БОТАНИКА И ОХРАНА ПРИРОДЫ

UKRAINIAN-CANADIAN RESOURCES' EXPEDITION IN THE CRIMEA IN 2009*

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Introduction

The Crimea has attracted the attention of botanists and geographers for a long time, because of the Mediterranean climate on the south shore, which is facilitated by the Crimean Mountains that stretch from the south-west to north-east (Regel 1943). The northern part of Crimea is lowland that has a continental climate comparable to many other parts of Eastern Europe and the Ukrainian mainland. The Crimean Mountains consist of three ranges that run parallel to the south-eastern coastline of Crimea protecting the shore facing the Black Sea from continental cold and allowing for a Mediterranean to nearly subtropical climate on a narrow strip of land along the coast. The tallest mountain range close to the coast is of Jurassic origin and sometimes referred to as the Yayla. It reaches an altitude of 1545 m at peak Roman Kosh and has several other peaks higher than 1200 m. The Yayla drops steeply towards the coast of the Black Sea. Extremely different eco-climatic zones with diverse floral elements typical for the Mediterranean, Near East, European and Caucasian regions can be found in close proximity. Walter (1943) distinguished the following three major landscape types of Crimea: (1) The steppe ranging from semi desert to grassland north of the Crimea mountains and including most of the Kerch peninsula is used as grassland or for agriculture with emphasis on cereal production; (2) the Crimean Mountains with oak forests, beech forests and nearly subalpine meadows resembling temperate to oceanic European landscapes with agricultural use limited to grazing; and (3) the south-eastern coastline with Mediterranean character. Agricultural use dominates the northern parts of Crimea. The grazing of the Crimean mountainous meadows by sheep and cattle has declined during recent years. The southern slopes of the Yayla has some vineyards, while other agricultural or horticultural activities are nowadays not very noticeable and seem restricted to occasional home gardens in this area. The most important industry in the South of Crimea is tourism and a lot of recent development of related infrastructure could be seen. Housing construction is very active and many simple buildings not yet inhabited have been erected on former meadows or other open spaces during recent years, obviously bypassing any regular planning by state authorities. This rapid development puts natural habitats at risk.

Already in 1812 the Nikitsky Botanical Gardens was established in close proximity to the city of Yalta. The flora of Crimea is well documented in the herbarium of the Nikitsky Botanical Gardens as well as in literature. The Crimean botanist E.V. Vul'f (1885-1941) scientifically connected botany to the sphere of plant genetic resources. He worked at the Nikitsky Botanical Gardens and systematically compiled the flora of Crimea published in three volumes between 1927 and 1969. Vul'f scientifically connected botany to the sphere of plant genetic resources. He moved in 1926 upon invitation by N.I. Vavilov from Crimea to Leningrad (now. St. Petersburg) to lead the section on volatile oil plants and since 1931 the section herbarium and geography at the All-Union Research Institute of Plant Industry, which is now the Russian national genebank named after N.I. Vavilov (Agayev 1994).

A recent inventory of the Crimean flora by Golubev (1996) lists 2775 species of which 2560 are endemic. Of these, 904 species were classified as being rare, very rare, disappearing or critically threatened, indicating the need for close monitoring. This inventory also provides information about

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biological features and potential economic usages of each species pointing at the richness of endemic species that have potential as forages, for volatile oil extraction and as medicinal plants.

Rationale for Colleting

The motivation for this collection mission was the interest in genetically diverse material of wild relatives of cultivated lentil (*Lens culinaris* L). Three wild lentil species (*Lens ervoides*, *L. nigricans*, and *L. orientalis*) are endemic to Crimea and they are all categorized as being very rare (Golubev 1996). Due to their close relationship to the cultivated lentil, they are sometimes considered as subspecies of *L. culinaris* (Cubero 1984). *L. ervoides* has been reported by pathologists to be a source of resistance to anthracnose disease in Canada (Tullu et al. 2006). Access to this material will contribute to the sustainability of lentil production in Canada and other countries that have problems with this disease. Information from specimen labels of the State Nikitsky Botanical Gardens Herbarium (YALT) and knowledge of experts of the Crimean flora was used to determine locations for finding the wild lentil species in Crimea. Germplasm of other crop wild relatives or wild plants that may have potential for cultivation and utilisation was also collected. Recent collecting missions conducted in Crimea as collaborations among Ukrainian institutions and the United States Department of Agriculture (USDA) focused on crop wild relatives and potential forage legumes with emphasis on the family Poaceae Barnhart (Bockelman 1999) and the genus *Medicago* L. (Greene 2008). These missions resulted in 500 accessions deposited in the National Centre for Plant Genetic Resources of Ukraine (NCPGRU) as well as the USDA National Plant Germplasm System, including two accessions of wild lentil species.

Table 1.

Germplasm collected in Crimea (Ukraine) in 2009

Usage group	Genus	Species	Authority	Family	Conservation status[1]	No. Accessions
1	2	3	4	5	6	7
Crop	*Coriandrum*	*sativum*	L.	Apiaceae	n.a.	1
	Cuminum	*cyminum*	L.	Apiaceae	n.a.	1
	Sinapis	*alba*	L.	Brassicaceae	n.a.	1
	Cicer	*arietinum*	L.	Fabaceae	n.a.	1
	Phaseolus	*vulgaris*	L.	Fabaceae	n.a.	1
	Hordeum	*vulgare*	L.	Poaceae	n.a.	1
	Triticum	*aestivum*	L.	Poaceae	n.a.	1
Crop wild relative - Brassicaceae	*Brassica*	*incana*	Ten.	Brassicaceae	1	1
	Camelina	*microcarpa*	Andrz.	Brassicaceae	11	1
	Crambe	*koktebelica*	(Junge) N. Busch	Brassicaceae	9	1
	Crambe	*pinnatifida*	R. Br.	Brassicaceae	11	1
	Crambe	*pontica*	Stev. ex Rupr.	Brassicaceae	11	1
Crop wild relative - cereal - barley	*Hordeum*	*bulbosum*	L.	Poaceae	13	3
	Hordeum	*murinum*	L.	Poaceae	13	1
Crop wild relative - cereal - oat	*Avena*	*fatua*	L.	Poaceae	12	1
	Avena	*ludoviciana*	Durieu	Poaceae	13	8
Crop wild relative - cereal - rye	*Secale*	*sylvestre*	Host	Poaceae	12	1

1	2	3	4	5	6	7
Crop wild relative - cereal - wheat	*Aegilops*	*biuncialis*	Vis.	Poaceae	14	1
	Aegilops	*cylindrica*	Host	Poaceae	14	2
	Aegilops	*triuncialis*	L.	Poaceae	14	1
	Dasypyrum	*villosum*	(L.) Borb.	Poaceae	13	3
	Triticum	*baeoticum*	Boiss.	Poaceae	3	7
Crop wild relative - flax	*Linum*	*austriacum*	L.	Linaceae	13	2
Crop wild relative - lentil	*Lens*	*ervoides*	(Brign.) Grande	Fabaceae	11	2
	Lens	*nigricans*	(Bieb.) Webb et Berth.	Fabaceae	11	3
	Lens	spec.	Mill.	Fabaceae	n.a.	3
Grass	*Agropyron*	*dasyanthum*	Ledeb.	Poaceae	11	2
	Agropyron	*desertorum*	(Fisch. ex Link) Schult.	Poaceae	6	1
	Agropyron	*pectinatum*	(Bieb.) Beauv.	Poaceae	14	1
	Agropyron	spec.	Gaertn.	Poaceae	n.a.	2
	Arenatherum	*elatius*	(L.) J. et C. Presl	Poaceae	12	1
	Bromus	*secalinus*	L.	Poaceae	9	1
	Bromus	*squarrosus*	L.	Poaceae	14	1
	Bromus	spec.	L.	Poaceae	n.a.	3
	Cynosurus	*echinatus*	L.	Poaceae	12	1
	Dactylis	*glomerata*	L.	Poaceae	14	2
	Festuca	spec.	L.	Poaceae	n.a.	1
	Koeleria	*cristata*	(L.) Pers.	Poaceae	14	1
	Leymus	*racemosus*	(Bieb.) Tzvel.	Poaceae	13	1
	Lolium	*austriacum*	L.	Poaceae	14	1
	Melica	spec.	L.	Poaceae	n.a.	1
	Puccinellia	*distans*	(Jacq.) Parl.	Poaceae	12	1
	Stipa	spec.	L.	Poaceae	n.a.	1
	Taeniatherum	*asperum*	(Simonk.) Nevski	Poaceae	14	1
Forage legume	*Astragalus*	spec.	L.	Fabaceae	n.a.	2
	Coronilla	*scorpioides*	(L.) Koch	Fabaceae	13	1
	Coronilla	*varia*	L.	Fabaceae	14	1
	Lathyrus	*aphaca*	L.	Fabaceae	14	1
	Lathyrus	*pratensis*	L.	Fabaceae	13	1
	Lathyrus	spec.	L.	Fabaceae	n.a.	3
	Medicago	*arabica*	(L.) Huds.	Fabaceae	13	1
	Medicago	*denticulata*	Willd.	Fabaceae	12	1
	Medicago	*lupulina*	L.	Fabaceae	14	1

1	2	3	4	5	6	7
Forage legume	*Medicago*	*minima*	(L.) Bartalini	Fabaceae	14	1
	Medicago	*orbicularis*	(L.) Bartalini	Fabaceae	14	1
	Trifolium	*pratense*	L.	Fabaceae	14	1
	Trifolium	spec.	L.	Fabaceae	n.a.	5
	Trigonella	*monspeliaca*	L.	Fabaceae	14	1
	Vicia	*dalmatica*	A. Kerner	Fabaceae	12	2
	Vicia	*ervilia*	(L.) Willd.	Fabaceae	1	1
	Vicia	spec.	L.	Fabaceae	n.a.	7
Medicinal	*Echballium*	*elaterium*	(L.) A. Rich.	Cucurbitaceae	11	1
	Lepidium	*perfoliatum*	L.	Brassicaceae	13	1
	Nigella	*damascena*	L.	Ranunculaceae	13	1
	Plantago	*lanceolata*	L.	Plantaginaceae	14	1
	Rumex	*euxinus*	Klok.	Polygonaceae	13	2
	Securigera	*securidaca*	(L.) Degen et Doerfl.	Fabaceae	13	1
	Verbascum	spec.	L.	Scrophulariaceae	n.a.	1
	Ziziphora	*tenuior*	L.	Lamiaceae	12	1
Ornamental	*Allium*	*rotundum*	L.	Alliaceae	14	1
	Bellevalvia	*sarmatica*	(Pall. ex Georgi) Woronow	Hyacinthaceae	6	1
	Erodium	spec.	L'Hér	Geraniaceae	n.a.	1
	Hedysarum	*tauricum*	Pall. ex Willd.	Fabaceae	13	1
	Hedysarum	*candidum*	Bieb.	Fabaceae	13	1
	Iris	*pumila*	L.	Iridaceae	13	1
	Matthiola	*odoratissima*	(Bieb.) R. Br.	Brassicaceae	9	1
	Salvia	*pratensis*	L.	Lamiaceae	13	1
	Tulipa	*schrenkii*	Regel	Liliaceae	11	1
	Tulipa	spec.	L.	Liliaceae	n.a.	1
Wild	*Lepidium*	*crassifolium*	Waldst. et Kit.	Brassicaceae	11	1
	Unknown			Brassicaceae	n.a.	3

1 Conservation status according to Golubev (1996): 1=occurs only at one location; 3=occurs at 6-10 locations; 6=very rare; 9=rare; 11=quite rare; 12=scarce; 13=quite common; 14=common.

The present collecting mission was conducted from June 26 to July 7, 2009 as a joint project between the national genebanks of Ukraine, NCPGRU, Kharkiv) and Canada (Plant Gene Resources of Canada, PGRC, Saskatoon, Saskatchewan). Local expertise for Crimea was provided by botanists from the State Nikitsky Botanical Gardens, Yalta. A driver with local experience from the Nikitsky Botanical Gardens was part of the collection team. Germplasm was collected from 57 locations mostly along the mountainous southern coastline of Crimea, including the nature reserve “Cape Martyan” close to the village Nikita, and the archaeological park “Ayu-Dag” (**Figure 1**).

Figure 1. Map of Crimea indicating the collecting sites. Sites in close proximity are only represented by one dot only. The area of the Crimean Mountains is shaded.

On the Kerch peninsula, collections were made in the nature reserves "Opuk" at the coast of the Black Sea and "Kazantip" at the coast of the Sea of Azov.

Collected plant material

A total of 127 accessions covering 16 families, 55 genera and at least 66 species were collected (Table 1). In 35 instances, mostly grasses and forage legumes, the mature plants could only be identified on the genus level and the species identification will be conducted during the first genebank regeneration. Poacea (41%), Fabacea (36%) and Brassicaceae (9%) dominated in the collected material, as the remaining 13 families were represented by one or two species each.

About 34% of the collected accessions are wild relatives of field crops. The populations of wild lentils occurred on dry rubble in sparse stands of native oak (*Qercus pubescens* Willd.) and juniper (*Juniperus excelsa* Bieb.). Spring 2009 was dry and by end of June most wild lentil plants had shattered their seeds, so they had to be picked from the ground (**Figure 2**). Eight accessions of *L. ervoides* and *L. nigricans* were found at different locations. These accessions will be further investigated regarding their disease resistance to lentil anthracnose.

Wild relatives of the major cereals wheat, barley, oat and rye were found. With the exception of wild einkorn, *Triticum baeoticum*, the cereal wild relatives found during this mission are not classified as being rare on Crimea (Table 1). The first report of *T. baeoticum* is by M. Bieberstein from 1809; after 1967 it was missing (Dorofeev et al. 1979) but Bockelman (1999) reported collecting this species as well. The reduction of agricultural intensity after 1990 in the southern Crimea may have allowed for small populations of *T. baeoticum* to become larger in recent years. Among the seven accessions of wild einkorn forms with white, red and black awns occurred together in mixed populations of considerable size, but there are only few locations of this species, usually on abandoned fields or field margins (**Figure 3**). Cultivation of the closely related cultivated einkorn, *T. monococcum* L., does presently not occur on Crimea but was part of agriculture practised by the native Tartars that were expelled from Crimea in 1944 and have been returning since 1990 (Dorofeev et al. 1979, Bagrov and Rudenko 2004). A search for *Aegilops tauschii* Coss. at the shores of the Sea of Azov on the Kerch peninsula was not successful, although its occurrence for this location was

documented in 1982 by an according herbarium specimen. The wild relative of rye *Secale sylvestre* was found on dry grassland close to the shores of the Sea of Azov and wild relative species of barley, genus *Hordeum* L., were frequent.

Figure 2. *Lens ervoides* (Brign.)Grande in native habitat (left) with seeds mostly shattered (right)

The hexaploid wild oat species *A. sterilis* was common on dryer, open and slightly disturbed locations. *A. fatua* was found as a weed in a bread wheat (*Triticum aestivum* L.) field. The tetraploid *A. barbata* Pott ex Link and the diploid *A. eriantha* Durieu, both documented in the Nikitsky Botanical Gardens Herbarium, were not found at the expected locations.

The perennial wild cabbage *Brassica incana* was collected from the shores of the Black Sea at cap "Cape Ayu-Dag", which is difficult to access by foot (**Figure 4)**. A healthy populations of this rare species exists here. It represents the most eastern occurrence of the disjunctive distribution range of the wild species of the genus *Brassica* in the Mediterranean-Atlantic area of Europe and the Near East (Snogerup et al. 1990). This species belongs to the primary genepool for breeding of cultivated cabbage (*B. oleracea* L.) and to the secondary genepool for breeding rapeseed (*B. napus* L.) (Gladis and Hammer 2001). The location may become more influenced by bathing tourists due to its easy accessibility by boat from the seaside; such excursions seem quite popular and the location is closed to the tourist centres Yalta and Alushta. At the same location, plants of *Pisum elatius* Bieb. were found, but the seeds were all shattered and could not be collected. It has been suggested that both *Brassica incana* and *Pisum sativum* may be escapes from medieval gardens of a monastery that existed on Cape Ayu-Dag and established as wild plants.

A remarkable richness of the genus *Linum* exists in Crimea and Golubev reports 16 wild species of this genus for Crimea. Seed material was only collected from *Linum perenne* subsp. *austriacum*, while some other species were in full flower when collecting (**Figure 5**). These species are crop wild relatives and have also ornamental potential. The wild habitats of the Crimean Mountains, the southern shore and the Kerch peninsula are particularly rich in grassland plants and many leguminous species (Fabaceae) that have economic potential as forages. Features such as cold and drought tolerance may be found in this germplasm. Nine collected accessions have potential as medicinal plants.

The seven seeds samples of crop germplasm collected were either bought on local markets (coriander, cumin, chickpea, garden bean) or occurred on ruderal sites (barley, wheat, white mustard). Compared to other regions of Ukraine, home gardening and small scale agriculture was not as visible in the areas visited during this expedition. An exception may be the local type of red and flattened *Allium cepa* L. which was offered frequently by street vendors in the region around Yalta (**Figure 6**).

Figure 3. Population of *Triticum baeoticum* Boiss. with black, read and white glumes and awns from one location close to Feodosiya.

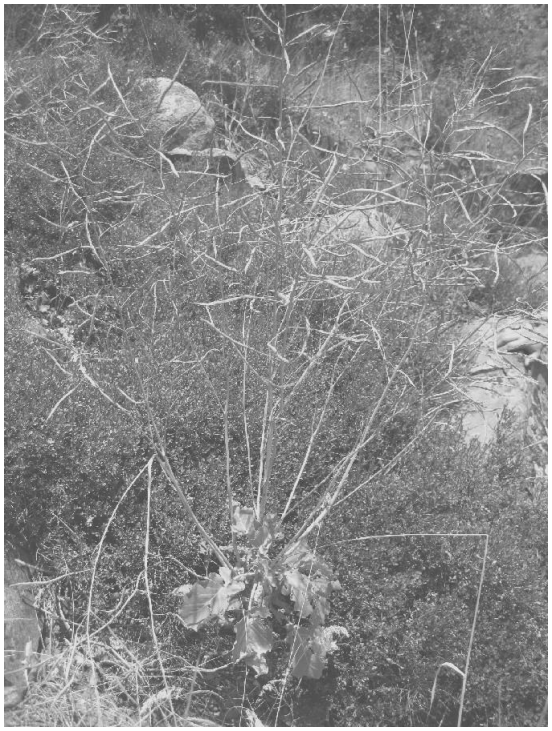

Figure 4. Fruiting perennial *Brassica incana* at cap "Cape Ayu-Dag".

Figure 5. *Linum tenuifolium* L., *L. corymbulosum* Reichenb. and *L. austriacum* L. from a dry meadow close to village Orlinoye, southern Crimea.

Figure 6. Local type of *Allium cepa* L. popular in Crimea.

Based on this observation, it seems most likely that landraces of field or garden crops have for the most vanished from Crimea, although the returning Tartars may bring some of such material back from western Siberia or central Asia.

The Kerch peninsula has a continental climate and very low precipitation compared to the southern coast of Crimea. The nature reserves Kazantip and Opuk on the Kerch peninsula showed a

wide diversity of plants that could be explored as ornamental plants for harsh continental climates in western Canada, where the Canadian national genebank is located. Wild relatives of oilseed Brassicas of the genera *Camelina* and *Crambe* were frequent on the locations visited on the Kerch peninsula. Both, the Kazantip and the Opuk nature reserves have been assigned highest priority regarding the preservation of biological diversity of Crimea (Korzhenevsky and Sadogursky 2006). Material collected from the Kerch peninsula is useful when looking for winter hardiness, drought and salt tolerance in the related cultivated species. Material collected from the mud vulcanos close to the village Bondarenkovo, e.g. *Lepidium crassifolium*, is adapted to grow on very basic soils (*p*H 10,4) with high concentration of toxic salts (Korzhenevsky and Klyukin 1991), and is of interest when looking for such extreme adaptation.

Conclusions

Crop wild relatives from Crimea deserve attention as plant genetic resources for food and agriculture. Maxted et al. (2008) have pointed at the growing threats to crop wild relatives in the Mediterranean region during recent years in other parts of Europe. Such pressure on the native flora is increasing in Crimea. The change to a market economy after 1990, the return of the native Tartars and the active development of tourism and recreational housing in recent years influence the native habitats. The dynamics in the populations of crop wild relatives over time were obvious as some were more frequent than expected (*Triticum baeoticum*) while others documented in the recent past could not be found (*Aegilos tauschii*). The State Nikitsky Botanical Gardens at Yalta will have an important role in protecting the plant diversity of Crimea for future generations. Depositing such germplasm in genebanks for *ex situ* conservation will be part of a strategy, but protection of the natural habitats including monitoring of the populations dynamics should have highest priority.

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