GERMPLASM ENHANCEMENT OF ANNUAL FORAGE LEGUMES SUITABLE FOR USE IN COLD HIGHLAND ENVIRONMENTS

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ABSTRACT
The Central Highlands (CH) of Turkey are characterized by cold winters and dry summers. Under these extreme air temperatures, forage crops are still underexploited as a part of crop rotations. Half of the total vetch hectarage in Turkey is in the CH, and farmers still use the local cultivars that have good adaptability but low yield potential. Therefore, with the aim of identifying and improving the annual forage legume species for the cold and dry environment of the CH, research work was carried out during the 1993/94 and 1994/95 crop seasons. Initial results showed that Hungarian vetch *(Vicia pannonica)* and wooly-pod vetch *(Vicia villosa ssp. dasycarpa)* were promising vetches for autumn-sowing and utilization for grazing and/or hay. Narbon vetch *(Vicia narbonensis)* also performed well in the autumn-sown, and was found suitable to grow for grain and straw yields.

KEYWORDS
Autumn-sown, Hungarian vetch, wooly-pod vetch, narbon vetch, biological and seed yields

INTRODUCTION
Although forage crop production has increased in the last 20 years, in the Central Highlands (CH) of Turkey, forage crops are still underexploited as a part of crop rotations. A shortage of high quality forages is experienced especially during the winter supplementary feeding time. Fifty percent of the total vetch hectarage grown in the CH is used to feed livestock as grain and straw. Among vetches, common vetch (*V.sativa*) is the most popular, and is grown as a spring crop. This practice occurs because of the cold sensitivity of common vetch and the fact that it often is subject to terminal drought that cause losses in seed and straw yields. Autumn planting, in certain cases, can result in higher seed, straw and hay yields.

Considering the above situation, it was considered necessary to strengthen the research efforts on introduction, adaptation and improvement of annual forage legumes to identify better species and cultivars for specific regions (Elçi, 1971). This study was designed to identify productive forage legume species with sufficient cold tolerance for winter planting and desirable agronomic traits for the cold environments of CH.

METHODS
Three autumn-sown annual forage legume species were evaluated during the 1993/94 and 1994/195 crop seasons. Hungarian vetch *(V. pannonica)*, wooly-pod vetch *(V. villosa spp. dasycarpa)* and narbon vetch *(V. narbonensis)* were evaluated for autumn (October) sowing. The nurseries of each species were planted at the Haymana Research Farm, located 35 km south-west of Ankara at 1055 m altitude with 320 mm annual rainfall. Test lines of each species were planted in six-rows, 5-m rows, 0.25 m apart (7.5 m^2 plots) in three replications. Across the two seasons, the seeding times remained the same, however additional lines were included the second year. Observations were made on biomass and seed yields.

RESULTS AND DISCUSSION
The 1993/94 season was relatively mild which did not favor screening for cold tolerance. However, as a result of good plant growth during early spring, biomass and seed yields were much higher than those expected (table 1). The narbon vetch produced the highest biomass and seed yields (6371 and 2528 kg/ha), whereas the wooly-pod vetch the lowest seed yield (966 kg/ha). The 1994/95 season also had with a mild winter although the rainfall received was much higher (400 mm) than the long-term average (320 mm). The average yields of all species were higher than those of the previous two season (table 1). The wooly-pod vetch produced the highest biomass yield (5567 kg/ha), whereas the Hungarian vetch the lowest (4561 kg/ha). The narbon vetch produced the highest seed yield (2285 kg/ha) and harvest index (0.47), whereas the wooly-pod vetch produced the lowest seed yield (1105 kg/ha) and harvest index (0.20). Over the years, the narbon vetch produced the highest biomass yield (5686 kg/ha) followed by wooly-pod vetch (5539 kg/ha) and Hungarian vetch (4188 kg/ha). For seed yield, the narbon vetch was the best, with a seed yield of 2427 kg/ha followed by the Hungarian vetch (1219 kg/ha) and wooly-pod vetch (1036 kg/ha). For harvest index, the narbon vetch was the best (0.44) followed by the Hungarian vetch (0.30) and the wooly-pod vetch (0.19).

In a harsh environment like the CH, the major constraints are low winter air temperatures and variable drought through the growing season. Therefore, it would be difficult for a single crop species to produce stable yields under these unstable climatic conditions, the identification of adapted species and lines for a given place and time is essential (Keatinge *et al.*, 1991). Therefore, the introduction of additional annual forage legumes in the farming system could provide alternatives to farmers. These initial results showed promising potential of the Hungarian vetch and wooly-pod vetch. These species produced high crop biomass and harvest index for hay and grazing. These could be either cut or grazed during the spring when herbage quality is still high and forage is badly needed as emphasized by Abd El Moneim *et al.,* (1990). Contrarily, the narbon vetch produced the highest biomass and seed yields, and harvest index. The occurrence of the high seed yield of the narbon vetch could make this species a good grain legume crop in the semi-arid regions of West Asia (Abd El Moneim *et al.*, 1988). In the CH also, this forage legume species has good potential as an important crop for seed and straw yields.

REFERENCES
Abd El Moneim A.M., M.A. Khair, and P.S. Cocks. 1990. Growth analysis, herbage and seed yield of certain legume species under rainfed conditions. J. Agronomy & Crop Science **164**: 34-41.

Abd El Moneim A.M., P.S. Cocks, and Y. Swedan. 1988. Yield stability of selected forage vetches *(Viciaspp.)* under rainfed conditions in West Asia. J. Agric. Sci. Camb. **111**: 295-301.

Elçi, S. 1971. Forage crop production in Turkey. 47-54 pp. In: Proc. CENTO Conference on Development of Feed Resources.

Keatinge, J.D.H., A. Asghar, B.R, Khan, A.M. Abd El Moneim and S. Ahmad. 1991. Germplasm evaluation of annual sown forage legumes under environmental conditions marginal for crop growth in the highlands of West Asia. J. Agronomy & Crop Science **166**: 48-57.

Table 1
The mean, minimum, maximum values and overall means of biological (BY) and seed (SY) yields (kg/ha), harvest index (HI,%) of the autumn-sown species, at Haymana Research Farm near Ankara, during 1993/1994 and 1994/1995 crop seasons.

		1993/94			1994/95			Over two years		
Species		BY	SY	HI	BY	SY	HI	BY	SY	HI
V.pannonica	Mean	3814	1168	0.31	4561	1269	0.28	4188	1219	0.30
	Minimum	1517	533	0.24	3336	836	0.14			
	Maximum	6577	1673	0.36	6432	2026	0.40			
	SEM(+,-)	149	83	0.4	70	27	0.60			
	No. of lines	30			15					
V.villosa spp. dasycarpa	Mean	5510	966	0.18	5567	1105	0.20	5539	1036	0.19
	Minimum	3143	367	0.11	2918	482	0.70			
	Maximum	6887	1257	0.24	7976	1700	0.30			
	SEM(+,-)	197	32	0.6	133	39	0.60			
	No. of lines	16			19					
V.narbonensis	Mean	6371	2568	0.40	5001	2285	0.47	5686	2427	0.44
	Minimum	4590	1650	0.31	1576	808	0.33			
	Maximum	7603	3167	0.47	9038	3400	0.57			
	SEM(+,-)	190	71	0.8	183	71	0.6			
	No. of lines	25			28					