VARIATIONS in SOME WILD MEDICAGO POPULATIONS of the CENTRAL ANATOLIAN HIGHLANDS of TURKEY

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ABSTRACT

Despite high genetic diversity of wild Medicago in Turkey, so far a no medicago cultivar has been registered for use in range restoration. Thus, there is an urgent need for a medicago cultivar that could be used for rangeland rehabilitation. Wild populations could be used as a useful tool in enhancement of medicago germplasm. The purpose of this study was to determine the magnitude of phenotypic variation in order to search for improve plant material which may be suitable for use in rehabilitation of degraded rangelands in Central Anatolian Highlands of Turkey. Present Medicago populations were collected in a wide range of altitude from 1050 m to 1770 m in both the provinces of Ankara and Sivas. This study was conducted during the years of 2001 to 2003 in the research farm of The Central Research Institute for the Field Crops, located 44 km south-west of Ankara. In total 16 populations of medicago were investigated for morphological and phenological attributes.

Plant growth habit of the populations varied from medium to semi-prostrate types indicating suitability of the populations for grazing. The plants with a prostrate growth habit tendency had larger creeping diameter and earlier maturity. The 16 populations were grouped in 4 four main groups in view of investigated characteristics. As a result, the populations placed in the second and third main groups had of more grazing type plants. Thus, these populations were selected for further studies for cultivar development for rehabilitation of rangelands in Central Anatolia.

Key words: Medicago populations, morphologic characters and phenologic characters.

TÜRKİYE ORTA ANADOLU BÖLGESİ YÜKSEK ALANLARININ BAZI YABANİ YONCA POPULASYONLARINDAKİ FARKLILIKLAR

ÖZET

Yabani Medicago türleri açısından Türkiye'de yüksek genetik çeşitlilik olmasına rağmen henüz şimdiye kadar meraların iyileştirilmesinde kullanılabilecek çeşit geliştirilememiştir. Bu nedenle meraların ıslahı için kullanılabilecek yonca çeşidine ihtiyaç bulunmaktadır. Yabani populasyonlar yonca germplasmı geliştirme çalışmalarında kullanılabilecek önemli kaynaklardır. Bu çalışmanın amacı, Türkiye'nin Orta Anadolu Bölgesi yüksek alanlarındaki meraların ıslahında kullanılabilecek yabani yonca materyalinde fenotipik çeşitliliğin tespit edilmesiyle temel bitki materyalinin geliştirilmesidir. Mevcut medicago populasyonları Ankara ve Sivas illerinde 1050 m'den 1770 m'e kadar olan geniş bir rakım aralığından toplanmıştır. Çalışma 2001 ve 2003 yılları arasında Tarla Bitkileri Merkez Araştırma Enstitüsü'nün, Ankara'nın 44 km güney-batısında yer alan Haymana İkizce'de bulunan deneme tarlalarında yürütüldü. Bu araştırmada Orta Anadolu kıraç koşullarında 16 adet medicago populasyonunun morfolojik, fenolojik özellikleri incelendi. Bu populasyonların bitki gelişimi açısından orta' dan yarı yatığa kadar değişim gösterdiği bulunmuş, böylece meraların üstten tohumlanmasında aranılan yatık gelişme özelliğine sahip bitki tipleri tespit edilmiştir. Yatık gelişme tabiatlı bitkilerin diğer bitkilere göre, yayılma çaplarının daha fazla ve daha erkenci oldukları görülmüştür. Sonuçta, kümeleme analizinde ikinci ve üçüncü gruptaki populasyonlar daha fazla otlatma tipi özellikte olup meraların üstten tohumlanmasına uygun bulunmuşlar, böylece bu populasyonlar gelecekte yapılacak çeşit geliştirme çalışmaları için seçilmişlerdir.

Anahtar kelimeler : Medicago populasyonları, morfolojik özellikler, fenolojik özellikler.

INTRODUCTION

Turkey has a total of 13.1 million hectares of range area, which is the main feed resource for livestock production of this 33.3 % is located in the Central Anatolian Highlands (CAH) (S.S.I., 2001). In rangelands of the CAH, the vegetation mostly consisted of weedy species with low feeding value. The percentages of high quality leguminous species decreased to less than 1% in the botanical composition (Büyükburç, 1983). The early and overgrazing practices caused degradation of ranges in the CAH. Over-sowing of some legume species in deteriorated rangelands can be used efficiently to improve range conditions. Wild Medicago species frequently exist in the native vegetation community, and as the major

legume species, wild medicago offer great potential to improve the production potential. In fact, legume plant species have important characteristics such as good adaptability, herbage quality and better persistence to grazing.

Lowe et al. (1972) described that grazing type medicago has prostrate growth habit, drought tolerance, high dormancy in autumn, slow growth after defoliation and high cold tolerance. Michaud et al (1988) reported that *Medicago falcata* has high cold and drought tolerance, rhizomatous growth habit, but possesses low seed production. Moreover, *M. falcata* largely contributed to enlargement and enhancement of medicago genetic pool and also to resistance and wide adaptability of hybrid *M. varia* (Michaud et al (1988,*a*). The same author, also reported that the gene center of medicago was described to include including in the highlands of Anatolia, as well as Caucasus, Iran and Turkmenistan by Vavilo's near east description. Despite of high genetic diversity of wild medicago in Turkey, yet there hasn't been any medicago cultivars developed for use of range improvement. Turkey, as being the gene center of many plant species, is quite rich for number of genus *Medicago* L. species. Davis (1970) reported that medicago species, Black medick *Medicago lupulina* L. and common alfalfa *Medicago sativa* L. exist in native flora of all over Turkey, except Mediterranean and Southeastern regions Hybrid medicago (*Medicago varia* Martyn) subsists in the natural vegetation of the Central, Eastern, South-Eastern Anatolia and Mediterranean regions. Uluocak (1977) pointed out that the existence of alfalfa (*Medicago sativa*) and sainfoin (*Onobrychis sativa, O. alba, O. tenuifolia*) within native vegetation generated a positive effect on range condition. There are many studies on medicago in the literature some being on plant morphology. Chamble and Warren (1990) found that in North Caroline the plant height of medicago populations in 1977 and 1978 ranged from 45 to 60 cm and 29 to 54 cm respectively. Rosellini et al (1991) placed medicago populations in two groups and found out that the plant heights and their coefficient of variation were 80.5 cm and 18.0 %, and 82.5 cm and 60 %, respectively. Also, Alınoğlu et al (1972) reported that local variety Kayseri medicago the main plant height and tiller diameter were 86.2 cm and 5.2 mm, respectively. Volenec et al (1987) recorded that tiller length and diameter varied from were 61.0 to 68.0 cm and 2.8 to 3.3 mm, respectively. Prosperi et al. (1996) reported that in medicago the basal cover diameter and plant height ranged from 30.0 cm to 33.0 cm and 63.0 cm to 67.0 cm in spring; from 18.0 to 26.0 and from 37.0 to 46.0 cm in summer, respectively. Enguita (1996) and Rotili et al. (1996) found the basal cover diameter of medicago populations to range from 13.0 to 23.0 cm, and from 15.5 cm (in rhizomes plants) to 8.4 cm (in erect plants), respectively.

Local genetic resources have played an important role as a variation resource in breeding programs (Prosperi et al. 1996). All these studies indicated that there is a great utilization for wider diameter and height in *Medicago* spp. . Therefore, this variation could be utilized efficiently to identify population and individual genotypes which could be used for development of cultivars that are suitable for rangeland rehabilitation.

Therefore, wild populations of medicago could be used as a useful tool in germplasm enhancement. The purpose of this study was to determine the magnitude of phenotypic variation and enhance the preliminary plant material for cultivar development for use in rehabilitation of degraded rangelands in the Central Anatolian Highlands of Turkey.

MATERIAL AND METHODS

This study was conducted during the years of 2001 to 2003 at the research farm of The Central Research Institute for the Field Crops, located 44 km south-west of Ankara. The soil of the experiment site had a clay loam texture, slightly alkaline, poor organic matter, but high lime content. Long-term rainfall is 377.3 mm, and during the experiment years of 2001 and 2002, there were 21.0 % and 2.7 % more rainfall than that of long term average

respectively. But, 2003 was a dry year with 24.1% less rainfall than that of long term (S.M.A.R.I., 2004). The sixteen medicago populations collected from Sivas and Ankara provinces of the CAH constituted the experimental material (Table 1).

For production of the experimental materialize, first seedlings were grown in the greenhouse, and then transplanted to the observation nursery in the field in 22 May 2001. At least five seedlings of each population were planted in rows 70 cm apart and with 70 cm row spacing as recommended by Açıkgöz (1982) . The following properties were for evaluation plant characters measured ;

Phenological characteristics

Days to first flowering: the number of days from planting to first flower appearance.

Days to flowering: the number of days from planting to 50 % flowering.

Days to pod formation: the number of days from planting to full pod-formation.

Morphological characteristics

Main stem length (cm) : the longest stem of a plant was considered as a main stem, and it was measured from ground level to the stem tip.

Main stem diameter (mm) : Measurement of diameter between the second and third nodes from bottom of main stem.

Plant creeping diameter (cm) : the diameter of the plant creeping area on ground was considered as the plant creeping diameter.

Plant growth habit: Depending on prostrate or erect growth habit, each plant was scored as 1=erect, 2=semi erect, 3=medium, 4=semi-prostrate and 5=prostrate.

The descriptive statistics was conducted in Excel, and Pearson correlation and cluster analysis were performed with MINITAB-Version 13.0 .

Table 1. Names and altitudes of the collection sites of 16 accessions in four *Medicago* species

No	Accession numbers	Years	N *	Collected sites	Altitude (m)	Species	Traits
1	L-1249	2002	11	Haymana -Ankara	1050	*Medicago sativa*	Wild
		2003	11				
2	L-1247	2002	12	Haymana -Ankara	1050	*M. lupulina*	Wild
		2003	8				
3	L-1384	2002	9	Ulaş-Sivas	1560	*M. sativa*	Wild
		2003	8				
4	L-1368	2002	13	Merkez- Sivas	1410	*M. sativa*	Wild
		2003	10				
5	L-1257	2002	8	Kalecik-Ankara	1520	*M. sativa*	Wild
		2003	7				
6	L-1248	2002	14	Haymana- Ankara	1050	*M. lupulina*	Wild
		2003	12				
7	L-1367	2002	7	Gürün-Sivas	1650	*M. varia*	Landrace
		2003	5				
8	L-1394	2002	17	Gürün-Sivas	1350	*M. sativa*	Wild
		2003	8				
9	L-1378	2002	18	Gürün-Sivas	1770	*M. sativa*	Wild
		2003	15				
10	L-1413	2002	18	Kangal-Sivas	1590	*M. sativa*	Wild
		2003	13				
11	L-1391	2002	10	Merkez-Sivas	1350	*M. sativa*	Wild
		2003	10				
12	L-1395	2002	9	Kangal-Sivas	1530	*M. sativa*	Wild
		2003	10				
13	L-1376	2002	16	Merkez-Sivas	1560	*M. falcata*	Wild
		2003	15				
14	L-1371	2002	21	Merkez-Sivas	1350	*M. sativa*	Wild
		2003	16				
15	L-1381	2002	15	Ulaş-Sivas	1620	*M. sativa*	Wild
		2003	14				
16	L-1382	2002	19	Gürün-Sivas	1620	*M. varia*	Wild
		2003	15				

*****Plant numbers observed

RESULTS

Morphological characters

The mean, standard error and coefficients of variations of the stem length, stem diameter, plant creeping diameter and plant growth habit for the 16 wild medicago populations are given in Table 2. The stem lengths were not significantly different between the first (67.30 cm) and second year (71.21 cm) (Table 2.). However, the coefficients of variation were significantly different between the years being 21.17 % for the first year and 27.31 % in the second. The average stem length ranged from 35.30 cm to 89.04 cm.

Table 2. The population size (N), mean (X), standard error of means (SEM), standard deviation (std) and coefficient of variation for main stem length (MSL), main stem diameter (MSD), plant creeping diameter (PCD), and plant growth habit (PGH)

	Population Accession	Years	N	MSL (cm) X ±SEM	MSD (mm) X ±SEM	PCD (cm) X ±SEM	PGH (1-5) X ±SEM
1	L 1249	2002	11	59.64±4.86	2.62±0.15	86.36±8.68	4.82±0.12
		2003	11	67.77±4.84	3.44±0.15	127.64±10.63	4.38±0.16
		Mean		**63.71**	**3.03**	**107.00**	**4.60**
2	L 1247	2002	12	36.83±2.23	2.79±0.10	57.54±3.02	4.00±0.00
		2003	8	42.94±4.01	2.45±0.09	67.94±5.37	5.00±0.00
		Mean		**39.89**	**2.62**	**62.74**	**4.50**
3	L 1384	2002	9	65.38±5.98	2.72±0.13	79.88±6.27	4.11±0.11
		2003	8	71.81±5.12	3.43±0.14	129.13±9.99	4.50±**0.00**
		Mean		**68.60**	**3.08**	**104.51**	**4.31**
4	L 1368	2002	13	79.85±2.15	4.14±0.28	14.92±1.01	1.00±0.00
		2003	10	97.90±10.86	4.84±0.37	22.30±2.88	1.00±0.00
		Mean		**88.88**	**4.49**	**18.61**	**1.00**
5	L 1257	2002	8	74.75±3.27	2.46±0.12	121.75±9.30	3.5±0.19
		2003	7	39.57±14.23	7.03±3.83	104.00±13.90	4.00±0.00
		Mean		**57.16**	**4.75**	**112.88**	**3.75**
6	L 1248	2002	14	32.54±2.13	2.78±0.10	55.71±3.46	5.00±0.00
		2003	12	38.05±1.82	2.58±0.11	66.14±3.59	5.00±0.00
		Mean		**35.30**	**2.68**	**60.93**	**5.00**
7	L 1367	2002	7	80.57±4.10	4.40±0.37	17.57±1.36	1.00±0.00
		2003	5	97.50±6.17	5.00±0.37	63.40±28.90	1.80±0.20
		Mean		**89.04**	**4.70**	**40.49**	**1.40**
8	L 1394	2002	17	71.06±4.16	3.38±0.13	53.47±12.26	2.47±0.21
		2003	8	89.25±5.22	4.43±0.26	35.88±3.94	2.13±0.13
		Mean		**80.16**	**3.91**	**44.68**	**2.30**
9	L 1378	2002	18	70.56±3.75	3.07±0.17	75.17±10.10	3.44±0.17
		2003	15	64.30±3.65	2.81±0.14	79.67±11.18	3.10±0.35
		Mean		**67.43**	**2.94**	**77.42**	**3.27**
10	L 1413	2002	18	74.28±2.81	3.17±0.14	61.89±7.39	3.17±0.20
		2003	13	84.04±6.12	3.48±0.18	84.20±17.56	2.67±0.14
		Mean		**79.16**	**3.33**	**73.05**	**2.92**
11	L 1391	2002	10	79.80±3.24	3.89±0.33	38.40±9.25	2.28±0.35
		2003	10	94.17±2.79	3.60±0.08	49.40±9.95	2.00±0.00
		Mean		**86.99**	**3.75**	**43.90**	**2.14**
12	L 1395	2002	9	65.22±6.48	2.90±0.20	65.33±13.43	3.67±0.28
		2003	10	61.81±7.05	2.78±0.15	96.11±11.13	3.17±0.37
		Mean		**63.52**	**2.84**	**80.72**	**3.42**
13	L 1376	2002	16	66.13±4.12	2.53±0.15	93.81±10.86	4.06±0.06
		2003	15	72.17±3.79	2.76±0.13	116.00±8.38	4.00±0.23
		Mean		**69.15**	**2.65**	**104.91**	**4.03**
14	L 1371	2002	21	70.86±3.89	3.38±0.12	60.50±5.81	3.26±0.16
		2003	16	82.38±3.82	3.30±0.12	124.44±12.14	2.83±0.18
		Mean		**76.62**	**3.34**	**92.47**	**3.05**
15	L 1381	2002	15	67.60±4.44	2.99±0.25	68.87±9.15	3.90±0.26
		2003	14	62.54±4.49	2.61±0.10	99.21±12.60	4.29±0.32
		Mean		**65.07**	**2.80**	**84.04**	**4.10**
16	L 1382	2002	19	81.74±3.89	3.48±0.19	76.42±7.14	3.97±0.03
		2003	15	73.13±3.76	2.98±0.14	110.18±11.14	4.06±0.20
		Mean		**77.44**	**3.23**	**93.30**	**4.02**
2002 (Average)		**X ±** SEM		**67.30±3.84**	**3.17±0.18**	**64.22±7.40**	**3.35±0.13**
		CV (%)		**21.17**	**18.20**	**41.66**	**34.62**
2003 (Average)		**X ±** SEM		**71.21±5.48**	**3.60±0.40**	**85.98±10.83**	**3.37±0.30**
		CV (%)		**27.31**	**33.56**	**38.39**	**36.03**
Overall mean		**X**		**69.25**	**3.38**	**75.10**	**3.36**
		Std		**15.65**	**0.73**	**27.80**	**1.16**
		CV (%)		**22.60**	**21.48**	**37.02**	**34.62**

Coefficient of variation for the mean stem diameters in 2002 and 2003 were measured as 3.17 mm and 18.20 % in 2002, and as 3.60 mm and 33.56 % in 2003 respectively . Though two-year average was 3.38 cm, the stem diameter between populations had high variation (21.48 % C.V.) .

The plant creeping diameter is a very significant parameter especially for erosion control in the rangelands. The annual plant creeping diameters of the population showed great variation, ranging from 64.22 cm in first year to 85.98 cm in second year, with similar the coefficients of variations (Table 2). According to the year averages, the creeping diameter ranged from 18.61 cm (lowest) to 112.88 cm (highest). The overall mean creeping diameter of populations was measured to be 75.10 cm, while the coefficient of variation was relatively great (37.02 %) .

Erect (1.0) and prostrate (5.0) plant growth types were identified within populations (Table 2.). The mean growth habit scores of the populations in two years were close to each other, being 3.35 in 2002 and 3.37 in 2003, as well as their coefficient of variations which were 34.62 % in 2002 and 36.03 % in 2003. Overall mean growth habit scores of populations for the two-years were the 3.36 with 34.62 % C.V. .

Phenological characters

Days to first flowering date were 74.26 with 13.82 % C.V. in 2002 and 72.41 with 12.18 % C.V. in 2003 (Table 3.). The two-year averages of populations varied from 50.04 to 85.36 days, the overall average being 73.33 days with a 12.87 % C.V. . The average days to flowering were 84.10 with 13.46 % C.V. in 2002 and 84.40 with 10.73 % C.V. in 2003 (Table 3.). The two-year average of the population for days to flowering varied from the 58.66 (earliest) and 94.27 (latest), the overall mean being 83.25 days with 11.94 % C.V. .

The mean days to pod formation of the populations were found to be 84.60 with 13.08 % C.V in 2002 and 81.34 with 8.77 % C.V (Table 3.). The two year mean of the populations for days to pod formation was 59.98 (earliest) and 93.62 (latest), the overall mean being 82.97 with 10.84 % C.V. .

Correlations

The correlation coefficients for the plant characteristics were given in Table 4. The main stem length was associated significantly and positively with main stem diameter (r=0.564*) , days to first flowering (r=0.833**), flowering (r=0.878**) and pod formation(r=0.837**); significantly and negatively with plant growth habit (r=- 0.820**), but not significantly with plant creeping diameter (Table 4). The grazing type plants are important for use in the natural rangeland rehabilitation in the CAH. The stem diameter had a significant negative relation with the plant growth habit (r=- 0.740**), and significant positive correlation with the plant phenological characteristics such as days to first flowering (r=0.607*), flowering (r=0.576*), and pod formation(r=0.579*). The plant creeping diameter had a significant positive relation with the plant growth habit (r=0.722**), but no significant correlation with the plant phenological characteristics such as days to first flowering, flowering and pod formation. Plant growth habit was negatively and significantly correlated with the plant phenological characteristics such as days to first flowering (r=-0.650**), flowering (r=-0.658**), and pod formation (r=-0.614**). The days to first flowering had a significant and positive relation with days to flowering (r= 0.987**) and days to pod formation (r= 0.989**) while days to flowering had a significant and positive relation with days to pod formation (r= 0.990**).

Cluster analysis

As a results of cluster analysis, the 16 populations pertaining to the investigated characteristics were divided into the four main groups (Figure 1). The first group was splitted into two subgroups, consisting of the population 4, whereas second-subgroup contained populations 7, 8 and 11. The phenotypic similarity level of the population 4 with the population 7 was 72.23 %. The phenotypic similarity of the populations (7 and 8) placed in the second-subgroupwas 84.27 %, and was quite high between the other two populations (92.40 %) . The second main group consisting of the populations 2 and 6, though different subspecies, they had the 94.52 %, which was a quite high similarity level. Both populations were collected from the site Haymana. The third main group was divided into two-subgroups; the first and second subgroups consisting of the populations of 1, 3, 13, and 15.

Table 3. The population size (N), mean (X), standard error of means (SEM), standard deviation (std) and coefficient of variation for the days to first flowering (DFF), days to flowering (DTF) and days to pod formation (DPF)

	Population acessions	Years	N	DFF (days) X ±SEM	DTF (days) X ±SEM	DPF (days) X ±SEM
1	L 1249	2002	11	70.36±2.72	81.36±2.78	83. 00±3.22
		2003	11	72.45±2.46	86.36±0.92	84.09±1.12
		Mean		**71.41**	**83.86**	**83.55**
2	L 1247	2002	12	50.75±2.29	58.42±2.45	60.58±3.44
		2003	8	49.33±0.35	59.50±0.98	63.00±0.00
		Mean		**50.04**	**58.96**	**61.79**
3	L 1384	2002	9	73.56±2.06	84.22±2.16	85.75±0.85
		2003	8	73.25±1.98	85.50±1.02	83.13±1.16
		Mean		**73.41**	**84.86**	**84.44**
4	L 1368	2002	13	81.00±0.92	94.85±0.93	89.69±1.36
		2003	10	77.83±2.90	85.56±0.36	84.56±0.42
		Mean		**79.42**	**90.21**	**87.13**
5	L 1257	2002	8	80.13±1.14	85.75±1.24	91.38±0.82
		2003	7	79.13±1.12	87.50±0.50	86.25±0.72
		Mean		**79.63**	**86.63**	**88.82**
6	L 1248	2002	14	50.79±2.54	56.64±1.36	56.29±0.96
		2003	12	52.00±1.27	60.67±0.70	63.67±0.45
		Mean		**51.40**	**58.66**	**59.98**
7	L 1367	2002	7	90.71±2.28	98.71±1.11	100.57±1.94
		2003	5	80.00±3.05	89.83±1.25	86.67±2.43
		Mean		**85.36**	**94.27**	**93.62**
8	L 1394	2002	17	80.59±1.67	92.88±1.08	89.88±1.63
		2003	8	73.76±2.81	85.60±1.08	82.47±1.21
		Mean		**77.18**	**89.24**	**86.18**
9	L 1378	2002	18	78.56±1.42	88.61±1.48	86.69±0.86
		2003	15	77.83±1.52	85.56±0.79	84.56±0.91
		Mean		**78.20**	**87.09**	**85.63**
10	L 1413	2002	18	74.33±1.15	85.72±0.92	86.50±1.51
		2003	13	72.94±1.89	84.94±0.85	83.88±1.20
		Mean		**73.64**	**85.33**	**85.19**
11	L 1391	2002	10	80.90±2.52	91.70±1.99	93.30±3.02
		2003	10	77.00±2.05	86.63±1.10	84.25±0.95
		Mean		**78.95**	**89.17**	**88.78**
12	L 1395	2002	9	75.89±2.04	86.22±1.53	86.78±1.48
		2003	10	74.56±1.91	84.11±1.57	83.22±1.07
		Mean		**75.23**	**85.17**	**85.00**
13	L 1376	2002	16	75.88±1.72	84.88±1.54	86.75±1.34
		2003	15	75.63±1.47	83.53±1.12	83.87±0.79
		Mean		**75.76**	**84.21**	**85.31**

14	L 1371	2002	21	74.00±1.18	84.19±1.20	84.19±0.88
		2003	16	72.16±1.68	84.00±1.03	83.00±0.89
		Mean		**73.08**	**84.10**	**83.60**
15	L 1381	2002	15	75.73±1.69	85.20±1.26	87.00±1.33
		2003	14	75.64±1.37	84.36±0.75	82.36±0.84
		Mean		**75.69**	**84.78**	**84.68**
16	L 1382	2002	19	75.00±1.34	86.32±0.89	85.26±1.21
		2003	15	75.00±1.72	84.69±0.90	82.44±0.90
		Mean		**75.00**	**85.51**	**83.85**
2002 (Average)		**X±** SEM		**74.26±1.79**	**84.10±1.49**	**84.60±1.61**
		CV (%)		**13.82**	**13.46**	**13.08**
2003 (Average)		**X ±** SEM		**72.41±1.85**	**82.40±0.93**	**81.34±0.94**
		CV (%)		**12.18**	**10.73**	**8.77**
Overall mean		**X**		**73.33**	**83.25**	**82.97**
		Std		**9.44**	**9.94**	**9.00**
		CV (%)		**12.87**	**11.94**	**10.84**

The phenotypic similarity between the populations of 1 and 3, and 3 and 13 were 92.45 %, and 97.26 % respectively. The fourth main group contained the three-subgroups, which comprised of population 10 in the subgroup 1, the populations of 9, 12 and 15 in the subgroup 2, and the populations of 14 and 16 in the subgroup 3. The similarity levels between the populations 9 and 12; and between the populations 12 and 15 were 92.05 % and 96.20 %, respectively.

Table 4. The correlation coefficient matrix for the relations between some plant characters of the 16 wild medicago populations

	MSL	**MSD**	**PCD**	**PGH**	**DFF**	**DPF**
Main stem length (MSL)	-					
Main stem diameter (MSD)	0.564*	-	-	-	-	-
Plant creeping diameter (PCD)	-0.354	-0.393	-	-	-	-
Plant growth habit (PGH)	-0.820**	-0.740**	0.722**		-	-
Days to first flowering (DFF)	0.833**	0.607*	-0.034	-0.650**	-	-
Days to flowering (DTF)	0.878**	0.576*	-0.045	-0.658**	0.987**	
Days to pod formation (DPF)	0.837**	0.579*	0.030	-0.614*	0.989**	0.990**

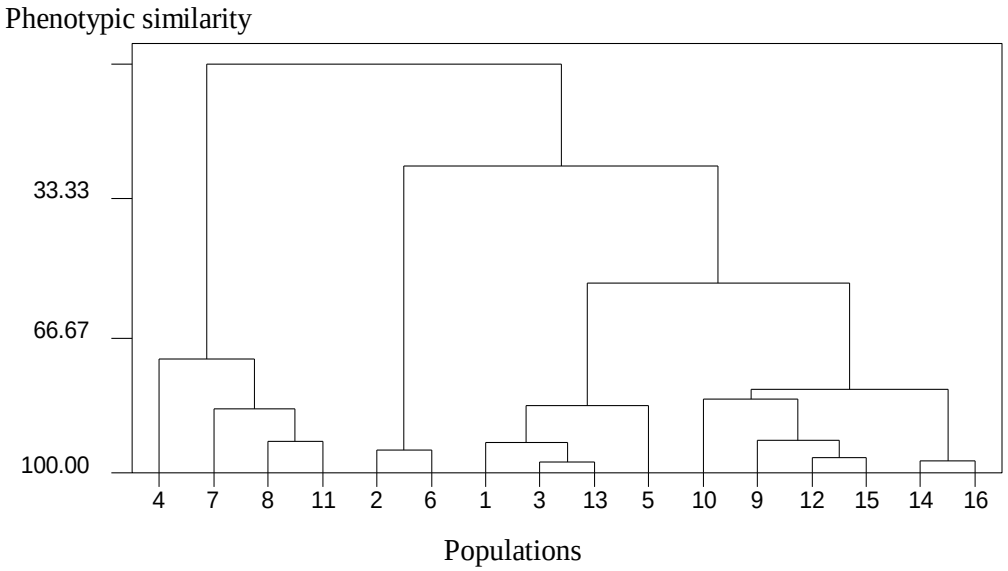

Figure1. Dendogram of the 16 wild medicago populations

DISCUSSION

Morphological characteristics

The largest variation occurred for plant creeping diameter (37.02 % C.V.) among the populations followed by plant growth habit (34.62 % C.V.). This is very important especially for erosion control properties of the populations. The other two characteristics had almost the similar variations. The stem length is very important property for vegetative growth. Stem height of 69.25 revealed some similarities with the measurement done by Koç and Tan (1996) as the 65.5 cm in medicago crosses and measurement of Volenec et al (1987) who found populations to have lengths from 61.00 cm to 68.00 cm.

The stem diameter is other important aspect for vegetative growth. Volenec et al. (1987) suggested that stem diameter varied from 2.8 to 3.3 mm, which was quite similar to our measurements (3.38 mm). Though, this result was greater than those of Alınoglu et al. (1972) and Iwaasa et a.l (1997), it was smaller than that of the measurement of Hakyemez (2000).

In fact, plant creeping diameter in this study was higher than what Rotili et al. (1996) and Prosperi (1996) reported . This might be an indication suitability of our material for use against soil erosion and over-grazing which was imposed on the populations by natural selection during centuries in the Central Highlands. Accessions of L-1257 and L-1376 showed higher plant creeping diameter than the others in two experimental years, showing a great prospectfor use in rangeland rehabilitation.

In average, the plant growth habits of these populations varied from medium to semi-prostrate, therefore it reveals the suitability of the current populations for grazing type medicago. The scores indicated that L-1248, L-1249 and L-1247 were the most prostrate populations while L-1368 and L-1367 were the most erect types.

Phenological characters

Though the coefficient of variation of days to flowering was 11,94 %, there was a great difference of 36 days between the earliest and the latest flowering populations. L-1247 and L-1248 were the earliest populations in terms of all phenological characters measured. Since earliness is very important plant characteristics for the natural vegetation in grasslands (Açıkgöz, 2001), these enties also have great prospects for rehabilitation of Central Anatolian Highlands.

Correlations

The plant species with prostrate growth habit, shielding the ground are quite important in the restoration of the rangelands through over-seeding. For this reason, the desired characteristics associated with other plant aspects should be considered together. To draw a conclusion from these relations, the plants with a prostrate growth habit tendency had larger creeping diameter and earlier maturity.

Cluster analysis

In the second and third main groups formed for plant growth habit, the populations 2, 6, 1, 3 and 13 had a prostrate growth habit, while the population 5 was semi-prostrate type. The populations of the third main group had the plants with largest creeping diameter. The populations 12 and 15 placed in the fourth main group were collected from the Sivas province, similar to the populations 14 and 16, which had 97.15 phenotypic similarity.

CONCLUSION

There is an urgent for a medicago variety which can be used for the improvement of degraded rangelands through over-sowing in The Highlands of Central Anatolia. Unfortunately, so far this has not been realized. Therefore, this study sets such as opportunity Wild *Medicago* populations were collected and evaluated in Haymana. Variations among populations for the morphological and phenological characteristics indicated diversity in the natural population.

It was determined that the populations had a high variation (22.60 to 37.02 % C.V.) for morphological characteristics, but relatively low variation (10.84 to 12.87 % C.V.) for phenological characteristics.

This study has permitted to determine existing variability in the collected plant material. These results show the wide diversity and richness in *Medicago* species in Ankara and Sivas Provinces of Turkey. A particular attention has been given to the wide plant creeping diameter of genus *Medicago* in order to improve a variety for use on the rangeland. The populations placed in the second and third main groups of cluster analysis were more grazing type plants, and these populations were selected for further studies.

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