orache (*Thal* in Armenian) is an annual herb, grown in Europe and South-West Asia for its leaves that are used like spinach. It is cultivated at least since Roman times (Small 1997; Hammer 2001). Its ancestry is not clear yet, although some wild *Atriplex* taxa, closely resembling the crop, appear to be attractive candidates. The identification of the crop's origin is further complicated by the occurrence of wild-growing weedy escapees in Central and South Europe and in the Caucasus. Two wild and weedy *Atriplex* species, native to South Russia, the Caucasus and West Asia, namely (I) *A. micrantha* Ledeb. [= *A. heterosperma* Bunge] and (II) *A. aucheri* Moq. are morphologically closely related to the crop. As Hedge (1997) already noted, very likely they belong to the *A. hortensis* crop complex.

What seem to be feral populations of *A. hortensis*, are rather common in Erevan floris-

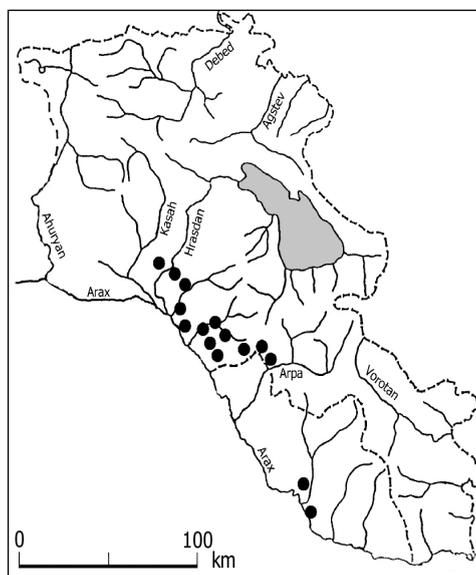


Fig. 30. Distribution of *Spinacia tetrandra* Steven ex M. Bieb.

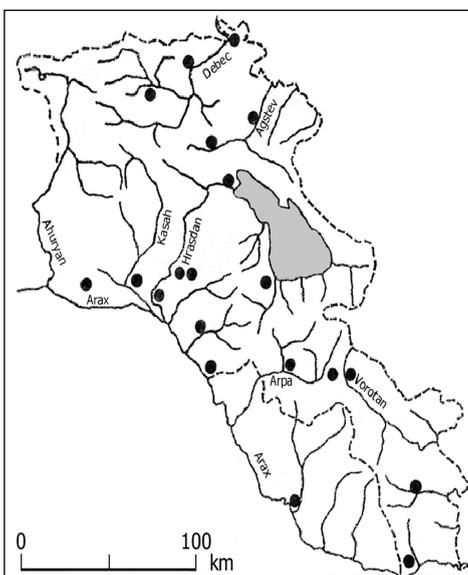


Fig. 31. Distribution of *Raphanus raphanistrum* L.

tic region, where they colonize gardens, loamy slopes, banks of streams and waste places (but rarely saline sites) at altitudes ranging from 700 to 1400 m. Also the two wild relatives pointed out by Hedge (1997) occur in this country. *A. micrantha* is found in Erevan and in Nakhichevan floristic regions (Fig. 28) colonizing edges of ditches, river banks, roadsides, and somewhat saline places, at altitudes ranging from 700 to 1600 m. Polymorphic *A. aucheri* thrives in Idjevan, Erevan and Zangezur floristic regions (Fig. 29) infesting gardens and colonizing roadsides and waste places. It also occurs in the semi-desert *Artemisia fragrans* formation, and on saline loamy slopes, at altitudes ranging from 800 to 1800 m.

Spinach, *Spinacia oleracea* L.

Spinach (*Spanakh* in Armenian) is an annual, dioecious, diploid ($2n=2x=12$) seed planted vegetable, grown for its leaves (Smith 1976; Sneep 1982). In addition to the crop, the genus *Spinacia* contains (Uotila 1997) two wild species: (I) *S. turkestanica* Iljin, which occurs in Central Asia, and (II) *S. tetrandra* Steven ex M. Bieb. native to the Trans-Caucasus, West Iran and Iraq. On morphological grounds, both these annual, dioecious, diploid ($2n=2x=12$) wild taxa seem closely related to each other. They also closely resemble the crop. Both might belong to the primary gene pool of the cultivated vegetable, and each might be the progenitor of the crop. However, their crossability and their genetic affinities with cultivated *S. oleracea* were not examined yet.

In Armenia *S. tetrandra*, characterized by its low habit and flat, somewhat fleshy leaves, is obviously native. The chromosome number in local populations is $2n=2x=12$ (Araratian

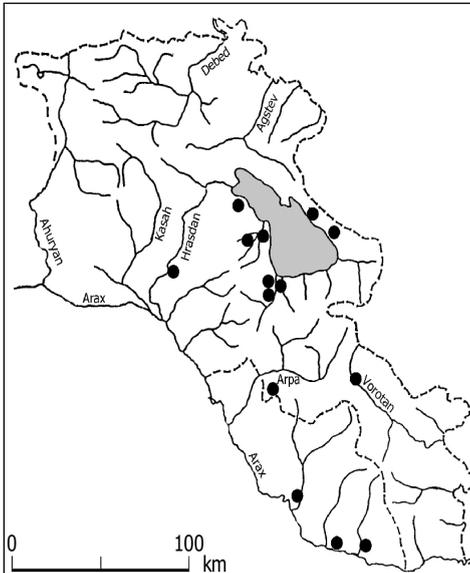


Fig. 32. Distribution of wild and weedy forms of salad rocket, *Eruca sativa* Mill. [= *E. vesicaria* (L.) Cav.].

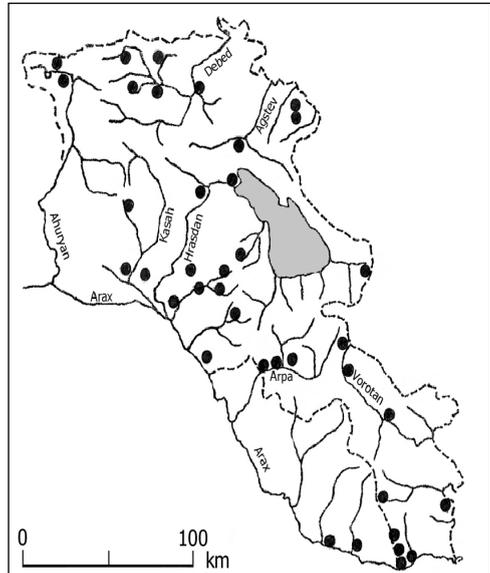


Fig. 33. Distribution of wild forms of watercress, *Rorippa nasturtium-aquaticum* (L.) Hayek [= *Nasturtium officinale* R. Br.].

1939). This wild spinach occurs in Erevan (Ararat valley), Darelegis and Nakhichevan floristic regions (Fig. 30). It grows on Tertiary red clays, and on stony slopes in semi-desert sagebrush and in phrygana formations, at altitudes ranging between 700 and 1600 m. *S. tetrandra* also appears occasionally as a weed in cultivation. Our impression is that in recent years *S. tetrandra* populations lost ground in this country, and became quite rare.

Garden sorrel, *Rumex rugosus* Campd.

The garden sorrel (*Thrthndjuk* in Armenian) is a traditional dioecious vegetable and potherb (Small 1997). Today it is only occasionally grown in Europe, but it is much more appreciated in the Caucasus, where it is consumed both fresh and cooked. The crop is yet of uncertain origin (Heywood & Zohary 1995). It closely resembles wild *R. acetosa* L. that is widely distributed over the temperate parts Europe and Asia. Most botanists regard this wild sorrel as the ancestor of the crop, and place the cultivars in *R. acetosa*. However, in some morphological features the domestic garden sorrel forms is closer to *R. thyrsiflorus* Fingerh., native to East, Central and North Europe. Therefore, some workers keep the cultivars apart (under the binomial *R. rugosus* Campd.). Very likely wild *R. acetosa* and wild *R. thyrsiflorus* are cytogenetically closely related to each other – as well as to the crop. Probably both wild taxa belong to the primary wild gene pool (GP-1) of the crop. All have $2n=2x=14$ chromosomes (in female individuals) and $2n=2x=15$ (in male ones).

In Armenia, wild *R. acetosa* is a rather common plant, occurring in Lori, Shirak, Aparan, Sevan, Daralegis, Zangezur and Meghri floristic regions. It thrives in meadows,

steppes and between rocks, and it climbs up to the alpine zone, being present at altitudes ranging from 1200 to 3200 m. Furthermore, in this country wild *R. acetosa* frequently complements the cultivated sorrel. It is extensively collected from the wild, and prepared for eating the same way the cultivars are being used.

In addition to the garden sorrel, also wild *Rumex crispus* L. (*Avelook* in Armenian) is highly appreciated in Armenia, both as a medicinal and as a culinary herb. It is a common plant in this country, extensively collected from the wild, and occasionally locally grown in farmhouses' gardens. The young sprouts and leaves of *R. crispus* are gathered in the Spring, dried in long braids, and used in a variety of local dishes.

Purslane, *Portulaca oleracea* L.

Purslane (*Dandur* in Armenian) cultivars [*P. oleracea* L. subsp. *sativa* (How.) Čelak.] are grown for their succulent leaves and young shoots. Weedy forms of purslane, such as hexaploid ($2n=6x=54$) subsp. *oleracea*, as well as the less common $6x$ subsp. *stellata* Danin & H.G. Baker, are common weeds all over Europe, North Africa and West Asia. They heavily infest irrigated summer cultivation all over the Mediterranean basin. The variable *P. oleracea* complex is however a meso-American element (Danin *et al.* 1979). Most of its races occur in this part of the World, including the diploid ($2n=2x=18$) and tetraploid ($2n=4x=36$) cytotypes.

In Armenia, *P. oleracea* is a very common summer weed (particularly in the Ararat valley) infesting irrigated gardens, vineyards and orchards. Both cultivars and wild forms are extensively used.

Radish, *Raphanus sativus* L.

Radish (*Bokhk* in Armenian) is an annual herb, widely grown mainly for its fleshy root (Pistrick 1987; Crisp 1995). The crop *Raphanus sativus* L. is apparently derived from its closely related wild *R. raphanistrum* L., with which it is fully inter-fertile. The latter is a diploid ($2n=2x=18$) self-incompatible, highly variable wild and weedy species; distributed over much of temperate Europe, the Mediterranean basin and West Asia (Pistrick 1987; Jalas & al. 1996).

In Armenia, *R. raphanistrum* is scattered over Lori, Idjevan, Sevan, Erevan, Darelegis, Zangezur and Meghri floristic regions, as well as in Nakhichevan (Fig. 31). It is a colonizer of waste places, edges of cultivation and dry stony sites, at altitudes ranging from 800 to 2000 m.

Salad rocket, *Eruca sativa* Mill. [= *E. vesicaria* (L.) Cav.]

Salad rocket (*Asoreak* in Armenian) is an annual, diploid ($2n=2x=22$) herb, grown for its foliage used as a salad herb since Roman times (Bianco 1995; Specht 2001). It is commonly grown in Armenia. Wild forms of *E. sativa*, fully inter-fertile with the crop, are native in the Mediterranean basin and in the Near East. Weedy and feral forms are more widely spread, and are found over most of Europe (Jalas *et al.* 1996) the Caucasus and South-West Asia.

In Armenia, wild-growing forms of *E. sativa* infest gardens and tilled fields, and colonize edges of cultivation and waste places. They also grow on dry stony sites. Their distri-

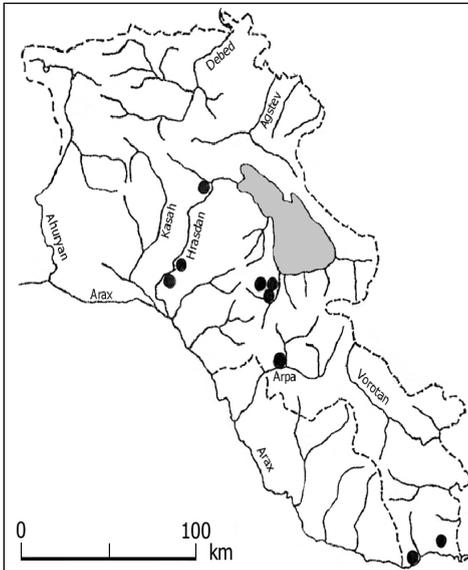


Fig. 34. Distribution of wild forms of the garden cress, *Lepidium sativum* L.

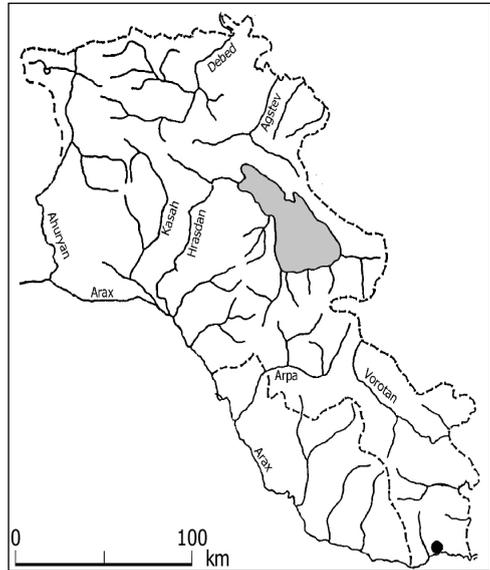


Fig. 35. Distribution of *Citrullus colocynthis* (L.) Schrad.

bution encompasses Shirak, Lori, Sevan, Erevan, Zangezur and Meghri floristic regions, as well as Nakhichevan (Fig. 32) at altitudes ranging between 800 and 2100 m.

Watercress, *Rorippa nasturtium-aquaticum* (L.) Hayek [= *Nasturtium officinale* R. Br.]

Watercress (*Dzhrkotem* in Armenian) is a rhizomatous, perennial herb with $2n=2x=32$ chromosomes, grown for its foliage as a salad vegetable, as well as a traditional medicinal herb (Small 1997; Specht 2001). Hybrids containing $2n=3x=48$ chromosomes are also used. They are products of hybridization between $2n=2x=32$ *R. nasturtium-aquaticum* and $2n=4x=64$ *R. microphylla* (Boenn.) Reichenb. Wild forms of *R. nasturtium-aquaticum* grow in wet places all over the Mediterranean basin, temperate Europe and temperate Asia. They also occur in some tropical parts of Asia and Africa (Rich 1991; Jalas & Suominen 1994).

In Armenia, wild forms of watercress occur along streams and in ditches, springs and marshes in the lower and middle mountain zones, at altitudes ranging from 500 to 1700 m, in Upper Ahuryan, Aragatz, Lori, Idjevan, Aparan, Sevan, Gegham, Erevan, Zangezur and Meghri floristic regions, as well as in Nakhichevan (Fig. 33).

Garden cress, *Lepidium sativum* L.

Garden cress (*Kotem* in Armenian) is an annual herb, grown as a salad plant. The cultivars (subsp. *sativum*) usually have crisp, simple leaves and spineless fruiting racemes (Small 1997; Specht 2001). Wild-growing forms of the garden cress [subsp. *spinescens* (DC.) Thell.] are usually characterized by pinnatifid leaves; and their fruiting racemes end in a spiny point. They seem to be native in South-West Asia and the Mediterranean basin,

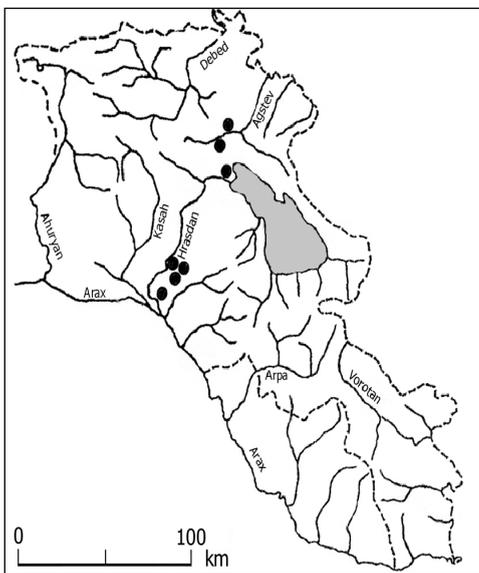
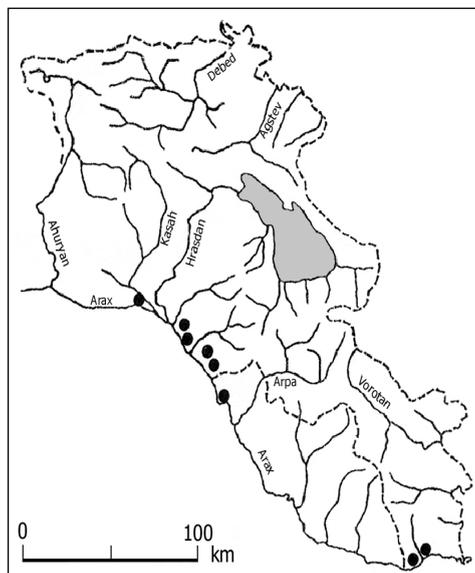


Fig. 36. Distribution of wild forms of melon, *Cucumis melo* L. subsp. *agrestis* (Naud.) Pangalo. Fig. 37. Distribution of wild forms of celery, *Apium graveolens* L.

and have been widely introduced into temperate Europe (Rich 1991).

In Armenia, wild-growing forms of *L. sativum* occur in Aparan, Sevan, Erevan, Darelegis and Meghri floristic regions (Fig. 34). They grow as weeds and colonizers in gardens, vineyards, tilled fields, edge of cultivation and in waste places, at altitudes ranging from 450 to 1500 m.

Watermelon, *Citrullus lanatus* (Thunb.) Mats. & Nakai

Watermelon (*Dzmeruk* in Armenian) is a trailing annual, cultivated for its large and juicy fruits. It was one of the earliest vegetables grown in ancient Egypt already in Bronze Age time (Zohary & Hopf 2000). Its wild ancestry is not yet definitely determined, and some of its closest wild relatives occur in southern Africa (Kirkbride 1993; Jeffrey 2001). However, the crop is also closely related to (and fully inter-fertile with) *C. colocynthis* (L.) Schrad., a perennial, wild watermelon widely distributed over the Saharan, Arabian, Iranian, Turkmen and Pakistani deserts, extending to some dry, sandy sites in the Mediterranean basin, the Trans-Caucasus and C. Asia.

In Armenia, *C. colocynthis*, with its characteristic bitter fruits, is a rare plant, restricted to few sandy and pebbly sites in semi-desert environments (c. 600 m altitude) along the Arax River in Meghri floristic region (Fig. 35).

Melon, *Cucumis melo* L.

Also the melon (*Sech*, *Duthma* or *Shamam* in Armenian) is one of the earliest vegetables taken into cultivation in the Old World. It was grown in Mesopotamia and Egypt

already in Bronze Age times (Zohary & Hopf 2000). Wild and weedy melon forms, fully inter-fertile with the *C. melo* cultivars, are widely distributed over the subtropical parts of Asia, as well as some parts of Africa and Australia. These wild forms are now included in the *C. melo* species complex (Jeffrey 1980, 2001; Kirkbride 1993). The wild forms native to South-West and Central Asia [often referred to as *C. melo* L. subsp. *agrestis* (Naud.) Pangalo; or as *C. callosus* (Röttl.) Cong.] are suspected to represent the wild stock from which the groups of melon cultivars traditionally grown in these parts of Asia could have been derived from.

In Armenia, wild and weedy *agrestis* forms occur (Fig. 36) in the Arax River valley in Erevan and Meghri floristic regions (Melikyan 2000). Until recently they were rather common weeds in irrigated cultivation of cotton and melons. However, as a result of the recent drastic changes in crop cultivation in these regions (particularly the decrease in cotton production) the wild melon populations shrunk considerably.

Celery, *Apium graveolens* L.

Celery (*Nekhur* in Armenian) is a biennial, diploid ($2n=2x=22$) aromatic herb, widely cultivated (Riggs 1995) for its young leaves [var. *secalinum* Alef.] its fleshy petioles [var. *dulce* (Miller) Pers.] or its turnip like swollen root [var. *rapaceum* (Mill.) Gaudin]. Wild forms of *A. graveolens*, fully inter-fertile with the cultivars, thrive in marshy places all over the Mediterranean basin (including the Black Sea), the Caucasus and the southern coast of the Caspian Sea (Meusel & al. 1978). Along the slightly saline coastal marshes of the Atlantic ocean *A. graveolens* extend north as far as the British Islands and Denmark.

In Armenia, wild forms of celery occur sporadically in wet, slightly saline places in Idjevan, Erevan and Sevan floristic regions (Fig. 37) at altitudes ranging from 800 to 2000 m.

Carrot, *Daucus carota* L.

Carrot (*Gazar* in Armenian) is an annual or biennial herb, cultivated for its edible root since Greek and Roman times (Zohary & Hopf 2000). The cultivated varieties [grouped in *D. carota* L. subsp. *sativus* (Hoffm.) Arcang.] are closely related to (and fully inter-fertile with) a highly variable aggregate of wild and weedy subspecies that are widely distributed over the Mediterranean basin, temperate Europe and West Asia (Heywood 1983). All are diploid ($2n=2x=18$), geitonogamous, and largely cross-pollinated plants. The other 20-22 wild species recognized in the genus *Daucus*, are far more distant. Attempts to cross several of them with the crop failed altogether.

In Armenia, wild and weedy forms of *D. carota* (*Giazruk* in Armenian) occur in Lori, Idjevan, Aparan, Sevan, Erevan, Darelegis, Zangezur and Meghri floristic regions, as well as in Nakhichevan (Fig. 38). They thrive in bush thickets, herbaceous open slopes, meadows, and in juniper or oak open forests. They also colonize edges of cultivation, roadsides and waste places - at altitudes ranging from 500 to 2100 m.

Parsnip, *Pastinaca sativa* L.

Parsnip (*Stepghin* in Armenian) is a biennial herb, grown since classical times for its edible root. Wild forms, grouped in several major races or subspecies, are widely distributed over much of temperate Europe and in the Caucasus (Small 1997; Pistrick 2001).

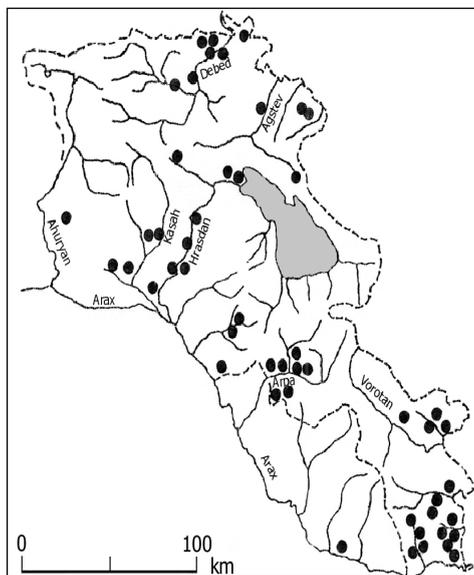


Fig. 38. Distribution of wild forms of carrot, *Daucus carota* L.

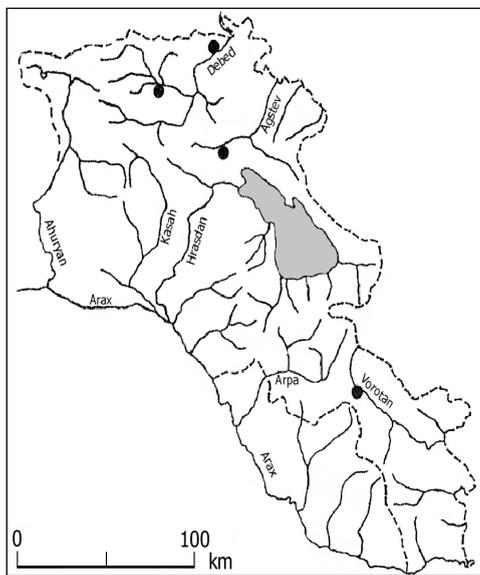


Fig. 39. Distribution of wild forms of parsnip, *Pastinaca sativa* L.

Feral populations are also common, particularly in the Northern parts of its distribution area. For this reason it is hard to delimit today its distribution before cultivation.

In Armenia, wild forms of parsnip occur in Lori, Idjevan and Zangezur floristic region (Fig. 39). They grow in bush thickets and at the edges of broad-leaved forests.

Chicory, *Cichorium intybus* L.

Chicory (*Egherdak* or *Charchatook* in Armenian) is a perennial, diploid ($2n=18$) herb, with branching flowering stems, and bright-blue flowers. The thick roots of some cultivars (Small 1997) are used for preparing a coffee substitute. Others are grown for their leaves and used in salads, or cooked. Wild and weedy forms of *C. intybus*, inter-fertile with the crop, are widely spread over most of temperate Europe, the Caucasus, and the relatively humid parts of South-West Asia and the Mediterranean basin (Meusel & Jäger 1992). They are common constituents of meadow communities; and colonizers of areas opened up by human activity.

In Armenia, wild forms of *C. intybus* are conspicuously variable. They are widespread throughout the country, as well as in Nakhichevan (Nazarova 1995) occupying a wide range of open habitats such as meadows, edges of forests, roadsides and margins of cultivation (Fig. 40) at altitudes ranging from 450 to 2000 m.

Lettuce, *Lactuca sativa* L.

Lettuce (*Marul* in Armenian) is an annual, diploid ($2n=4x=18$) predominately self-pollinated, and a leading salad crop. Both morphologically and genetically the cultivated lettuce shows close affinities to a group of 5-6 wild lettuce species native to South-West Asia,

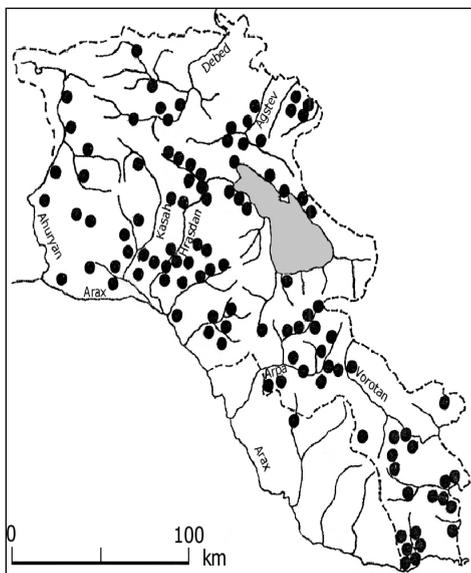


Fig. 40. Distribution of wild forms of chicory, *Cichorium intybus* L.

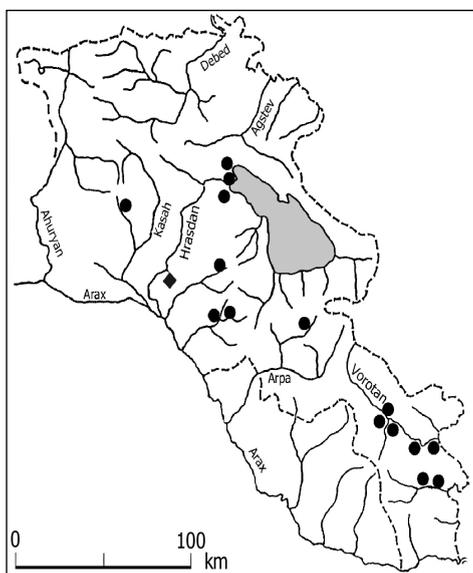


Fig. 41. Distribution of: ● *Lactuca georgica* Grossh. and ◆ *L. aculeata* Boiss. & Kotschy.

and a single species confined to South Africa (Zohary 1991). All these wild species are predominantly self-pollinated, summer flowering, annual (rarely biennial) plants. Five of them were already cytogenetically tested and found to be diploid ($2n=2x=18$) cross compatible and inter-fertile with the crop. Moreover, their close genetic affinities (both between themselves and with cultivated *L. sativa*) were recently further indicated by the find of close similarity in their internal transcribed spacer (ITS-1) sequences (Koopman & al. 1998). Among the wild species placed in the *Sativa* group, prickly lettuce, *L. serriola* L. is the closest wild relative of the crop (de Vries 1997; Koopman & al. 1998). It is regarded as the wild stock from which the cultivated lettuce has been derived. All other members of the *Sativa* group seem to belong to the primary wild gene pool (GP-1) of this vegetable.

(I) Prickly lettuce, *Lactuca serriola* L. (*Kathnook* in Armenian) is conspicuously weedy, and has characteristic vertically held leaves (in the north-south plane). It is the most common and widespread wild member of the *Sativa* group. As a weed, *L. serriola* is widely distributed over the non-tropical parts of Eurasia and North-West Africa (Meusel & Jäger 1992), occupying mainly disturbed areas such as waste places, roadsides, fallow and cultivated fields. In the Near East it also occurs in more primary habitats, such as rocky gullies, marls or basaltic slopes. It is frequently very variable, particularly in Turkey and Armenia. In post Columbus times *L. serriola* successfully invaded agricultural environments in North America, Australia and South Africa. In Armenia, *L. serriola* is a common summer weed all over the country. It massively colonizes agriculture lands, roadsides and waste places below 2000 m altitude.

(II) *Other members of the Sativa series of species:* In addition to *L. serriola*, the following two members of series *Sativa* occur in Armenia (Zohary 1991): (a) *Lactuca georgica* Grossh. This is a diploid ($2n=2x=18$), tall (up to 2.5 m), mesic plant, with large, entire, strongly dentate leaves. Its heads and flowers are bigger than those in *L. serriola*. It is largely a Trans-Caucasian element, but it extends also to Dagestan. Its distribution in Armenia is rather patchy, and covers the following floristic regions: Aragatz, Sevan, Erevan (Geghart), Gegham, Darelegis and Zangezur (Fig. 41). It occurs mainly in open places on basaltic bedrock and among rocks, at altitudes ranging from 1600 to 2200 m, and flowers and set seeds 2-3 weeks later than *L. serriola*. Crosses confirmed the close affinities between *L. georgica* and both *L. sativa* and *L. serriola*. The inter-specific F_1 hybrids obtained were fully fertile. (b) *Lactuca aculeata* Boiss. & Kotschy. Also this is a tall wild lettuce distributed in the Near East. Young plants, with aculeate leaves, conforming morphologically to this xeric wild species were recently discovered in the Erebuni wild cereals reserve, south of Erevan (Fig. 41) growing on clays in the relatively dry (semi desert) conditions that prevail in this location. Also *L. aculeata* is diploid ($2n=2x=18$) and fully inter-fertile with the crop. Up to date, this is the only known site of this wild lettuce in Armenia. It is also the most North-Eastern record for this species.

Asparagus, *Asparagus officinalis* L.

Cultivated asparagus (*Tsnebek* in Armenian) is a rhizomatous, diploid ($2n=2x=20$), dioecious, perennial vegetable, extensively grown (by seed or by vegetative propagation) for its young succulent shoots (“spears”). Wild forms of *A. officinalis* are widely distributed over the temperate parts of Europe, the Mediterranean basin, the Caucasus, and West and Central Asia. They are variable and not sufficiently studied cyto-genetically. Yet they are known to contain both diploid ($2n=2x=20$) and tetraploid ($2n=4x=40$) cytotypes. The $2x$ crop very likely originated from wild, diploid *officinalis* stock.

In Armenia, wild forms of *A. officinalis* are common in all floristic regions (including Nakhichevan) - from the foothills to the upper mountain zones (Fig. 42) at altitudes ranging from 600 to 2000 m (Tamanjan 2001). They thrive in bush thickets, steppes, along margins of forests, between rocks, in gorges and in meadows. Their young shoots are frequently collected from the wild. Chromosome counts were carried out in several collections (Tamanjan & Pogosian 1979). All turned out to be tetraploid.

The young shoots of two other asparagus species, namely *A. verticillatus* L. and *A. persicus* Baker, are also much appreciated in Armenia. They too, are commonly collected from the wild; and occasionally planted in farm houses' yards.

Leek, *Allium porrum* L.

Leek (*Pras*, *Savzi* in Armenian) is a bulbous vegetable grown for its bulbs and leaf-bases (leek cultivars), its leaves (kurrat cultivars), or its large garlic-like cloves (great headed garlic). Most cultivars (Brewster 1994) are tetraploid ($2n=4x=32$) and some are hexaploid ($2n=6x=48$). Leek is one of the earliest vegetables of the Old World (Zohary & Hopf 2000). It was grown in Egypt and in Mesopotamia already in Bronze Age times. The $4x$ and $6x$ cultivars are closely related to (and fully inter-fertile with) $4x$ and $6x$ wild and weedy forms of *A. ampeloprasum* L. The latter is a very variable polyploid complex ($2n =$

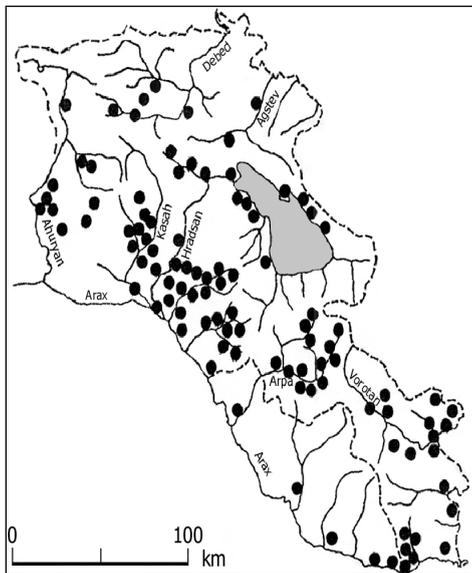


Fig. 42. Distribution of wild forms of *Asparagus officinalis* L.

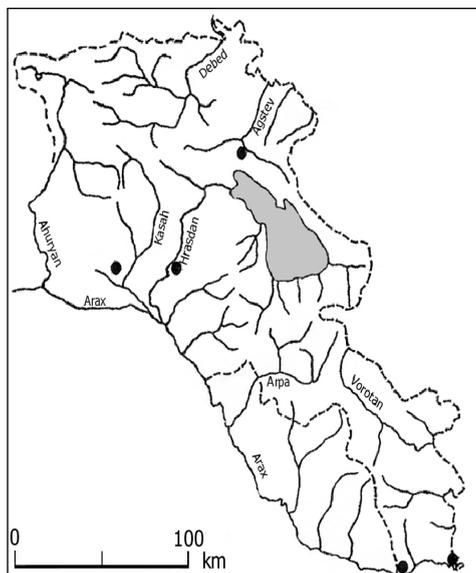


Fig. 43. Distribution of wild forms of *Brassica juncea* (L.) Czern.

16, 24, 32, 40, 48) native to the Mediterranean basin, the warmer parts of temperate Europe, South-West Asia, and the Caucasus (Jones 1990; Mathew 1996)

Armenia harbors the following two wild taxa, which are commonly included in the variable *A. ampeloprasum* complex (Oganesian & Agababian 2001): (I) var. *leucanthum* (K. Koch) Ledeb. [= *A. leucanthum* K. Koch] which grows on dry stony slopes, scree, sandy places, at edges of cultivation and in waste places - in Idjevan, Zangezur and Meghri floristic regions, at altitudes ranging from 550 to 1500 m. (II) var. *atroviolaceum* (Boiss.) Regel [= *A. atroviolaceum* Boiss.] that thrives in semi-desert *Artemisia fragans* formation, in mountain steppes, open juniper forests and shibliak, as well as in cultivation and waste places. This wild leek occurs in Shirak, Lori, Aparan, Sevan, Erevan, Darelegis, Zangezur and Meghri floristic regions, and also in Nakhichevan, at altitudes ranging from 700 to 2300 m. It thrives in semi-desert *Artemisia fragans* formation, in mountain steppes, in open juniper forests and shibliak, as well as in cultivation and waste places.

Several other wild *Allium* species in Armenia are collected from the wild for flavoring different dishes and cheeses. Selected forms of such species are sometimes locally grown in family gardens.

Condiments

Brown mustard, *Brassica juncea* (L.) Czern.

Brown or Indian mustard (*Mananekh* in Armenian) is an annual, self-pollinated, allo-

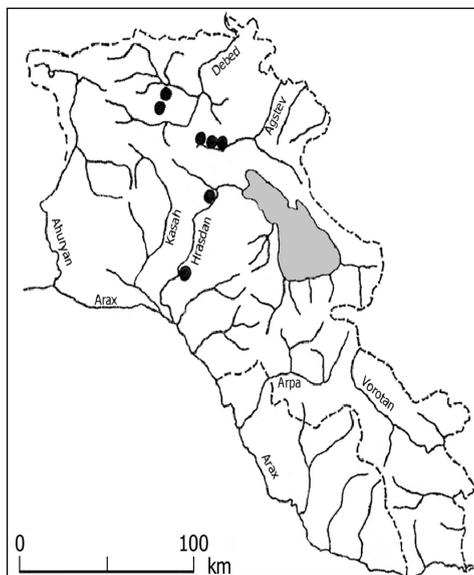


Fig. 44. Distribution of wild-growing horseradish, *Armoracia rusticana* P. Gaertn.

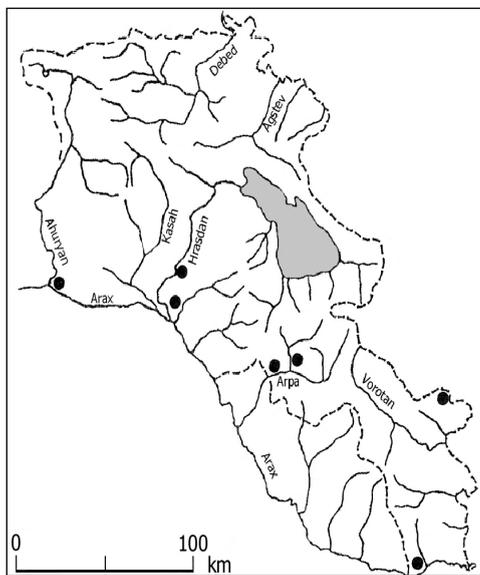


Fig. 45. Distribution of wild forms of black cumin, *Nigella sativa* L.

tetraploid ($2n=4x=36$) crop, which originated by hybridization between diploid ($2n=2x=16$) *B. nigra* and diploid ($2n=2x=20$) *B. rapa*. Seed varieties of *B. juncea* are used (Hemingway 1995) for: (I) extraction of edible oil, and (II) as an ingredient (in combination with white mustard *Sinapis alba*) for preparation of the mustard spice. Wild and weedy forms of *B. juncea* are widely distributed over Central and South-West Asia, the Caucasus, Siberia and north India.

In Armenia, *B. juncea* - with its characteristic bright yellow flowers - is native in the lower mountain zone in Idjevan, Erevan and Meghri floristic regions (Fig. 43) growing on dry, stony slopes, on clays and in waste places.

Horseradish, *Armoracia rusticana* P. Gaertn., B. Mey. & Schreb.

Horseradish (*Ktsvich* in Armenian) is a perennial, tetraploid ($2n=4x=32$) herb, widely cultivated (by vegetative propagation) for its rhizomes that are used as a spicy condiment (Courter & Rhodes 1969). Similar to several other vegetatively propagated root or corm crops, horseradish cultivars rarely set viable seeds. The origin of the domestic horseradish is yet unclear. Wild-growing populations of horseradish are widely distributed over temperate parts of Europe and Asia, but most workers (see Rich 1991; Jalas & Suominen 1994; Specht 2001) regard most of them as introduced. They also suggest that *A. rusticana* is possibly native in the Volga-Don region of South Russia and East Ukraine. However, this proposition needs further verification.

In Armenia, what appear to be naturalized populations of *A. rusticana* thrive along

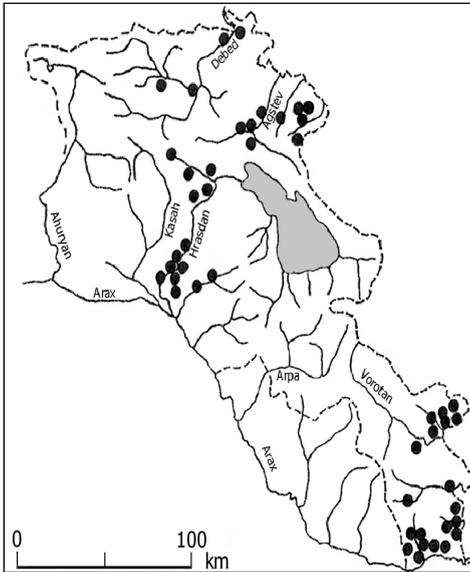


Fig. 46. Distribution of wild forms of hop, *Humulus lupulus* L.

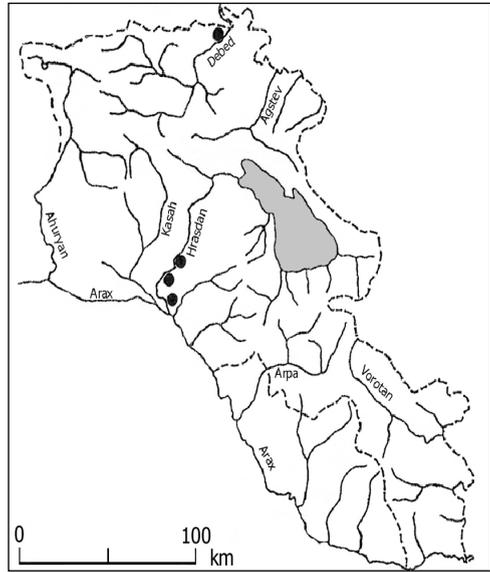


Fig. 47. Distribution of wild forms of fennel, *Foeniculum vulgare* Mill.

streams and rivers in the north and central parts of the country, in Lori, Idjevan, Sevan and Erevan floristic regions (Fig. 44). They seem to be well established in these areas.

Black Cumin, *Nigella sativa* L.

Black Cumin (*Sonich* in Armenian) is an annual, seed planted herb grown for its seeds that are widely used to flavor bread, cakes and various kinds of pickles (Small 1997). Wild growing forms of *N. sativa* are probably native in South-West Asia, and naturalized in parts of South Europe and North-West Africa.

In Armenia, wild forms of black cumin occur in Erevan, Darelegis, Zangezour and Meghri floristic regions (Fig. 45). They appear as weeds in cultivation, and also colonize dry slopes and waste places, at altitudes ranging from 700 to 1300 m.

Hop, *Humulus lupulus* L.

Hop (*Gayluk* in Armenian) is a dioecious, wind pollinated, vegetatively propagated, diploid ($2n=2x=20$) climber, widely grown for its female inflorescences used to contribute both bitterness and aroma to beer. The plants have a perennial rootstock; but their aerial parts die back each winter. Wild forms of *H. lupulus* are widespread throughout much of the temperate parts of Europe, Asia and North America. They have diverged into five inter-fertile eco-geographical subspecies (Neve 1995; Small 1997). Spontaneous crosses between wild and cultivated forms seem to be quite common. So are feral populations. For these reasons it is hard to define the original, pre-cultivation distribution of the wild forms.

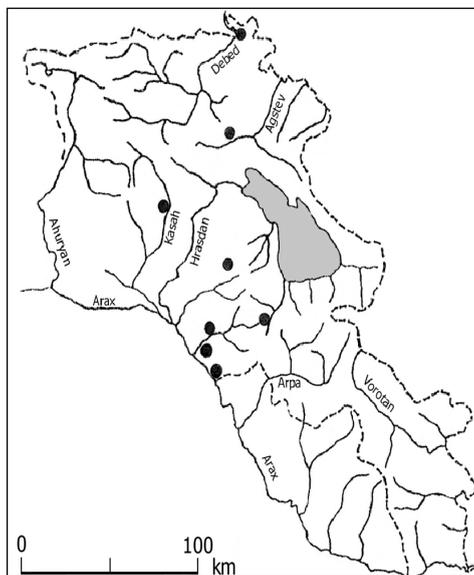


Fig. 48. Distribution of wild forms of coriander, *Coriandrum sativum* L.

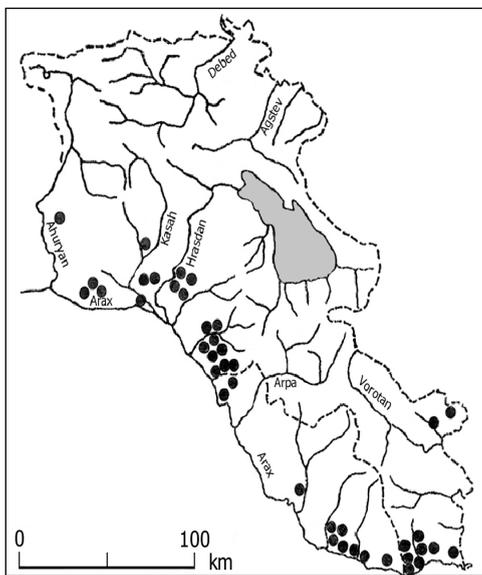


Fig. 49. Distribution of *Cymbocarpum anethoides* DC.

In Armenia wild-growing populations of *H. lupulus* are rather common. They thrive in wet places along streams and river terraces, and in bush thickets in Lori, Idjevan, Aparan, Erevan, Zangezur and Meghri floristic regions (Fig. 46) at altitudes ranging from 500 to 1000 m.

Fennel, *Foeniculum vulgare* Mill.

Cultivated fennel (*Razina* in Armenian) commonly referred to as *F. vulgare* Mill. subsp. *vulgare* is a diploid ($2n=2x=22$) biennial or perennial herb (Small 1997, Pistrick 2001). It is widely grown (by seed) for its fleshy leaf bases used in salads and for cooking (Florence fennel cultivars), for its mericarps (“seeds”) and leaves used for flavoring (sweet fennel cultivars), and for medicinal purposes (bitter fennel cultivars). Wild forms of fennel commonly referred to as subsp. *piperitum* (Urcia) Cout. [= *F. piperitum* (Urcia) Presl.] are apparently native in the Mediterranean basin and in the Near East. As weeds and colonizers they extend over much wider territories.

In Armenia wild forms of *F. vulgare* are quite rare. They occur in Idjevan and Erevan floristic regions (Fig. 47) where they grow along irrigation canals, at roadsides and in bush thickets, at altitudes ranging from 700 to 800 m.

Coriander, *Coriandrum sativum* L.

Coriander (*Hamem* or *Gindz* in Armenian) is an annual, diploid ($2n=2x=22$) largely self-pollinated herb, extensively grown (by seed planting) for its aromatic leaves and for its dry fruits (Diederichsen 1996; Small 1997). It is one of the earliest condiment crops of the Old World. It remains were uncovered in archaeological excavations in the Near East

and Egypt already in Neolithic and Bronze Age contexts (Zohary & Hopf 2000). Records on the crop's wild relatives are yet discouragingly few. Truly wild forms, growing on rocky non-arable grounds in dwarf-shrub and in steppe-type vegetation, are known from Northern Israel and from Turkey. Very likely they exist also in other parts of the Near East. Weedy forms and escapees are more widely distributed. They occur, rather sporadically, in the Mediterranean basin and in several South-West Asian countries, along roadsides, in waste places, at edges of agriculture as well as in cereal cultivation.

In Armenia weedy forms of *C. sativum* occur in Idjevan, Aparan, Sevan and Meghri floristic regions, as well as in Nakhichevan (Fig. 48).

Cymbocarpum anethoides DC.

This umbellifer (*Sari hamem* in Armenian) is an appreciated local condiment with a coriander-like taste. In Armenia it serves as a replacement for coriander during the dry and hot summer, when the foliage supply of the latter dwindles and becomes unavailable. It is grown (as well as collected) in the western, central and southern parts of the country. Wild forms of *C. anethoides* grow on dry stony slopes, and on screes in Shirak, Erevan, Zangezur and Meghri floristic regions, as well as in Nakhichevan (Fig. 49) at altitudes ranging from 500 to 1500 m.

Caraway, *Carum carvi* L.

Caraway (*Khemon* in Armenian) is a diploid ($2n=2x=22$) largely biennial herb (some cultivars are annual) grown (by seed planting) for its aromatic mericarps ("seeds") used to flavor foods and drinks (Small 1997). Truly wild forms of this condiment occur in eastern Anatolia, the Caucasus, the Trans-Caucasus, and Central Asia where they grow in meadows within the forest zone. They seem to be native also in some parts of temperate Europe. In addition, naturalized populations of caraway are widely scattered in temperate Europe, mainly in waste places.

In Armenia, wild forms of *C. carvi* are characteristic elements of mountain meadows (middle to upper zones, 1200 to 2600 m. altitude) in Lori, Idjevan, Aparan, Sevan, Darelegis, Zangezur and Meghri floristic regions (Fig. 50).

Oregano, *Origanum vulgare* L.

Oregano (*Khkatsaghik* in Armenian) is a perennial, diploid ($2n=2x=30$) herb, widely grown (mostly by vegetative propagation) for its aromatic leaves that serve to flavor foods, for medicinal purposes, and for extraction of essential oils (Small 1997). Wild forms of *O. vulgare* are widely distributed over the Mediterranean basin, temperate Europe, the Caucasus and South-West and Central Asia. They are highly variable, and they have diverged into numerous variants and eco-geographical races. Six subspecies have been recognized (Ietswaart 1980; Pistrick 2001).

In Armenia and Nakhichevan, wild forms of *O. vulgare* are widely distributed (Fig. 51). They abound in the lower, middle and upper altitude zones (between 1200 and 2200 m) in mountain steppes, meadows, bush thickets and forests, practically all over the country. *O. vulgare* is commonly collected in the wild. Selected clones are also planted in this country, particularly in family gardens.

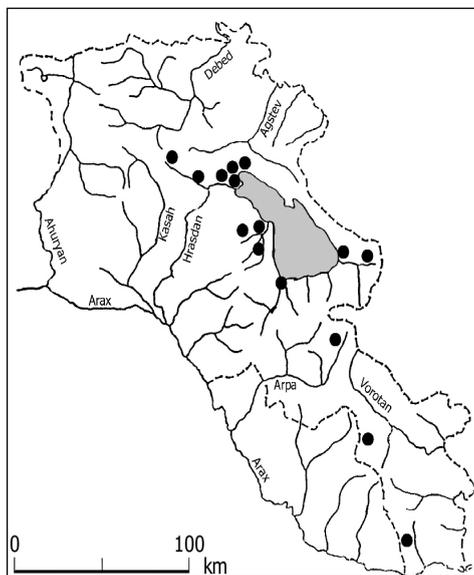


Fig. 50. Distribution of wild forms of caraway, *Carum carvi* L.

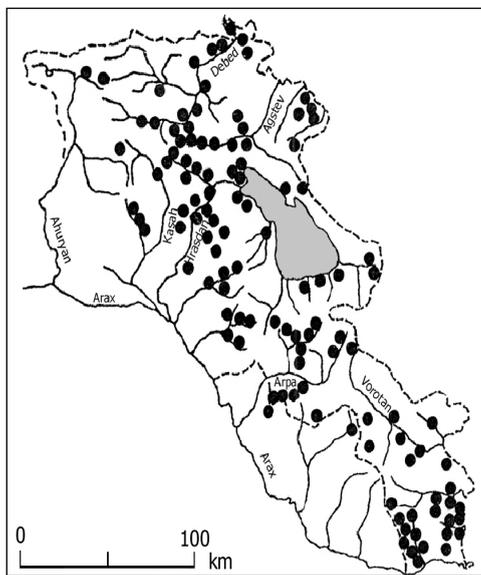


Fig. 51. Distribution of wild forms of oregano, *Origanum vulgare* L.

Thymus kotschyanus Boiss. & Hohen.

This thyme (*Urtz* in Armenian) is a strongly ramified, aromatic dwarf shrub extensively collected as well as locally grown (in Armenia) for its foliage, used to prepare a popular herbal tea, flavor foods and beverages, and for medicinal purposes. *T. kotschyanus* is a Caucasian and South-West and Central Asian element.

In Armenia and Nakhichevan, *T. kotschyanus* occurs practically over the whole country - from the lower to the upper altitude zones (Fig. 52). It occupies dry, warm, stony or rocky slopes and scree. It is an important component of meadows, mountain steppes and phrygana-type vegetation all over the area. Also this aromatic herb is commonly collected from the wild; and selected clones are grown in family gardens.

Mints, *Mentha* L.

The genus *Mentha* (*Daghdz* in Armenian) includes a variable group of perennial cultivars that are extensively grown (by vegetative propagation) for their aromatic foliage, for their essential oils which are widely used to flavor foods and drinks, and in medicine. Mints under domestication seem to have had a complex origin. Some domestic clones were most likely directly derived from several European and West Asian *Mentha* species. Many other domestic mint clones are inter-specific hybrids (often sterile hybrids), products of crosses (sometimes composite crosses) between five or six European *Mentha* species (Harley and Brighton 1977; Small 1997; Hammer 2001). Some of the mint cultigens have also extensively naturalized, and/or their variation has been enriched by introgression from other mint taxa.

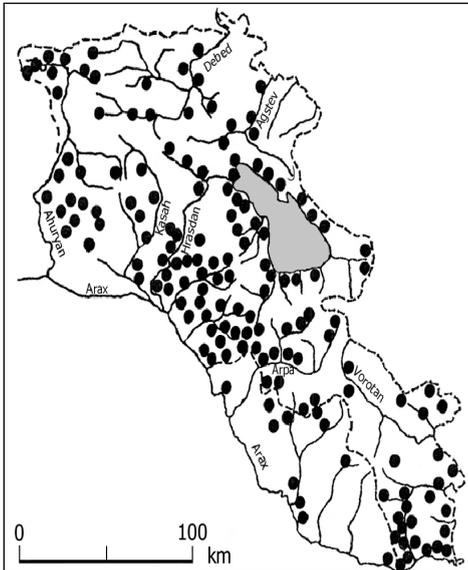


Fig. 52. Distribution of *Thymus kotschyanus* Boiss. & Hohen.

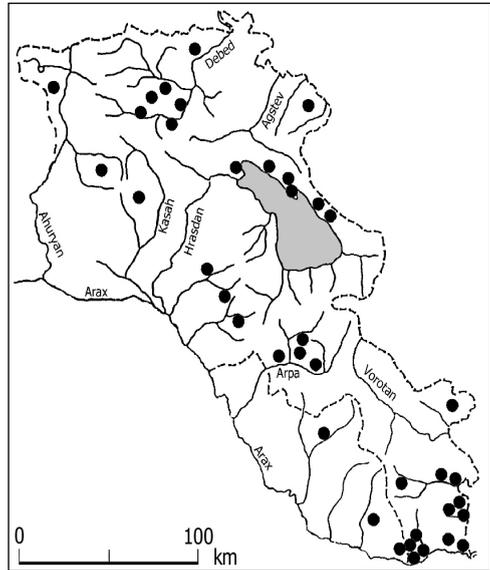


Fig. 53. Distribution of wild forms of summer savory, *Satureja hortensis* L.

One of the European wild *Mentha* species from which cultigens have evolved is the silvery mint, *M. longifolia* (L.) L. Domestic clones of this species are grown for their spearmint-scented leaves, particularly in South-West and Central Asia. In addition, the silvery mint is identified as one of the two diploid parents that participated in the formation of the allo-tetraploid spearmint *M. spicata* L. It is also one of the parents that hybridized to form the hybrid taxon *M. x rotundifolia* (L.) Hudson [= *M. longifolia* x *M. suaveolens*] (Harley and Brighton 1977; Small 1997).

Wild forms of *M. longifolia* are common in Armenia, occupying wet places along streams and rivers, canals and shores of lakes - in all the floristic regions of this country, at altitudes ranging from 500 to 2500 m. Two other mint species, namely *M. arvensis* L. and *M. pulegium* L. are less common in Armenia. *M. arvensis* occurs in wet places in Upper Ahuryan, Lori, Idjevan (Dilizhan), Aparan (Hrazdan), Sevan and Erevan (Masis, Sarvanlar) floristic regions. It was apparently involved in the formation of the domestic hybrid taxon *M. x gentilis* L. [= *M. arvensis* x *M. spicata* L.]. *M. pulegium* is less common. It is confined only to Idjevan floristic region (near Alaverdy).

Summer savory, *Satureja hortensis* L.

This aromatic plant (*Korthin* or *Tzithron* in Armenian) is an erect, rather densely pubescent, annual, aromatic herb, widely grown (by seed planting) in the Mediterranean basin, the Caucasus and South-West Asia for its foliage that serves to flavor foods and drinks (Small 1997; Pistrick 2001). The plant is widely used in Armenia both fresh (with cheese, fish, etc.) and dry (with numerous local dishes). *S. hortensis* is also commonly used in tra-

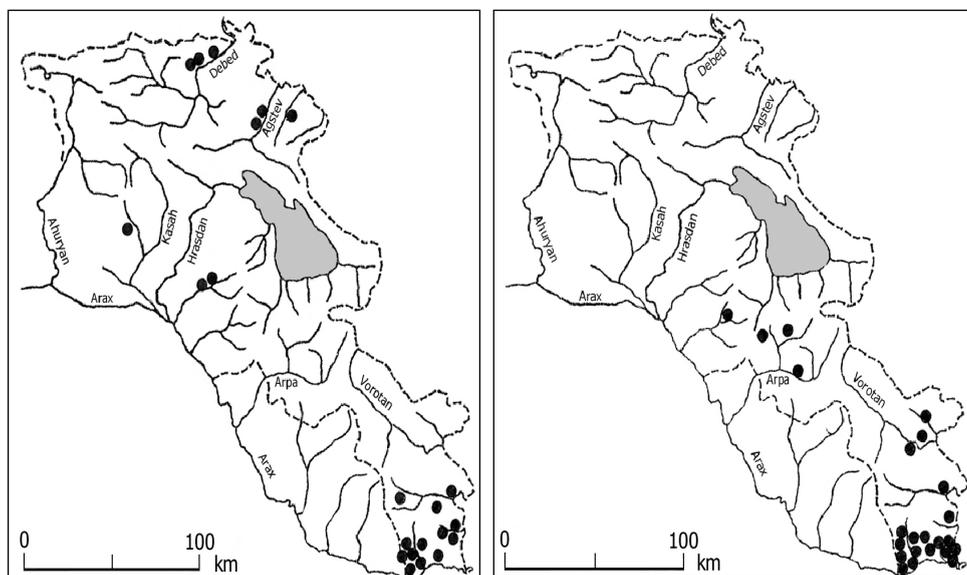


Fig. 54. Distribution of wild forms of lemon balm, *Melissa officinalis* L. Fig. 55. Distribution of sumac, *Rhus coriaria* L.

ditional medicine. It is apparently native in the Eastern Mediterranean basin, the Near East, west Iran and the Caucasus (Dagestan, Trans-Caucasus, Talysh). However, it is difficult to delimit its native distribution area because this aromatic plant frequently escapes from cultivation. Feral or introduced populations of *S. hortensis* occur over much wider areas. They are now scattered over large parts of Europe, Central Asia, Siberia, the Himalayas as well as North America (Small 1997).

In Armenia, wild populations of *S. hortensis* occur in Upper Ahuryan, Shirak, Aragatz, Lori, Idjevan, Sevan, Darelegis, Erevan, Zangezur and Meghri floristic regions as well as in Nakhichevan (Fig. 53). They grow on dry, stony or sandy slopes, at altitudes ranging between 500 and 2200 m.

Lemon balm, *Melissa officinalis* L.

Lemon balm (*Pathrindzh* in Armenian) is a perennial herb grown (both by planting seeds and by vegetative propagation) for its lemon-scented foliage, used to flavor food, for preparation of herbal tea, and for use in traditional medicine (Small 1997; Pistrick 2001). A local garden variety has evolved in Armenia with thick, fragile stems and leaves. It is being used as a fresh salad herb, much like the local fleshy cultivars of basil or tarragon. Wild forms of *M. officinalis* are native in the East Mediterranean basin, the Caucasus and South-West Asia.

In Armenia, wild forms of *M. officinalis* occur in Aragatz, Idjevan, Zangezur and Meghri floristic regions (Fig. 54) occupying rather wet, deep soils at edges of oak-hornbeam forests, and in natural *Platanus orientalis* and *Juglans regia* groves, at altitudes ranging from 600 to 1600 m.

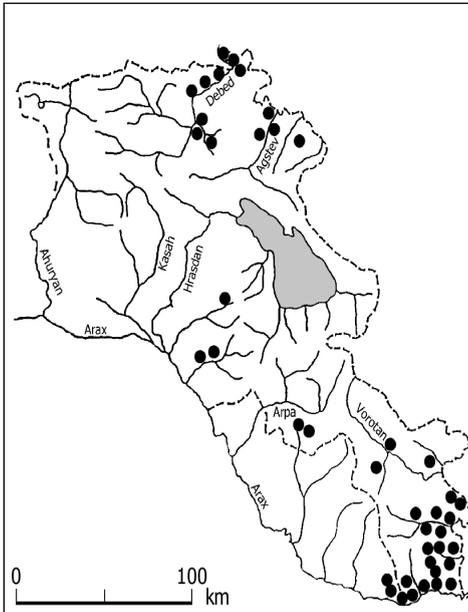


Fig. 56. Distribution of wild forms of grape vine, *Vitis vinifera* L. subsp. *sylvestris* (C.C. Gmelin) Hegi.

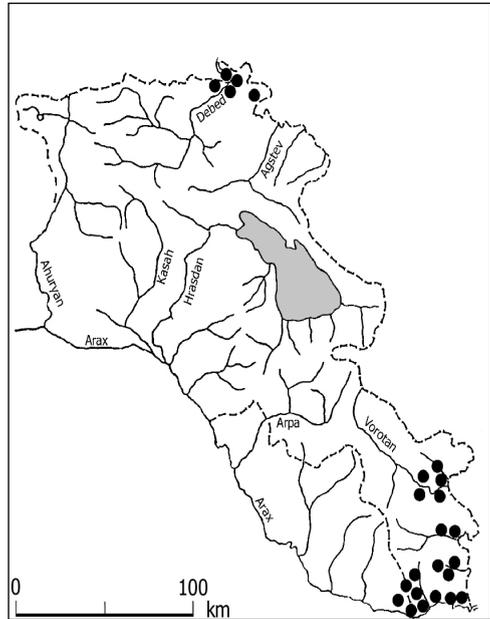


Fig. 57. Distribution of wild forms of fig, *Ficus carica* L.

Wormwood or absinthe, *Artemisia absinthium* L.

Wormwood (*Oshindr* in Armenian) is a perennial, diploid ($2n=2x=18$) herb, grown for flavoring of alcoholic drinks, for extraction of its essential oils (Small 1997); and traditionally, also as a vermifuge. Wild and weedy forms of wormwood are widely distributed over the temperate parts of Europe, the Caucasus, West Siberia and Central Asia (Meusel & Jäger 1992).

In Armenia, wild and weedy forms of *A. absinthium* occur all over the country. They are particularly common in waste places, at roadsides and in and near cultivation, at altitudes ranging from 500 to 2500 m.

Tarragon, *Artemisia dracunculus* L.

Taragon (*Tharkhun* in Armenian) is a perennial aromatic herb grown for its foliage used for culinary purposes (Small 1997). *A. dracunculus* is an insufficiently studied polyploid complex ($2n=18, 36, 54, 72, 90$). It is represented in cultivation by at least two polyploid chromosomal strains: 'Russian tarragon' is a fertile decaploid ($2n=10x=90$), while 'French tarragon' is a sterile, vegetatively propagated, tetraploid ($2n=2x=36$) (Zeven & de Wet 1982). Wild forms of *A. dracunculus* are widely distributed over South-East Europe and temperate West and Central Asia.

In Armenia, tarragon is widely cultivated all over the country. Occasionally this condiment escapes from cultivation and becomes naturalized.

Sumac, *Rhus coriaria* L.

Sumac (*Sumakh* in Armenian) is an erect, suckering, dioecious bush, grown in the Mediterranean basin and South-West Asia at least since classical times. It is planted for the following usages: (I) The leaves, the young shoots and other parts of the plant contain considerable amounts of tannins; and have been widely used for tanning and dyeing of animal skins. (II) The crushed, mature red fruits flavor foods (particularly meat and fish). *R. coriaria* was widely planted in the past, but today its role as a tanning element has decreased drastically. Wild-growing populations of sumac occur all over South Europe, the Caucasus, South-West and Central Asia - from the Canary Islands to Tadjikistan (Browicz 1984). However, it is hard to decide how much of these wild-growing bushes are genuinely wild, and what part of them is feral.

In Armenia, wild (or wild-growing) populations of *R. coriaria* occur (Mulkidjanyan 1973) in Idjevan, Erevan (Khosrov reserve), Darelegis (Vaikh), Zangezur and Meghri floristic regions, as well as in Nakhichevan (Fig. 55). They thrive in juniper open forests, on scree, in shibliak and bush thickets, growing on south facing, dry, stony slopes, at elevations ranging between 600 and 1200 (1700) m, sometimes forming dense pure stands. Some of *R. coriaria* main associates are *Juniperus polycarpus*, *Celtis tournefortii*, *C. caucasica*, *Amygdalus fenzliana*, *Pistacia mutica*, *Jasminum fruticans* and *Rhamnus pallasii*.

Fruit Crops

Grape vine, *Vitis vinifera* L.

The cultivated grape vine, *V. vinifera* L. subsp. *vinifera* (*Khaghogheni*, *Khaghogh* in Armenian) is closely related to, and fully inter-fertile with, an aggregate of wild forms commonly referred to as *V. vinifera* L. subsp. *sylvestris* (C. C. Gmelin) Hegi [= *V. sylvestris* C. C. Gmelin]. These wild grapes are largely forest climbers. They are widely distributed over the relatively humid parts of the Mediterranean basin (including the Black Sea) and over South-West Asia - from the Atlantic coast of the Iberian Peninsula to North Iran (Zohary & Hopf 2000), and they extend to Turkmenia and Tadjikistan (Zaprjagaeva 1964). *Sylvestris* grapes differ from the cultivated varieties by their smaller and usually rather acid berries, and by their more globular pips. Wild *sylvestris* populations are dioecious, and contain 50% female and 50% male individuals. Under domestication, dioecy is almost fully replaced by hermaphroditic cultivars.

In Armenia, wild *V. vinifera* subsp. *sylvestris* occurs both in the northern and in the southern parts of the country, growing in relatively mild subtropical niches in Lori, Idjevan, Erevan, Darelegis, Zangezur and Meghri floristic regions, as well as in Nakhichevan (Fig. 56). They are conspicuous climbers both in riparian forests and in open mixed forests, in altitudes ranging from 500 to 1400 m. In these habitats *V. vinifera* is frequently associated with *Platanus orientalis*, and with wild forms of *Juglans regia*, *Ficus carica* and *Punica granatum*.

Fig, *Ficus carica* L.

The fig (*Thzeni*, *Thuz* in Armenian) is a functionally dioecious, diploid ($2n=2x=26$) fruit tree, with large, lobed (rarely simple) leaves. It is a characteristic Mediterranean fruit crop

(Zohary 1995) and one of the founders of horticulture in this region. Wild forms of *Ficus carica* are widely distributed over the Mediterranean basin, the Near East “Fertile Crescent” belt, the south shore of the Black Sea, and the Hyrcanic vegetation belt in the southern Caspian basin. They further extend eastwards to several sites in central Asia (Browicz 1986; Zohary & Hopf 2000).

In Armenia, wild forms of *F. carica* occur both in the northern and in the southern parts of this country, growing in relatively mild, dry, “subtropical” niches in Lori, Idjevan, Zangezur and Meghri floristic regions. They also occur in Nakhichevan (Fig. 57). They thrive on open, calcareous, stony slopes, in cracks between rocks and in cliffs, ruins, gorges, bottomlands, and open mixed forests at altitudes ranging from 500 to 1500 m. In these habitats *F. carica* is frequently associated with *Punica granatum*, *Vitis vinifera* subsp. *sylvestris*, *Amygdalus fenzilana*, *Diospyrus caucasicus*, *Berberis iberica*, *B. turkomanica* and *Cercis griffithii*.

Pomegranate, *Punica granatum* L.

The pomegranate (*Nrneni*, *Nur* in Armenian) is a deciduous bush or small tree, with large (3-5 cm) scarlet-red flowers. The fruits (in wild forms) are round, 3-7 cm in diameter, protected by a hard rind. They contain numerous fleshy, juicy seeds, which are usually tart (but sometimes also sweet) in taste. Wild *P. granatum* is a West and Central Asian element. It is particularly common in the belt of Hyrcanic vegetation in the southern Caspian basin. It extends westward as far as the southern Balkan, and eastward to Tadzhikistan and the western Himalayas (Browicz 1996).

In Armenia, populations of wild, bushy, more or less small fruited *P. granatum* thrive in the northern and southern parts of the country, namely in Idjevan, Zangezur and Meghri floristic regions (Fig. 58). They occur in altitudes ranging from 500 to 1200 meters, growing in flood plains, stony and loamy slopes, screes, crevices in rocks, shibliak bush formations, and in open mixed forests. In these habitats the wild pomegranate is frequently associated with *Ficus carica*, *Amygdallus fenzliana*, *A. nairica*, *Acer iberica*, *Carpinus schuschensis*, *Cotynus coggygria*, *Berberis iberica*, *B. turcomanica*, *B. crataegyna*, *Cercis griffithii* and *Rosa* ssp. Climatically pomegranate is a moderately hardy bush, withstanding winter temperatures as low as -15°C.

Gooseberry, *Grossularia reclinata* (L.) Mill. [= *Ribes uva-crispa* L.]

Gooseberry (*Kokrosh* in Armenian) is a spiny shrub, up to 1.5 m in height, grown for its round or ovoid, green, purple or yellow berries. Wild forms are widespread over the temperate parts of Europe, the Caucasus, South-West Asia and Turkmenia. The genus *Grossularia* is frequently included (as a distinct subgenus) in the genus *Ribes*.

In Armenia, wild forms of *G. reclinata* grow in broad-leafed forests (or at the edges of such forests) and in rocky streams, in the upper mountain zones at altitudes ranging from 1300 to 2500 m. They occur in Upper Ahuryan, Lori, Idjevan, Aparan, Sevan, Erevan, Darelegis and Meghri floristic regions, as well as in Nakhichevan (Fig. 59).

Currants, *Ribes* L.

Both the black currant *Ribes nigrum* L. and the red currant *R. rubrum* L. (*Haghardj sev*

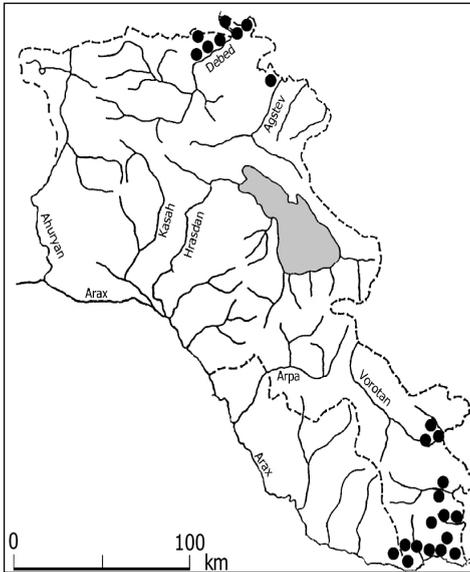


Fig. 58. Distribution of wild forms of pomegranate, *Punica granatum* L.

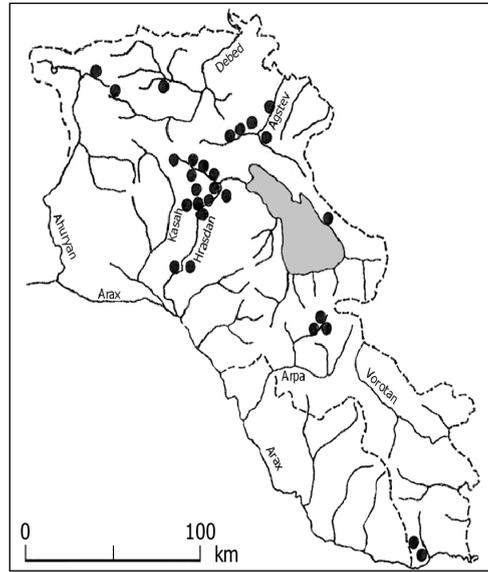
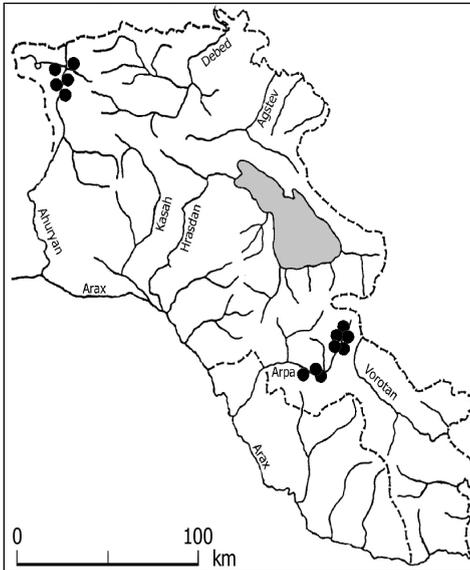
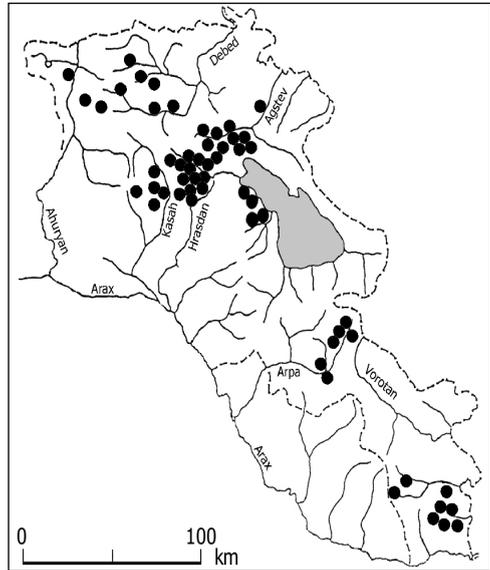


Fig. 59. Distribution of wild forms of gooseberry, *Grossularia reclinata* (L.) Mill.

and *Haghardj karmir* in Armenian) were very likely introduced into cultivation only in the last 400-500 years (Keep 1995; Fritsch 2001). Today, they are widely grown (by vegetative propagation) for their juicy berries, particularly in the cooler parts of the World. *Ribes* L. is relatively a large genus, containing some 150 species, and subdivided into several subgenera and sections. Most crosses between species placed in a given taxonomic section (as well as few intra-subgeneric crosses) produce vigorous, fertile hybrids. In contrast, crosses between subgenera, and many of the crosses between sections either fail, or result in sterile hybrids that invariably show meiotic irregularities (Brennen 1990; Keep 1995). The black currant and the red currant belong to different subgenera. They are strongly reproductively isolated from one another. Yet, similar to many other fruit crops, the wild primary gene pool of each of the domestic currants contains not a single wild species, but a whole section of the genus *Ribes*. In both currents, the crop species were apparently the first to enter cultivation. However, some of the modern currant cultivars are products of crosses with additional intra-sectional species.

(I) Black currant: Wild forms of *R. nigrum* are native in the northern half of Europe, Siberia, the Caucasus and the Himalayas (Meusel & al. 1965). They do not extend to Armenia. However, taxonomically, the endemic *R. armenum* Pojark., stands taxonomically close to *R. nigrum* and to *R. petraeum* Wulfen. Very probably *R. armenum* belongs to the primary gene pool of the black currant crop.

In Armenia, wild *R. armenum* occurs in Idjevan, Upper Ahuryan, Aparan, Sevan and Darelegis floristic regions (Fig. 60). It grows at edges of the oak forests, between rocks and

Fig. 60 . Distribution of *Ribes armenum* Pojark.Fig. 61. Distribution of *Ribes biebersteinii* Berland. ex DC.

in stony places, at altitudes ranging from 1900 to 2300 m. The fruits of *R. armenum* are very tasty. Selected clones of this species are locally grown in this country.

(II) Red currant: Also *R. rubrum* does not grow wild in Armenia. It is a West European element. However, a close relative of the red currant, namely *R. biebersteinii* Berland. ex DC. is native here. Very likely this wild currant is inter-fertile with the crop. *R. biebersteinii* is a Caucasian element that extends to North Turkey, Siberia and North-West Iran.

In Armenia, *R. biebersteinii* occurs in Upper Ahuryan, Shirak, Lori, Idjevan, Aparan, Sevan, Darelegis and Zangezur floristic regions (Fig. 61). It grows in the middle and upper mountain zones, at altitudes ranging from 1500 to 2200 m, in forests or at edges of forests, between rocks and in gorges.

Diospyros lotus L.

The Caucasian persimmon (*Kovkasian khurma* in Armenian) is a tall tree, up to 20 m. high, with a dense crown, and rather small (2,0-2,5 cm in diameter) round, slightly compressed fruits, first orange colored, then ripening into dark blue-black. It is locally cultivated in Dagestan, Transcaucasia, and in China. It is also used as a rootstock for the more widely cultivated Chinese persimmon, *D. kaki* L. (Fritsch 2001). Wild forms of *D. lotus* have a disjunct distribution (Browicz 1982). They occur in the following three regions: (I) Central and southern China, (II) western Himalayas (from Kashmir to Afghanistan), and (III) the Caucasus, North Iran and North-East Anatolia.

In Armenia, wild forms of *D. lotus* occur in Idjevan and Meghri floristic regions (Fig. 62). They occupy lowland areas and the lower elevation zone of the mountains, at altitudes

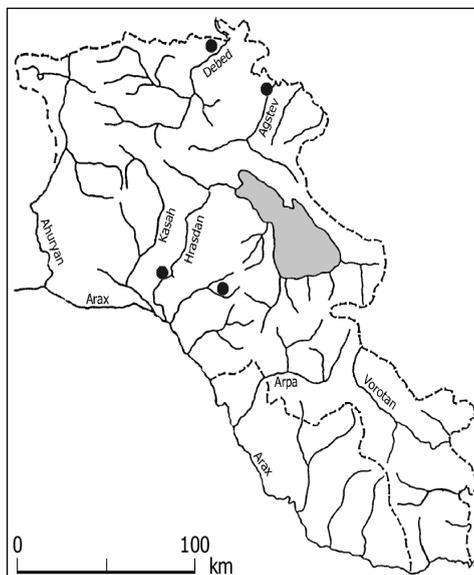


Fig. 62. Distribution of wild forms of Caucasian persimon, *Diospyros lotus* L.

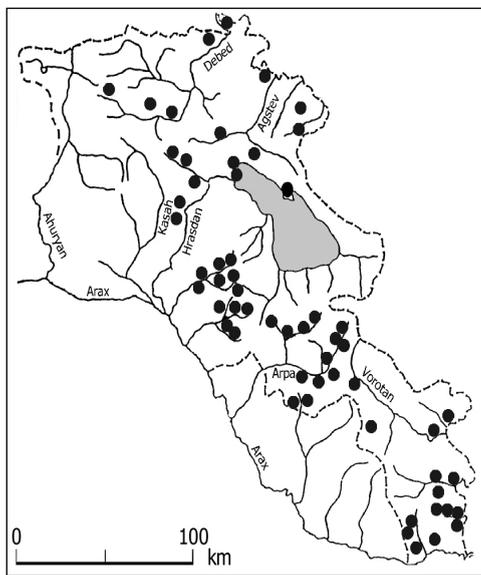


Fig. 63. Distribution of the oriental crab apple, *Malus orientalis* Uglitzk. [= *M. sylvestris* (L.) Mill. subsp. *orientalis* (Uglitzk.) Browicz].

ranging from 600 to 1300 m. They grow along streams and rivers, and on margins of broad-leaved forests, often in association with *Juglans regia*, *Ficus carica*, *Fagus orientalis*, *Carpinus betulus*, *Pyrus caucasicus*, *Punica granatum*, *Tilia caucasica*, *Prunus divaricata* and *Vitis vinifera* subsp. *sylvestris*. The several trees of *D. lotus* growing in Hrazdan river gorge, near Erevan, probably escaped from cultivation.

Apple, *Malus domestica* Borkh. [= *M. pumila* Mill.]

The apple (*Khndzoreni*, *khndzor* in Armenian) is a major fruit crop, characteristic to the temperate parts of the World. The genus *Malus* Mill. contains some 30 wild species (Way & al. 1990). Most of them are self-incompatible, contain $2n=2x=34$ chromosomes, can be crossed with one another, and their inter-specific hybrids are fertile or at least partly fertile (Korban 1986). The cultivated apple varieties (usually referred to as *M. domestica* Borkh. or as *M. pumila* Mill.) are closely related to a variable group of wild “crab apples” (Series *Pumilae* in Section *Malus* of the genus *Malus*, sensu Rehder 1940, p. 290; Way *et al.* 1990, p. 30). These wild apples are widely distributed over the temperate forest zone of Europe, South-West and Central Asia. Closest to the crop (and freely crossing with it) are the European and Caucasian crab apple forms, which are placed by some apple taxonomists in wild *M. sylvestris* (L.) Miller. In other taxonomic treatments the western populations of these crab apples are kept as *M. sylvestris* while the eastern wild forms (growing in North Turkey, The Caucasus and North Iran) are referred to as *M. orientalis* Uglitzk. [= *M. sylvestris* subsp. *orientalis* (Uglitzk.) Browicz]. These European and South-West Asian wild apples are diploid ($2n=2x=34$) and self-incompatible. They seem to represent a *gen-*

eral wild stock from which the apple cultivars (or some of the apple cultivars) could have evolved. For this reason they are sometimes regarded as conspecific with the crop (Zohary & Hopf 2000). Several additional *Malus* species, native to Central Asia, Siberia and the Far East [e.g., *M. sieversii* (Ledeb.) M. Roem. or *M. prunifolia* (Willd.) Borkh.] are also fully inter-fertile with the crop. They too might have participated in the build up of the apple's cultivars.

In Armenia *M. orientalis* [= *M. sylvestris* subsp. *orientalis*] is a common and variable wild fruit tree. It grows practically in all of the floristic regions of this country (Fig. 63). At the time of blooming its presence is particularly conspicuous. This wild crab apple is a common constituent of the Armenian broad-leaved temperate forests, and it extends to the juniper, pear and oak open forests, occurring at altitudes ranging from 650 to 2000 m. In addition, it colonizes secondary habitats, such as pastures, edges of cultivation and roadsides. The wild populations are outstandingly variable in traits like the shape of the tree and of the leaves, the color of the flowers, and the size, shape, color and taste of the ripe fruits. As Vartapetian (1989) reports, the fruits of the Armenian wild forms are also quite varied biochemically.

Pear, *Pyrus communis* L. [= *P. domestica* Med.]

The cultivated pear of Europe and West Asia (*Tandzeni*, *Tandz* in Armenian) is second to the apple in its contribution to fruit production in the temperate parts of Old World. Closest to the crop (and fully inter-fertile with it) is a group of wild pears distributed over the temperate parts of Europe, North Turkey, and the Caucasus (Zohary & Hopf 2000). The populations growing in the western parts of this large geographic area are frequently named *P. pyraster* Burgstd. Those of the eastern part are referred to as *P. caucasica* Fed. Because of their tight morphological affinities (and full inter-fertility) with the crop, these wild pears are regarded as a main wild stock from which the European cultivated pear could have evolved (Zohary & Hopf 2000). For these reasons Browicz (1992, 1993) regards *P. pyraster* and *P. caucasica* as elements of the crop's complex, and treats them as two wild subspecies of *P. communis* L.

Similar to many other fruit trees, the primary wild gene pool (GP-1) of the European domestic pear includes not only the *pyraster* and the *caucasica* forms, but probably most *Pyrus* species. With few exceptions, all these wild pear species have a diploid ($2n=2x=34$) chromosome system, and are largely inter-fertile with the crop. They are also inter-fertile when crossed among themselves (Rubtzov 1944, Watkins 1986).

The Caucasus and Trans-Caucasus in general, and Armenia in particular, appear to be the richest geographic area for *Pyrus* species diversity (Fedorov 1952, 1954, 1958; Mulkidjanyan 1969; Gladkova 1989, 1990; Browicz 1993). In this part of the world wild pears grow under a very wide range of climatic and edaphic conditions. Armenia is also unique in the amounts of contacts between the various *Pyrus* species, and the volume of spontaneous inter-specific hybridization that takes place under such conditions. In fact, in this country, several wild *Pyrus* species frequently form mixed pear stands, locally called "tandzut", exhibiting remarkably wide variety of forms. Hybridization between these wild pear species (as well as crosses between the wild pears and the cultivars) often results in massive gene exchange, introgressive hybridization variation patterns, and blurring of species boundaries. As stressed by Gladkova (1990) and Browicz (1993) this frequently

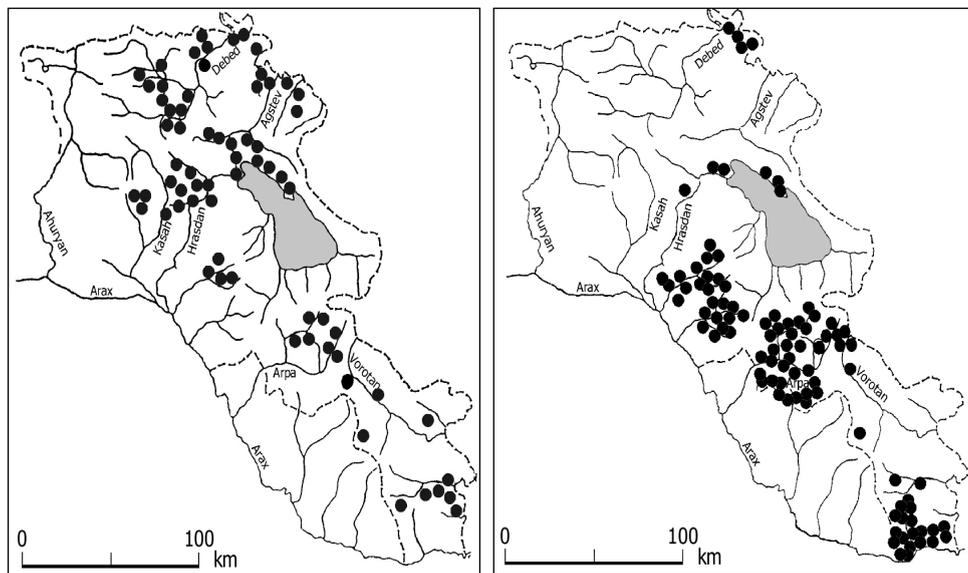
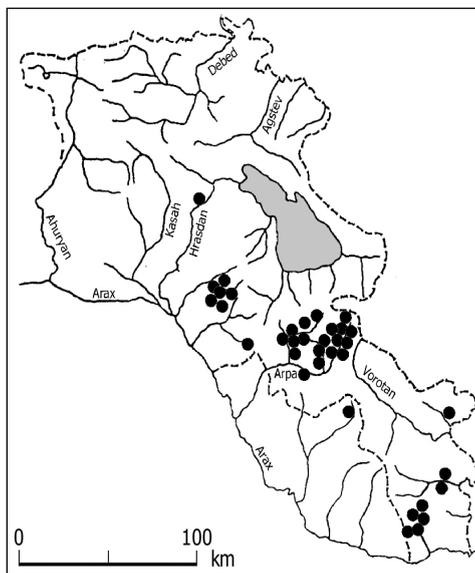
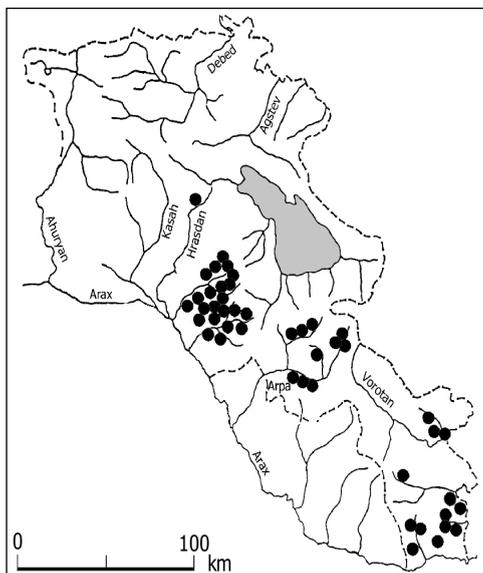


Fig. 64. Distribution of the Caucasian wild pear, *Pyrus caucasica* Fed. [= *P. communis* L. subsp. *caucasica* (Fed.) Browicz]. Fig. 65. Distribution of *Pyrus salicifolia* Pall.

renders *Pyrus* species delimitation in Armenia difficult or even impossible. Indeed, different pear specialists have listed in this country between 25 and 33 wild *Pyrus* taxa. Some are no doubt only inter-specific hybrids. What is however clear is that Armenia contains a vast, still largely untapped, wild primary gene pool (GP-1) of the domesticated European pear. The following examples illustrate this richness.

- (a) In Armenia, the wild pear morphologically closest to the crop seems to be *P. caucasica* Fed. [= *P. communis* L. subsp. *caucasica* (Fed.) Browicz]. This wild pear is a common element of the temperate broad-leaved forests of this country. It also extends to the oak or juniper open forests. Its distribution comprises Upper Ahuryan, Aragatz, Lori, Idjevan, Aparan, Sevan, Erevan, Zangezur and Meghri floristic regions (Fig. 64) at altitudes ranging from 650 to 2200 m.
- (b) As already noted, species diversity in *Pyrus* in Armenia is outstanding; and this country harbors numerous wild pear species. Several are endemic to this country, or are restricted to the Trans-Caucasus (Fedorov 1952, 1954, 1958; Browicz 1982, 1992, 1993, 1994; Gladkova 1989, 1990). The following taxa were chosen to represent the extraordinary rich, wild primary gene pool of this crop in Armenia:

(1) *P. salicifolia* Pall. - This is a relatively xeric wild pear, growing in oak, juniper, mountain ash and pistachio open forests, as well as on stony slopes and in shibliak and bush thickets. It occurs in Idjevan, Aparan, Sevan, Erevan, Darelegis, Zangezur and Meghri floristic regions, as well as in Nakhichevan (Fig. 65) at altitudes ranging from 500 to 2200 m.

Fig. 66. Distribution of *Pyrus syriaca* Boiss.Fig. 67. Distribution of *Pyrus takhtadzhianii* Fed.

(II) *P. syriaca* Boiss. - A relatively xeric element, widespread in mixed or in oak forests as well as in pear, oak and juniper open forests, and extending to the traganth steppes. *P. syriaca* occurs in Aparan, Erevan, Darelegis and Zangezur floristic regions as well as in Nakhichevan (Fig. 66) at altitudes ranging from 1200 to 2300 m.

(III) *P. takhtadzhianii* Fed. - An endemic wild species and an element of open forests, phrygana, and sub-alpine meadows, at altitudes ranging from 500 to 2200 m found in Idjevan, Aparan, Gegham, Erevan, Darelegis, Zangezur and Meghri floristic regions (Fig. 67).

(IV) *P. medvedevii* Rubtsov - Also this wild pear is endemic. It grows on dry stony slopes, mountain steppe and phrygana-like vegetation, as well as in juniper or pear open forests. Found in Aparan, Gegham, Erevan, Darelegis, Zangezur and Meghri floristic regions (Fig. 68) at altitudes ranging from 1400 to 2000 m.

(V) *P. zangezura* Maleev - An endemic, moist climate species, growing in the middle and upper altitude zones (from 1000 to 2200 m) in Darelegis, Zangezur and Meghri floristic regions (Fig. 69) in oak-hornbeam forests, in association with *Quercus* species, *Carpinus betulus*, *Platanus orientalis* and *Juglans regia*.

Quince, *Cydonia oblonga* Mill. [= *C. vulgaris* Pers.]

Quince (*Serkevileni*, *Serkevil* in Armenian) is a deciduous, diploid ($2n=2x=34$) small rosaceous tree grown for its pome-type aromatic fruits, which in most cultivars are seldom eaten raw, but taste delicious when cooked, baked or used to prepare jams, jellies, com-

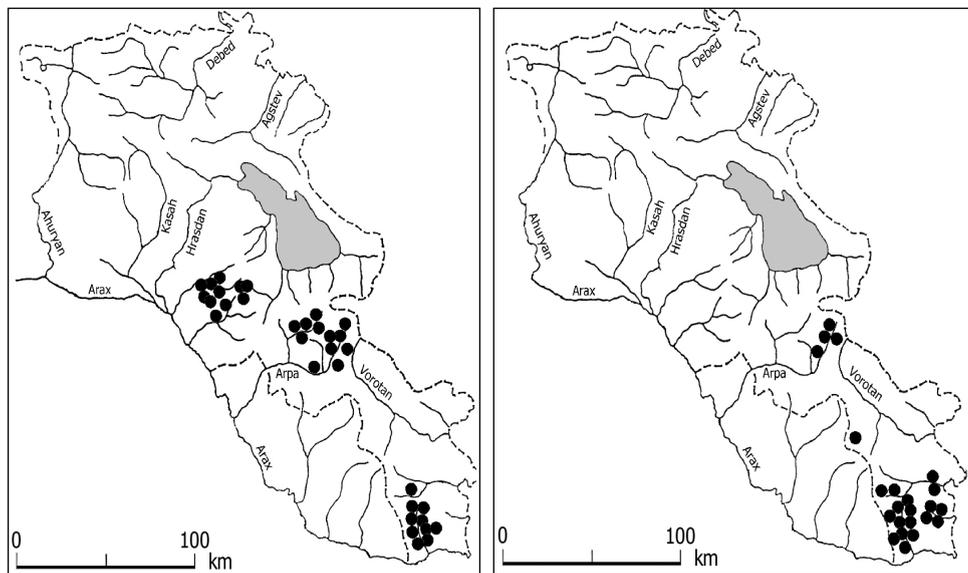


Fig. 68. Distribution of *Pyrus medvedevii* Rubtzov. Fig. 69. Distribution of *Pyrus zangezura* Maleev.

potes and juices. This fruit crop is very popular and extensively cultivated in Armenia, where attractive, non-astringent cultivars, devoid of stone cells, have been locally selected, and can be eaten fresh (Gabrielian-Beketovskaja 1957, 1973). Wild forms of *C. oblonga* are reported from the Caucasus, North Iran, and in the Kopet Dagh range in Turkmenia (Browicz 1996). They are fully inter-fertile with the cultivars. The main changes under domestication were larger, tastier fruits, and higher yields.

In Armenia, wild forms (as well as feral populations) of *C. oblonga* occur in the northern and southern parts of the country (Fig. 70) in Aragatz, Idjevan, Erevan, Zangezur and Meghri floristic regions, at altitudes ranging from 700 to 1400 m. They grow in mixed forests, frequently together with *Juglans regia*, *Mespilus germanica*, *Pyrus caucasica*, *Malus orientalis*, *Prunus cerasifera* and different species of *Crataegus*.

Crataegus orientalis Pallas ex M. Bieb.

This species of hawthorn (*Alocheni* in Armenian) is a small tree or a bush 3-5(9) m tall, with softly pubescent, gray shoots, and with lobed leaves. The fruits are relatively large and fleshy, orange-yellow or orange-red in color. *C. orientalis* is a mountainous species that grows wild in the Balkan Peninsula, Crimea, Anatolia, the Caucasus and the Trans-Caucasus (Browitz & Zieliński 1984). It is a variable and common element in degraded forest areas and in forest openings. Over most of its geographic distribution, the tasty fruits of this hawthorn are extensively collected from the wild. In some parts of its distribution area (including Armenia) individuals with tasty fruits have been protected from cutting, and/or introduced into cultivation.

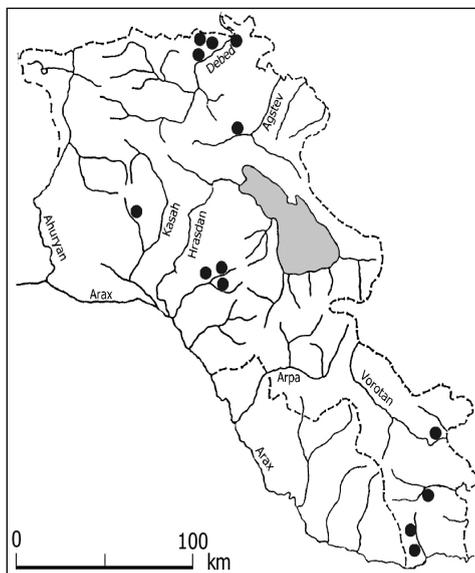


Fig. 70. Distribution of wild forms of quince, *Cydonia oblonga* Mill. [= *C. vulgaris* Pers.].

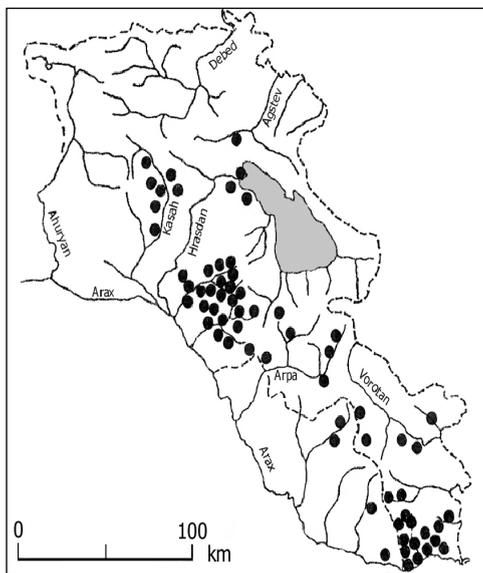


Fig. 71. Distribution of wild forms of *Crataegus orientalis* Pallas ex M. Bieb.

In Armenia, *C. orientalis* is widely distributed (Fedorov 1958) in Aragatz, Shirak, Aparan, Sevan, Erevan, Darelegis, Zangezur and Meghri floristic regions, and in Nakhichevan (Fig. 71). This hawthorn grows on dry rocky slopes, in bush thickets, along and in cultivated fields and pastures, in juniper and oak open forests and in mountain steppes at altitudes ranging from 600 to 2300 m. The fruits are very popular and in the autumn are brought to the markets. They are collected from the wild and often grown in family gardens.

Crataegus pontica K. Koch

A small tree 6-10 m high, with rounded crown and leathery, lobate, glaucous leaves and fleshy, yellow or orange-yellow fruits, distributed over North and North-East Anatolia, the Transcaucasus, North Iran and Middle Asia.

In Armenia, *C. pontica* occurs (Fedorov 1958) in Erevan, Darelegis and Meghri floristic regions (Fig. 72). In the wild, small groups or single individuals of this hawthorn grow in juniper open forests, and on stony or rocky slopes, at altitudes ranging from 600 to 2300 m. It is highly valued both for its ivory-like wood and for its fleshy, fragrant and tasty fruits. Because of these traits also this hawthorn is locally planted in family gardens.

Medlar, *Mespilus germanica* L.

Medlar (*Zker* in Armenian) is a minor fruit crop grown for its strange-looking fruits that are set in receptacles with five gaping holes. It is cultivated today mainly in the Caucasus, and Crimea, less often in the Balkan countries. *M. germanica* is a typical Euxino-

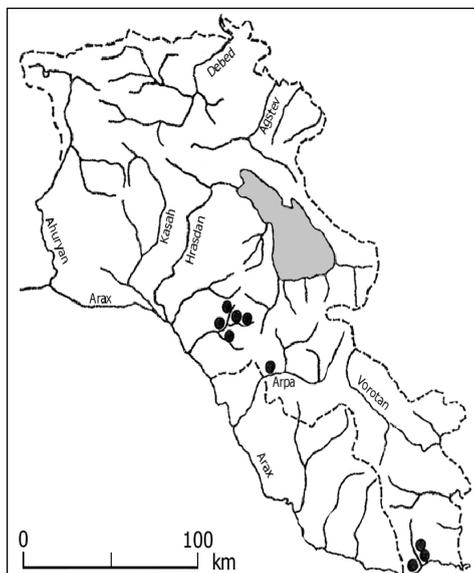


Fig. 72. Distribution of wild forms of *Crataegus pontica* K. Koch.

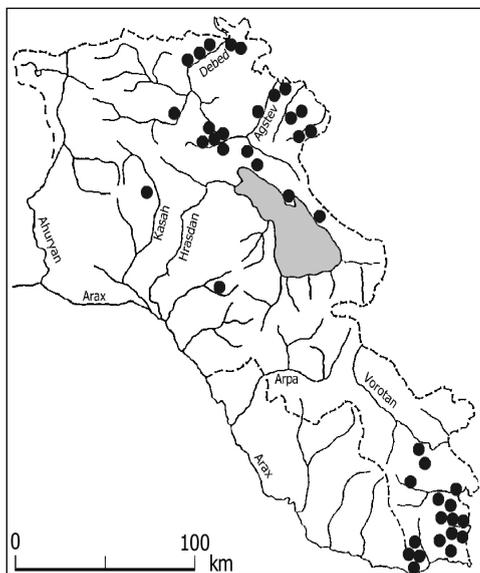


Fig. 73. Distribution of wild forms of medlar, *Mespilus germanica* L.

Hyrcean element (Browicz 1982). Wild forms of this small tree occur in North Turkey, in the Caucasus and the Trans-Caucasus, and in North Iran. They extend to Crimea, and the Kopet-dagh range in South-West Turkmenia. In this fruit tree, the main developments under domestication were selection for larger, tastier fruits, and against thorniness.

In Armenia, wild forms of medlar occur in the temperate north and south parts of the country, in Idjevan, Aparan, Sevan, Erevan, Zangezur and Meghri floristic regions, as well as in Nakhichevan (Fig. 73) at altitudes ranging from 600 to 2100 m. They thrive in beech-oak or beech-hornbeam forests, in *Platanus orientalis* or *Taxus baccata* groves, in shibliak, on open stony slopes and between rocks, usually in association with *Fagus orientalis*, *Carpinus betulus*, *C. orientalis*, *Juglans regia*, *Cornus mas*, *Tilia caucasica*, *Ficus carica*, *Malus orientalis* and several *Quercus* species. Forms with simple leaves occur in relatively drier places; forms with serrate leaves grow in wetter habitats (Fedorov 1958).

Mountain ash, *Sorbus aucuparia* L.

Mountain ash (*Aroseni* or *Tstikhndzor* in Armenian) is a deciduous, diploid ($2n=2x=34$) hardy tree (Gabrielian 1958, 1972 1978) with attractive red fruits, grown as an ornamental, as well as for its fruits that are used to prepare jams and alcoholic drinks. Clones with tasty fruits were selected mainly in Russia and the Caucasus. Also in Armenia they are grown locally in household gardens. Wild forms of *S. aucuparia* are widely spread over Europe, the Caucasus and South-West Asia (Gabrielian 1972, 1978; Browicz 1982).

In Armenia, wild forms of *S. aucuparia* occur in mixed and in broad-leaved forests, at the edges and the upper fringe of such forests, and on igneous rock slopes. They grow in

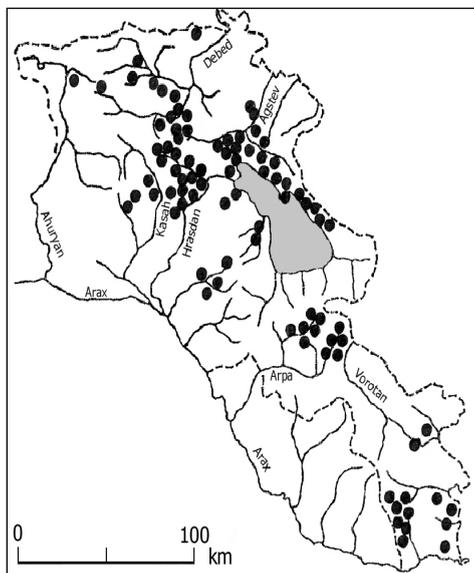


Fig. 74. Distribution of wild forms of mountain ash *Sorbus aucuparia* L.

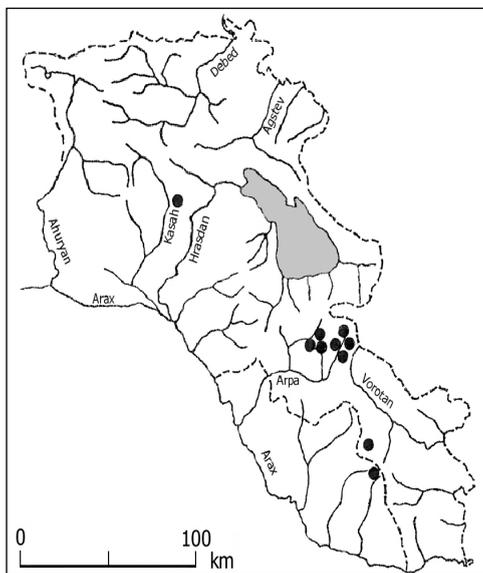


Fig. 75. Distribution of *Sorbus takhtadjanii* Gabrielian.

Upper Ahuryan, Lori, Idjevan, Aragatz, Aparan, Sevan, Gegham, Erevan, Darelegis, Zangezur and Meghri floristic regions (Fig. 74) at altitudes ranging from 1500 to 2500 m. They are often associated with *Quercus macranthera*, *Betula litvinovii*, *Malus orientalis*, *Pyrus caucasica*, *Cerasus avium*, *Fraxinus oxycarpa*, *Salix capraea* and other several species of *Sorbus*.

Other *Sorbus* species

In addition to the mountain ash, twelve other *Sorbus* species (all with simple or lobate leaves) grow wild in Armenia (Gabrielian 1958, 1972, 1978; Jankun & Gabrielian 1979). At least the following three species bear attractive fruits that are frequently juicier and sweeter than those of *S. aucuparia*. Selected clones of these three *Sorbus* species are also planted in family gardens.

(I) *Sorbus takhtadjanii* Gabrielian. This is a beautiful tetraploid ($2n=4x=68$) tree with pyramidal crown, simple, lobate leaves, dark-green on their upper side and white tomentose on lower side, white flowers, and relatively large, pinkish yellow, juicy, tasty fruits which are densely covered by characteristic lenticels. Geographically this species is confined to the southern Trans-Caucasus and to North Iran. In Armenia *S. takhtadjanii* occurs in Aparan, Darelegis and Zangezur floristic regions, as well as in Nakhichevan (Fig. 75). It grows singly or in groups in oak forests in altitudes ranging from 1200 to 2200 m.

(II) *Sorbus hajastana* Gabrielian. This species (*Aspab* in Armenian) is a very attractive

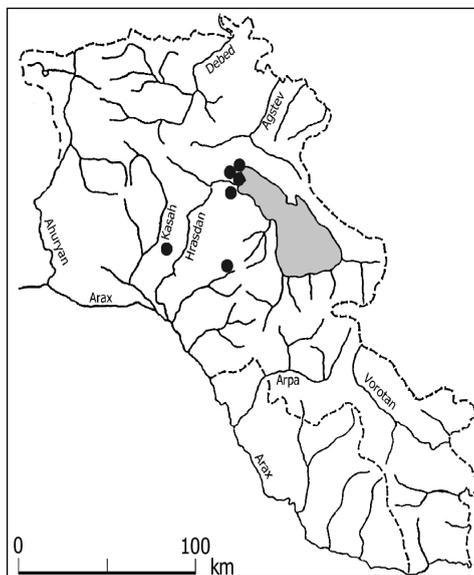


Fig. 76. Distribution of *Sorbus hajastana* Gabrielian.

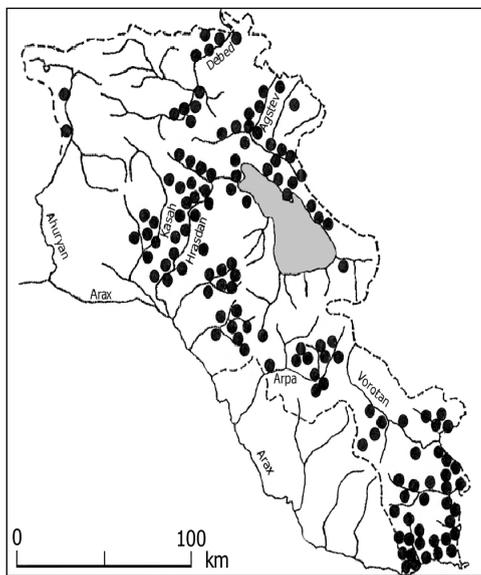


Fig. 77. Distribution of wild forms of cherry plum, *Prunus cerasifera* Ehrh, [= *P. divaricata* Ledeb.].

tetraploid ($2n=4x=68$) small tree or bush, some 8-10 m tall, with a round or oval crown. The leaves are simple with large dentate margins, shiny dark-green on their upper side and silvery tomentose on their lower side. The flowers are white, with red anthers. The fruits are crimson, rather sweet, with deciduous calyces. Almost totally restricted to Armenia, but reappears (in two sites) in Khevsurety (River Argun gorge) on the northern slope of the Grate Caucasus Mountain ridge. In Armenia *S. hajastana* grows singly or in groups in Aparan, Sevan and Gegharnik floristic districts (Fig. 76) on cliffs, between rocks, in subalpine meadows or in *Quercus macranthera* forests, in altitudes ranging from 1600 to 2400 m.

(III) *Sorbus subfusca* (Ledeb.) Boiss. [= *S. albovii* Zinserl.]. This is a diploid ($2n=2x=34$) shrub or small tree, up to 5 m high. The leaves are obovate, with double serrate margins, glabrous or tomentose on their lower side, the flowers are rather large, white, with red anthers, and the fruits are bright red. Geographically *S. subfusca* is almost fully restricted to the Caucasus, with a single known extension to North Iran. In Armenia it grows mainly in the upper margin of the forest zone in subalpine *Betula* thickets, in Aparan, Darelegis and Zangezur floristic regions, at altitudes ranging from 2000 to 2400 m. It is a rather rare species.

Garden Plum, *Prunus domestica* L.

The Garden Plum (*Dambul* in Armenian) is a deciduous, hexaploid ($2n=6x=48$) fruit tree, extensively cultivated for its fruits. *P. domestica* comprises both the European plum cultivars (subsp. *domestica*), and the more small-fruited damsons, bullaces and green-

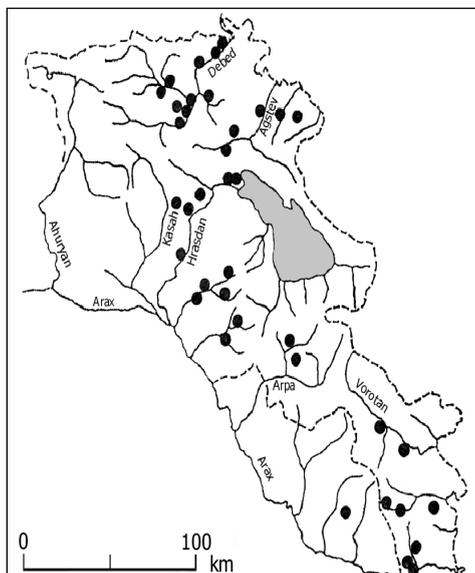


Fig. 78. Distribution of wild forms of sloe, *Prunus spinosa* L.

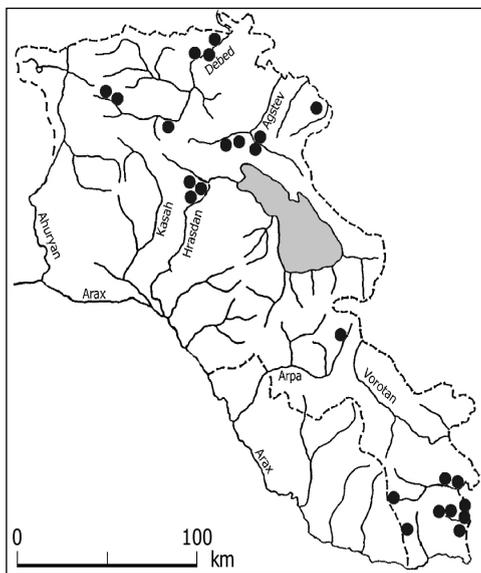


Fig. 79. Distribution of wild forms of sweet cherry, *Cerasus avium* (L.) Moench [= *Prunus avium* L.]

gages (subsp. *insittia* (L.) Schneid.). The origin of this 6x fruit crop is yet not satisfactorily elucidated. However, the wild relatives of *P. domestica* are already reasonably recognized (Zohary 1992; Hanelt 1997); and some information on their ploidy levels, their cross-compatibility with the crop, and the fertility of the F_1 hybrids is also available. The available data can be summarized as follows:

- (I) Wild-growing *P. domestica*: Such spontaneous 6x *domestica* forms, with characteristic small fruits, are fully inter-fertile with the crop. They occur in some parts of temperate Europe and in the Caucasus; and they are obviously closely related to the cultivars (Zohary 1992; Hanelt 1997). The prevailing view among botanists (see for example Webb 1968) is that all the wild-growing 6x *P. domestica* material in Europe is feral; and that subsp. *domestica* escaped cultivation mainly near human habitations, while subsp. *insittia* is widely naturalized in hedges and woods. However, archaeo-botanical finds indicate (Zohary & Hopf 2000) that this plum already existed in Central Europe in Neolithic and Bronze Age times, that is before the development of horticulture in this part of the World. In Armenia, small-fruited, wild-growing *P. domestica* individuals are sporadically distributed over this country, particularly at edges of farmyards. Indeed, in such environments they seem to be feral – also in this country.
- (II) *Cherry plum*, *P. cerasifera* Ehrh. [= *P. divaricata* Ledeb.]: This plum (*Saloreni*, *Salor* in Armenian) too is closely related to 6x *P. domestica*. It is a variable fruit crop containing a whole range of domestic clones, including diploid, tetraploid and hexaploid

types ($2n = 16, 32, 48$). The cherry plum is sparsely cultivated in temperate Europe and the Mediterranean basin. However, in the Caucasus this plum is a major fruit crop (Hanelt 1997), known to contain also hexaploid forms. Significantly, cherry plum cultivars (particularly its hexaploid clones) cross readily with $6x P. domestica$ (Beridze and Kvatchadze 1981). Wild forms of *P. cerasifera* are widespread in the South Balkan countries, the Caucasus, and Southwestern and Central Asia. They are very variable, and fall into four eco-geographical subspecies (Browicz 1996). In Armenia *P. cerasifera* is obviously native; and its wild forms are very common and very variable. Their fruits range from round to ovoid-oblong, and their color can be yellow, red, pink, violet or even black. They occur practically in all floristic regions of this country (Fig. 77) thriving on south facing slopes, between rocks, in open margins of broad-leaved forests, in bush thickets, and along roadsides – from the lower to the upper altitude zones (up to 2200 m).

- (III) Sloe, *P. spinosa* L. (*Mamukh* in Armenian): This wild plum is a spiny tetraploid ($2n=4x=32$) shrub, widely distributed over most of the temperate parts of Europe, the Caucasus, the Trans-Caucasus, West Siberia and the relatively cool parts of the Mediterranean basin (Meusel & al. 1965; Browicz & Zieliński 1990). Cytogenetically, the sloe lies far more distant from the garden plum, compared to the former taxa. Crosses with *P. domestica* are still possible, although the F_1 hybrids are largely sterile (Zohary 1992; Hanelt 1997). In some places in Central Europe and in the Caucasus also *P. spinosa* has been introduced into cultivation (Hanelt 1997). In Armenia too, selected clones of sloe with large, very sweet, non-astringent fruits are locally grown. Wild forms of *P. spinosa* are rather common in Armenia. They occur in Lori, Idjevan, Aparan, Sevan, Erevan, Darelegis, Zangezour and Meghri floristic regions, as well as in Nakhichevan (Fig. 78) growing in bush tickets, edges of forests, on pastures, along streams and rivers, and along roads, at elevations ranging from 500 to 2200 m.

Sweet cherry, *Cerasus avium* (L.) Moench [= *Prunus avium* L.]

Sweet cherry (*Keraseni*, *Keras* in Armenian) is a deciduous, diploid ($2n=2x=16$), rather tall tree, extensively grown for its sweet, red-black fruits which are consumed fresh, and are also cooked, caned, frozen, dried and fermented into alcoholic drinks. Most cultivars are self-incompatible. Maintenance is by grafting. Wild and feral forms of *P. avium* (fully inter-fertile with the cultivars) are widely distributed over the temperate parts of Europe, North Anatolia, the Caucasus, and North Iran (Browicz & Zieliński 1964; Meusel & al. 1965).

In Armenia, wild *C. avium* occurs in Lori, Idjevan, Aparan, Sevan, Zangezour and Meghri floristic regions (Fig. 79). They grow on relatively fertile soils in oak-hornbeam or other types of broad-leaved forests, and they are scattered on terraces along streams, in gorges, and on sloping banks of rivers, at altitudes ranging from 600 to 1900 m.

Sour cherry, *Cerasus vulgaris* Mill. [= *Prunus cerasus* L.]

The sour cherry (*Baleni*, *bal* in Armenian) is a small tree, rarely exceeding 8 m in height, bearing dark red berries with characteristic acid taste. It is a tetraploid ($2n=4x=32$), largely self-compatible, commonly suckering fruit crop, grown mainly in East, Southeast and

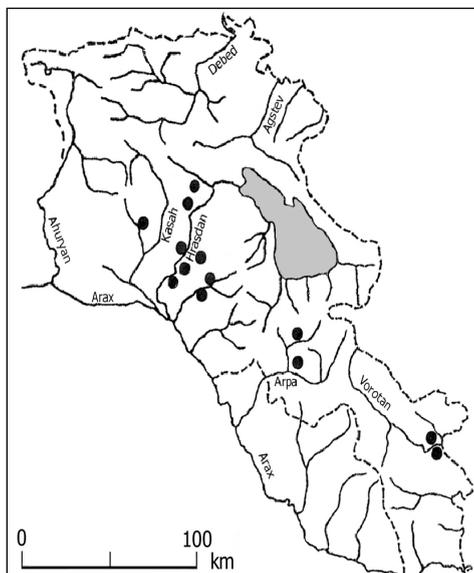


Fig. 80. Distribution of wild-growing stands of saur cherry, *Cerasus vulgaris* Mill. [= *Prunus cerasus* L.]

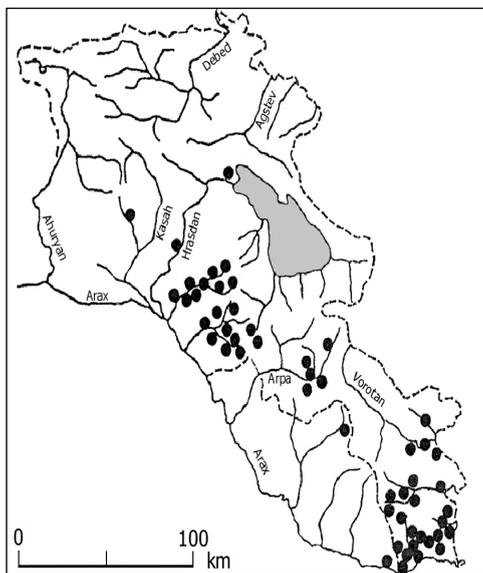


Fig. 81. Distribution of wild forms of mahaleb cherry, *Cerasus mahaleb* (L.) Mill. [= *P. mahaleb* L.]

Central Europe, the Caucasus and Northwest Asia. Also the fruits of this cherry are consumed fresh, dried or cooked. They are also used to prepare alcoholic drinks. Because sour cherry is a hardy crop that withstands low temperatures, it can be grown also in relatively cold places.

The crop is closely related to the ground cherry *C. fruticosa* (Pall.) Woron. [= *P. fruticosa* Pall.] a suckering wild shrub or small tree, native to parts of East and Central Europe and West Siberia (Meusel & al. 1965), where it occurs in forest-steppe or in steppe formations. Both the crop and the ground cherry are tetraploid ($2n=4x=32$), largely self-compatible, fully inter-fertile and known to hybridize spontaneously (Hanelt 1997; Zohary & Hopf 2000). These facts strongly suggest that *C. fruticosa* is the wild progenitor that gave rise to the cultivated sour cherry. However, the development of this fruit crop might have also involved crosses with, and introgression from, diploid *C. avium*.

In Armenia, what seem to be naturalized wild-growing stands of *C. vulgaris* occur in Aragatz, Aparan, Erevan, Darelegis, Sevan and Zangezur floristic regions (Fig. 80) in altitudes ranging from 500 to 2100 m. They are common especially in the Ararat Valley.

Mahaleb cherry, *Cerasus mahaleb* (L.) Mill. [= *P. mahaleb* L.]

Mahaleb cherry (*Sheshi* in Armenian) is a diploid ($2n=16$) small tree, 6-10 m tall, with broadly ovate light green leaves and white flowers. The fruits are ovoid, small (8-10 mm long, 7-9 mm wide) bitter, red when young and then turning black. It is commonly cultivated as an ornamental tree and for its wood. It is also widely used as a hardy stock for

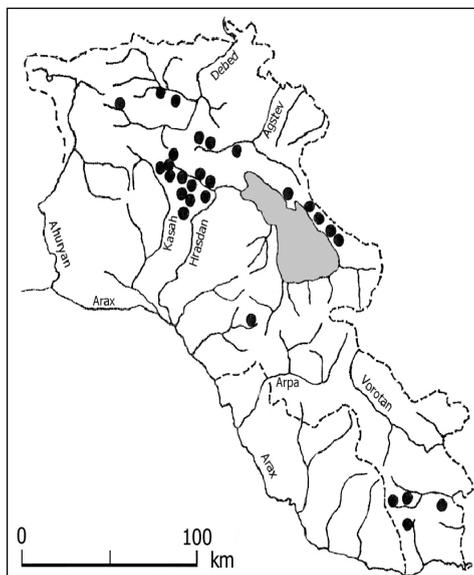


Fig. 82. Distribution of wild forms of bird cherry, *Padus racemosa* (Lam.) Gilib. [= *Prunus padus* L.]

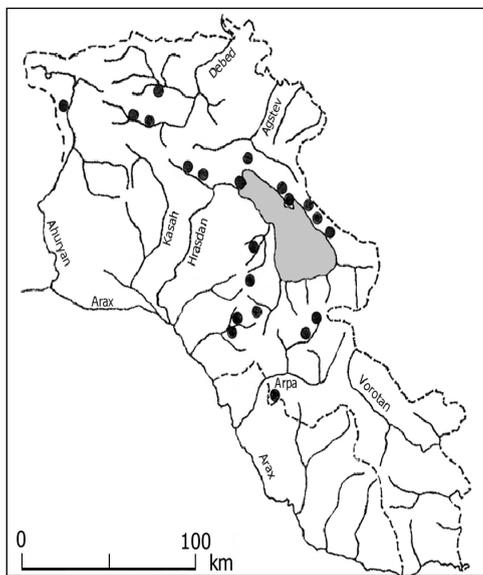


Fig. 83. Distribution of wild forms of *Amelanchier ovalis* Med. [= *A. rotundiflora* (Lam.) Dum.-Courset]

grafting sweet cherry and sour cherry cultivars. Wild forms of *C. mahaleb* are distributed over Southeast Europe, the Mediterranean basin, the Caucasus and Southwest and Central Asia (Zaprjgaeva 1964; Browicz 1984).

In Armenia, *C. mahaleb* is widely used as a hardy stock for cherry grafting. It is grown also for obtaining its hard, shining, aromatic wood, which is highly appreciated in this country. Wild forms of *C. mahaleb* occur in Lori, Idjevan, Erevan, Darelegis, Zangezur and Meghri floristic regions, as well as in Nakhichevan (Fig. 81) in park-like oak forests, on dry rocky slopes, on edges of scree and along streams and rivers (Fedorov 1958) at altitudes ranging from 600 to 1800 m.

Bird cherry, *Padus racemosa* (Lam.) Gilib. [= *Padus avium* Mill.; = *Prunus padus* L.]

A variable small tree or bush (*Thkheny* in Armenian) up to 8 m tall with white and very fragrant flowers; and small, ovate (7-8 mm long), black, sweet-bitter tasting fruits; planted in parks and gardens. The fruits are dried and ground, and used for filling tarts and for preparation of alcoholic drinks. The wood is also appreciated, and the bird cherry has been traditionally used to prepare green and red-brown dyes. Wild forms of *P. racemosa* occur in temperate Europe, the Caucasus and West Siberia (Meusel & al. 1965).

In Armenia the bird cherry is an appreciated ornamental tree. Selected clones are occasionally planted for their fruits in family gardens. The wild forms are sparsely distributed (Fedorov 1958) in mountain forests in Lori, Idjevan, Aparan, Sevan, Gegham, Zangezur and Meghri floristic regions (Fig. 82). They grow in oak, oak-hornbeam or oak-aspens

forests in altitudes ranging from 1600 to 2300 m frequently in association with *Amelanchier rotundiflora* and several *Sorbus* species.

Amelanchier ovalis Medik. [= *A. rotundiflora* (Lam.) Dum.-Courset]

A shrub 1–3 m tall, with thin twigs and glabrous, small (6–8 mm), globose fruits, red when young and bluish-black when ripe. A valuable ornamental tree planted in parks, and also grown for its sweet fruits. Wild forms occur in South and Central Europe, Anatolia and the Caucasus (Browicz & Zieliński 1984; Meusel & al. 1965).

In Armenia, *A. ovalis* is an appreciated ornamental shrub and hedge element. Selected clones are often planted in family gardens for their sweet fruits used to prepare alcoholic beverages, juices and jams. Wild populations occur (Fedorov 1958) in the North and the Central parts of the country, i.e., in Upper Ahuryan, Lori, Idjevan, Aparan, Sevan, Gegham, Yerevan, and Darelegis floristic regions (Fig. 83). Being rather mesophilous, this bush thrives (usually in small groups or as single individuals) in oak forests and in dense bush thickets, and it extends to rocky slopes in open juniper or oak forests as well as to edges of forests, in altitudes ranging from 1200 to 2200 m.

Apricot, *Armeniaca vulgaris* Lam. [= *Prunus armeniaca* L.]

Apricot (*Tsiraneni*, *Tsiran* in Armenian) is an erect, deciduous tree, extensively grown for its sweet fruits. In some non-bitter cultivars also the seeds are used. Armenia is a classical center for apricot cultivation, and its local cultivars rank among the best available in this fruit crop. Wild forms of apricot, fully inter-fertile with the crop, occur in the Tien Shan range in Central Asia, in East Tibet, and in North China. They reappear in the Caucasus (Dagestan, Armenia).

In Armenia, wild forms of *A. vulgaris* (with characteristic spiny twigs, and relatively small leaves and fruits) occur in Aragatz, Darelegis and Zangezur floristic regions (Fig. 84), at altitudes ranging from 1200 to 2100 m. They occupy scree and dry rocky slopes in relatively xeric open forests of oak, pear, juniper and ash, as well as in bush thickets and in shibliak formations, in association with *Paliurus spina-christi*, *Prunus divaricata*, *Amygdalus fenzliana*, *A. nairica* and *Rhamnus pallasii*.

Wild forms of apricot were discovered in Armenia (by Manook Harutjunyan) only in 1974. They were first detected in Amberd Gorge, Mt. Aragatz; and soon later in several locations in Darelegis and Zangezur floristic regions (Hambartzumyan & Harutjunyan 1977). These workers encountered wide variation in the material they discovered. They verified that the chromosome number in their plants was $2n=2x=16$. They also found that compared to cultivars grown in Armenia, the wild-growing apricot populations were relatively drought tolerant and disease resistant; and regarded these features as an indication that these wild-growing stands were indeed indigenous. This conclusion was supported also archaeologically. A single apricot stone was retrieved from Early Bronze Age Garni (Arakelyan 1951) and if this find is not intrusive, it suggests that *A. vulgaris* existed in Armenia already at this early age. If indeed *A. vulgaris* does grow wild in Armenia, the prevailing view (Simoons 1991; Watkins 1995) that the apricot had to be taken into cultivation either in East Asia or in Tien Shan needs a re-consideration. Its domestication could have taken place also in the Trans-Caucasus.

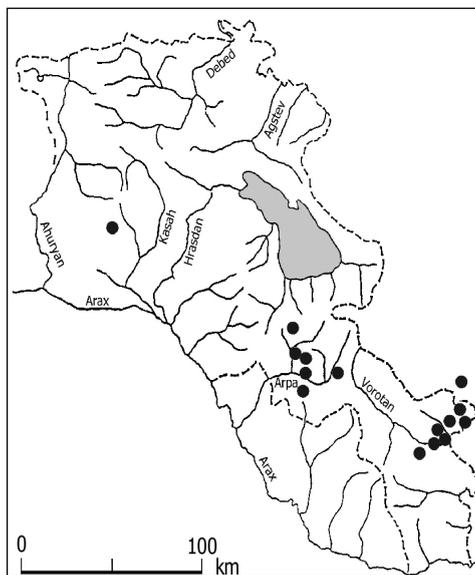


Fig. 84. Distribution of wild forms of apricot, *Armeniaca vulgaris* Lam. [= *Prunus armeniaca* L.].

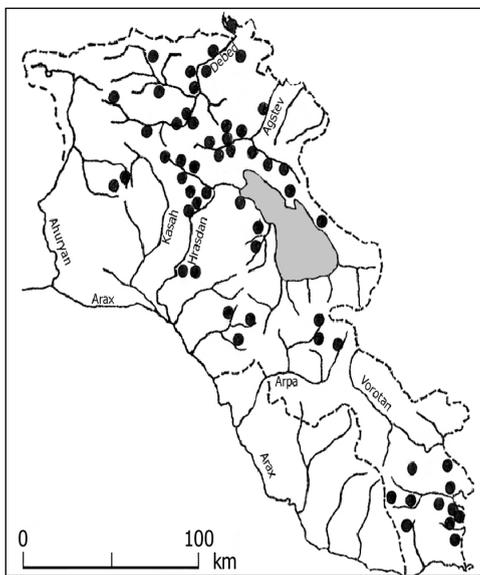


Fig. 85. Distribution of wood strawberry, *Fragaria vesca* L.

Wood strawberry, *Fragaria vesca* L.

This strawberry (*elak* in Armenian) is a diploid ($2n=2x = 14$) perennial herb, with its epigeal long stolons, and conical or oval, aromatic red fruits. It is the indigenous strawberry crop of the Old World. Its domestication started in Europe in the 14th and 15th Centuries, and already in the 16th Century improved clones were grown -

particularly in France (Jones 1995). Today *F. vesca* is largely replaced by the larger, more productive, octaploid ($2n=8x = 56$) pineapple strawberry *F. x ananassa* Duch. that originated from an artificial crossing between two American wild species of *Fragaria* [(Jones 1995). However, because of its excellent taste and aroma, *F. vesca* is still cultivated, on a small scale, in some parts of Europe and in the Caucasus. Wild forms of *F. vesca* occur in Europe, North-West Africa, South-West Asia and Central Asia (Meusel et al. 1965).

In Armenia, *F. vesca* is widely collected from the wild, and selected clones are still occasionally planted in family gardens. Its fruits are consumed fresh, are widely used to prepare highly aromatic liquid jams, or dried for brewing tea. Wild forms of *F. vesca* occur in Aragatz, Lori, Idjevan, Aparan, Sevan, Erevan, Darelegis, Zangezur and Meghri floristic regions (Fig. 85). They thrive in meadows at the edges of oak-hornbeam and other broad-leaved forests or in shibliak formations (Fedorov 1958), at altitudes ranging from 450 to 2200 m.

Raspberry, *Rubus idaeus* L.

Raspberry (*Mori* in Armenian) is a diploid ($2n=2x=14$) self-incompatible thorny shrub,

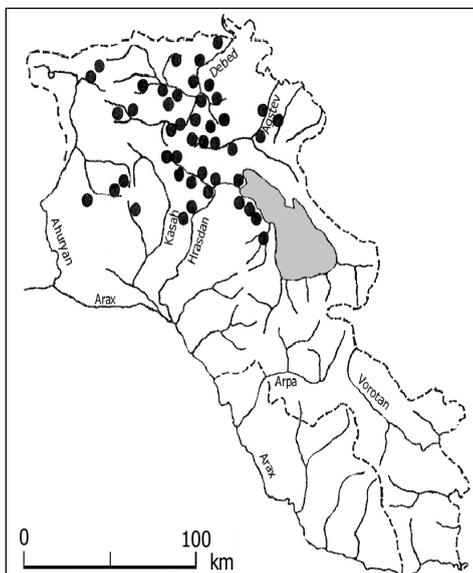


Fig. 86. Distribution of *Rubus idaeus* L.

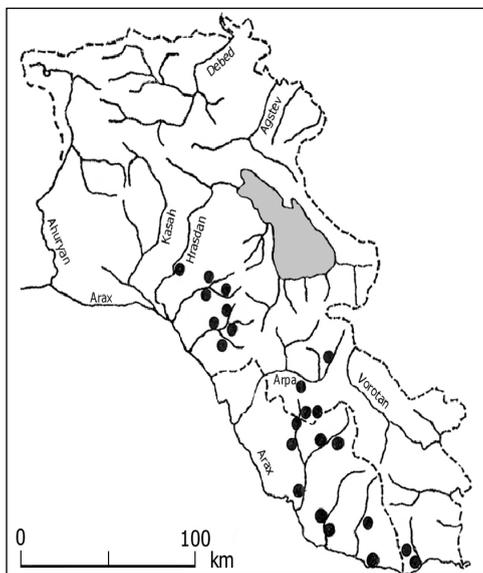


Fig. 87. Distribution of *Rosa hemispherica* J. Herrm.

extensively cultivated (by vegetative propagation) for its juicy fruits. Commercially, *R. idaeus* is today the most important *Rubus* species under cultivation. Its domestication started in Europe already in the Middle Ages. Recent breeding work (including crosses with other *Rubus* species) led to development of numerous tasty, large-fruited, less thorny clones (Jennings 1995). Wild forms of *R. idaeus* are widely distributed over much of the cooler parts of Europe and Asia. They extend, as a distinct subspecies [subsp. *strigosus* (Michx.) Focke] to the climatically similar parts of North America (Meusel & al. 1965). Several of the modern raspberry clones are products of crossing between Old World and New World taxa (Jennings 1995).

In Armenia, *R. idaeus* grows wild in the middle and upper altitude zones (1500 to 2400 m) of Upper Ahuryan, Aragatz, Lori, Idjevan, Aparan and Sevan floristic regions (Fig. 86). It thrives in broad-leaved forests, in edges and felled areas of such forests, and in meadows and lush thickets.

Rosa hemispherica J. Herrm.

This rose (*Masreni* in Armenian) is a compact, prickly shrub 1,0-2,0 m tall, with bluish leaves and fragrant yellow flowers. The fruits are globose or short-ovoid, about 1,5-1,8 cm long. *R. hemispherica* is confined (in the wild) to inner Anatolia, the southern Trans-Caucasus, North Iran and the Kopetdag range in Turkmenia (Browicz & Zieliński 1984). This rose has also been used as an ornamental; and its double-flower forms participated in the breeding of the yellow garden roses.

In Armenia, wild forms of *R. hemispherica* occur in relatively dry habitats in Erevan,

Darelegis and Meghri floristic regions, as well as in Nakhichevan (Fig. 87). They grow in ravines, mounds, igneous rock escarpments, overgrazed slopes, thorny thickets, and at edges of open forests of junipers or oaks (Fedorov 1958; Browicz & Zieliński 1984) at altitudes ranging from 600 to 1900 m. The fruits of *R. hemispherica* are fleshy and sweet. They are used to prepare jam, paste, compot and juice; and the dried fruits for brewing tea. Nutritional tests carried out at the Institute of Botany, Erevan (Charchoghlyan & al. 1996) revealed that the fresh fruits are very rich in sugars, vitamin C and carotene. More over, this shrub is hardy and resists drought, frost, pests, and diseases. Because of these qualities, *R. hemispherica* is at present used in Armenia as a noval fruit crop, recommended for planting in family gardens. It is also used for protection of roadsides, and for soil conservation purposes.

Cornelian cherry, *Cornus mas* L.

A small tree (*Honeni*, *Hon* in Armenian), with characteristic dark red fruits, appreciated in some parts of Europe (and more so in the Caucasus) for its medicinal properties and for its fruits that have a distinct taste and aroma. Clones with superior fruits were selected in several countries (including Armenia). The fruits are used (both fresh and dried) to flavor foods, and for preparing jam, jellies, juices and alcoholic drinks (including excellent vodka). Wild forms of *C. mas* are native in Central and South-East Europe, North Turkey, and the Caucasus (Browicz 1986).

In Armenia, wild forms of *C. mas* occur in Lori, Idjevan, Zangezur and Meghri floristic regions. They occupy the lower and the middle mountain belts, at altitudes ranging from 600 to 1500 m. They grow in broad-leaved forests, together with *Fagus orientalis*, *Juglans regia*, *Carpinus betulus*, *C. orientalis*, several *Quercus* species, *Mespilus germanica* and *Malus orientalis*.

Silver berries, *Elaeagnus angustifolia* L. and *E. orientalis* L.

(I) *Elaeagnus angustifolia* L. (*Pshateni*, *pshat* in Armenian) is a large bush or small tree 5-8 (10) m high, with rather round, silvery crown, linear-lanceolate leaves densely covered by silvery stellate scales, small scented flowers, and $2n=2x=28$ chromosomes (Araratian 1937). It is grown, particularly in Central and South-West Asia and the Caucasus, for its elongated, slightly sweet, floury fruits. Some 50 distinct cultivars are recognized in Armenia (Dovlatyan 1977). They are highly appreciated not only as fruit trees but also for their ornamental qualities, their attractiveness to the honeybee, for tolerance to drought and salinity, and for their remarkable resistance to cold temperatures (as low as -30°). Wild (as well as naturalized) populations of *E. angustifolia* are widely distributed over Central and South-West Asia (Zaprjagaeva 1964; Browicz 1996), and they extend to some of the southern parts of former European USSR. They propagate themselves both by seeds and by root suckers; and frequently form large stands, particularly in river valleys, along canals and in areas of high ground water table.

In Armenia, wild forms of *E. angustifolia* occur in most of the floristic regions of this country (Fig. 88), mainly in the lower and the middle altitude zones, from 450 to 2000 m (Mulkidjanyan 1973). *E. angustifolia* is a common arboreal element in relatively wet places along rivers, streams and irrigation canals, as well as in juniper open forests. In the

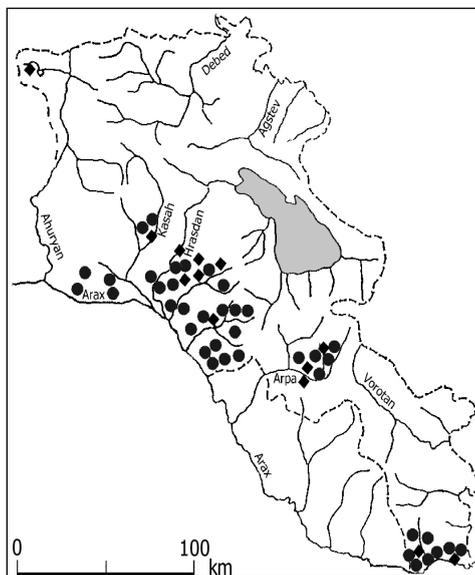


Fig. 88. Distribution of wild forms of silver berries: ● *Elaeagnus angustifolia* L. and ◆ *E. Ziziphus jujuba* Mill. *orientalis* L.

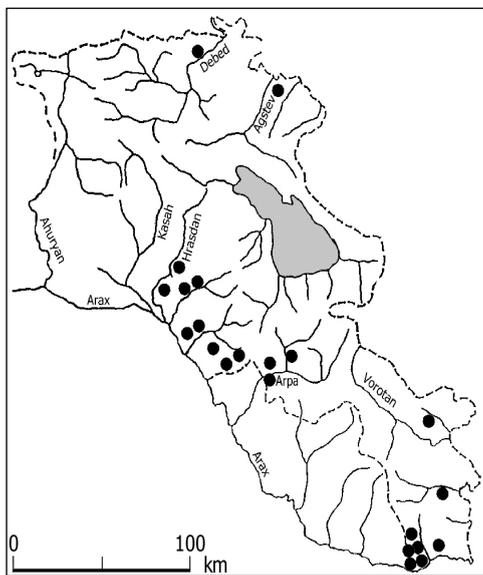


Fig. 89. Distribution of wild forms of jujube, ● *Elaeagnus angustifolia* L. and ◆ *E. Ziziphus jujuba* Mill.

first habitat it commonly grows together with other riparian elements such as *Populus euphratica*, *Hippophaë rhamnoides* and *Lycium*, *Tamarix* and *Salix* species. In the open forest formations its common associates are *Juniperus polycarpus* and *Crataegus*, *Pyrus* and *Sorbus* species.

(II) *E. orientalis* L. [= *E. angustifolia* L. var. *orientalis* (L.) Schlecht.]. Also this silver berry is a spiny bush or small tree, 6-7 m high. It differs from the previous one by its oval to oblong leaves. Here too, traditional selection led to the emergence of large-fruited cultivars, rich in farinaceous pulp. Several such clones are popular in Armenia. Most appreciated today are the *matnapshat* and *khurmapshat* cultivars, which bear large, sweet fruits. Compared to *E. angustifolia*, wild forms of *E. orientalis* are more restricted in their distribution. They are native in the southern Trans-Caucasus and in the southern parts of Middle Asia; and they extend to some parts of Iran, Afghanistan, Pakistan, Hindu-Kush, and the Himalayas. Unlike *E. angustifolia*, *E. orientalis* avoids saline soils.

In Armenia, wild forms of *E. orientalis* grow (Mulکیدjanjan 1973) at low altitudes (up to 900 m) along the Arax River in Erevan, Darelegis and Meghri floristic regions (Fig. 88).

Sea buckthorn, *Hippophaë rhamnoides* L.

Sea buckthorn (*Chichkhan* in Armenian) is a spiny, profusely suckering, dioecious shrub or small tree 5-8(11) m high, with leaves and other young parts covered with silvery, stellate scales. The fruits are small (6-10 mm long) subglobose to ovoid, borne on the flow-

ering shoots in dense clusters, yellow or orange-reddish in color. After an exposure to the autumn frost they turn sour-sweet, very tasty, and develop a pineapple-like aroma. The fruits are commonly collected from wild plants; and in some areas (including Armenia) superior clones have been locally selected and introduced into cultivation. In the wild, *H. rhamnoides* is a widespread, polymorphic species subdivided into nine main races or subspecies; and distributed (rather discontinuously) over vast areas - from the Atlantic shore of Europe to Mongolia and East China (Rousi 1971; Browicz 1986).

In Armenia, the ripe fruits of *H. rhamnoides* are extensively collected from the wild, and used to prepare juice, jams, wine, liqueur, and a very aromatic vodka. The fruits and the seeds are also esteemed medicinally. Traditional selection resulted in clones with tastier and larger fruits, and reduced spinescence. Such clones are locally grown in farm holds (mostly for the family use). Wild forms of *H. rhamnoides* occur in Armenia in Aragatz, Lori, Idjevan, Aparan, Sevan, Gegham, Erevan, Darelegis, Zangezour and Meghri floristic regions, at altitudes ranging from 600 to 2200 m. They occur along rivers and streams, in dry pebbly beds of rivers, and on open mountain slopes. Large stands occur on the sandy banks of Lake Sevan, where *H. rhamnoides* sometimes forms impassable thickets.

Jujube, *Ziziphus jujuba* Mill.

Jujube (*Unab* in Armenian) is a small tree or shrub 3-9(15) m high, widely grown (particularly in China and central Asia) for its round or elongate fruits that contain sweet and crisp pulp; and are also esteemed for their medicinal qualities (Simoons 1991). Wild forms of *Z. jujuba* are native in West China, and Central and South-West Asia. A closely related taxon, frequently referred to as *Z. mauritiana* Lam. [= *Z. jujuba* Lam.], is both wild and cultivated in the warmer Indian subcontinent.

In Armenia, wild-growing populations of *Z. jujuba* occur in Idjevan, Erevan (Khosrov reserve, Garni, Urtz mountains), Darelegis, Zangezour and Meghri floristic regions (Fig. 89) growing on dry, south facing, stony or rocky slopes; as well as along streams, at altitudes ranging from 500 to 1400 m, frequently together with *Amygdalus fenzliana*, *Rhamnus pallasii*, *Berberis orientalis* and *Pyrus salicifolia*.

Nut Crops

Almond, *Amygdalus communis* L. [= *Prunus amygdalus* Batsch., *Prunus dulcis* (Mill.) D. A. Webb].

The cultivated almond (*Nsheni*, *Nush* in Armenian) is a diploid ($2n=2x=16$), largely self-incompatible tree, extensively cultivated for its tasty seeds. The crop is closely related to (and fully inter-fertile with) an aggregate of wild forms native to the Levant countries. These wild forms are now taxonomically included in the crop species *A. communis* L., and identified (Browicz & Zohary 1996) as the ancestral stock from which the cultivated almond varieties could have evolved. In addition, the crop seems to be largely cross-fertile with many of the other 25 wild species grouped in the genus *Amygdalus* (Browicz & Zohary 1996). In particular, *A. communis* shows close affinities with a cluster of seven vicarious wild species placed in Series *Communis*. Also these wild species seem to be fully

inter-fertile with the cultivars, i.e., they belong to the primary wild genepool (GP-1) of the crop.

The following two wild almonds are native in Armenia (Fedorov 1958). In addition, the domestic almond escaped from cultivation in some places in this country, particularly in areas of almond cultivation.

- (I) *Amygdalus fenzliana* (Fritsch) Lipsky. [= *Prunus fenzliana* Fritsch]. This is a shrub or a small tree, native to Trans-Caucasia (Browicz & Zieliński 1984). Within the genus *Amygdalus* it is placed in Series *Communis* (Browicz & Zohary 1996). It is fully inter-fertile with the crop. In Armenia *A. fenzliana* grows on dry stony or rocky slopes, in bush thickets or in juniper open forests, occupying a relatively a wide range of altitudes (500 to 2150 m). It is a variable species, and a common constituent of open forest formations. Its distribution encompasses Idjevan, Aragatz, Erevan, Darelegis, Zangezur and Meghri floristic regions, as well as Nakhichevan (Fig. 90). The seeds of *A. fenzliana* are usually bitter. However, very rare, non-bitter individuals were encountered in some populations.
- (II) *Amygdalus nairica* Fed. & Takht. This is a xeric, strongly branching, very thorny shrub, about 1m high. Compared to *A. fenzliana*, *A. nairica* is much more distant from the crop, and placed in the spiny subgenus *Dodecandra* (Spach) Browicz [= Sect. *Lycioides* Spach]. *A. nairica* is confined to Trans-Caucasia, and it is closely related to the more widely distributed *A. lycioides* Spach. Since some members of this subgenus are still able to cross with members of the *Communis* species group (Browicz and Zohary 1996), it is very likely that *A. nairica* belongs to the secondary wild gene pool (GP-2) of the crop. In Armenia, *A. nairica* is reported from Zangezur and Meghri floristic regions, as well as in Nakhichevan (Fig. 91) in altitudes ranging from 450 to 1000 m.
- (III) Feral populations of *Amygdalus communis* L. As already mentioned, the cultivated almond seems to have escaped from cultivation in Armenia, particularly in areas of almond culture (Erevan, Darelegis, Zangezur and Meghri floristic regions). In some places where cultivated *A. communis* and wild *A. fenzliana* grow side by side, signs of spontaneous hybridization were detected between these two species. This suggests that introgressive hybridization could have assisted the naturalization of *A. communis* in Armenia.

Walnut, *Juglans regia* L.

Both the cultivated and the wild forms of *Juglans regia* (*Enkuzeni*, *Enkuiz* in Armenian) are large, deciduous trees. Wild forms tend to differ from the cultivated varieties by their smaller nuts and thicker shells. They are widely distributed in the temperate, deciduous forest belts of South Turkmenia, South Caspian basin, The Caucasus, North Turkey and the Balkans (Browicz 1996). Further east, wild forms of *J. regia* reappear in Central Asia and in the Himalayas, and extend to Tien Shan in western China.

J. regia grows wild in North, Central and South Armenia (Fig. 92) preferring slightly moist and deep soils: on mountain slopes, in ravines, along streams and in valleys of rivers. Almost half of its wild stands are concentrated in the floristic regions of Ijevan, Zangezur and Meghri. Wild populations in this country are very variable, particularly in the shape of

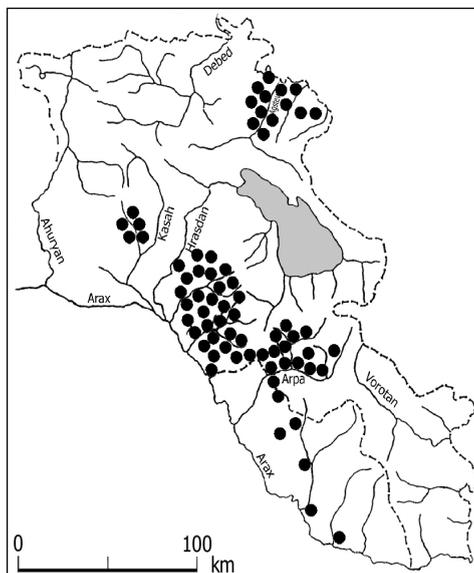


Fig. 90. Distribution of *Amygdalus fenzliana* (Fritsch) Lipsky.

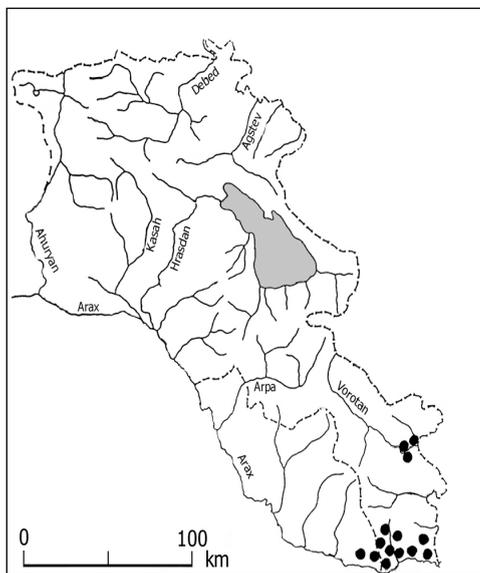


Fig. 91. Distribution of *Amygdalus nairica* Fed. & Takht.

leaves and nuts. *J. regia* is a conspicuous component of mixed forests, at altitudes ranging from 500 to 1800 m. It is also an element of riparian forests in bottomlands. In the first environment *J. regia* is often associated with *Platanus orientalis*, *Carpinus caucasicus*, *C. orientalis*, *Taxus baccata*, *Quercus iberica*, *Q. araxina*, *Cerasus avium*, *Tilia caucasica*, *Pyrus caucasica*, *P. zangezura*, *P. salicifolia*, *Sorbus persica*, *S. takhtajanii*, and *S. graeca*. In river valleys, its frequent companions are *Eleagnus angustifolius*, *Hippophaë rhamnoides*, *Vitis vinifera* subsp. *sylvestris*, *Berberis* sp., *Rosa* sp., *Periploca graeca*, *Datisca cannabina*, and *Humulus lupulus*.

Sweet Chestnut, *Castanea sativa* L.

The European or Sweet Chestnut (*Shakanakeni*, *Shakanak* in Armenian) is a deciduous, large tree, grown for its nuts. A common practice of cultivation of this tree is grafting of selected clones on existing wild growing trees or on seedlings. Wild or naturalized forms of *C. sativa* are widespread in the relatively rainy parts (600 mm or more) in the Mediterranean basin and adjacent parts of S. Europe. They are obviously native in N. Turkey, the Caucasus and in N. Iran (Browicz 1982). This nut crop develops best on moderately acid soils of light texture (Fernández-López & Alía 1999).

In Armenia, wild *C. sativa* is very rare (Fig. 93) and considered an endangered species. This tree has been known to be limited to the relatively warm and humid Shikahokh reserve (ca 700 m altitude) in Zangezur floristic region, where several trees are protected as relics. Recently, an additional wild-growing *C. sativa* population was discovered; this time in North Armenia (Gabrielian 2002). This new stand grows in one of the gorges of

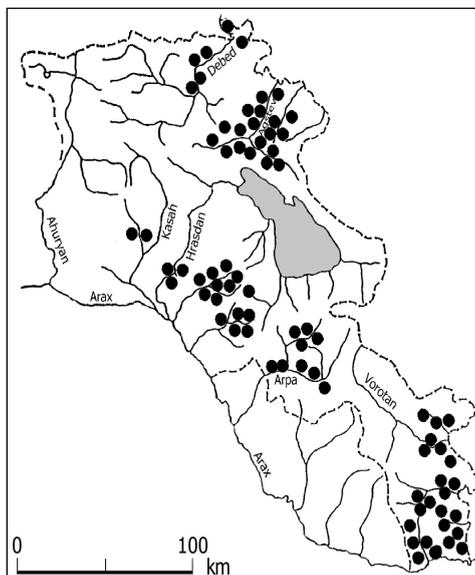


Fig. 92. Distribution of wild forms of walnut, *Juglans regia* L.

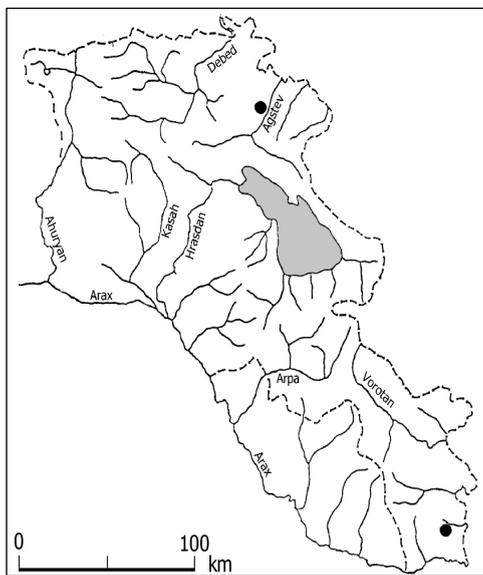


Fig. 93. Distribution of wild forms of sweet chestnut, *Castanea sativa* L.

Aghay Mountains in the Idjevan range. It grows on South-East slopes at 1100 m altitude, in oak-beech-hornbeam forest together with *Quercus iberca*, *Fagus orientalis*, *Carpinus betulus*. Other associates are *Juniperus polycarpus*, *Juglans regia*, *Pyrus caucasica*, *Cornus mas*, *Carpinus caucasica*, different species of *Acer* and *Tilia*. Rarely *Taxus baccata* is also present. Altogether, some 130 chestnut trees occur in this gorge. Some are old individuals (with trunks ca. 40 cm in diam.) as well as many young trees. Fruiting is apparently abundant; many spiny cupules are found on the ground, and others occur on the upper branches of the trees.

Hazel, *Corylus avellana* L. (including *C. maxima* Mill.)

Hazel (*Thkhleni*, *Thkhil* in Armenian) is a deciduous, diploid ($2n=2x=28$) shrub or small tree, cultivated for its ovoid nuts; that was grown as a nut crop already in classical times. North Anatolia has been a major center for its cultivation, and it is in this area that some of its tasty, large fruited clones seem to have evolved (some are apparently of hybrid origin). The wild forms of *C. avellana* are widely distributed over the temperate parts of Europe, Turkey and the Caucasus. They are important constituents of deciduous and mixed forests, occupying a wealth of habitats. Wild populations in Europe bear relatively small nuts, surrounded by short involucre. Those in the Pontic and Hyrcanic regions have frequently larger nuts and longer involucre; and are sometimes treated as a separate species. They seem to have been a major source for the development of the modern large-fruited cultivars.

In Armenia wild forms of *C. avellana* are common in the temperate parts of the coun-

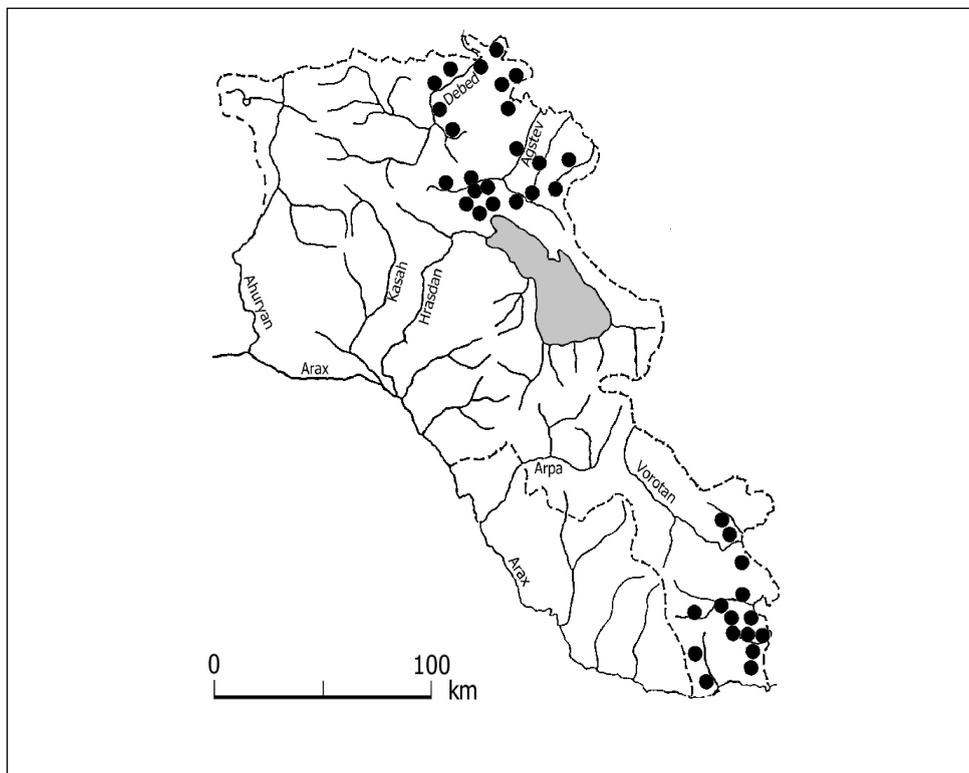


Fig. 94. Distribution of wild forms of hazel, *Corylus avellana* L.

try in Lori (only south-eastern part), Idjevan, Zangezur and Meghri floristic regions (Fig. 94) at altitudes ranging from 600 to 2000 m. They thrive at edges of beech, hornbeam and oak forests, in bush thickets and in gorges.

References

- Arakelyan, B. N. 1951: Garni 1. Archeologicheskie raskopki v Armenii No. 3. — Garni 1. Archaeological excavations in Armenia No. 3. — Erevan.
- Araratian, A. G. 1937: K kariologii semeistva Eleagnaceae. [A contribution to the cariology of Eleagnaceae.] — Trudy Arm. Fil. Akad. Nauk SSSR Biol. Ser. **2**: 5-11.
- 1939: Geterochromosoma u dikogo shpinata. [Heterochromosomes in wild spinach.] — Doklady Akad. Nauk SSSR **24** (1): 54-56.
- Ben-Ze'ev, N. & Zohary, D. 1973: Species relationships in the genus *Pisum* L. — Israel Jour. Bot. **22**: 73-91.
- Beridze, R. K. & Kvatchadze, M. V. 1981: Origin and evolution of cultivated plums in Georgia. — Kulturpflanze **29**: 147-150.
- Bianco, V. V. 1995: Rocket, an ancient underutilized vegetable crop and its potential. — Pp. 13-15 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.

- Bothmer, R. von, Jacobsen, N., Baden, C., Linde-Laursen, I. & Jorgesen, R. B. 1991: An ecogeographical study of the genus *Hordeum*. — Systematic and Ecogeographic Studies on Crop Gene-pools 7. — International Board for Plant Genetic Resources (IPGRI). Rome, Italy.
- Brennan, R. M. 1990: Currants and gooseberries (*Ribes*). — Pp. 459-488 in: Moore, J. N. & Ballington, J. R. (ed.), Genetic resources of temperate fruit and nut crops. — Acta Horticulturae 290. International Society for Horticultural Science (ISHS), Wageningen. The Netherlands.
- Brewster, J. K. 1994: Onions and other vegetable Alliums. — CAB International. Wallingford, Oxon.
- Browicz, K. 1982-1996: Chorology of trees and shrubs in South-West Asia and adjacent regions, **1** (1982), **3** (1984), **5** (1986), **9** (1992), **10** (1994), Supplement (1996) — Institute of Dendrology, Polish Academy of Sciences, Kórnik, Poland.
- 1993: Conspect and chorology of the genus *Pyrus* L. — Arboretum Kórnickie **38**: 17-33.
- & Zielinski, J. 1984-1990: Chorology of trees and shrubs in South-West Asia and adjacent regions, **4** (1984), **7** (1990). — Institute of Dendrology, Polish Academy of Sciences, Kórnik, Poland.
- & Zohary, D. 1996: The genus *Amygdalus* L. (*Rosaceae*): species relationships, distribution and evolution under domestication. — Genetic Resources and Crop Evolution **43**: 229-247.
- Burenin, V. I. & Pivovarov, V. F. 1998. Svekla [Beet]. — St. Petersburg. 65 pp.
- Charchoghlyan, A. A., Kazaryan, V. V. & Davtyan, V. A. 1996: Trudy 1 Vseross. Conf. po Botan. Resursovedeniju. — St. Petersburg.
- Crisp, P. 1995: Radish. — Pp. 86-88 in: Smartt, J. & Simmonds N. W. (ed.), Evolution of crop plants, 2nd edn. — Longman, UK.
- Courter, J. W. & Rhodes, A. M. 1969: Historical notes on horseradish. — Econ. Bot. **23**: 156-164.
- Danin, A., Baker, I. & Baker, H. G. 1979: Cytogeography and taxonomy of the *Portulaca oleracea* L. polyploid complex. — Israel Jour. Bot. **27**: 177-211.
- Davis, P. H. 1970: *Vavilovia* Fed. — Pp. 372-373 in: Davis, P.H. (ed.), Flora of Turkey and the east Aegean islands, **3**. — Edinburgh, UK.
- De Wet, J. M. J. 1995: Foxtail millet. — Pp. 170-172 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, 2nd edn. — Longman, UK.
- Diederichsen, A. 2001: *Brassica rapa* (Pp. 1446-1453), *B. napus* (Pp. 1457-1461). — In: Hanelt, P. (ed.), Mansfeld's encyclopedia of agricultural and horticultural crops, 1st English edition. — Springer Verlag, Berlin.
- & Hammer, K. 1995: Variation of cultivated flax (*Linum usitatissimum* L. subsp. *usitatissimum*) and its wild progenitor pale flax (subsp. *angustifolium* (Huds.) Thell.). — Genetic Resources and Crop Evolution **42**: 263-272.
- Dorofeev, V. F., Filatenko, A. A., Migushova, E. F., Udashin, R. A. & Jakubziner, R. R. 1979: Pšenica [Wheat]. — Kul'turnaja Flora SSSR. **1**, Dorofeev V. F. & Korovina, O. N. (ed.). — Kolos, Leningrad. 347 Pp.
- Dovlatyan, A. L. 1977: Kul'tura lokha v Armjanskoi SSR. [The culture of silver berry in Armenian SSR.] — Izvestija sel'sko-khozjaistvennykh Nauk **2**: 37-42.
- Dvořák, J., Di Terlizzi, P., Zhang, H. B. & Resta, P. 1993: The evolution of polyploid wheats: identification of the A genome donor species. — Genome **36**: 21-31.
- , McGuire, P. E. & Cassidy, B. 1988: Apparent sources of the A genomes of wheats inferred from polymorphism in abundance and restriction fragment length of repeated nucleotide sequences. — Genome **30**: 680-689.
- , Luo, M. C., Yang, Z. L. & Zhang, H. B. 1998: The structure of the *Aegilops tauschii* gene-pool and the evolution of hexaploid wheat. — Theoretical and Applied Genetics **67**: 657-670.
- Fedorov, An. A. 1952: *Pyrus* L. — Pp. 14-27, 421-42 in: Grossheim A. A. (ed.), Flora Kavkaza Vol. **5**.
- 1954: Rod Grusha. *Pyrus* L. — Pp. 384-414 in: Sokolov, S. J. (ed.), Derevoja i kustarniki SSSR, **3**. — Moskva-Leningrad.

- 1958: *Fragaria* L. (Pp. 66-72), *Cydonia* Mill. (Pp. 228-233), *Pyrus* L. (Pp. 235-248), *Amelanchier* Medik. (Pp. 285-286), *Mespilus* L. (Pp. 286-291), *Crataegus* L. (Pp. 291-303), *Amygdalus* L. (Pp. 315-318), *Cerasus* Duhamel (Pp. 318-328), *Padus* Mill. (Pp. 328-331). — in: Takhtajan, A. L. (ed.), *Flora Armenii* **3**. — Arm. Akad. Sci. Press. Erevan.
- Feldman, M., Lupton, F. G. H. & Miller, T. H. 1995: Wheats. — Pp. 184-192 in: Smartt, J., Simmonds, N. W. (ed.), *Evolution of crop plants*, 2nd edn. — Longman, UK.
- Fernández-López, J. & Alía, R. 1999: Chestnut (*Castanea sativa*). — Pp. 21-27 in: Turok, J., Jensen, J., Palmberg-Lerche, Ch., Rusanen, M., Russel, K., Vries, S. de & Lipman, E. (ed.), *Noble hardwoods network. Report of the third meeting, 13-16 June 1998, Sagadi, Estonia*. — International Plant Genetic Resources Institute (IPGRI), Rome.
- Ford-Lloyd, B. V. 1995: Sugar beet and other cultivated beets. — Pp. 35-40 in: Smartt, J. & Simmonds, N. W. (ed.), *Evolution of crop plants*, 2nd edn. — Longman, UK.
- Fritsch, R. 2001: *Grossulariaceae* (Pp. 399-408), *Diospyros* (Pp. 1639-1646) - in: Hanelt, P. (ed.), *Mansfeld's encyclopedia of agricultural and horticultural crops*, 1st English edition. — Springer Verlag, Berlin.
- Gabrielian, E. T. 1958: *Sorbus* L. — Pp. 256-285 in: Takhtajan, A. L. (ed.), *Flora Armenii* **3**. — Arm. Akad. Sci. Press. Erevan.
- 1962: *Vavilovia* Fed. — Pp. 332, 334 in: Takhtajan, A. L. (ed.), *Flora Armenii* **4**. — Erevan.
- 1972: *Sorbus* L. — Pp. 147-156 in: Davis P. H. (ed.), *Flora of Turkey and the east Aegean islands* **4**. — Edinburgh.
- 1978: Rjabiny (*Sorbus* L.) zapadnoj Azii i Gimalaev [The genus *Sorbus* L. in Western Asia and the Himalayas]. — Armenian Acad. Press, Erevan. 263 Pp. [Russian with English summary]
- 1991: Wild relatives of cultivated plants in Armenia. — *Botanica Chronica* **10**: 475-79.
- 1995: *Carthamus* L. — Pp. 435-444 in: Takhtajan, A.L. (ed.), *Flora Armenii* **9**. — Germany.
- 2002: O nakhodke tretichnogo relikta *Castanea sativa* v lesakh severnoi Armenii [A discovery of the Tertiary relic *Castanea sativa* in the forests of North Armenia]. — *Fl. Rastit. Rast. Res. Armenii* **14**: 84.
- Gabrielyan-Beketovskaja E. A. 1957: Ayva Armjanskoi SSR Monografija. [A monograph of quince in Armenian SSR]. — Erevan. 202 pp.
- 1973: Ayva. [Quince] — *Plody Armenii* **3**: 132-186.
- Gandilyan, P. A. 1971: Dikij dvurjadnyj jachmen' *Hordeum spontaneum* K. Koch v Armjanskoi SSR i ego dve novye raznovidnosti [Wild two-rowed barley *Hordeum spontaneum* K. Koch in Armenian SSR and its two new varieties]. — *Dokl. Akad. Nauk Arm. SSR*. **52**(5): 289-293.
- 1972: O dikorastuščih vidach *Triticum* Armjanskoi SSR. [On wild growing *Triticum* species of Armenian SSR]. — *Botan. Zhurn.* **57**: 173-181.
- 1980a: Opredelitel pšenicy, egilopsa, ržji i jačmenja. [Key to wheat, *Aegilops*, rye, and barley]. — Erevan. 287 pp.
- 1980b: Dikorastušchie sorodichi zernovykh, zernobobovykh kul'tur v Armjanskoi SSR I voprosy ikh okhrany [Wild relatives of cereals and legume kultigens in Armenian SSR and the question of their protection]. — *Sbornik nauchnykh trudov* **35**: 91-109.
- 1990: Dikie sorodichi kulturnykh rastenii. Pp. 248-249 in: Kazarian, V.O. (ed.), *Krasnaja kniga Armjanskoi SSR* [Wild relatives of cultivated plants. Red data book of Armenian SSR]. — Erevan.
- & Melikyan, A. 1999: *Beta* genetic resources in Armenia. — Pp. 15-16 in: IPGRI Report of a Working Group on *Beta*, Part IIA National Collections. — Rome.
- Gladkova, V. N. 1989: Zametki o vidach roda *Pyrus* L. (*Rosaceae*) flory Kavkaza. [Notes on the species of the genus *Pyrus* (*Rosaceae*) in the flora of the Caucasus]. — *Novosti Sist. Vysš. Rast.* **26**: 10-113.

- 1990: Obzor vidov roda *Pyrus* (*Rosaceae*) flory Kavkaza. [Synopsis of the species of the genus *Pyrus* (*Rosaceae*) for the flora of the Caucasus]. — Botan. Zhurn. SSSR **75**: 874-883.
- Grossheim, A. A. 1939-1967: Flora Kavkaza, 2nd edn. **1-7**. — Baku, Moskva, Leningrad.
- 1948: Rastitel'nyj pokrov Kavkaza. [Vegetation cover of the Caucasus]. — Mosk. Obsch. Ispyt. Prir. Moskva. 267 Pp.
- 1952: Rastitel'nye bogatstva Kavkaza. [Plant resources of the Caucasus]. — Mosk. Obsch. Ispyt. Prir. Moskva. 632 Pp.
- Hambartzumyan, A. M. & Harutjunyan, M. N. 1977: Dikie formy abricosa v Armenii. [Wild forms of apricot in Armenia]. — Biolog. Zhur. Armenii **30** (12): 3-8.
- Hammer, K. 2001: *Beta* L. (Pp. 235-241), *Atriplex hortensis* L. (Pp. 253-254), *Mentha* L. (Pp. 1971-1980) — in: Hanelt, P. (ed.), Mansfeld's encyclopedia of agricultural and horticultural crops, 1st English edition. — Berlin.
- Hanelt, P. 1963: Monographische Ubersucht der Gattung *Carthamus* L. (*Compositae*). — Feddes Repert. Spec. Nov. **67**: 41-180.
- 1997: European wild relatives of *Prunus* fruit crops. — [In: Valdes, B., Heywood, V. H., Raimondo, F. M. & Zohary, D. (ed.), Proceedings of the workshops on conservation of European cultivated plants.] — Boccone 7: 40-408
- 2001: *Sorbus aucuparia* (P. 482-486), *Pisum* (Pp. 852-856), *Triticum* (Pp. 2565-2594), in: Hanelt, P. (ed.), Mansfeld's encyclopedia of agricultural and horticultural crops, 1st English edition. — Berlin.
- Harlan, J. R. & Zohary, D. 1966: Distribution of the wild wheats and barley. — Science **153**: 1074-80.
- & De Wet, J. M. J. 1971: Towards a rational classification of cultivated plants—Taxon **20**: 509-17.
- Harley, R. M. & Brighton, C. A. 1977: Chromosome numbers in the genus *Mentha* L. — Bot. Jour. Linn. Soc. **74**: 71-96.
- Hedge, I. C. 1997: *Atriplex*. — Pp. 66-68 in: Rechinger, K. H. (ed.), Flora Iranica, Cont.197. — Akademische Druk, Graz, Austria.
- Hemingway, J. S. 1995: Mustards. — Pp. 82-86 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, 2nd edn. — Longman, UK.
- Heywood, V. H. 1983: Relationships and evolution in the *Daucus carota* complex. — Israel Jour. Bot. **32**: 52-65.
- & Zohary, D. 1995: A catalogue of the wild relatives of cultivated plants native to Europe. — Flora Mediterranea **5**: 375-415.
- Ietswaart, J. H. 1980: A taxonomic revision of the genus *Origanum* (*Labiatae*). — Leiden Botanical Series 4. — Leiden, The Netherlands.
- Jaaska, V. 1997: Isoenzyme differences between the wild diploid and tetraploid wheats. — Genetic Resources and Crop Evolution **44**: 137-146.
- Jalas, J. & Suominen, J. 1994: Atlas Florae Europaeae: Distribution of vascular plants in Europe, **10**. — Helsinki.
- , Suominen, J. & Lampinen, R. 1996: Atlas Florae Europaeae: Distribution of vascular plants in Europe, **11**. — Helsinki.
- Jankun, A. & Gabrielian, E. T. 1979: Kariologia przedstawicieli rodzaju *Sorbus* L. z terenu Armenskiej SSR. [Karyology of the representatives of the genus *Sorbus* L. distributed in Armenian SSR]. — 4th Ogolnopolska Konferencja Cytogenetyczna Gdansk. 20 Pp.
- Jeffrey, C. 1980: A review of *Cucurbitaceae*. — Bot. Jour. Linn. Soc. **81**: 475-93.
- 2001: *Cucumis melo* (Pp. 1512-1520), *Citrullus* (Pp. 1533-1536) — in: Hanelt, P. (ed.), Mansfeld's encyclopedia of agricultural and horticultural crops, 1st English edition. — Berlin
- Jennings, D. R. 1995: Raspberries and blackberries. — Pp. 429-434 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, 2nd edn. — Longman, UK.

- Jones, J. K. 1995: Strawberry. — Pp. 413-418 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, 2nd edn. — Longman, UK.
- Jones, R. N. 1990: Cytogenetics. — Pp. 199-214 in: Rabinowitch, H. D. & Brewster, J. L. (ed.), Onion and allied crops **1**. — Boca Raton, Florida.
- Kearney, J. & Smartt, J. 1995: Grasspea. — Pp. 266-270 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, 2nd edn. — Longman, UK.
- Keep, E. 1995: Currants. — Pp. 235-239 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, 2nd edn. — Longman, UK.
- Kirkebride, J. H. 1993: Biosystematic monograph of the genus *Cucumis* (*Cucurbitaceae*). — Boone, North Carolina. 159 Pp.
- Knowles, P. F. & Ashri, A. 1995: Safflower. — Pp. 358-366 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, 2nd edn. — Longman, UK.
- Kobylyanskiy, V. D. 1989: Rozh. [Rye]. — Kul'turnaja Flora SSSR. **2**, Part 1. — Agropromizdat, Leningrad. 366 Pp.
- Koopman, W. J. M., Guetta, E., Weil, C. C. M. van der, Vosman, B. & Berg, R. G. van den, 1998: Phylogenetic relationships among *Lactuca* (*Asteraceae*) species and related genera based on ITS-DNA sequences. — Amer. Jour. Bot. **85**: 1517-1530.
- Korban, S. S. 1986: Interspecific hybridization in *Malus*. — HortScience **21**: 41-48.
- Ladizinsky, G. 1993: Wild lentils. — Critical Reviews in Plant Sciences **12**: 169-184.
- & Oss, H. van 1984: Genetic relationships between wild and cultivated *Vicia ervilia*. — Bot. Jour. Linn. Soc. **89**: 97-100.
- Lange, W., Bandenburg, W. A. & Bock, T. S. M. de 1999: Taxonomy and cultonomy of beet (*Beta vulgaris* L.). — Bot. Jour. Linn. Soc. **130**: 81-96.
- Leggett, J. M. & Thomas, H. 1995: Oat evolution and cytogenetics. — Pp. 120-149 in: Welch R. W. (ed.), The oat crop. — London.
- Letschert, J. P. W. 1993: *Beta* section *Beta*: biogeographical patterns of variation and taxonomy. — Wageningen Agricultural University Papers, No. 93-1. — The Netherlands.
- Maan, S. S. 1973: Cytoplasmic and cytogenetic relationships among tetraploid *Triticum* species. — Euphytica **22**: 287-300.
- Markgraf, F. F. 1975: *Camelina sativa* (L.) Crantz. — Pp. 342-345 in: Gustav Hegi (ed.), Illustrierte Flora von Mitteleuropa (2nd edn), vol. **4**(1). — Berlin.
- Mathew, B. 1996: A review of *Allium* section *Allium*. — Royal Bot. Gardens, Kew, UK.
- McNaughton, I. H. 1995: Turnip and relatives. — Pp. 62-68 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, 2nd edn. — Longman, UK.
- Melikyan, A. 1989: K voprosu o genofonde dikorastuschikh vidov svekly v Armjanskoi SSR. [On the question of genetic resources of the wild species of beet in Armenian SSR]. — Biol. Zhur. Armenii **42**(7): 654-658.
- 2000: Wild melon (*Cucumis melo*) genetic resources in Armenia. — IPGRI Newsletter for Europe No.18, August 2000.
- 2001: Biological peculiarities and variety of usage of several wild vegetable plants spread throughout Armenia. [Armenian, with English and Russian summaries]. — Erevan. 171 Pp.
- Meusel, H., Jäger, E. & Weinert, E. 1965: Vergleichende Chorologie der zentraleuropäischen Flora, **1** (Karten und Text). — Jena.
- , Jäger, E., Rauschert S. & Weinert, E. 1978: Vergleichende Chorologie der zentraleuropäischen Flora, **2** (Karten und Text). — Jena.
- & Jäger, E. 1992: Vergleichende Chorologie der zentraleuropäischen Flora, **3** (Karten und Text). — Jena.
- Mulkidjanyan, J. I. 1969: Armjanskaja SSR odin iz osnovnykh ochagov vidoobrazovanija roda

- grusha (*Pyrus* L.) [Armenian SSR one of the main centers of speciation of the genus pear (*Pyrus* L.)]. — Dokl. Acad. Sci. Arm. SSR. **49**: 288-291.
- 1973: *Rhus coriaria* L. (Pp. 166-167), *Elaeagnus* L. (Pp. 460-462) - in: Takhtajan, A. L. (ed.), Flora Armenii **6** — Erevan.
- Nazarova, E. A. 1995: *Cichorium* L. — Pp. 78-80 in: Takhtajan, A. L. (ed.), Flora Armenii **9**. — Germany.
- Neve, R. A. 1995: Hops. — Pp. 33-35 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, 2nd edn. — Longman, UK.
- Nevo, E. 1992: Origin, evolution, population genetics and resources for breeding of wild barley, *Hordeum spontaneum*, in the Fertile Crescent. — Pp. 19-43 in: Shewry, P. R. (ed.), Barley: genetics, biochemistry, molecular biology and biotechnology. — Oxon, UK.
- Oganesian, M. E. & Agababian, M. V. 2001: *Allium* L. — Pp. 282-348 in: Takhtajan, A. L. (ed.), Flora Armenii **10**. — Germany.
- Pistrick, K. 1987: Untersuchungen zur Systematik der Gattung *Raphanus* L. — Kulturpflanze **35**: 225-321.
- 2001: *Pastinaca* (Pp. 1322-1323), *Origanum* (Pp. 1983-1989), *Satureja* (Pp. 1997-1999), *Melissa* (Pp. 1995-1997). — In: Hanelt, P. (ed.), Mansfeld's encyclopedia of agricultural and horticultural crops, 1st English edition. — Berlin.
- Rehder, A. 1940: Manual of cultivated trees and shrubs hardy in North America, 2nd edn. — Macmillan, New York. 996 pp. Reprinted 1989 — Portland, Oregon.
- Rich, T. C. G. 1991: Crucifers of Great Britain and Ireland. — Botanical Society of the British Islands, Handbook No. 6. London.
- Riggs, J. J. 1995: Umbelliferous minor crops. — Pp. 481-485 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, 2nd edn. — Longman, UK.
- Rousi, A. 1971: The genus *Hippophaë* L. A taxonomic study. — Ann. Bot. Fenn. **8**: 177-227.
- Rubtzov, G. A. 1944: Geographic distribution of the genus *Pyrus* and trends and factors in its evolution. — Amer. Naturalist **78**: 358-66.
- Sears, E. R. 1969: Wheat cytogenetics. — Ann. Rev. Genet. **3**: 451-68.
- Sencer, H. A. & Hawkes, J. G. 1980: On the origin of cultivated rye. — Biol. Jour. Linn. Soc. **13**: 299-313.
- Shkhijan, A. S. 1962: *Cannabis* L. — Pp. 360-365 in: Takhtajan, A. L. (ed.), Flora Armenii **4**. — Erevan.
- Simoons, F. J. 1991: Food in China: a cultural and historical inquiry. — Boca Raton, Florida.
- Slageren, M. W. van 1994: Wild wheats: a monograph of *Aegilops* L. and *Amblyopyron* (Jaub. & Spach) Eig (*Poaceae*). — The Netherlands. 512 pp.
- Small, E. 1995: Hemp. — Pp. 28-32 in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, 2nd edn. — Longman, UK.
- 1995: Culinary herbs. — Ottawa, Ontario.
- & Cronquist, A. 1976: A practical and natural taxonomy for *Cannabis*. — Taxon **25**: 405-435.
- Smartt, J. 1990: Grain legumes: evolution and resources. — Cambridge.
- Smith, P. M. 1976: Spinach — Pp. 304 in: Simmonds, N. W. (ed.), Evolution of crop plants, 1st edn. — London.
- Sneep, J. 1982: The domestication of spinach and the breeding history of its varieties. — Euphytica, 2nd Suppl., 27 Pp.
- Specht, C. E. 2001: *Amoracia rusticana* (Pp. 1419-1420), *Nasturtium officinale* (Pp. 1421-1423), *Lepidium sativum* (Pp. 1429-1432), *Eruca sativa* (Pp. 1470-1472) — in: Hanelt, P. (ed.): Mansfeld's encyclopedia of agricultural and horticultural crops, 1st English edition. — Berlin.
- Stutz, H.C. 1972: On the origin of cultivated rye. — Amer. Jour. Bot. **59**: 59-70.
- Takhtajan, A. L. 1954-2001: Flora Armenii, **1-10**. — Erevan.

- & Mulkidjanyan, J. I. 1956: *Beta* L. — Pp. 280-291 in: Takhtajan, A. L. (ed.), *Flora Armenii* **2**. — Erevan.
- & Fedorov, A. A. 1972: *Flora Erevana*. — Nauka, Leningrad, 392 Pp.
- Tamanjan, K. G. 2001: *Asparagus* L. — Pp. 373-378 in: Takhtajan, A. L. (ed.), *Flora Armenii* **10**. — Germany.
- & Pogosian, A. I. 1979: Tzitolaksonomicheskoe issledovanie kavkazskikh vidov roda *Asparagus* L. (*Liliaceae*). [Cytotaxonomic study of the Caucasian species of the genus *Asparagus* L. (*Liliaceae*)]. — *Botan. Zhurn.* **64**(3): 398-403.
- Thomas, H. 1995: Oats. — Pp. 132-137 in: Smartt, J. & Simmonds, N. W. (ed.), *Evolution of crop plants*, 2nd edn. — Longman, UK.
- Tumanian, M. G. 1934: Botanicheskiy sostav dikih pšenic Armenii i uslovija proizrastaniya v prirode. [Botanical composition of wild wheats of Armenia and their growing conditions in nature]. — *Trudy Prikl. Bot. Genet. & Selekt.* **25**(2): 52-59.
- 1937: Novyj vid dikoj pšenicy, *Tr. urartu* Tuman. [A new species of wild wheat *Tr. urartu* Tuman.]. — *Trudy Armjansk. Fil. Akad. Nauk SSSR*, ser. Biol. II, 210-215.
- Uotila, P. 1997: *Spinacia*. — Pp. 59-63 in: Rechinger, K. H. (ed.), *Flora of Iran*, Cont. No. 172. — Graz, Austria.
- Valkoun, J., Waines, J. G. & Konopka, J. 1998: Current geographical distribution and habitat of wild wheats and barley. — Pp. 293-299 in: Damania, A. B., Valkoun, J., Willcox, G. & Qualset C. O. (ed.), *The origins of agriculture and crop domestication*. — Aleppo, Syria.
- Vardi, A. & Zohary, D. 1967: Introgression in wheat via triploid hybrids. — *Heredity* **22**: 541-560.
- Vartapetian, V. V. 1989: Biohimičeskij polymorphism prirodnyh populjacij jabloni vostočnoj *Malus orientalis* Uglitzk. v uslovijah Armjanskoj SSR. [Biochemical polymorphism of natural populations of *Malus orientalis* Uglitzk. in Armenian SSR.]. — *Biol. Zhurn. Armenii* **42**(7): 647-54.
- Vries, I. M. de 1997: Origin and domestication of *Lactuca sativa* L. — *Genetic Resources and Crop Evolution* **44**: 165-74.
- Waines, J.G. 1996: Molecular characterization of the einkorn wheat. — Pp. 193-197 in: Padulosi, S., Hammer, K. & Heller, J. (ed.), *Hulled wheats*. — International Plant Genetic Resources Institute (IPGRI), Rome.
- & Barenhart, D. 1992: Biosystematic research in *Aegilops* and *Triticum*. — *Hereditas* **116**: 207-212.
- Watkins, R. 1986: Pears. — Pp. 187-196 in: Hora, B. (ed.), *The Oxford encyclopedia of trees of the World*, 2nd edn. — Oxford.
- 1995: Cherry, plum, peach, apricot and almond. — Pp. 423-428 in: Smartt, J. & Simmonds, N. W. (ed.), *Evolution of crop plants*, 2nd edn. — Longman, UK.
- Way, R. D., Aldwinckle, H. S., Lamb, R. C., Rejman, A., Sansavini, S., Shen, T., Watkins, R., Westwood, M. N. & Yoshida, Y. 1990: Apple (*Malus*). — Pp. 3-62 in: Moore, J. N. & Ballington, J. R. (ed.), *Genetic resources of temperate fruit and nut crops*. — *Acta Horticulturae* 290, International Society for Horticultural Science (ISHS). Wageningen. The Netherlands.
- Webb, D.A. 1968: *Prunus* L. — Pp. 77-80 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.
- Zaprzjagaeva, V. I. 1964: Dikorastuščie plodovye Tadzikistana [Wild growing fruits of Tadzjikistan]. — Nauka, Moskva-Leningrad. 695 Pp.
- Zeven, A. C. & de Wet, J. M. J. 1982: *Dictionary of cultivated plants and their regions of diversity*. — Centre for Agricultural Publishing and Documentation, Wageningen, The Netherlands. 263 Pp.
- Zhukovsky, P. M. 1971: Kul'turnye rastenija i ich sorodiči. Sistematika, geographija, citogenetika, immunitet, ekologija, proischozhdenie, ispol'zovanie. [Cultivated plants and their wild rela-

- tives. Systematics, geography, cytogenetics, resistance, ecology, origin and use.] 3rd edn. — Kolos, Leningrad. 751 Pp.
- Zohary, D. 1991: The wild genetic resources of the cultivated lettuce (*Lactuca sativa* L.). — *Euphytica* **53**: 31-35.
- 1992: Is the European plum, *Prunus domestica* L., a *P. cerasifera* Ehrh. x *P. spinosa* L. allopolyploid? — *Euphytica* **60**: 75-77.
- 1995: Lentil (Pp. 271-274), Fig (Pp. 366-370) — in: Smartt, J. & Simmonds, N. W. (ed.), Evolution of crop plants, 2nd edn. — Longman, UK.
- , Harlan, J. R. & Vardi, A. 1969: The wild diploid progenitors of wheat and their breeding values. — *Euphytica* **18**: 58-65.
- & Hopf, M. 2000: Domestication of plants in the Old World, 3rd edn. — Oxford, 316 Pp.

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