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**AN ECOGEOGRAPHIC SURVEY OF WILD LENS SPECIES IN
AEGEAN AND SOUTH WEST TURKEY**

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ABSTRACT: Turkey is rich in many of the wild relatives of temperate crops including lentil (*Lens culinaris* Medik. ssp. *culinaris*). It is only in Aegean and the south west that the distributions of all four wild taxa of the genus *Lens* (*L. culinaris* ssp. *orientalis*, *L. odemensis*, *L. ervoides* and *L. nigricans*) overlap. Unfortunately, Turkey, like other Mediterranean countries is suffering the rapid loss of many of its valuable genetic resources. An ecogeographic survey and collection missions were thus undertaken in Aegean and south west of Turkey with four main objectives: to increase the number of accessions, of each taxon, from these regions conserved ex-situ; to collect samples for the analysis of withinpopulation variation in order to assess the potential for in-situ conservation; to determine habitat preferences for each species and the major determinants of their distribution; to evaluate the threat of genetic erosion to each species. Collections were made from 37 populations, and 20-30 seeds from at least five populations of each taxon were collected for the study of withinpopulation diversity. Ecogeographic data was collected to determine habitat preferences. Based on evidence of grazing pressure, number of populations located, area covered by a population and the number of plants per population, *L. odemensis* and *L. ervoides* are the taxa most threatened by genetic erosion. The low association of all species with disturbed habitats indicates their vulnerability.

Keywords: *L. culinaris* ssp. *orientalis*, *L. odemensis*, *L. nigricans*, *L. ervoides*, population variation, population distribution, genetic erosion

INTRODUCTION

The flora of Turkey is extremely diverse and includes many of the wild relatives of temperate crops including lentil (*Lens culinaris* Medik. ssp. *culinaris*). Lentil is thought to have been domesticated in the south east of Turkey (Ladizinsky et al., 1984) from its recognised wild progenitor, *L. culinaris* ssp. *orientalis* (Boiss.) Ponert (Barulina, 1930; Ladizinsky, 1979 a; Ladizinsky, 1979b; Williams et al., 1974; Zohary, 1972).

According to the latest classification by Ladizinsky (1993), three additional species are included in the genus: *L. odemensis* Ladiz., *L. ervoides* (Brign.) Grande and *L. nigricans* (Bieb.) Godr.

Wild *Lens* taxa are widely distributed in the Mediterranean basin. *L. culinaris* ssp *orientalis* has an eastern distribution from Turkey, Cyprus and Palestine across to Uzbekistan. *L. odemensis* has a more restricted distribution in the east, extending from Turkey southwards to Syria and Palestine. A single population has been found in Libya. *L. ervoides* has a broad distribution from Spain to Ukraine and south to Jordan. Outlier populations have also been found in Ethiopia and Uganda. *L. nigricans* has a more western distribution from Spain to Turkey and south to Morocco. It is only in Aegean and south west of Turkey that the distributions of all four wild taxa overlap. Unfortunately, Turkey, like other Mediterranean countries is suffering the rapid loss of many of its valuable genetic resources. These resources, which have the potential to provide useful genetic material for plant - breeding efforts, are being eroded primarily by habitat destruction (Solh and Erskine, 1981). The poor competitive ability and palatability of *Lens* species, together with the fact that they occur in small disjunct populations, intensifies this threat. The Aegean Agricultural Research Institute (AARI), in collaboration with the International Center for Agricultural Research in the Dry Areas (ICARDA), is attempting to conserve these resources both *ex-situ* and *in situ*.

ICARDA currently houses the largest collection of the wild *Lens* in the world, amounting to 434 accessions. Aegean region and south west of Turkey, however, was under-represented in the collection, particularly in the light of the importance of the region according to previous studies of diversity (ICARDA, 1992) and species richness.

The establishment of *in-situ* conservation reserves has been initiated by the Republic of Turkey and the International Bank for Reconstruction and Development (World Bank) in three areas in Turkey. Kazdağ in Aegean region, Ceylanpınar State Farm in south east and Anatolian Diagonal of Turkey, include wild relatives of lentil. The project aimed at complementing existing *ex-situ* germplasm collections. An understanding of within population variation is a fundamental requirement for *in-situ* conservation. It allows the determination of minimum population size for the conservation of genetic diversity and enables plant population dynamics to be monitored, to ensure that the genetic variation is being conserved.

An ecogeographic survey and collection were thus undertaken in Aegean and the south west Turkey with four main objectives:

- 1.to increase the number of accessions, of each taxon, conserved *ex-situ* from these region;
- 2.to collect samples for the analysis of within-population variation in order to assess the potential for *in-situ* conservation;
- 3.to determine habitat preference for each species and the major determinants of their distribution;
- 4.to assess the threats to the wild species.

The environment

Aegean region and south west Turkey is made up of highly contrasting environments. In the coastal regions, temperatures reach a maximum of 32 °C in August, and a minimum of 8°C in January, with approximately 1170- 970 mm of rainfall per annum, with a maximum in December and January . The region inland is mountainous, reaching an altitude of approximately 3500 m in the area surrounding Elmalı. Here, maximum temperatures are 24°C in July and minimum temperatures -10°C in January. Rainfall totals 665 mm per annum with a maximum in December (Mýzrak, 1983).

METHOD

Due to their nature, *Lens* populations are renowned for being extremely difficult to locate. For this reason, together with the fact that they are easier to find when green as opposed to dry at maturity, a survey mission was carried out, from 23 April to 6 May 1995 to locate the populations prior to collection.

The target area is shown in Fig 1. Potential sites, particularly ungrazed and non-arable land surveyed for *Lens* populations. These did not occur at regular intervals. When populations were located, the following site descriptors were recorded: latitude, longitude, altitude, aspect, angle of slope, water relations, parent rock, soil texture, soil depth, area over which the population was distributed, dominant species, characteristic species, plant population density, land use and grazing pressure. In addition, stage of development was noted, and herbarium specimens and rhizobium samples were taken.

Due to extreme variation in development of different populations in different environments, two collections missions were undertaken, the first from 28 May to 7 June 1995. Seeds were collected from between 20 and 30 individual plants of each population . Seed from each plant was kept separately for the measurement of within-population variation. A bulk sample was also taken.

RESULT AND DISCUSSION

Genebank additions and assessment of in-situ potential

The distribution of populations surveyed and collected is shown in Fig. 1. In total 9 populations of *L. culinaris* ssp. *orientalis*, 8 populations of *L. ervoides*, 13 populations of *L. nigricans* and 7 populations of *L. odemensis* were located, surveyed and collected. Of these, single plant seed was collected, for diversity studies, from 8 populations of *L. culinaris* ssp. *orientalis*, 5 of *L. ervoides*, 11 of *L. nigricans* and 4 of *L. odemensis* in order to assess the potential effectiveness of *in-situ* conservation for *Lens* species. Previously only 6 populations of *L. culinaris* ssp. *orientalis*, 10 populations of *L. ervoides*, 8 populations of *L. nigricans* and 1 population of *L. odemensis*, from south west Turkey, were held in the ICARDA collection

Figure 1. Distribution of populations surveyed and collected in 1995 (The ellipse roughly defines the area surveyed).

Habitat preferences

Site characteristics are shown in Table 1. All sites of *L. culinaris* ssp. *orientalis* were inland above 500 m in altitude.

Table 1. Summary of ecogeographic characters of *Lens* populations surveyed and collected in 1995

Species	No. population	% coastal (<20 km from coast)	% inland (>20 km from coast)	% above 500m	Grazing pressure (% of sites affected)	Slope >16 ⁰ (%)	Parent rock		Soil type (% stony)	Soil Depth <20cm (%)
							limestone %	alluvial %		
<i>L. culinaris</i>	9	0	100	100	0	33	78	11	44	22
<i>ssp. orientalis</i>										
<i>L. ervoides</i>	8	63	38	38	38	88	88	13	63	50
<i>L. nigricans</i>	13	8	92	85	0	77	54	31	46	54
<i>L. odemensis</i>	7	57	43	42	28	100	14	71	57	100
Species	Habitat (% associated with woodland)			Dominant tree species						
				Pine		Quercus		Fruit trees (olive/apple)		
<i>L.culinaris</i>	44			33		44		11		
<i>ssp.orientalis</i>										
<i>L. ervoides</i>	88			75		75		13		
<i>L. nigricans</i>	69			46		15		0		
<i>L. odemensis</i>	43			29		43		14		
Species	No. plants per populations			Size of area (<10m ²)	Development stage (%) at survey					
	<100 (%)	100-500 (%)	>500 (%)			Vegetatif	Flowering	Podding	Shattering	
<i>L.culinaris</i>	33	33	33	33		*0	*100	*0	*0	
<i>ssp.orientalis</i>										
<i>L. ervoides</i>	50	50	0	25		0	25	63	13	
<i>L. nigricans</i>	23	54	23	31		31	38	31	0	

<i>L. odemensis</i>	57	29	14	71	0	43	57	0
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* Only based on 4 of 9 accessions

This was also the predominant situation with *L. nigricans*. This is in contrast to *L. ervoides*, in which only 38% of populations were found inland and above 500 m altitude, *L. odemensis* was evenly distributed across altitude and distance from the coast. There did not appear to be any trends according to aspect, except in *L. ervoides* in which 63% of accessions were located on south-facing slopes.

All populations were found on soils that drain freely. A high proportion were on steep slopes, except for *L. culinaris* ssp. *orientalis* (35%). *L. ervoides*, *L. nigricans* and *L. culinaris* ssp. *orientalis* were found predominantly on limestone parent rock (88,54 and 78% respectively), thus facilitating free drainage. Most (71%) *L. odemensis* populations were found on alluvial parent rock. A high proportion of all species were found on thin, stony soils. All *L. odemensis* populations were found on soils less than 20 cm. deep.

L. ervoides and *L. nigricans* are frequently associated with woodland (88 and 69%, respectively), particularly that of *Quercus* and *Pinus*; *L. ervoides* is particularly associated with mature woodland with large, sparsely distributed pine trees often mixed with *Quercus* sp. shrubs. *L. nigricans* on the other hand was more often associated with young pine plantations, particularly in the Burdur area. *L. culinaris* ssp. *orientalis* and *L. odemensis* are associated to a lesser extent with woodland, but are often associated with grasses e.g. *Avena* and *Aegilops*.

L. ervoides and *L. odemensis* were the earliest developing. This is not surprising as these two species are generally found at lower latitudes, close to the coast.

The threat of genetic erosion

Parameters which may be useful in determining the relative threat of genetic erosion to a species, are, firstly, the degree of association of the species with disturbed, including grazed, habitats, as habitats are becoming increasingly disturbed, and secondly, the number and size of populations.

The low association of all species with disturbed habitats indicates their vulnerability. *L. ervoides*, *L. odemensis*, *L. culinaris* ssp. *orientalis* populations were found associated with fruit tree orchards (olive and apple) in 13, 14 and 11% of cases. Populations were never found in areas of moderate or intense grazing. Grazing damage was evident, however, on 38% of *L. ervoides* populations and 28% of *L. odemensis* populations. The vast majority of sites were in protected, ungrazed areas. These areas are, however, becoming fewer. The association of *L. nigricans* with young pine forests may be

purely due to the fact that these are the only relatively undisturbed, protected areas remaining. It would be interesting to asses the soil seed bank in terms of *Lens* seed and also monitor the establishment of populations in newly protected area.

Only 7 populations of *L. odemensis* were located, 71% of populations were found on area less than 10 m², two-thirds of the populations had less than 100 plants and only one had more than 500 plants. The majority of populations of the other taxa covered an area greater than 10 m². Only one population, of *L. culinaris* ssp. *orientalis*, covered an area greater than 100 m². One third of the populations of *L. culinaris* ssp. *orientalis* had more than 500 plants, yet half of the *L. ervoides* populations had less than 100 plants and none had more than 500 plants, once again indicating a vulnerable sitaiton. Caution should, however, be taken when using data relating to population size and number as indicators of genetic ersion as these may be natural attributes of the species in the region.

In conclusion, the number of accessions preserved ex-situ, from these region was substantially increased. Sufficient seed was collected from each taxon, for the study of within-population diversity, in order to establish the potential of *in-situ* conservation for wild *Lens*. Based on the grazing pressure, number of populations located, area covered by each population and the number of plants per population, *L. odemensis* and *L. ervoides* are the taxa most threatened by genetic erosion.

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