RESEARCH ARTICLE

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Investigation of yield and yield components in main crop soybean genotypes in Adana conditions

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Abstract

The research was carried out in Adana conditions to determine the relati-onships between seed yield and yield components of some soybean ge-notypes depending on the years. In this research, which was carried out in 2015 and 2016 years, it was established with 5 soybean varieties and one variety candidate and according to Randomized Complete Block De-sign with 4 replications. In the combined analysis of variance, the year*genotype interaction was insignificant in terms of yield and yield components, while other sources of variation (year and genotype) were found to be statistically significant compared to P <0.01. Seed yield showed changed between 5782-6788 kg ha-1 in 2015 and 3597-4359 kg ha-1 in 2016. In the correlation between the examined traits; While there was a significant and positive relationship between seed yield and day to flowering, days to maturity, first pod height and oil rate, there was a significant and negative relationship between 1000 seed weight and the number of pods per plant. The varyans analysis showed that the inter-actions of year, genotype and year*genotype were significant in terms of seed yield and yield components of genotypes. As a result, Cinsoy, variety candidate 1 (Mona) and Blaze of varieties showed high performance in Adana conditions, and it was determined that the effect of the environment was higher than the effect of genotype and interaction in terms of seed yield and other traits. As a result of this study, the variety candidate 1 was registered under the name Mona. In addition, it was concluded that Cinsoy, Blaze and newly registered Mona varieties can be recommended for main crop soybean cultivation in Adana conditions.

Keywords: Soybean, Main product, Seed yield and yield components, Interaction

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INTRODUCTION

Soybean (*Glycine max* L.) is an important industrial plant in terms of oil, protein and carbohydrates. The origin of soy is known as Korea, Japan, China and Far East countries. Soybean has found a wide production area in South American countries, especially Argentina, Brazil and Paraguay, with the expansion of land in parallel with the increase in yield, especially thanks to the technological innovations in recent years (OECD/FAO, 2019). Soybean is one of the plants with the most (61%) production among oilseed plants and is among the 5-6 most important plants in the world in terms of plant food source. (Lopes da Silva et all, 2017). It is the world's leading source of high-quality protein and edible oil for both human food and animal feed. In addition, thanks to the ability of soybean as a legume

plant to benefit from nitrogen in the air, it can increase soil fertility for the plants to be planted after it by adding nitrogen to the soil (Morsy et al., 2015) and it is known to save fertilizer. Therefore, soybean can be described as one of the most suitable plants for crop rotation. One of the biggest reasons for the increase in world consumption of soy is that it is the raw material of many industrial industries and is used in the production of biodiesel (Kinney and Clemente, 2004).

According to SoyStats data, 367.8 million tons of soybean production is made in an area of 136.8 million hectares in the world in 2021. The countries that produce the most soy in the world are Brazil, USA, Argentina, China, India, Paraguay and Canada. Turkey is at the bottom of the world ranking with 182 thousand tons of soybean production in an area of 44 thousand hectares in the 2021 production season. Soybean consumption in Turkey reached 2.9 million tons in 2021. However, only 6% of consumption is met by local production and the remaining part is met by imports, approximately 94% (TUIK, 2022). More importance should be given to soybean studies both in Turkey and in the world, in order to combat the drought that emerged with global warming and to eliminate the vegetable oil deficit, which has increased in importance in the food crisis.

Soybean plant has generally adapted to different climatic regions and can be grown in many parts of Turkey. The provinces with the highest soybean production in Turkey are Adana, Mersin, Kahramanmaraş, Osmaniye, Samsun and Hatay. Approximately 63% of soybean production in Turkey is produced in Adana (TÜİK, 2022). Varieties that adapt more easily to climatic conditions, show high seed yield and oil performance are more preferred by producers. The fact that both yield and other characteristics are affected by different environmental conditions increases the importance of environment genotype interaction. The G x E (Genotype x environment) interaction is defined by the variation in performance of varieties according to changing environmental conditions. However, if this interaction does not change the yield order of genotypes in different environments, there is no problem in terms of cultivar recommendation (Kaya and Atakisi, 2002). The main purpose of yield studies is to predict the performance of the best variety in the future using available data. However, the GE effect is the biggest obstacle in determining the effectiveness of a genotype in different environments and choosing stable genotypes, affecting yield and production (Khomari et al., 2017; Ansarifard et al., 2020). In addition, many different studies are carried out to determine stable varieties in terms of seed yield and to reveal the effect of GE interaction. Whingham and Minor, (1978), Karaslan et al., (1998), Eswari and Rao (2006), Sudaric et al., (2006), Çopur et al., (2009), Karasu et al., (2009), Karaaslan, (2011), Hu and Wiatrak, (2012), Wheeler and Von Braun, (2013), Verma and İzhar (2017), İlker et al., (2018), Cubukcu et al., (2020) reported that genotype, year and year*genotype interactions are important in terms of seed yield in their studies.

The aim of this study is to analyze the effect of year, genotype, year*genotype interaction for yield and yield components obtained from studies conducted in different environmental conditions in main product soybean cultivation, to determine stable varieties and to suggest suitable varieties for the region.

MATERIALS AND METHODS

Materials

The study was carried out with 5 soybean variety and one variety candidate in Adana conditions in 2015-2016. Information on the genotypes used in the study is pre-

Table 1. Some Information About the Varieties

Varietys	Variety Owner Organization	Registration Year	Reclamation place	1000 Seed Weight (g)	Plant Height (cm)	First Pod Height (cm)	Days to maturity	Protein Ratio (%)	Oil Ratio (%)
SA 88	Agrova Agri. Ind. Ltd. Co.	1996	Türkiye	126-177	78-130	9-15	112-143	38	19
Cinsoy	Aegean Agricultural Res. Ins.	2010	Türkiye	137-184	89-117	13-19	126-150	31	21
Ataem 7	West Mediterranean Agricultural Res. Ins.	2006	Türkiye	148-166	108-145	14-27	120-181	32	24
Atakişi	Çukurova Uni. Fac. of Agriculture	2006	Türkiye	142-213	88-124	10-19	84-127	27	23
Vary 1 (Mona)	Polen Seeds Ltd. Co.	2017	Argentina	118-266	99-115	10-16	117-149	39	21
Blaze	May Agro Seeds Inc.	2009	Türkiye	149-212	75-98	11-14	138-156	34	21

Source: *Variety Registration and Seed Certification Center, Ankara,-2022.*

sented in Table 1, information on the location in Table 2, and the climatic data of the location in detail in Table 3. The variety candidate (Candidate 1) used in the study was registered under the name as Mona in 2017.

Table 2. Information about the Location

Location Coordinates			
Location	**Altitude (m)**	**Latitude**	**Longitude**
Adana/Yüregir/ Doğankent	11	36°51'13.31"K	35°20'46.21"D

kage program, and the factors that were found to be important were determined according to their importance levels, and the traits that were found to be important were evaluated and grouped according to the LSD test.

RESULTS AND DISCUSSION

The variance analysis values of the traits examined in the study were given in Table 4; the averages of flowering days and days to maturity and the resulting groups in Table 5, the averages of 1000 seed weight and plant height and the resulting groups in Table 6, the averages of the

Table 3. Climate Data of Locations

	Climate Factors								
Location	**Total Precipitation (mm)**			**Average temperature (°C)**			**Average Humidity (%)**		
Adana/Yüregir/Doğankent	**Years**			**Years**			**Years**		
Months	**2000-2022 (Uzun Yıllar)**	**2015**	**2016**	**2000-2022 (Uzun Yıllar)**	**2015**	**2016**	**2000-2022 (Uzun Yıllar)**	**2015**	**2016**
April	39.9	15.5	5.6	18.2	15.5	19.1	70.3	69.9	64.0
May	43.4	58.9	75.0	22.3	21.0	20.6	65.9	73.7	74.3
June	22.4	25.8	6.2	26.1	24.0	25.8	69.9	77.2	72.8
July	3.2	1.2	0.7	28.9	27.2	27.7	75.3	76.3	77.4
August	3.5	0	4.4	29.5	28.6	28.0	75.0	69.9	77.1
September	23.4	9.3	28.5	26.9	26.8	24.6	71.3	71.8	68.7
October	27.3	56	1.5	22.6	21.8	21.4	65.0	72.9	61.5

Source: *General Directorate of Meteorology-Ankara*

Methods

This study was carried out according to the Randomized Complete Block Design with 4 replications. Trial sowing was done on 28 April 2015 and 01 May 2016. In the trials, planting depth was determined as 3-5 cm, spacing between rows 60 cm, spacing between rows 3-4 cm, plot length 5 m and 4 rows and only the middle 2 rows were harvested in the trials. The seeds used in the trial were 25 cc for 8 kg of seeds. Treated with 1x109 *Bradyrhizobium japonicum* nitrogen bacteria. In the trials, 36 kg ha^{-1} N and 92 kg ha^{-1} P_2O_5 fertilizer were used. During the growing period, 2 hand hoes and 6 irrigations were made, and a total of 700 mm of water need was met with irrigation. The first irrigation was done before flowering, and irrigation was done at 15-20 day intervals during the pod formation and seed filling periods.

In the research; flowering days (days), days to maturity (days), plant height (cm), first pod height (cm), number of pods per plant (plant.$number^{-1}$), 1000 seed weight (g) and oil ratios (%) examines were taken according to the directive of Ankara Variety Registration and Certification Center to measure soybean agricultural values.

Statistical Analysis

The combined variance analysis of the data obtained from the research was made using the JMP Pro 13 pac-

first pod height and the number of pods per plant and the resulting groups Table 7, the averages of seed yield and oil ratio characteristics and the resulting groups in Table 8, and the correlation values of the bilateral relations between the examined properties in Table 9. It was determined that there were statistically significant differences at the level of 1% and 5% between the year, genotype and year*genotype interaction in terms of all the traits examined (Table 1).

Days to maturity (day)

In terms of days to maturity of the genotypes; it was indicated that there were statistically significant differences at the level of 1% between year, genotype and year*genotype interaction (Table 4). Days to maturity varied between 135.7 and 145.7 days depending on the years. A longer day to maturity time was calculated in the first year (2015) in which the study was conducted compared to the second year (2016). It is thought that factors such as precipitation and low temperatures were effective in the longer duration of the days to maturity period in the first year. Days to maturity of the genotypes varied between 130.0 and 147.8 days. Among the longest days to maturity variety candidate (Mona) - the shortest days to maturity was determined in SA 88 variety. In the year*genotype interaction, days to maurity varied between 130 days (SA

Table 4. Variance Analysis Table For The Examined Characteristics

Variation Sources	DF	Seed yield	Flowering days	Days to maturity	Plant Height	First Pod Height	number of pods per plant	1000 seed weight	Oil ratio
Model	17	42737.6	6.62745	242.971	415.856	46.0999	104.678	7323.71	1.05613
Year	1	646607**	16.3333**	1200**	1371.74**	682.521**	387.603*	115591**	7.0227**
Genotype	5	9948.13**	10.5333**	379.483**	1034.2**	13.5448**	78.73	1032.19**	1.56645**
Year* Genotype	5	2043.28	8.53333**	206.15**	83.3988**	4.78483**	166.403*	634.718*	0.48311**
Error 1	6	3329.01	0.16667	0.38889	18.3042	1.58806	27.71	96.2135	0.11396
Error 2	30	969.2	0.23333	0.139	7.557	0.6054	34.852	156.65	0.02749
CV (%)		6.03	1.82	0.26	2.28	6.09	10.55	5.93	0.73

***, p<0.01; *0.01<P<0.05; **:% 1; *:%5 level is statistically significant.DF: degrees of freedom*

88 in 2016, Cinsoy and Ataem 7), and 160 days (Atakisi in 2016) (Table 5). Obtaining the shortest and longest day to maturity time values of the year*genotype interaction from the same year (2016), shows that the physiological death period is mostly under the influence of the genetic characteristics of the genotypes. For this reason, it shows that years are not as effective as genetic characteristics of genotypes on days to maturity.

Flowering days (day)

In terms of the number of flowering days of the genotypes; it was examined that there were statistically significant differences at the level of 1% between year, genotype and year*genotype interaction (Table 4). Flowering days of the genotypes varied between 25.8 days (in 2015) and 27.0 days (in 2015) depending on the years (Table 5). Flowering days of the genotypes varied between 25.4-28.1 days. The longest flowering days was determined in variety candidate 1 (Mona), and the shortest flowering days was determined in Atakisi variety. In the year*genotype interaction, it varied between 24.3 days (Atakisi 2016) and 30.3 days (variety candidate 1 in 2016) (Table 5). The fact that flowering days changes in the same year shows that this feature is affected by the environment but mostly due to the genotype.

Table 5. Means and Groups of Days to Maturity and Flowering Days Characteristics

Genotypes	Days to Maturity (day)			Flowering days (day)		
	2015	2016	Average	2015	2016	Average
SA 88	130.0 g	130.0 g	130.0 D	25.8 d	25.0 e	25.4 E
Cinsoy	145.3 d	130.0 g	137.6 C	26.0 d	26.0 d	26.0 D
Ataem 7	145.3 d	130.0 g	137.6 C	27.3 c	26.0 d	26.6 C
Atakişi	160.0 a	135.0 f	147.5 A	24.3 f	26.0 d	25.1 E
Vary candidate 1 (Mona)	147.5 b	148.0 b	147.8 A	30.3 a	26.0 d	28.1 A
Blaze	146.0 c	141.0 e	143.5 B	28.5 b	26.0 d	27.3 B
Average	145.7 A	135.7B	140.7	27.0 a	25.8 b	26.4
LSD 0.05 Year		0.44			0.28	
LSDF 0.05 Genotype		0.38			0.49	
LSD 0.05 Year* Genotype		0.53			0.69	

1000 Seed weight (g)

In terms of 1000 seed weight (g) of genotypes; it was examined that there were statistically significant differences at the level of 1% between year and genotypes, and at the level of 5% on interaction (Table 4). The 1000 seed weight varied between 162.0 and 260.1 over the years. Genotypes varied between 195.5 and 221.4 g Maximum 1000 seed weight was taken from Ataem 7 variety, at least from SA 88 variety. In the year*genotype interaction, 1000 seed weight; it has been examined that it varies between 144.5 g (SA 88 in 2015) and 277.6 g (Ataem 7 in 2016). Blaze, Candidate 1, Ataem 7 and Cinsoy genotypes had the highest values in terms of 1000 see weight in 2016. The fact that 1000 seed weights are in different years indicates that this characteristic is mostly caused by the environment (Table 6).

Plant height (cm)

In terms of plant height of genotypes; it was examined that there were statistically significant differences at the level of 1% between year, genotype and year*genotype interaction (Table 4). Depending on the years, the plant height varied between 115.2 and 125.9. Plant heights of genotypes; It varied between 106.1-135.0 cm (Table 6). In the year*genotype interaction, the plant height was 102.1 cm (Candidate 1) in 2016 and 140.0 cm in 2015. The change in all genotypes on the basis of years shows that the effect of the environment is very dominant.

First pod height (cm)

Table 6. Averages and Groups of 1000 Seed Weight and Plant Height Characteristics

Genotypes	1000 Seed Weight (g)			Plant Height (cm)		
	2015	2016	Average	2015	2016	Average
SA 88	144.5 d	246.0 b	195.2 B	127.5 c	116.4 f	122.0 B
Cinsoy	161.0 cd	272.6 a	216.8 A	120.0 ef	111.9 g	116.0 C
Ataem 7	165.3 c	277.6 a	221.4 A	135.8 b	134.2b	135.0 A
Atakişi	166.0 c	229.7 b	197.8 B	140.0 a	124.4 cd	132.2 A
Vary candidate 1 (Mona)	166.8 c	266.6 a	216.7 A	122.0 de	102.1 h	112.0 D
Blaze	168.0 c	268.0 a	218.0 A	110.0 g	102.3 h	106.1 E
Average	162.0 b	260.1 a	211.1	125.9 a	115.2 b	120.6
LSD 0.05 Year		6.92			3.02	
LSDF 0.05 Genotype		12.78			2.8	
LSD 0.05 Year* Genotype					3.96	

In terms of first pod height of genotypes; it was examined that there were statistically significant differences at the level of 1% between year, genotype and year*genotype interaction (Table 4). Depending on the years, the height of the first pod varied between 9.0-16.5. First pod height of genotypes; it varied between 11.0 – 15.0 cm. In terms of first pod height of genotypes, the first pod height was taken from the shortest variety SA 88 and the longest from Atakisi variety. In the year*genotype interaction, it was taken from SA 88 cultivar with 6.5 cm and Atakisi variety with 20.0 cm in 2016. (Table 7). The examined change in all genotypes in 2015 and 2016 shows that this trait is more affected by the environmental conditions.

Seed yield (kg ha^{-1})

In terms of seed yield of genotypes; It was found to be statistically significant at the 1% level between years and genotypes and insignificant in terms of year*genotype interaction, however, it varied between 48.0 (variety candidate 1 in 2015) and 67.7 (Cinsoy in 2015). Number of pods per plant in genotypes; varied between 48.0 plant number^{-1} variety candidate 1 in 2015 and Cinsoy in the same group) and 67.7 plant number^{-1} (Cinsoy in 2016) (Table 7). Examine of changes on the basis of years in all genotypes shows that this trait is more affected by the environment.

Table 7. Averages and Groups of The First Pod Height and the Number of Pods Per Plant

Genotypes	First Pod Height (cm)			Number of Pods per Plant (number)		
	2015	2016	Average	2015	2016	Average
SA 88	15.3 b	6.5 d	11.0 C	56.1 b-e	63.5 ab	59.9 A
Cinsoy	16.0 b	9.1 c	12.5 B	48.5 e	67.7 a	58.1 A
Ataem 7	16.0 b	9.2 c	12.6 B	55.8 b-e	52.9 de	57.2 A
Atakişi	20.0 a	9.9 c	15.0 A	52.0 de	62.5 a-c	55.0 AB
Vary candidate 1 (Mona)	16.0 b	9.6 c	12.8 B	48.0 e	54.1 c-e	54.3 AB
Blaze	16.0 b	9.9 c	13.0 B	58 b-d	52.1 de	51.0 B
Average	16.5 a	9.0 b	12.8	53.1 b	58.8 a	56.0
LSD 0.05 Year		0.89			3.71	
LSDF 0.05 Genotype		0.79				
LSD 0.05 Year* Genotype		1.12			8.52	

Number of pods per plant (plant number $^{-1}$)

In terms of the number of pods per plant of genotypes; was examined that there were statistically significant differences at the level of 5% in terms of year and year*genotype interaction, and it was statistically insignificant between genotypes (Table 4). Depending on the years, the number of pods per plant varied between 53.01 and 58.8. The maximum number of pods per plant was obtained in 2016. It varied between 51.0 and 59.9. The lowest number of pods per plant was taken from Blaze variety and the highest from SA 88 variety. In the year*genotype interaction (Table 4). Depending on the years yield (kg ha^{-1}) varied between 3994-6316 kg ha^{-1}. It is thought that the total precipitation in the first development period of the plant was higher in 2015 than in 2016. Seed yields of the genotypes varied between 4781 kg ha^{-1} (Atakisi) and 5460 kg ha^{-1} (Blaze). In the year*genotype interaction, it varied between 3597 kg ha^{-1} and 6788 kg ha^{-1}. In terms of seed yield, Cinsoy, variety candidate 1 and Blaze genotypes had the highest values in 2015, while Ataem 7 and Atakisi genotypes formed the lowest seed yield group in 2016 (Table 8). While all genotypes gave the highest seed

yield in 2015, the lowest seed yield was obtained in 2016. This situation strengthens the opinion that the effects of environmental changes over the years on genotypes are very strong.

Oil ratio (%)

In terms of oil ratio of genotypes; year was found to be statistically significant at the 1% level between genotype and year*genotype interaction (Table 4). Depending on the years, oil ratio (%) varied between 22.3-23.0. Oil ratios of the genotypes ranged from 22.1 to 23.3. In terms of oil ratio of genotypes, the lowest oil ratio was taken from Atakisi variety, and the highest oil ratio was taken from variety candidate 1 genotype. In the year*genotype interaction, it varied between 22.0 (SA 88 in 2016, Ataem 7, Atakisi) to 24.0% (variety candidate 1 in 2015). While the highest value in terms of oil ratio was obtained from variety candidate 1 in 2015, the lowest oil ratios were obtained from SA 88, Ataem 7 and Atakisi genotypes in the same group in 2016 (Table 8).

According to the analysis from Table 9, yield and flowering days (r=0.4889**), days to maturity (r=0.5393**), first pod height (r=0.822**) and oil ratio (r=0.7114**) statistically significant and positive correlation at the level of 1%; It was determined that there was a statistically significant and negative relationship at the level of 1% between 1000 seed weight (r=-0.8592**) and 5% between the number of pods per plant (r=-0.4102*).

It was examined that there was a significant and positive relationship at the 1% level between the number of flowering days and the oil ratio (r=0.703**).

While there was a significant and positive correlation at the 1% level between days to maturity and the height of the first pod (r=0.701**); it was examined that there was a 5% and negative correlation between the number of pods per plant (r=-0.4479*) and 1000 seed weight (r=-0.4414*).

While there is a significant and positive relationship at the level of 1% between plant height and first pod height (0.4739**); It was determined that 1000 seed weight (r=-0.439*) had a negative relationship at the level of 5%.

While there was a significant and negative relationship at the 5% level between the height of the first pod and the number of pods per plant (r=-0.427*), there was a significant and positive relationship between the oil ratio (r=0.4618**) at the 1% level.

It was examined that there was a significant and positive correlation at the 1% level between the number of pods per plant and 1000 seed weight (r=0.3043**).

It was determined that there was a significant and negative relationship at the 1% level between 1000 seed weight and oil ratio (r=-0.5506**).

While the total precipitation (15.5-58.9-25.8) in April, May and June in Adana conditions in 2015 is close to the long-term average (39.9-43.4-22.4); however, total precipitation in April, May and June in 2016 (5.6-75.0-6.2) remained below the long-term average (Table 3). Therefore, while the average seed yield of the variyeties was 6316 kg ha^{-1} in 2015, the average of the varieties remained at 3994 kg ha^{-1} in 2016. In terms of seed yields; In 2015 and 2016, the most negative change occurred in Ataem 7 cultivars, while the least change occurred in SA 88 and Blaze cultivars. This situation strengthened the judgment that the performance of varieties is mostly affected by the environment. Many researchers have also state that seed yield is most affected by the environment. Many researchers, in their studies in different genotypes and locations, Çalışkan and Arıoğlu (2004) 2410-2628 kg ha^{-1}, Arıoğlu et al., (2012) 2752-3674 kg ha^{-1}, Arıoğlu et al., (2015) seed yields vary between 4288-5377 kg ha^{-1} and Ozkan et al., (2019) 1330-4010 kg ha^{-1} and Ahmadi and Arien (2022) 1046-1212 kg ha^{-1} and they reported that the seed yield was more affected by the environment and agricultural practices. Mebrahtu and Elmi (1997), Carvalho et al. (2002), Hossain et al. (2003), Oliveira et al. (2012), El-Refaey et al. (2013), and Morsy et al. (2015) reported that some varieties have high yields in suitable environments, while others are adapted to bad environments. In addition, Yothasiri and Somwang (2000), Primomo et al.,

Table 8. Averages and Groups of Seed Yield and Oil Ratio Characteristics

Genotypes	Seed Yield (kg ha^{-1})			Oil Ratio (%)		
	2015	2016	Average	2015	2016	Average
SA 88	5782 c	3847 ed	4814 B	23.2 b	22.0 e	22.6 C
Cinsoy	6788 a	4317 d	5552 A	23.1 b	22.7 c	22.9 B
Ataem 7	6245 b	3597 f	4921 B	22.6 c	22.0 e	22.3 D
Atakişi	5785 c	3778 ef	4781 B	22.1 e	22.0 e	22.1 E
Vary candidate 1 (Mona)	6735 a	4069 de	5402 A	24.0 a	22.6 cd	23.3 A
Blaze	6559 a	4359 d	5460 A	23.1 b	22.4 d	22.7 C
Average	6316 a	3994 b	5155	23.0 a	22.3 b	22.7
LSD 0.05 Year		40.75			0.23	
LSDF 0.05 Genotype		31.79			0.16	
LSD 0.05 Year* Genotype					0.23	

Table 9. Correlation Values of the Bilateral Relations Between the Examined Traits

Examined Characteristics	Seed Yield	Flowering days	Days to maturity	Plant Height	First Pod Height	Number of Pods per Plant	1000 Seed Weight
Seed Yield							
Flowering days	0.4889**						
Days to maturity	0.5393**	0.1602					
Plant Height	0.2102	-0.1415	0.1101				
First Pod Height	0.822**	0.244	0.701**	0.4739**			
Number of Pods per Plant	-0.4102*	-0.2121	-0.4479*	-0.1241	-0.427*		
1000 Seed Weight	-0.8592**	-0.2964	-0.4414*	-0.439*	-0.8502	0.3043**	
Oil Ratio	0.7114**	0.703**	0.2016	-0.1271	0.4618**	-0.2735	-0.5506**

*** % 1; *:%5 level is statistically significant.*

(2002) and Olievira et al. (2012) reported that genotypes with higher stability or good adaptability in a wide range of environments for seed yield. Sudaric et al., (2006), in their study on soybean, reported that the interaction of environment, genotype, and GE is important in terms of seed yield. In many studies, it has been reported that adverse environmental conditions have a negative effect on the growth and seed yield of soybean plants (Whingham ve Minor, 1978; Hu ve Wiatrak, 2012; Wheeler ve Von Braun, 2013). Çubukçu et al., 2020, determined that the GE interaction was statistically significant ($P<0.01$) in terms of seed yield. Karasu et al., (2009) reported that genotype, year, location effects and genotypexyr x location interactions are important. While the data obtained in this study were in agreement with some studies, some were different. The main reasons for these differences are thought to be due to different location, climate and soil characteristics or differences in the genetic structures of the cultivars used.

Yield components affecting seed yield in soybean have a strong positive relationship with flowering days, days to maturity and first pod height. Aremu and Ojo (2005), in their study in different environments, reported that the year*genotype interaction is important for days to maturity and the number of pods per plant.

In the studies of environment*genotype interaction in soybean cultivation, varieties that adapt more easily to climatic conditions and show higher seed and oil yield performance are more preferred by producers in different regions. For this reason, it is extremely important that the seed yield of the desired genotypes does not fluctuate much under different environmental conditions. However, if this interaction does not change the yield order of the genotypes in different environments, there is no problem in terms of cultivar proposal (Kaya and Atakisi, 2002).

In terms of the characters examined in the study; yield, flowering days, days to maturity, plant height, first pod height, 1000 seed weight and oil ratios were found to be statistically significant at the 1% level between year and genotype. In the relations between the examined characters; It was concluded that the yield was significant and positive at the level of 1% between the number of days of flowering, days to maturity and the height of the first pod.

CONCLUSION

In this study; It was conducted in 2015 and 2016 to test the performance of 5 varieties and one variety candidate (Mona) in main product soybean cultivation in Adana conditions in terms of yield and yield components. According to the results of the analysis, SA 88, Cinsoy, Atakisi and Blaze varieties, which did not show much change depending on the years in terms of yield and yield elements, came to the fore. However, the best results in terms of seed yield and yield components were obtained from Cinsoy, Candidate 1 (Mona) and Blaze varieties. As a result, year, genotype and year*genotype interactions were examined in terms of yield and yield elements of the main crop soybean cultivars and it was concluded that Cinsoy, Candidate 1 (Mona) and Blaze cultivars showed high performance in Adana conditions and the effect of the environment was higher than the genotype effect. In line with the data obtained as a result of this study, the variety candidate 1 was registered with the name Mona with its high performance. In addition, it was concluded that Cinsoy, Mona and Blaze varieties can be recommended for the main product soybean cultivation in Adana conditions.

COMPLIANCE WITH ETHICAL STANDARDS

Conflict of interest

The authors declared that for this research article, they have no actual, potential or perceived conflict of interest.

Author contribution

The contribution of the authors to the present study is equal. All the authors read and approved the final manuscript. All the authors verify that the Text, Figures, and Tables are original and that they have not been published before.

Ethical approval

Ethics committee approval is not required.

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Data availability

Not applicable.

Consent for publication

Not applicable.

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