

PAPER DETAILS

TITLE: CONSERVATION AND UTILISATION OF PLANT GENETIC RESOURCES - TURKISH
FIELD COURSE 1995

AUTHORS: EMMA,Jane Lamont Emma Hadkins Nigel Maxted KITIKI

PAGES: 0-0

ORIGINAL PDF URL: <https://dergipark.org.tr/tr/download/article-file/20186>

**CONSERVATION AND UTILISATION OF PLANT GENETIC
RESOURCES - TURKISH FIELD COURSE 1995**

Emma-Jane LAMONT

Emma HADKINS

Nigel MAXTED

**School of Biological Sciences, University of Birmingham,
Edgbaston, Birmingham, B15 2TT, U.K.**

Ayfer TAN

Ayşe KITIKI

**Aegean Agricultural Research Institute,
P.O. Box 9 35661 Menemen, İzmir - TURKEY**

ABSTRACT: *The University of Birmingham and the Aegean Agricultural Research Institute have commenced a collaborative programme of Plant Genetic Resources Conservation training. This has for the last two years taken the form of joint Conservation Field Course to Western Turkey. The results of the 1995 field course are presented here for various leguminous, graminaceous and umbelliferous crop relatives groups. The project involved six pairs of students, each working on a genus or group of genera, and was jointly supervised by AARI and University of Birmingham staff. For each target group field observations were made and voucher specimens were collected. All collected information and specimens have been deposited at AARI.*

Keywords : *Plant genetic resources, conservation, genetic diversity, biological diversity.*

INTRODUCTION

A joint University of Birmingham, U.K. and Aegean Agricultural Research Institute (AARI) Conservation Field Course was held in North West Turkey (Izmir, Bursa, Balıkesir, Istanbul, Canakkale and Tekirdag Provinces) between the 22nd April and 6th May 1995. The training course was attended by thirteen students attending the Master's degree in Conservation and Utilisation of Plant Genetic Resources (CUPGR) at the University of Birmingham and a member of staff from the genebank, Horticultural Research International, Wellesbourne, U.K.

AIMS

The aim of the master's Course is to provide the student with the practical and theoretical skills required to conserve and utilise biological / genetic diversity. The theoretical basis of the subject is covered in detail in Birmingham, while the specific aim

of the Field Course is for the students to gain field experience, develop their practical skills and complement the theoretical element of the course.

METHODS

Students worked in pairs and each pair was assigned the task of effectively 'collecting and conserving' a target taxonomic group (genus or genera) of crop relatives. The groups selected were: *Lathyrus*, *Trifolium*, *Medicago*, *Lolium* / *Festuca*, *Triticum* / *Aegilops* and selected *Umbellifereae* species.

In order to plan, prior to visiting Turkey, and conserve their target taxonomic group, the students needed to cover various subject areas, including an ecogeographic survey, *ex situ* conservation of wild and crop species, field seed conservation, population sampling strategies, landrace sampling technique, inventory making, plant identification, voucher specimen collection, vegetation assessment, *in situ* reserve management, community ecology and field data collection.

Location and timing

The flora of Turkey is the richest in terms of number of taxa and diversity of crop relative in the Mediterranean (Davis, 1965) and West Asia has long been recognised as the centre of origin for many important crops (Vavilov, 1926). The host institute, the Aegean Agricultural Research Institute, is located in Western Turkey (Izmir Province) at the centre of this biological / genetic diversity.

Timing of the Field Course was determined by host institute (AARI) and the University of Birmingham, based on U.K. term dates and target species collecting windows. This was necessarily a compromise and many species were located at flowering stage, but where possible seed was collected.

Itinerary

- 25 April: survey and collection *en route* to Kalkim from Menemen
- 26 April: survey and collection *en route* to Yalova via Balıkesir
- 27 April: survey and collection S and SW of Yalova
- 28 April: survey and collection E and SE of Yalova in Bursa
- 29 April: survey and collection *en route* from Yalova to Tekirdag, via Istanbul.
- 30 April: survey and collection N and NE of Tekirdag
- 1 May: survey and collection W of Canakkale
- 2 May: survey and collection *en route* to Menemen

Site selection and sampling strategy

Thirty sites were sampled. Where possible diverse habitats types were sampled at a range of altitudes. The main habitat types visited were:

- Maquis
- Forest vegetation (*Pinus nigra*, *P. brutia*)
- Oleo-Lentiscus vegetation (*Olea europea* and *Pistacia lentiscus*)
- Marsh vegetation
- Grassland/meadow
- Cultivated fields and / or the borders of cultivated field

The priorities of the sampling strategy were to ensure that sites suitable for all the target taxa were visited and to maximize the genetic diversity collected. As many sites as possible were visited, given the time constraints, and the sites were chosen to cover as broad an environmental range as possible. Populations present at the sites were sampled randomly in order to minimize the number of collections required to sample the genetic diversity available.

Material collected

At least one herbarium voucher specimen of all target taxa found at each site was collected. For the majority of the target taxa however, it was only possible to collect herbarium voucher specimens because the seed was not yet ripe. Where possible (where there were large enough populations), additional herbarium specimens were taken, especially to demonstrate ecotypic variation within populations.

Collection processing

Each accession was given a unique identifier in order to link them to the relevant passport data. The identifiers combined a numeric element, which was sequential in operation and a code relating to the collectors names. Sites were also numbered. A range of environmental data were collected by each pair of students. Location data were collected using a satellite location device and altitude by using an altimeter. Location names were supplied by the local experts.

The herbarium voucher specimens were tagged with the appropriate identifier and stored in plant presses. The specimens were regularly inspected for any signs of fungal growth and the flimsies were changed when necessary. Where possible, the students identified the taxa collected to species or subspecific rank. At the end of the Field Course all the identified herbarium voucher specimens were deposited in the AARI herbarium, copies of the accompanying collection forms were incorporated in the AARI documentation system.

Target group summaries

Aegilops, *Triticum* and *Hordeum* - Mark Raven and Ian Watson (U.K.)

The target taxa allocated were wild species of the genera *Aegilops* and *Triticum*, but wild species of the genus *Hordeum* were later added to the list. This was because very little mature *Aegilops* or *Triticum* material was found. The field course took place too early in the year for the target taxa to be in seed, therefore no germplasm collections were made. However, a large area was surveyed for the presence of the target species and sites were identified that would be suitable for seed collections later in the year. Eighty one herbarium specimens were collected, including five species of *Aegilops*, four species of *Hordeum*, and two varieties of cultivated wheat (*T. aestivum*); *Kirik* (awnless) and *Kilcikli* (awned).

At some sites very few individuals of the target species were present, and sampling had to be done with great care in order to avoid destroying the entire population. At other sites, especially near Izmir, large expanses of mixed *Aegilops* species were found. Specimens at different stages of maturity from individual sites were collected as herbarium specimens to demonstrate the noticeable effect of micro-climate on development.

Wild species of *Aegilops*, *Triticum* and *Hordeum* are all potentially economically important genera due to their close taxonomic relationship with the cultivated wheats and barleys. The wild wheats and barleys could potentially introduce desirable characters to the cultivated species since they are interfertile. *Aegilops* is also an important genus because it includes at least one of the genome ancestors of cultivated wheat (*T. aestivum*). The DD genome comes from *Ae. squarrosa*, while the BB and GG genomes possibly originated in *Ae. speltoides*. *Aegilops* species form the majority of the secondary gene pool of wheat, thus with the advent of biotechnological tools to facilitate wide crosses, *Aegilops* species may provide genetic material for improved cultivars of wheat (Van Slageren, 1994).

Inter-generic hybrids form between *Aegilops* and *Triticum* species naturally and can be created artificially by crossing. All such hybrids are highly sterile. When artificial hybrids are created by chromosome doubling techniques, more stable hybrids are produced which can produce seed. Only one *Aegilotriticum* hybrid produced by after recombination has been reliably described (Kimber & Feldman, 1987; Van Slageren, 1994).

The world distribution of eight species of *Aegilops*, eight species of *Hordeum* and five species of *Triticum* overlap in Turkey, therefore Turkey is an ideal area in which to collect these species. A high level of genetic diversity of these species can be found in a single geographical region. For example in the field course some sites were found with five species of the target taxa (Davis, 1965).

Forty nine samples of *Aegilops* were collected, and all except eleven were determined to the species using Van Slageren's key (1994). Only immature specimens with no floral characters were not fully identified. Five species of *Aegilops* were identified: *Ae. umbellulata* (2 specimens), *Ae. biuncialis* (16 specimens), *Ae. neglecta* (3 specimens), *Ae. triuncialis* (7 specimens) and *Ae. geniculata* (9 specimens). The number of sites at which each species occurred was as expected; *Ae. umbellulata* is uncommon in its range, *Ae. biuncialis* is common and its range includes the whole of the area surveyed. *Ae. neglecta* is only common in the north west of Turkey, which was visited too early in the season to find identifiable specimens, and has only a scattered distribution in the rest of Turkey. *Ae. triuncialis* is generally wide-spread in Turkey, as is *Ae. geniculata*. The other *Aegilops* species that occur in Turkey, are either rare in the west or flower much later and therefore could not be collected in an identifiable form.

No samples of wild *Tritium* were found, but eight specimens of escaped *T. aestivum* were collected. With the help of local experts, it was possible to record some associated indigenous information, such as the local name and the culinary qualities. For example, two *T. aestivum* samples were collected from the same site, one of which was awned with a reddish grain and the other awnless. The local name of the awned variety is 'Kilcikli', and a local farmer explained that it is a very good wheat for making bread because the bread 'never goes stale'. The unawned variety is known as 'Kirik', which means broken, which refers to the lack of awns. This variety is higher yielding but is not so good for making bread.

Four species of *Hordeum* were collected in the survey. *H. vulgare* was found as a cultivated escape on many roadsides and fallow fields. *H. murinum* was found over a very wide range of sites, in fact it was found at nearly all the sites we visited. The height of the species was related to the surrounding vegetation; in short grass it grew to only about ten centimetres, whereas in longer grass it grew to fifty centimetres. *H. bulbosum*

was also collected from a lot of the sites. At some of the more northerly sites where *H. bulbosum* the was not collected the reason could have been that immature plants without flowers are difficult to distinguish from the surrounding grasses. *H. spontaneum* was only found near Izmir and in the protected area at Troy (*Truva*), where it was the most common grass, forming an extensive population of several acres between the sparse trees. It was surprisingly that no *H. geniculata* was found because its range includes the north west of Turkey (Davis, 1965), again, a lack of flowers may be to blame.

The perceived threat of genetic erosion to the target taxa in the target area has not been altered by the findings of this survey. The species do not appear to be highly at risk, but still deserve to be actively conserved because of their close relationship with crop plants. The conservation priorities are for *ex situ* conservation so that the germplasm can be evaluated and be available for use in breeding programs etc. The *in situ* sites do not seem to be in great risk at the present time.

***Lathyrus* - G.K. Melenga (Zambia) and P. Munisse (Mozambique)**

The target taxa allocated were species of *Lathyrus* occurring in the target area. Unfortunately, the timing of the field course made collection of germplasm (i.e. seed) impossible, since *Lathyrus* plants were still at the flowering stage. Therefore, only herbarium specimens were collected. In order to collect seed it would be necessary to visit north west Turkey in June or July. Seventy-three herbarium voucher specimens were collected from the thirty sites sampled.

One hundred and ten species of *Lathyrus* occur in temperate regions, of these, 58 are present in Turkey. Twelve species of *Lathyrus* were collected during the study, comprising *L. stenophyllus*, *L. digitatus*, *L. aphaca*, *L. annuus*, *L. nissolia*, *L. sylvestris*, *L. sphaericus*, *L. clymenum*, *L. ochrus* and *L. pseudocicera*. *Lathyrus pseudocicera* and *L. stenophyllus* were not recorded as occurring in the target area by Davis (1970) in the Flora of Turkey. Three species which were recorded as occurring in the area by Davis (*Lathyrus pratensis*, *L. aureus* and *L. undulatus*) were not found during this survey.

On average, 2 species of *Lathyrus* were collected per site. The sites richest in *Lathyrus* species were at Yalova, Gebze, Karacahali and Bornava, at each of which 4 to 6 species were collected. The poorest sites were at Narlica, Armutlu, Istanbul and Truva where none, or only one species, were collected. *Lathyrus cicera*, *L. laxiflorus* and *L. stenophyllus* were found to have broader geographic distributions, than *L. clymenum*, *L. ochrus* and *L. pseudocicera*.

Lathyrus species are utilized as forage, in the perfume industry and as an ornamental. Two species have been brought into cultivation, namely *L. sativus* and *L.*

odoratus, they are used for forage and as ornamental species. It was observed that some species, like *L. laxiflorus* and *L. stenophyllus* could have potential for domestication because they produce large amounts of foliage, but detailed characterisation would obviously be required to assess this potential.

Apart from collecting germplasm, the objectives of this field course and collection mission were met. The collection of herbarium specimens gave us the necessary training and this material can be used to help plan for future germplasm collection of *Lathyrus* species in north west Turkey.

***Lolium* and *Festuca* - Deborah Dale (U.K.) and Pedro Menendez (Spain)**

Lolium is a member of the Graminae that has commercial importance as a forage grass. It can be grown in permanent pastures, and can also be used as temporary pasture or cut as hay. *Festuca* may have potential use as a forage grass also. Altogether, sixty-two specimens of *Lolium* were collected, comprising five species: *Lolium perenne*, *L. rigidum*, *L. subulatum*, *L. multiflorum* and *L. persicum* (as described by Davis, 1970, in The Flora of Turkey). Unfortunately, no *Festuca* specimens were collected during this mission, nor was any germplasm collected. This was due to the timing of the collection mission being too early in the season to find any seed or mature *Festuca* specimens.

According to Davis (1970), *Lolium* is best adapted to secondary habitats such as waste ground, roadside and edges of wheat, barley and fallow fields. The habitat preferences of this species indicate a weedy nature i.e. it is able to colonise recently or frequently disturbed areas, but would possibly be out-competed by other species in more established areas of vegetation. This description was borne out by the ecological preferences of *Lolium* observed during this survey. Furthermore, at the two last sites visited, we found very tall individuals of *Lolium rigidum* growing among other lower grasses on good soil, while the plants found on the roadsides or disturbed sites were smaller. This suggests that *Lolium* shows low competitive ability against other grasses, unless it is growing in very favourable conditions in which case its fast growing capabilities may increase competitive ability.

By far the most common species of the target taxa in the collecting area were *L. perenne* and *L. rigidum*, which were found at many of the sites visited. *L. persicum* was more restricted in its distribution range, and was only found at two sites in the north of the collecting area. It was not anticipated that this species would be encountered, since its distribution described in the Flora of Turkey is to the south of the target area. Similarly, we did not expect to find *L. subulatum*, as the documented distribution of this species is further south and east than the target area. Therefore, the distributions of *Lolium* species

given by Davis (1970) may need to be up-dated, and more detailed distribution maps constructed.

An important source of variation within *Lolium* is that found within the highly polymorphic *L. rigidum* var. *rigidum*. This species has a highly variability number of florets per spikelet and spike shape and size. The variability in *L. rigidum* var *rigidum* caused difficulty in distinguishing it from young specimens of *L. perenne*. It was found that the taxonomic keys available were too simplistic to determine *Lolium* specimens reliably because they do not take the high levels of morphological variation into account (Terrell, 1968). Therefore, particularly where plant material was immature, it was almost impossible to differentiate the species. Also, some of the diagnostic characters used by the keys overlap each other, creating confusion. Often, specimens fit two species descriptions equally well.

There does not appear to be a severe threat of genetic erosion to most of the species of *Lolium* in the north west of Turkey. Habitat destruction should not be a problem, given the weedy nature of these species, and the fact that they prefer recently or frequently disturbed habitats. One possible exception is *Lolium subulatum*, which is rare species and is only found in parts of South Anatolia. It is therefore recommended that a more detailed survey be made of the distribution of *L. subulatum* to fully assess its conservation status. It is further recommended that *Lolium* populations in Turkey are monitored at regular intervals in the future, even though there is no immediate requirement for conservation for most of the species of *Lolium* either *in* or *ex situ*.

***Medicago* - J. Rogers and C. Douglas (U.K.)**

Medicago sativa, commonly known as alfalfa or lucerne is one of the oldest forage crops in cultivation (Lesins & Lesins, 1979). 60 million acres are sown annually, chiefly in the United States. The species is drought resistant and can be grown under conditions unsuitable for other legume crops. Many other species within the genus are cultivated to a lesser extent. For example *M. lupulina* can be grown along with rye and clover as fodder for sheep. Some species are grown as ornamental species but the main use of this genus is as a fodder and green manure. The latter may become more important in the future as agrochemicals give way to organic production, although probably not on large commercial farms.

It was observed that heavy, moist soils and loose, sandy soils supported the broadest diversity of *Medicago* spp. Acid soils characteristic of *Pinus brutia* forests contained very few populations of the genus, whereas littoral soils, the disturbed habitats of roadsides and verges provided by far the greatest diversity of species. Historical sites

such as Efes, Truva and Assos were found to support a wealth of *Medicago* species. This may be due to the protection from grazing afforded by the reserve status of these sites.

Minor inconsistencies between our collections and the habitat preferences described by Davis (1970) may be explained by the restricted period in which collections took place and the by the relatively small area covered. Davis considered general habitat preferences over Turkey as a whole. For example both *M. minima* and *M. arabica* were found to be far more widespread than "woodlands" as described the Flora. Such habitats were relatively poor sites for collection, even for *M. coronata* which is documented as common in these areas.

Flowering and fruiting were strongly correlated to light availability. Populations found in shady woodland and dense meadow exhibited less mature sexual development than did those individuals in open, more exposed habitats.

M. polymorpha was by far the most abundant species, it accounted for almost one third of all collections and was present at every site visited. *M. arabica* and *M. minima* were also common, both were present at the majority of sites. *M. orbicularis* displayed a more selective distribution. Although common (13% of all collections) this taxon was restricted to coastal areas apart from one inland site. Similarly, *M. disciformis* occurs in the west, and *M. truncatula* was limited to the extreme north west.

Sites sampled in the second week of the study supported a consistently higher diversity of species than those visited in the first week. This was possibly because more plants had come into fruit. Other possible explanations are that the local climate may be more suitable for *Medicago* species in the north and on the west coast, or that the unusually heavy rainfall prior to arrival in Turkey may have been a factor.

The only native perennial medic collected was *M. lupulina*, which flowers from May to July (Davis, 1970). Other perennial species, such as *M. sativa* and *M. falcata* flower later in the year. *M. arborea* is reported by Davis (1970) to be only found in the Greek Islands off the Aegean coast. As the collection was restricted to the mainland, it was not expected that this species would be encountered. The higher rainfall described above is likely to have a more pronounced effect upon perennial species. Conspicuous by its absence was alfalfa, the cultivated form of *M. sativa*. Other forage species such as *M. falcata* were also not found in cultivation.

A high degree of morphological variation was present in the fruit shape of most species. As this is the major characteristic used in Davis' key, some identification problems were initially encountered. In particular with respect to *M. orbicularis*, where

the fruit shape was always lenticular, discoid and spineless but varied from convex, biconvex and to helical forms.

Davis (1970) remarks on the complexities of distinguishing between some members of the genera *Trigonella* and *Medicago*. Such a problem was most evident with specimens mis-identified as *M. falcata* which were in fact upon closer investigation members of *Trigonella*.

Both local cultivars and wild examples of *M. sativa* L. would be available for the improvement of current varieties. However, the greatest source of genetic variation is be present in the related wild species such as the species collected in this survey. The degree to which these others will freely intercross is unclear. For example, *M. varia* Martyn and *M. sylvestris* Fr. are recognised as a hybrid of *M. falcata* L. and *M. sativa* L. Most species of this genus are polyploid, which may allow the species barrier to be overcome to hybridize species or substitute desirable traits. The application of biotechnology to this area should further extend the gene pool.

In a short time this study has collected a wide range of material, constituting almost one half of the taxa native to Turkey. It would be premature to reach any conclusions on genetic erosion from this study alone. Reference to previous MSc studies on *Medicago* would give a broader view of the need for conservation in this area.

There are many wild species *Medicago* in Turkey. This diversity represents a valuable genetic resource for the future improvement of cultivated alfalfa. The use of wild material in crop improvement and research programmes requires access to seeds. Therefore, comprehensive *ex situ* collections need to be coordinated, the following recommendations would help in that task:

- 1) To extend the study to previous years collections in order to build a more comprehensive view of the target genus in North West Turkey.
- 2) To look into moving the date of future collections and to collect further south in order to sample more mature material.
- 3) For *Medicago* collection, to take match boxes or similar containers for the preservation of fruits. It was found that once pressed the distinguishing characteristics of fruits were easily lost or concealed.
- 4) To look into the preparation of a key to *Medicago* based upon vegetative characteristics.

One hundred and twenty four *Medicago* herbarium specimens were collected, encompassing twelve of Turkey's thirty native species. Specimens from three species were determined to recognised varieties, raising the number of taxa to fifteen.

Umbelliferae - Mark Sawkins and Angela Pinnegar (U.K.)

The target taxa allocated were crop relatives in the family Umbelliferae. Highest priority was given to the genus *Daucus* L. Carrots are a near staple food, and are also used as animal feed. Commercial carrot varieties suffer from a number of pests and diseases, the most prevalent being carrot root fly. Wild species of *Daucus* may therefore be important as a source of resistance genes for new carrot varieties.

Only five species of *Daucus* L. occur in Turkey (Davis, 1971), therefore other genera within the Umbelliferae were also targeted. These genera were *Anthriscus* Pers., *Ferulago* W. Koch, *Microsciadium* Boiss., *Pimpinella* L. and *Torilis* Adans. These additional taxa were selected because they are in flower during April and May (Davis, 1971). In the second week of collecting the range target taxa was increased; it was decided to collect suitable material of any umbellifer encountered. This was because many of the target umbellifers were at an early stage of development, therefore they were not suitable preparation as voucher specimens.

The material collected consisted mainly of herbarium specimens, but when the previous year's seed of *Daucus* species was available it was collected. Particular care was taken to collect good quality voucher specimens bearing sufficient diagnostic characters to be determined. In some cases it is only possible to collect part of the plant, as many species are coarse, large herbs. When collecting voucher specimens of umbellifers it is important to include material such as mature seed, flowers and especially basal leaves, as these bear the diagnostic characters. In addition, since many umbellifers possess storage roots (swollen taproots or tubers) it is also important to collect these. Rather than attempting to press a whole storage root, it is often easier to remove a slice to be pressed.

Data collection sheets specifically designed for collecting umbellifers were used. These included particular diagnostic characteristics were noted as well as the standard environmental data. The characters in question include petal colour, presence or absence of bracts and bractioles, and the presence of any noticeable smell. It is important to note these characters from fresh material as they may change during pressing and drying. For example, the petal colour of some umbellifer species changes considerably on drying (Davis, 1971).

In total ninety six herbarium specimens were of Umbelliferae were collected. These included *Bunium ferulaceum* Desf., *Coriandrum sativum* L., *Daucus carota* L.,

Ferula communis subsp. *communis* L., *Foeniculum vulgare* Miller, *Oenanthe globulosa/fistulosa*, *Pastinaca* L. sp., *Scandix pecten-veneris* L., *Scandix australis* subsp. *grandiflora* (L.) Thell., *Smyrniium creticum* Miller, *Tordylium apulum* L. and *Torilis* Adans. species. In some cases it was not possible to identify specimens to genera.

The ecogeographic survey revealed that rocky and disturbed habitats are generally favoured by the target taxa (Davis, 1971, Heywood, 1971 & Knees, 1989). There seemed to be no preferences for any other environmental conditions such as rainfall or altitude indicated by the literature. Therefore, the authors ensured that disturbed secondary habitats such as grass verges and field margins were visited during the field course.

Secondary habitats proved to be ideal areas in which to collect umbellifers. By far the majority of umbellifers taken from areas that had been modified by man, such as roadsides, fallow fields, cultivated land, and rocky areas. In contrast, very few specimens were collected in closed and dense habitats such as forests and woods. Where specimens were encountered in these habitats they were invariably found in well lit clearings. Pressures due to grazing were not found to be a problem as thought prior the collecting trip, as it was still early in the year and the vegetation was still lush and plentiful.

***Trifolium* - H. Butler and P. Blackmore (U.K.)**

Trifolium species are important forage crops world wide. The ecogeographic study which was carried out prior to the trip revealed that 78 species of *Trifolium* are found in the north-west region of Turkey. Their nitrogen fixing abilities means they are often used as "green manure". Nutrients are returned to the soil by growing *Trifolium* along with a mixture of grasses, which are then ploughed back into the soil, thus releasing their supply of nutrients (Zohary & Hellier, 1984). *T. pratense* is the most widely used species of *Trifolium*. It is used both as a forage crop and for the production of honey and pollen. Several other species are also currently being used as forages, these are *T. hybridum*, *T. dubium*, *T. campestre*, *T. incarnatum* and *T. subterraneum*. *Trifolium* species are also used for land reclamation because of their nitrogen fixing abilities. Currently, research is being done to find salt tolerant and drought resistant varieties.

The total number of species found in the target area was thirty five. This is only a proportion of the number of species that are known to occur in this area. There are two main reasons why the remaining species may not have been identified. Firstly, these plants may not have been flowering during the time of the collecting trip. Flowers are essential for specimen determination, therefore the plants difficult to spot and identify so were unlikely to be collected. Secondly, these species may only be found in habitat types

that were not covered during this collection trip. The restraints of time limited the number of sites visited and it was not possible to visit all habitat types.

There were three species collected that were not listed in the conspectus. These were *T. ambiguum*, *T. montanum* subsp. *humboldtianum* and *T. aintabense*. It appears therefore, that either these species have a new distribution or they were misidentified.

Species were found in two vegetation types, Mediterranean and Euro-Siberian. Within each vegetation type species occurred in several habitat types growing on several soil types (calic brown, woodland brown, sandy loam and clay) with several types of parent rock (sandstone, limestone, granite, dolerite, alluvial and limestone shale). There did not appear to be any preference for slope or orientation of slope to the sun since species were found at all gradients from level to steep (>30%) and were collected at a range of orientations. Similarly, there was no apparent preference for rock type, since they ranged from flat to large boulders. There appeared to be no correlation between altitude and abundance of specimens as species were found throughout the altitude range from sea level to 490m.

Trifolium species do appear to prefer free draining land. Most of the sites were of this type but it was found that within sites the specimens would be found mainly away from wet or marshy land with the one exception of *T. campestre*, which was found in both dry and wet marshy sites. *Trifolium* species do appear to prefer open or only light covering and shade. We did not find specimens under trees, among Olive groves etc. The specimens were abundant however on road sides, wasteland, pasture, grassland, fallow disturbed and in mixed crop land. They could be found growing in woodland only if the vegetation cover was not too dense. There was little evidence of grazing on the *Trifolium* species at each site.

It is interesting to note that two specimens, *T. squamosum* and *T. repens* were found on land in close proximity to the sea at site 11 which was 3.8km from Yalova in the direction of Cinarcik. This would suggest that these specimens are salt tolerant and may therefore have important potential use.

There were two main problems that made the identification of specimens problematic. Firstly, one of the first characteristics used in the dichotomous keys related to the structure of fruits. Unfortunately, due to the time of collection, very few fruiting structures were present on the specimens. This made identification using the dichotomous keys very difficult. Secondly, the keys were designed to be used on fresh specimens, but we had to use them to identify pressed ones. Once pressed some features were difficult to accurately assess.

We collected 171 specimens, which contained 35 species out of the 78 possible species that are found in north-west Turkey (Davis, 1970). Considering the range of flowering and fruiting times within the genera, this would seem to be quite a good representative sample of the specimens that were flowering in this region of Turkey during this collecting window. There does not appear to be any evidence of an immediate threat of genetic erosion of species from the genus *Trifolium*, since they seem to be relatively abundant within a range of habitat types. However, a more detailed survey of the region, covering all the flowering times would be necessary to fully assess the situation.

Acknowledgments

The authors would like to thank Mr A. Ertug Firat, Director of the Aegean Agricultural Research Institute, for making available the facilities of the Institute. We also like to thank Mr Kemalettin Yilmaz, Director of the Ataturk Horticultural Research Institute and Dr Seyfi Ozisik, Director of the Grape Research Institute for their hospitality. Finally, we would like to thank Dr. Semra Kostak and Ms Lerzan Aykas for their help during the field work.

REFERENCES

- Davis, P.H., 1965. The flora of Turkey, Volume 1. Edinburgh University Press, Edinburgh.
- Davis, P.H., 1970. The flora of Turkey, Volume 3. Edinburgh University Press, Edinburgh.
- Davis, P.H., 1971. The Flora of Turkey, Volume 4. Edinburgh University Press, Edinburgh.
- Heywood, V.H., 1971. The biology and chemistry of the Umbelliferae. Supplement to the Botanical Journal of the Linnaen Society. Volume 64. Academic Press, London.
- Kimber, G. and M., Feldman. 1987. Wild wheat. An introduction. Special Report 353. College of Agriculture, University of Missouri - Columbia University Press, Columbia.
- Knees, S., 1989. Umbellifers of the British Isles. Shire Natural History Series, No. 49.
- Lesins, K.A. and I., Lesins. 1979. The Genus *Medicago*. Dr. W Junk bv Publishers, The Hague.

Terrell, E.E., 1968. A taxonomic revision of the genus *Lolium*. Tech. Bull. No. 1392. US Department of Agriculture, Washington DC.

Vavilov, N. I., 1926. Studies on the origins of cultivated plants. *Bulletin of Applied Botany* (Leningrad) 16, 1-245.

Van Slageren, M., 1994. Wild Wheats: A monograph of *Agilops* L. and *Amblypyram* (Jaub. & Spach) Eig. Wageningen Agricultural University Press and ICARDA, Wageningen.

Zohary, M., and D., Heller. 1984. The Genus *Trifolium*. The Isreal Academy of Sciences and Humanities, Jerusalem.