ADAPTATION OF BARLEY VARIETIES TO DRYLAND ENVIRONMENT OF CENTRAL ANATOLIA

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SUMMARY: Temporal and spatial fluctuations in climate and significant differences among locations used in regional yield trials and the management practices applied by farmers are the main obstacles of plant breeders when they try to overcome the substantial yield reduction during the production process. These drawbacks are especially more pronounced under rainfed conditions.

The objective of the study was to evaluate the performance of barley varieties for stability and adaptability. So seven two- rowed winter facultative barley varieties were tested in eight locations in Central Anatolia for three various (favorable, unfavorable and average) growing seasons.

The results indicated that Tarm-92 and Efes-3 cultivars were the most adaptive for the locations with average yield of more than 3.5 t/ha and under 3 t/ha, respectively. Hamidiye and Obruk-86 seemed slightly better than the average response in case of more than 4 t/ha seasonal yield. Considering locations and seasons combined Tarm-92 was outstanding.

It can be concluded that relatively small genotype by environment (GE) interaction, in spite of being statistically significant, implies that all varieties were well suited to the environments

ARPA ÇEŞİTLERİNİN ORTA ANADOLU KURU KOŞULLARINA ADAPTASYONU

ÖZET: *İklimdeki geçici ve uzun süreli dalgalanmalar, bölge denemelerinde kullanılan yerler arasındaki farklılıklar ve çiftçiler tarafından uygulanan farklı yetiştirme teknikleri kararlı bir verim seviyesine ulaşmak için çalışan bitki ıslahçıları için temel engeller teşkil etmektedir. Bu durum özellikle kurak alanlar için daha çok geçerlidir.*

Bu araştırmanın amacı uyum ve kararlılık yönünden arpa çeşitlerinin durumlarını değerlendirmekti. Böylece yedi tane iki sıralı kışlık arpa çeşidi sekiz yerde birbirinden farklı uç yıl boyunca denendi.

Elde edilen sonuçlara göre Tarm-92 ve Efes-93 çeşitleri verimleri 3,5 ton/'ha ve 3ton/ha olan yerlere sırasıyla en iyi uyumu olan çeşitler olarak bulundu. Hamidiye-85 ve Obruk-86 çeşitleri ise yıllık verimleri 4 ton/ha'dan fazla olan yerlere biraz daha iyi tepki verdiler. Yıllar ve yerleri birlikte değerlendirdiğimizde ise Tarm-92 en iyi çeşitti.

Oransal olarak küçük de olsa çeşitxçevre etkileşiminin istatistiksel önemine rağmen, tüm çeşitlerin kullanılan çevrelere uyumlu olduğu söylenebilir.

INTRODUCTION

Most cereals in Turkey is produced in semiarid and rainfed environments which are subject to wide fluctuations in climate, disease pressures and precipitation over and within growing seasons. Soil types and properties and production practices also vary widely within regions. Genotypes must possess the potential to sustain competitive yields in various sub-optimal as well as favorable conditions.

A genotype is generally considered stable if its grain yield varies little from years to years of a given location or considered adaptive if its grain yield varies little across locations (Lin and Binns, 1994). In the region, the average yield of barley ranges from 1.6 to 3.3 t/ha. The analysis of 16 provinces and 7 years yield statistics (SIS, 1994) indicated that coefficient of variations due to location and year were 20 and 58 %, respectively. The coefficient of variation in average yield of barley due to the location-year interaction is 5 % which is much less than that of location and year.

The aim of this study was to evaluate the yield performances of various varieties released for the Central Anatolia in terms of stability and adaptability.

MATERIALS AND METHODS

The seven 2 row-barley varieties were tested under 8 locations of dryland conditions of Central Anatolia in three seasons which were favorable (1993-94), unfavorable (1988-89) and average (1992-93) with respect to average seed yields. These years used in the research were deliberately selected from multi year experiments in order to get precise effect of years over cultivars. The design of experiments were RCB with 3 replications. The experimental plots had 1.5 x 8 m dimension. 70 kg/ha nitrogen and P_20_5 were given in all experiments, respectively. Experimental sites, and the names of the barley varieties were given in the Table 1. The annual rainfall and annual monthly average of experimental areas and years were presented in Table 2. Time of planting was between late September to late October. Two hundred twenty kg seed per hectare was used for all varieties. Experimental drill and harvester (Hege) was employed in the trials. Stability and adaptability tests were performed according to Eberhart and Russell (1969). Analysis of variance was carried out by using combined analysis of years and locations in MSTATC statistical software package.

Table 1. Barley cultivars, locations and years used in the experiment.

Barley Cultivars		Locations		Years
1. Tokak 157/7	5. Obruk-86	1. Haymana	5. Koçaş	1. Unfavorable (1988/89)
2. Hamidiye	6. Tarm-92	2. Eskişehir	6. Bala	2. Average (1992/93)
3. Ank-86	7. Efes-3	3. Altınova	7. Çiçekdağı	3. Favorable (1993/94)
4. Anadolu-86		4. Gözlü	8. Ulaş	

Table 2. Total annual rainfall (mm) and annual monthly average temperature (°C) of experimental locations and years.

Years		Experimental sites								
		Hayma-na	Eskişe-hir	Altın-ova	Gözlü	Koçaş	Bala	Çiçek-dağ	Ulaş	Orta-lama
1988/ 1989	Prec.	354.5	236.6	250.6	281.3	252.7	186.8	303.8	303.8	265.2
	Temp	7.6	8.8	8.8	5.8	13.1	8.7	8.5	5.8	
1992/ 1993	Prec.	271.9	236.0	266.2	224.9	336.9	351.5	478.5	478.5	343.4
	Temp	6.5	7.9	9.1	7.1	9.1	8.2	7.9	veri az	
1993/ 1994	Prec.	304.0	188.0	249.9	239.2	317.6	256.3	209.7	209.7	243.0
	Temp	9.9	8.8	11.5	9.2	11.4	9.6	veri az	7.4	

RESULTS

According to combined analysis of all experiments, except for the replications, all sources of the variance were significant ($P< 0.001$) concerning the seed yield (Table 2). It suggested that non-genotypic contribution to the variation of yield was overwhelmingly high as compare to variety and its interactions with location and season. Among the non-genotypic components of the variance, season played more important role than location and LY interaction.

Table 2. Summary of combined ANOVA over year and locations.

Source of variation	DF	MS $(t/ha)^2$	%	Significance
Season (Y)	2	87.86	66.89	***
Location (L)	7	35.59	27.09	***
YL	14	6.28	4.78	***
Varıety (V)	6	0.69	0.53	***
YV	12	0.42	0.32	***
LV	42	0.24	0.18	***
YLV	84	0.26	0.20	***

***(P< 0.001).

Location x season interaction

The analysis on the interaction indicated that barley yields in Eskişehir was remarkably high and was the best location. It was followed by Çiçekdağı and Haymana locations in terms of stable yield against seasonal fluctuations. Bala and Altınova were about the same as the mean response to changing season. While Gözlü was the worst, Koçaş responded remarkably well to the favorable season, but had poorer than mean up to 4 t/ha yield potential (Figure 1)

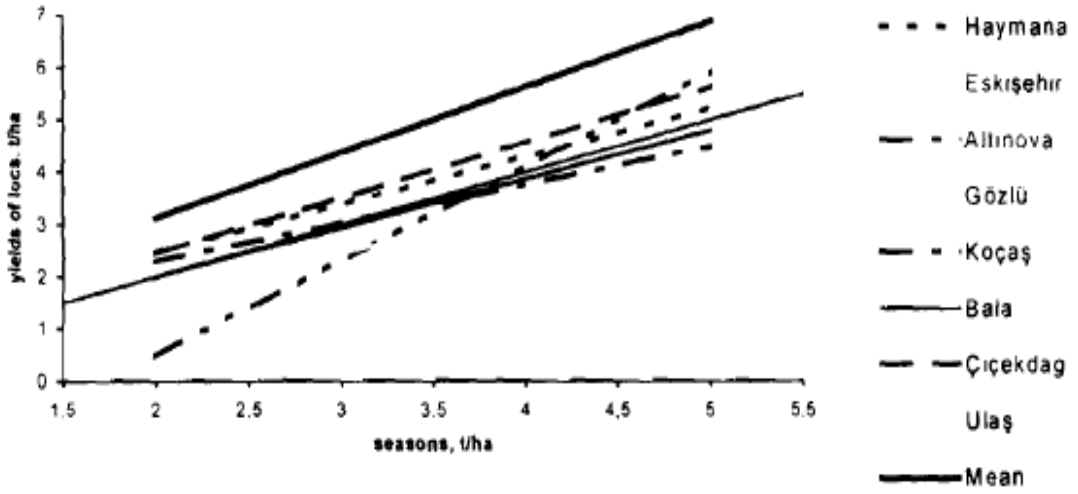

Figure 1. Yield responses of locations due to seasonal differences.

Season x variety interaction (stability)

The responses of varieties to changing seasons, as was suggested by Lin and Binns (1994), the stability of the barley varieties was analyzed. The results (Figure 2) indicated that in all seasons with 3-4 t/ha seed yields, all varieties except for Ank-86 had quite similar responses. In seasons having less than 3 t/ha yield, the varieties responded in the following order: Tarm-92>Tokak 157/7>=Ank-86>= Efes-3>=Obruk-86>Hamidiye

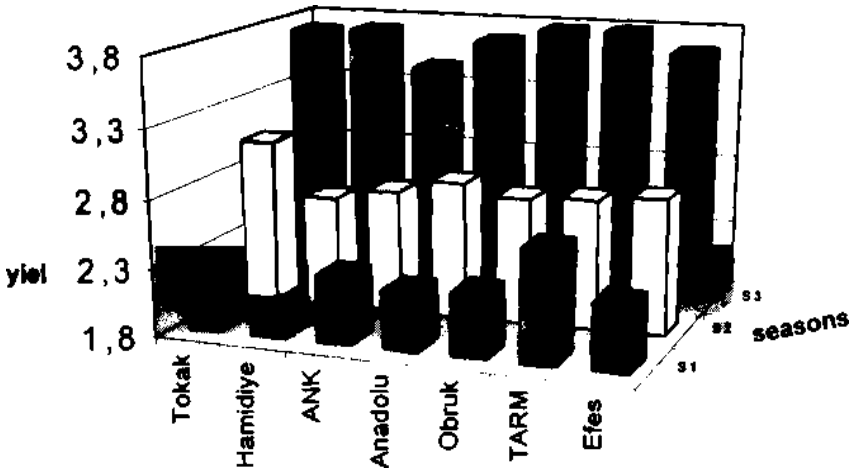

Figure 2. Varietal responses of barley to favorable, mean and unfavorable seasons in Central Anatolia.

In the seasons with more than 4 t/ha yield potential, Hamidiye and Obruk were leading while Ank 86 was the lowest. Ank 86 was better in low yielding (1 -2 t/ha) season following Tarm-92, however the latter dramatically changed as the high yielding seasons prevailed.

Location x variety interaction (adaptability)

The adaptability of the varieties to changing locations differed with respect to the yield potentials of the locations. From the figure 3 , it can be seen that Efes-3 provided the highest yield in locations having the yield potentials up to 2.5 t/ha. No substantial yield differences were detected among the varieties in the sites with approx. 2.5-3.5 t/ha yield potentials. In the sites with >3.5 t/ha yield potential Tarm-92 was superior to others and was followed by Tokak and Hamidiye whereas Efes-3 showed the poorest response (Figure 3).

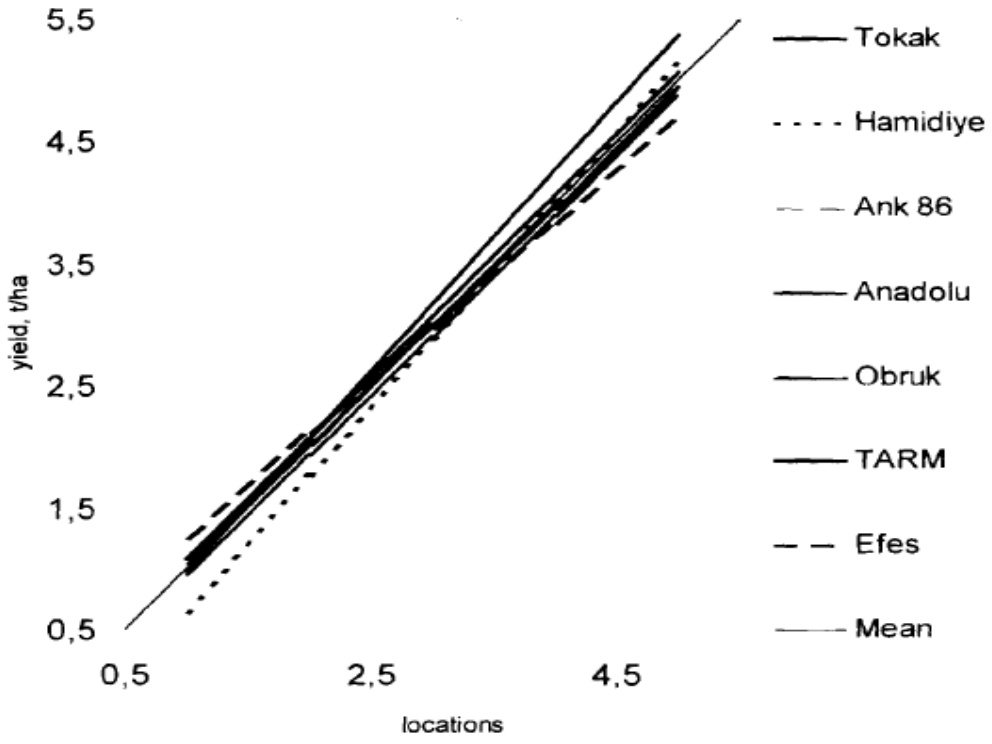

Figure 3. Responses of barley varieties to locations having different yield potentials.

Location x season (environment) vs variety

The yield performances of barley varieties in both spatially and temporally changing environments differed (Figüre 4). While Tarm-92 was the highest in all environments Efes-3,

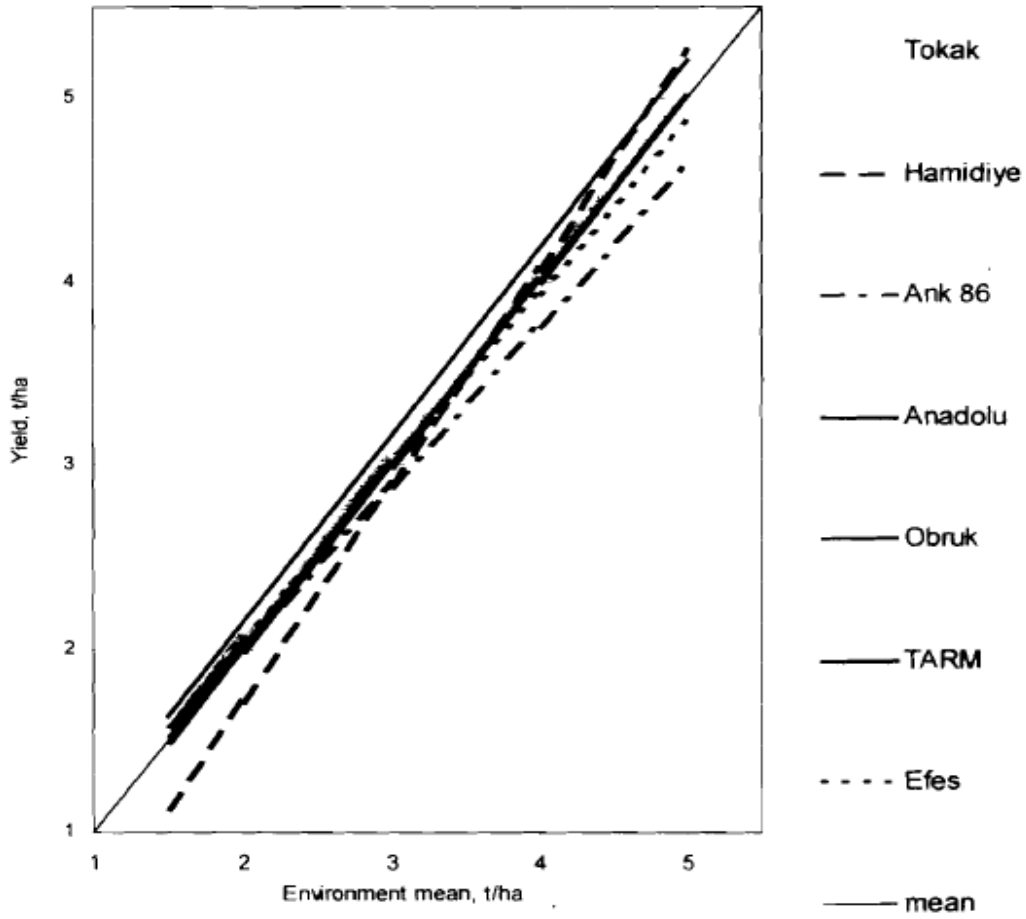

Figure 4. Environmental responses of various barley varieties.

stayed slightly below and Tokak 157/57 slightly over the environmental mean. Ank-86 was neither adaptive nor stabile in the high yielding environments. Despite having the lowest yields in poor environments, Hamidiye might have potentials for high yields in better environments (>4 t/ha).

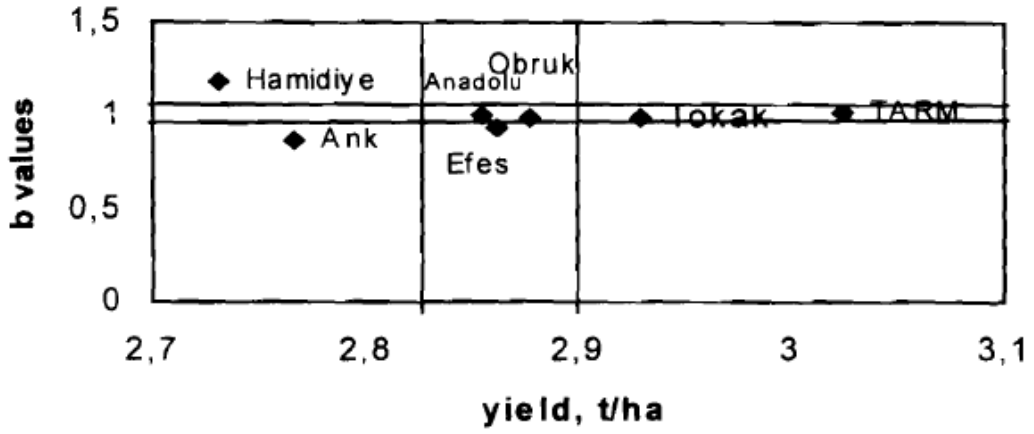

Figure 5. Distribution of b ± Sb (kg/da) values of various barley varieties over mean environmental yields (± Sy).

Cv.Tarm- 92 was outstanding in terms of yield and average response to changing environment and followed by Tokak but cvs. Anadolu, Obruk and Efes fell in the range of average environmental yield range. Hamidiye and Ank 86 had poor yield levels, however the former had sound response to the better environments (Figure 5).

CONCLUSIONS

The following conclusions can be drawn from the results:

1. Relatively small Genotype x Environment interaction implies that all varieties suited well to the environments.
2. Cv.Tarm-92 was the most stable below the seasonal average of 3 t/ha and most adaptable above the site average of 3.5 t/ha.
3. In lower yielding sites (up to 3 t/ha), cv. Efes-3 was the most adaptable.
4. Hamidiye and Obruk-86 cultivars performed slightly better stable when seasonal yield was more than 4 t/ha
5. When seasons and locations were considered together, Tarm-92 was outstanding in all environments.
6. In order to improve more stable new cultivars to be cultivated in different ecological zones of the Central Anatolia, advanced lines in the regional yield trials should be tested at least 2 -3 quite different years.

LITERATURE

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