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DETERMINATION OF THE SOME YIELD COMPONENTS OF DRY BEAN (*Phaseolus vulgaris* L.) GENOTYPES IN DIFFERENT ENVIRONMENTS

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ABSTRACT

The study was carried out between 2011 and 2015 to determine the responses of some yield components of dry bean to different environments. In the study, 20 dry bean genotypes comprising 7 varieties and 13 advanced lines were used. For each year, the trials were carried out in four repetitions in accordance with the randomized block experimental design. In the study, plant length, the first pod height, the number of pods per plant and the number of seeds per pod were investigated.

The results showed that the first, second, third and fifth environments had similar responses in terms of plant height. The genotype no. 4 was the most stable genotype in terms of plant height. In terms of the first pod height, the poorest results were obtained in the environment no. 5, while environments no. 2 and 4 were the most stable environments. In terms of number of pods per plant, the environment no. 3 had the best performance, while the genotypes no. 10 and 15 were the most stable genotypes. In terms of number of seeds per pod, the responses of all environments were similar to each other and the genotype no. 10 was the most stable genotype.

Keywords: Dry bean, genotype, environment, year, yield components, stability

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INTRODUCTION

The world is rapidly changing and these rapid changes bring along uncontrolled population growth and unbalanced income distribution, which result in the rapid destruction of agricultural lands and thereby render these lands unsuitable for agriculture. As a result of the high costs of animal protein procurement, people choose to consume proteins of vegetable origin. Among the sources of protein, legumes are the best protein sources (Sozen, 2012). Yield undergoes formation as a result of the interaction between environment and genotype (Wood, 1976). Although majority of the scientific studies have focused on yield, few, if any, studies have focused on yield-affecting characteristics. Koinov and Radkov (1979) reported that seed coat thickness, pod formation and seed yield were affected by in six different environmental conditions. Favoro and Pilatti (1988) stated that, in addition to their effects on yield, different environments also affected other factors in bean development. Binnie and Clifford (1981) reported that there were significant differences among bean cultivars in terms of number of pods per plant, 100-seed weight, number of seeds per plant and number of seeds per pod, and genotype and environmental conditions affected these factors in dry bean. Any change especially in the environmental factors such as, precipitation amount and distribution, temperature, its duration, and topographical features can significantly affect dry bean yield and yield-affecting characteristics (Wallace et al., 1991). In regions where economically important products, such as, dry bean, are grown, it is necessary to grow cultivars that are sufficiently stable to overcome environmental changes (Jensen, 1988). To determine stable varieties, emphasis should also be put on yield-affecting characteristics as well as yield.

This study aimed to determine the responses of yield-affecting characteristics of dry bean genotypes, which comprise plant height, first pod height, number of pods per plant and number of seeds per pod to different environments.

MATERIAL AND METHOD

This study was carried out five years between 2011 and 2015 in Samsun (Ambarkopru and Gelemen locations) and Kirsehir (Mucur and Cogun locations). In the study, 20 different dry bean genotypes were used, which comprised 7 varieties and 13 advanced dry bean lines. In the study, years were evaluated as environments. The analysis of the soil samples collected from the study areas in which the 5-year study was carried out showed that the soils in the study areas were organic matter-poor, clay-rich, and slightly alkaline (Table 1).

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Table 1: Physical and chemical properties of soils for trial areas*

Soil Properties	Samsun (Ambarkopru and Gelemen location)						Kirsehir (Mucur and Cogun location)			
	2011		2012		2013		2014		2015	
	Analysis						Analysis			
	Value	Grade	Value	Grade	Value	Grade	Value	Grade	Value	Grade
Saturation	64	loamy	88	loamy	62	loamy	67	loamy	69	loamy
Power of Hydrogen (pH)	7.22	neutral	7.41	neutral	7.58	neutral	7.57	neutral	7.44	neutral
Total Salt (%)	0.549	salty	0.079	saltless	0.478	salty	0.018	saltless	0.026	saltless
Calcium Carbonate (%)	2.90	calcareous	0.85	low calcareous	4.15	calcareous	8.7	calcareous	9.7	calcareous
Phosphorus (kg da^{-1})	18.0	high	21.7	high	22.5	high	6.37	medium	7.26	medium
Potassium Oxide (kg da^{-1})	34	low	125	high	31	low	202	high	214	high
Organic Matter (%)	1.81	low	2.43	medium	1.88	low	1.56	low	1.68	low

*Black Sea Agricultural Research Institute Soil Department Laboratory Results

The climate data for the locations in which the 5-year study was carried out is given in Table 2, which shows that, over the years, temperature did not significantly differ, while there were significant differences in the amount of precipitation. Since it is one of the factors directly affecting the growth and development of plants, the differences in the precipitation amounts resulted in the emergence of the variations among the plants.

Table 2: Climate data for Samsun and Kirsehir

	Months	Average Temperature (^{0}C)				Total Rainfall (mm)				Average Relative Humidity (%)			
		2011	2012	2013	Long Years	2011	2012	2013	Long Years	2011	2012	2013	Long Years
Samsun	May	15.0	17.5	16.7	15.4	66.1	34.4	55.6	51.1	84.1	82.3	79.3	79.4
	June	20.6	21.9	21.4	20.3	49.6	24.4	19.6	48.0	76.9	76.4	76.2	77.1
	July	24.3	24.0	23.8	23.3	26.0	96.0	68.5	31.8	77.9	77.1	76.2	76.7
	August	23.4	23.0	22.6	23.5	14.2	179.6	32.4	36.7	74.4	78.0	77.4	74.6
	September	19.8	20.1	19.7	20.0	39.1	113.0	80.5	52.9	77.3	80.4	79.9	76.9

	Months	Average Temperature (^{0}C)			Total Rainfall (mm)			Average Relative Humidity (%)		
		2014	2015	Long Years	2014	2015	Long Years	2014	2015	LongYears
Kirsehir	May	16.9	16.4	16.2	46.6	39.2	10.7	59.5	57.5	56.2
	June	20.8	18.9	20.6	36	161.4	13.9	51.6	65.6	50.9
	July	27.6	24.9	24.8	13	20.6	2.9	33.6	41.5	38.4
	August	28.2	25.9	24.9	17	11.8	1	33.6	45.4	37.6
	September	20.1	23.8	19.6	30.4	1	2.6	50.8	41.1	43.3

Each trial was carried out in accordance with the randomized block experimental design, and in four repetitions. In the trials, parcel lengths were 5 m, parcel widths were 2.5 m, and for each parcel, the dry bean genotypes were planted in 5 rows with a row spacing of 50 cm, while 8 cm of each row contained 63 seeds.

Although climate conditions necessitated some variations in the day of planting, all planting processes were carried out in May of each year. During the planting processes, each parcel was fertilized with 15 kg DAP (2.7 kg da^{-1} N and 6.9 kg da^{-1} P).

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In all trials, weed control was culturally carried out twice during vegetations and the plants were irrigated 7< times by considering the irrigation requirement of the plants. During the 5-year study, 10 plants from each parcel were chosen for use in the measurements. Genotype x Environment interaction was determined following the GLM procedure for randomized block experimental design by using the SAS (1999) package program. Interaction and GGE biplot analysis results were graphically analyzed following the proc REG procedure (Yan, 2001; Yan and Rajcan, 2002; Yan and Tinker, 2006). Environments and genotypes were given in rows. The genotype closest to the ideal environment was regarded as the most stable genotype.

Table 3 shows the plant heights obtained from the dry bean genotypes grown in different locations, which reveals that, with 46.9 cm, the highest plant length was obtained in the second environment, followed by the third environment with 46.7 cm. However, the first and fifth environments are also in the same statistical group as the two environments. Among all environments, with 41.5 cm, the lowest plant height was observed in the fourth environment. This environment was in a separate group from the other four environments.

The genotypes no. 2, 4 and 5 had the highest plant heights and were in the same group, while the genotypes no. 13 and 14 had the lowest plant heights and were in the same group. In terms of interaction, with 57 cm, the genotype no. 1 had the highest value in the second environment, followed by the genotype no. 4 in the first environment with 56.3 cm and genotype no 4. in the second environment with 55.8 cm; the analysis showed that they were in the same group.

Table 3: The plant height (cm) values in different environments

Genotypes	Names of genotypes	Number of genotypes	Environments					Average of genotypes
			E1* (2011)	E2* (2012)	E3* (2013)	E4* (2014)	E5* (2015)	
Varieties	Zulbiye	**1**	50.8	**57.0**	53.0	43.3	46.9	**50.2 ab**
	Onceler 98	**2**	52.5	54.2	51.7	46.3	49.4	**50.8 a**
	Yunus 90	**3**	46.1	52.1	56.7	44.4	50.6	**50.0 ab**
	Goynuk 98	**4**	**56.3**	**55.8**	54.2	46.9	50.6	**52.8 a**
	Noyanbey 98	**5**	53.1	54.9	50.1	46.2	47.5	**50.4 a**
	Sahin 90	**6**	48.8	46.9	52.1	44.2	49.4	**48.3 b**
	Akdag	**7**	50.1	45.3	45.3	44.7	45.6	**46.2 bc**
Advanced Lines	A.13	**8**	43.2	39.0	42.4	37.0	43.2	**41.0 b**
	A.14	**9**	47.1	49.1	51.3	45.5	44.5	**47.5 b**
	A.20	**10**	43.6	43.9	45.6	37.9	41.4	**42.5 d**
	A.27	**11**	42.1	41.9	43.9	36.7	43.3	**41.6 d**
	A.40	**12**	43.7	42.5	39.9	37.4	38.2	**40.3 de**

	A.107	**13**	40.1	36.0	37.9	38.5	39.9	**38.5 e**
	A.341	**14**	40.3	38.7	41.9	35.9	42.3	**39.8 e**
	A.349	**15**	42.5	44.5	41.6	43.8	44.9	**43.5 c**
	A.367	**16**	42.0	44.3	45.6	43.6	42.1	**43.5 c**
	A.378	**17**	41.9	43.0	44.4	43.2	42.3	**43.0 cd**
	K.1084	**18**	43.1	45.7	48.7	40.9	44.3	**44.5 c**
	K.1133	**19**	45.1	56.7	44.7	36.4	44.3	**45.4 c**
	K.1154	**20**	39.3	46.0	43.3	37.6	43.0	**50.2 ab**
Average of environments			**45,6 A**	**46.9 A**	**46.7 A**	**41.5 B**	**44.7 A**	

The limits of the genotypes and environments, and the distribution of the GGE biplot analysis results are given in Figure 1, which shows that, considering the plant heights, all environments remained in the same row and had similar effects. The genotypes no. 1, 4, 5, 6, 8, 13 and 16 formed the corners of the distribution, while the genotypes no. 9 and 10 were located in the middle of the distribution and therefore, did not show a distinct response.

Figure 2 shows the distribution of the genotypes based on the ideal environment and GGE biplot analysis results. Although Figure 2 shows that the environment no. 3 was closer to the ideal environment, the environments no. 1 and 5 were located close to the environment no. 3. The second and fourth environments were slightly farther from the ideal environment. The genotype no. 4 was closer to the ideal environment, followed by the genotypes no. 2 and 5, while the genotypes no. 13 and 14 were the farthest genotypes from the ideal environment.

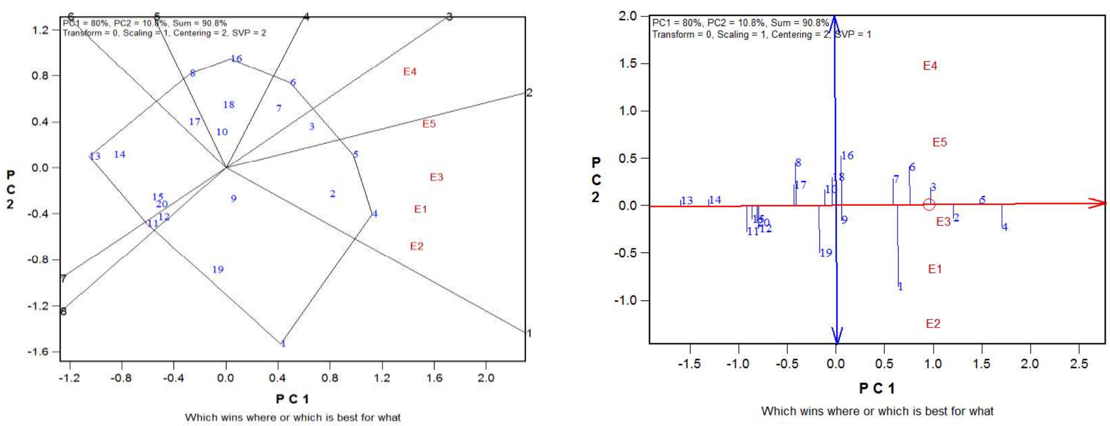

Fig. 1: Borders of genotypes and environments and GGE biplot analysis results

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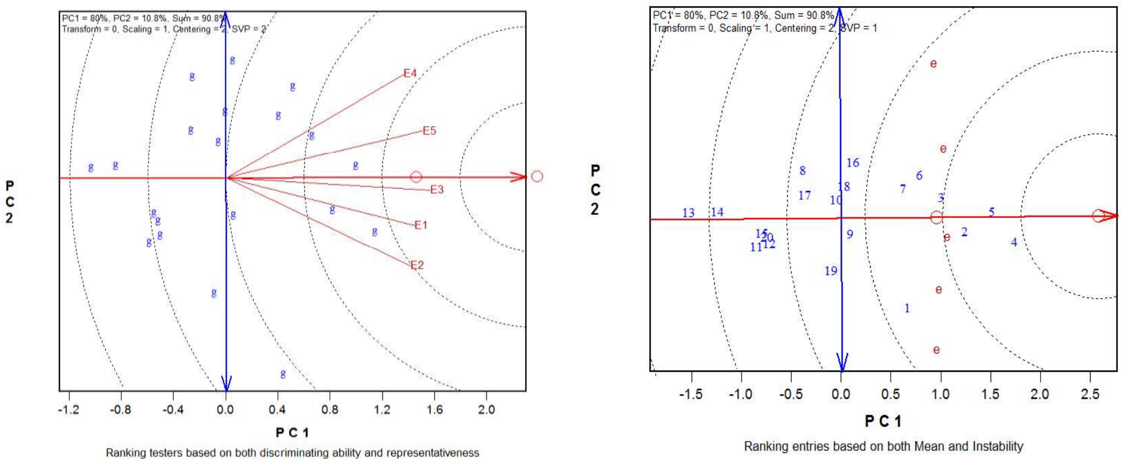

Fig. 2: Distribution of genotypes according to the results of the ideal environment and GGE biplot analysis

Figure 4 shows the first pod heights obtained from the genotypes in different environments and reveals that, with 19.1 cm, the fourth environment had the highest first pod height, followed by the second environment with 17.5 cm. However, the first, third and fifth environments also were statistically in the same group. The lowest first pod height was observed in the fifth environment with 15.5 cm. The genotypes no. 1, 2 and 4 had the highest first pod height and were in the same group, while, with 11.7 cm, the genotype no. 14 had the lowest first pod height. In terms of interaction, with 20.5 cm, the genotype no. 4 had the highest value in the fourth environment, followed by the genotype no. 3 with 19.2 cm, again, in the fourth environment. With 11.6 cm, the lowest value was obtained with the genotype no. 10 in the fourth environment, followed by the genotype no. 14 in the first environment with 11.7 cm. From a general point of view, we can conclude that the genotypes no. 2 and 4 performed better in terms of environment and genotype.

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Table 4: The first pod height (cm) values in different environments

Genotypes	Names of genotypes	Number of genotypes	Environments					Average of genotypes
			E1* (2011)	E2* (2012)	E3* (2013)	E4* (2014)	E5* (2015)	
Varieties	Zulbiye	**1**	16.3	17.5	16.9	19.1	15.5	**16.3 ab**
	Onceler 98	**2**	18.4	15.0	14.5	15.1	13.0	**18.4 a**
	Yunus 90	**3**	15.7	17.7	17.2	**19.2**	15.5	**15.7 b**
	Goynuk 98	**4**	17.7	18.1	17.3	**20.5**	15.1	**17.7 a**
	Noyanbey 98	**5**	15.1	16.3	15.7	14.0	15.0	**15.1 b**
	Sahin 90	**6**	13.7	13.8	15.9	12.0	14.3	**13.7c**
	Akdag	**7**	15.0	14.9	14.3	13.1	13.8	**15.0 bc**
Advanced Lines	A.13	**8**	14.1	11.9	14.5	12.7	13.9	**14.1bc**
	A.14	**9**	14.4	15.0	16.1	13.1	12.9	**14.4 bc**
	A.20	**10**	14.1	13.9	15.7	11.6	13.7	**14.1 bc**
	A.27	**11**	14.3	15.6	14.9	14.6	13.9	**14.3 bc**
	A.40	**12**	14.7	15.5	15.6	15.7	12.5	**14.7 bc**
	A.107	**13**	13.7	14.5	14.3	15.7	10.9	**13.7 c**
	A.341	**14**	11.7	14.1	12.7	12.4	15.3	**11.7 d**
	A.349	**15**	13.3	13.3	12.8	13.0	14.1	**13.3 c**
	A.367	**16**	12.8	13.7	14.5	13.4	13.1	**12.8 cd**
	A.378	**17**	13.2	14.0	14.5	13.8	13.5	**13.2 c**
	K.1084	**18**	13.7	14.7	15.9	18.5	11.7	**13.7 c**
	K.1133	**19**	13.9	15.1	12.6	16.9	15.5	**13.9 c**
	K.1154	**20**	13.0	16.9	14.8	13.0	15.0	**13.0 c**
Average of environments			**16.3 B**	**17.5 AB**	**16.9 B**	**19.1 A**	**15.5 B**	

Figure 3 shows the height limits for the first pod height of the genotypes and environments, and the distribution of the GGE biplot analysis results. Figure 3 shows that, for the first pod height, the environment no. 1, 2, and 4 were aligned in the same row and had similar responses. The environment no. 3 was close to these environments, while the environment no. 5 significantly diverged from the others. The corners of the distribution were formed by the genotypes no. 1, 4, 13, 14, 15, 18 and 19, while the genotypes no. 7 and 11 did not show a distinct response. Figure 4 shows the distribution of the genotypes based on ideal environment and GGE biplot analysis results. Although Figure 4 shows that the environment no. 2 was closer to the ideal environment, the environment no. 1 and 4 were close to the environment no. 2 and therefore, were not too distant from the ideal environment and had a tendency towards the ideal environment. The environment no. 5 was too distant from the ideal environment and clearly showed that it was not

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an ideal environment. In terms of genotypes, the genotype no. 4 was the genotype closest to the ideal environment, closely followed by the genotype no. 3. The genotypes no. 14 and 15 were the farthest genotypes from the ideal environment.

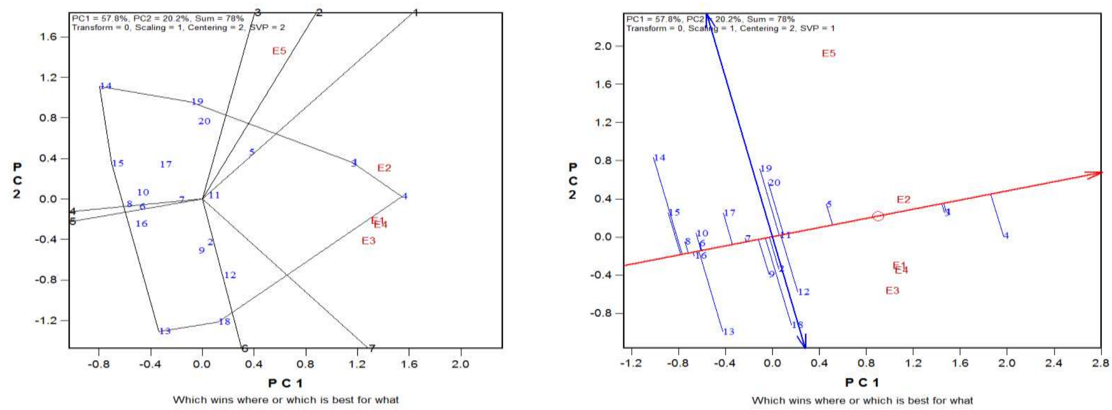

Fig. 3: Borders of genotypes and environments and GGE biplot analysis results

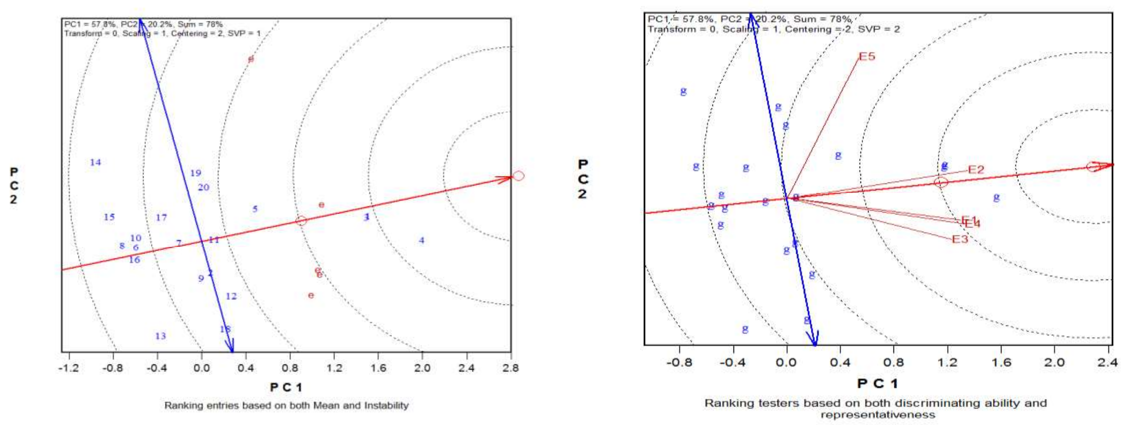

Fig. 4: Distribution of genotypes according to the results ofthe ideal environment and GGE biplot analysis

Table 5 shows the number of pods per plant obtained from the genotypes in different environments. The environments showed significant differences in the number of pods per plant. As can be seen in Table 5, with 38.5 pods, the third environment had the highest pod number, followed by the fifth environment with 37.4 pods. However, the first, second, and fourth environments were statistically in the same group. The environment with the lowest pod number per plant was the second environment with 29.3 pods.

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In terms of genotypes, the highest pod number per plant was obtained in the genotype no. 10 with 40.3 pods, followed by the genotype no. 15 with 35.7 pods. However, they were statistically in different groups. The lowest pod number per plant was obtained from the genotype no. 12 with 13.1 pods, followed by the genotype no. 8 with 18.6 pods. In terms of interaction, the highest value was obtained from the genotype no. 9 in the third environment, followed by the genotype no. 10 in, again, the third environment with 50.4 pods. With 10.1 pods, the lowest value was obtained from the genotype no. 12 in the third environment.

Table 5: The number of pods per plant (unit) values in different environments

Genotypes	Names of genotypes	Number of genotypes	Environments					Average of genotypes
			E1* (2011)	E2* (2012)	E3* (2013)	E4* (2014)	E5* (2015)	
Varieties	Zulbiye	**1**	31.0	29.3	38.5	31.7	34.7	**33.0 b**
	Onceler 98	**2**	39.3	24.6	46.7	30.7	30.8	**34.4 b**
	Yunus 90	**3**	26.0	23.3	28.3	15.3	31.7	**24.9 d**
	Goynuk 98	**4**	23.5	36.7	21.3	29.0	27.5	**27.6 c**
	Noyanbey 98	**5**	29.1	32.6	25.8	37.1	33.0	**31.5 bc**
	Sahin 90	**6**	32.8	22.2	20.3	28.4	28.8	**26.5 c**
	Akdag	**7**	32.5	25.4	23.0	20.7	29.5	**26.2 c**
Advanced Lines	A.13	**8**	17.7	15.5	25.1	19.6	15.2	**18.6 de**
	A.14	**9**	34.4	35.3	**57.5**	24.9	25.6	**35.5 b**
	A.20	**10**	36.7	39.4	**50.4**	38.3	36.6	**40.3 a**
	A.27	**11**	24.4	32.4	35.5	23.5	32.8	**29.7 c**
	A.40	**12**	12.6	16.7	10.1	14.2	12.0	**13.1 f**
	A.107	**13**	35.7	12.5	19.3	12.5	13.3	**18.7 e**
	A.341	**14**	21.1	22.8	27.4	21.9	17.6	**22.2 de**
	A.349	**15**	49.1	42.4	30.0	28.4	28.8	**35.7 b**
	A.367	**16**	36.6	27.2	24.1	26.4	20.9	**27.0 cd**
	A.378	**17**	30.2	19.0	20.7	25.6	25.0	**24.1 d**
	K.1084	**18**	27.3	39.4	30.0	18.0	24.4	**27.8 c**
	K.1133	**19**	28.8	36.6	19.0	19.6	18.9	**24.6 d**
	K.1154	**20**	19.3	23.9	21.7	17.4	20.3	**33.0 b**
Average of environments			**31.0 B**	**29.3 B**	**38.5 A**	**31.7 B**	**34.7 AB**	

Figure 5 shows the number limits of the genotypes and environment and the distribution of GGE biplot analysis results for the pod number per plant. As can be seen in Figure 5, although the second and the fifth environments seem to be relatively farther when compared to other

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environments (the first, third and fourth), all environments were generally aligned in the same row. The corners of the distribution were formed by the genotypes no. 2, 3, 6, 11, 16 and 19. While the genotype no. 8 did not show a distinct response, the genotypes no. 4, 13 and 15 were quite close to the genotype no. 8 and revealed that their characteristics were similar to those of the genotype no. 8. Figure 6 shows the distribution of the genotypes based on ideal environment and GGE biplot analysis results. As can be seen in Figure 6, although the environment no. 3 was closer to the ideal environment, the environment no. 1 and 4 were close to the environment no. 3 and therefore, were not too distant from the ideal environment and had a tendency towards the ideal environment. The environment no. 2 and 5 were distant from the ideal environment. In terms of genotypes, the genotype no. 11 was distinctly separated from the other genotypes and close to the ideal environment. This genotype was followed by the genotypes no. 12 and 20, while the genotypes no. 3 and 6 were the farthest genotypes from the ideal environment.

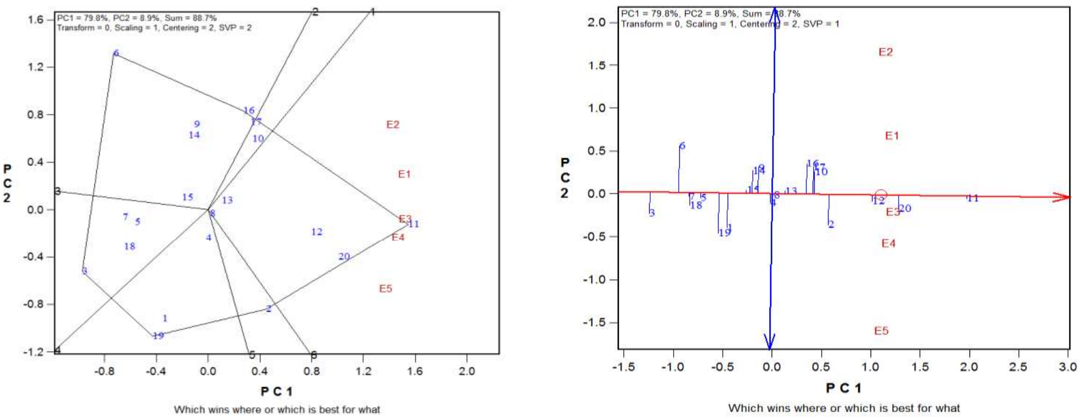

Fig. 5: Borders of genotypes and environments and GGE biplot analysis results

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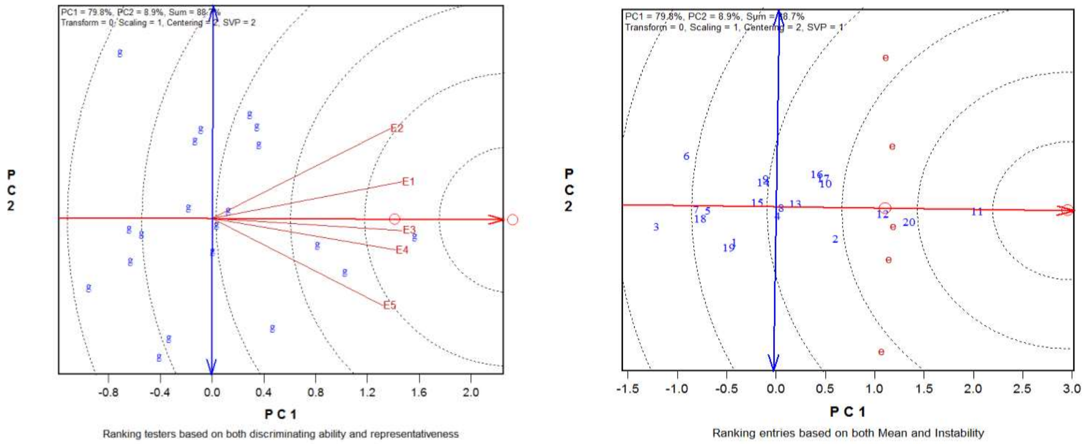

Fig. 6: Distribution of genotypes according to the results of the ideal environment and GGE biplot analysis

The numbers of seeds per pod of the genotypes in different environments are given in Table 6, which shows that the fifth environment had the highest seed number per pod with 4.3 seeds, followed by the first, third and fourth environments with 4.1 seeds. However, all environments were statistically in the same group. The second environment had the lowest seed number per pod with 4 seeds.

In terms of genotypes, the highest seed number per pod was observed in the genotype no. 11 with 5.3 seeds, followed by the genotype no. 12 with 4.8 seeds. The lowest seed number per pod was obtained from the genotype no. 3 with 3.4 seeds, followed by the genotypes no. 6 and 7 with 3.6 seeds. The varieties' general distribution around the middle rows and the fact that most of the varieties remained in the same group are noteworthy. In terms of interaction, with 5.7 seeds, the genotype no. 11 in the fifth environment had the highest value, followed by the same genotype in the third environment.

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Table 6: The number of seeds per pod (unit) values in different environments

Genotypes	Names of genotypes	Number of genotypes	Environments					Average of genotypes
			E1* (2011)	E2* (2012)	E3* (2013)	E4* (2014)	E5* (2015)	
Varieties	Zulbiye	**1**	3,8	3,6	3,7	3,9	4,6	**3,9 c**
	Onceler 98	**2**	4,4	4,0	4,6	4,4	5,1	**4,5 b**
	Yunus 90	**3**	3,2	3,3	3,5	3,3	3,8	**3,4 d**
	Goynuk 98	**4**	4,4	4,1	3,9	4,0	4,7	**4,2 bc**
	Noyanbey 98	**5**	3,4	3,7	3,7	4,0	3,8	**3,7 cd**
	Sahin 90	**6**	3,9	3,9	3,4	3,1	3,6	**3,6 cd**
	Akdag	**7**	3,5	3,6	3,6	3,9	3,6	**3,6 cd**
Advanced Lines	A.13	**8**	4,2	4,1	3,5	4,4	4,5	**4,1 c**
	A.14	**9**	4,0	4,1	4,2	4,2	3,7	**4,0 c**
	A.20	**10**	4,2	4,4	4,4	4,6	4,0	**4,3 bc**
	A.27	**11**	**5,2**	5,0	**5,5**	5,1	**5,7**	**5,3 a**
	A.40	**12**	4,8	4,4	4,9	4,7	5,1	**4,8 b**
	A.107	**13**	4,0	4,2	4,2	4,3	4,4	**4,2 c**
	A.341	**14**	4,2	4,2	3,5	3,9	4,3	**4,0 c**
	A.349	**15**	4,0	3,9	4,0	4,1	4,1	**4,0 c**
	A.367	**16**	4,6	4,3	4,0	4,1	4,4	**4,3 bc**
	A.378	**17**	4,5	4,3	4,4	4,3	4,2	**4,3 bc**
	K.1084	**18**	3,6	3,5	3,6	3,7	3,9	**3,7 cd**
	K.1133	**19**	3,9	3,3	3,7	4,0	4,4	**3,9 c**
	K.1154	**20**	4,8	4,1	4,7	4,9	5,0	**3,9 c**
Average of environments			**4,1 A**	**4,0 A**	**4,1 A**	**4,1 A**	**4,3 A**	

Figure 7 shows the number limits of the genotypes and environments and the distribution of the GGE biplot analysis results for seed number per pod. As can be seen in Figure 7, although the first environment was distant from the other environments, all environments were generally aligned in the same row. The genotypes no. 10, 12, 13, 15 and 17 formed the corners of the distribution. While the genotype no. 6 did not show a distinct response, the genotypes no. 3, 4 and 7 exhibited similar characteristics to those of the genotype no. 6. Figure 8 shows the distribution of the genotypes based on ideal environment and GGE biplot analysis. As can be seen in Figure 8, although the environment no. 3 was closer to the ideal environment, the environment no. 2, 4 and 5 were close to the environment no. 3 and therefore, were not too distant from the ideal environment and had a tendency towards the ideal environment. In terms

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of genotypes, the genotype no. 10 was distinctly separated from the other genotypes and closer to the ideal environment.

This genotype was followed by the genotypes no. 2, 9 and 15, while the genotype no. 12 was the genotype farthest from the ideal environment.

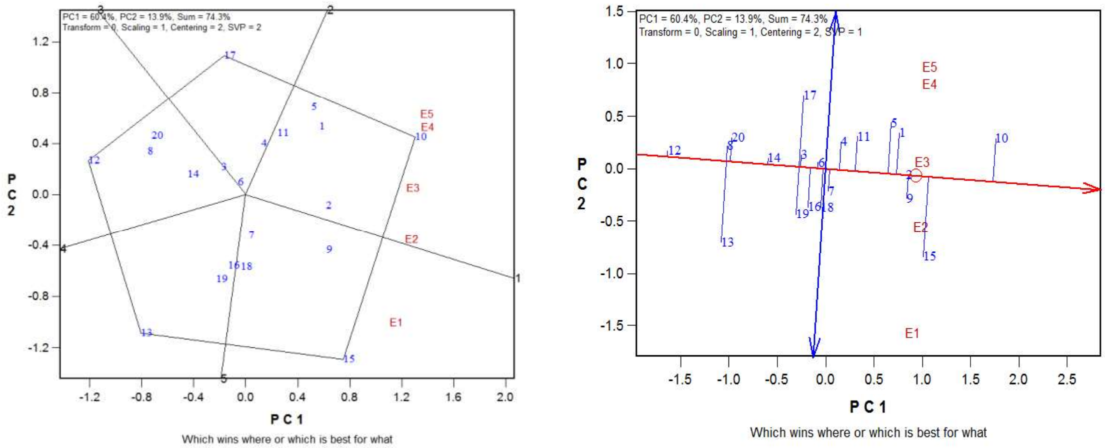

Fig. 7: Borders of genotypes and environments and GGE biplot analysis results

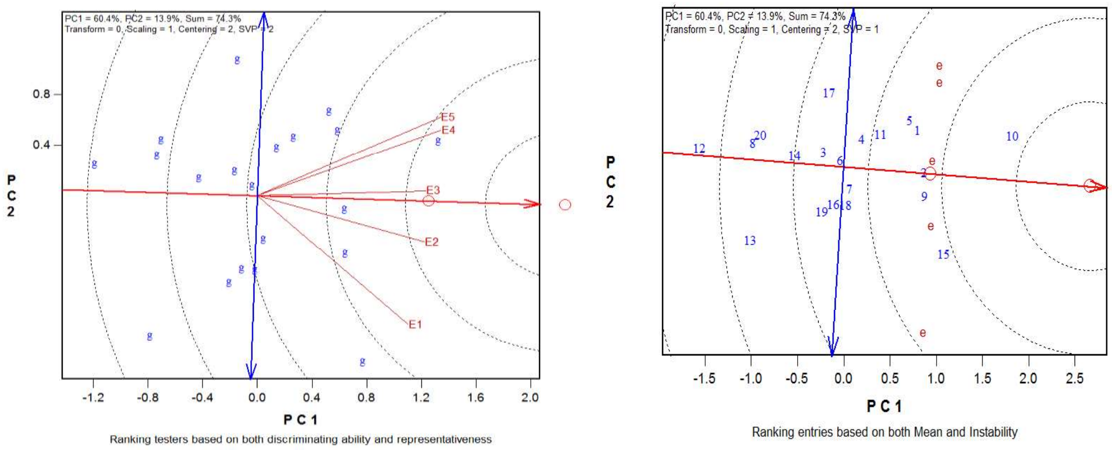

Fig. 8: Distribution of genotypes according to the results of the ideal environment and GGE biplot analysis

CONCLUSION

The study in which 20 dry bean genotypes were evaluated aimed to determine the responses of the dry bean genotypes for five years in four different environments. The results revealed that the environments resulted in differences in characteristics of concern to the dry bean cultivation, except for grain yield per pod. In terms of genotypes, the genotypes no. 2, 4, 5, 11 and 12 were close to the ideal environment, while the genotypes no. 13 and 14 diverged from the ideal environment and did not show the desired response. In terms of environment, the environment (2013 year) no. 3 was determined to be the ideal environment, while the environments no. 1, 2 and 4 were the ideal environments in terms of genotypes.

In conclusion, the genotypes no. 4 (Goynuk 98) and 11 (A.27) were determined to be the best genotypes in terms of yield-affecting components and stability.

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