

Performance of some Soybean [*Glycine max* (L.) Merr.] Genotypes Double Cropped in Semi-Arid Conditions

Osman ÇOPUR¹⁾, Mehmet Atilla GÜR¹⁾, Ufuk DEMİREL¹⁾, Mehmet KARAKUŞ²⁾

¹⁾Harran University, Faculty of Agriculture, Department of Crop Science, 63040 Şanlıurfa, Turkey; ocopur@harran.edu.tr

²⁾GAP Soil Water Resources and Agricultural Research Institute, 63040, Şanlıurfa, Turkey; karakusm27@hotmail.com

Abstract

The research was performed to determine suitable soybean [*Glycine max* (L.) Merr.] genotypes with high seed yield grown at double cropped in semi arid conditions. Seed yield and yield components were investigated in 25 soybean genotypes obtained from Karadeniz and Çukurova Research Institute in Turkey. In 2003 and 2004, experiments were carried out at the Harran University, Faculty of Agriculture research and application farm land in Şanlıurfa Turkey. According to the combined analysis of two years, seed yield was ranged from 2482 kg ha⁻¹ to 3945 kg ha⁻¹. Of the 25 genotypes, Irogious, Alhow and Macon were determined to be adaptable to semi arid conditions and yielding the highest. Significant and positive correlations between seed yield and number of pod per plant, number of fruit branch per plant and 1000 seed weight were also determined in this research.

Keywords: soybean, [*Glycine max* (L.) Merr.], seed yield, yield components, correlations

Introduction

Soybean [*Glycine max* (L.) Merr.] belonging to Leguminosae family is considered to be a miracle crop due to its extraordinary qualities (Arshad *et al.*, 2006). In Turkey, it is one of the most important oilseed crops that can be successfully grown as main and double cropped. It contains 40 to 42 % crude protein and 18 to 22% oil comprising 85% unsaturated fatty acid and is free from cholesterol along with plenty of mineral elements, so it is highly desirable in human diet. Soybean oil cake is used as feed for poultry and dairy/beef animals. Leguminosae family also fix the atmospheric nitrogen into available form.

In Turkey, despite the work started with soybean in 1975, it did not expand much because of the problems like agricultural factors, cultivation techniques, varieties and products pattern, etc. Thus, the planting area and production fall down to 8700 ha and 31.000 tonnes in 2008, respectively (Anonymous, 2009). The amount of imported soybean in Turkey was 1.239.000 tonnes in 2008. In our country, the amount of production is well below the amount of consumption. With the completion of the SAP (Southeast Anatolian Project), 1.7 million ha area will be opened to irrigation and this project is estimated to increase soybean planting area.

Since Şanlıurfa-Harran Plain conditions are suitable for the climate, (soybean having high yield potential especially in the second crop), this is one of the alternatives to meet our country's need for oil production. However, high air temperature coinciding with soybean's bloom period in the

region, can cause flower shedding and decreasing yield. Therefore, second crop of soybean farming will eliminate this adverse situation.

For an economic soybean farming, besides cultural processes, the selection of appropriate varieties is also important. Many breeding methods are used for variety selection or development of varieties. One of these is introduction and adaptation work. Basis of these, the recognition of the plant characteristics of varieties and yield potential must be determined. Thus, the preliminary information will be available about the types and varieties and recommended to field trials to register (Çopur ve Oğlakçı, 1997).

It was reported that soybean seed yields were ranged from 2500 kg ha⁻¹ to 3200 kg ha⁻¹ in case of growing soybean as a double cropping (İşler *et al.*, 1995; Tanrıverdi *et al.*, 2000 and Yılmaz *et al.*, 2005). According to many researches carried out regarding soybean in Southeast of Turkey, they were reported that pod number ranged between 58.4-110.8 per plant, seed number between 1.9-2.7 per pod and 1000 seed weight between 134.20-210.47 g (İşler *et al.*, 1995; Tanrıverdi *et al.*, 2000 and Yılmaz *et al.*, 2005). Yang and Wang (2000) and Karasu *et al.* (2001) were stated that plant height ranged between 66.22-136.1 cm, first pod height between 6.2-23.7 cm and fruit branch number between 2.18-3.72 per plant. Besides this, İşler and Çalışkan (1998) were found positive and significant correlation between seed yield and plant height and seed yield per plant and negative and significant correlation between seed yield and harvest index. Tayyar and Gül (2006) reported that positive and significant correlations were observed be-

tween seed yield and plant height, between plant height and first pod height and pod number per plant. Arshad *et al.* (2006) reported that positive and significant correlation between seed weight and unfilled, filled and total pods and seed yield had positive and significant correlation with fruit branches, total pods and 100 seed weight. Moreover, seed yield had significant but negative correlation with days to maturate being also negatively correlated with un-filled pods (Arshad *et al.*, 2006.) Number of pod per plant was the most effective character regarding the seed yield (Haliloğlu *et al.*, 2005). During selection of high seed yielding genotypes for soybean, genotypes with high first pod height, plant height and fruiting branches per plant should be selected (Malik *et al.*, 2007).

The aim of this research was to determine high seed yielded soybean genotypes at double cropped and the correlations between seed yield and seed yield components were examined at the Southeast of Turkey.

Materials and methods

25 genotypes (Macon, SXW 7, Ataem 29, LN 89-3264, SA 88, AXW 3, Türksöy, Ata 84, Ataem 7, Ata 83, Maverick, Omaha, A-3935, Mitchell, Ataem 6, LG 91-7350, Amsoy 71, Cisne, Nazlıcan, KS 4694, Alhow, Apollo, Stresland, SXW 3 and Irogious) obtained from Karadeniz and Çukurova Research Institute in Turkey were used in this research. Genotypes have been tested at University of Harran, Faculty of Agriculture research and at application farm land in Şanlıurfa Turkey during growing season of 2003 and 2004. The experimental field is located in Harran Plain (altitude: 465; 37°08' North and 38°46' East), near the Syrian border. The research area has clay type soil (32%) with mass based field capacity, permanent wilting point and bulk density values of 22% and 1.41 g cm⁻³, respectively; those values were typical for the study area. The soil was classified as İkizce soil series (Veric Calciorthid Aridisol) (Anonymous, 2003). The climate

conditions vary from arid to semi arid. According to the long term average from 7 decades of records, the yearly total precipitation reach 450 mm, the mean temperature is 18.1 °C and the relative humidity 50%. Some climatic data of growing seasons in 2003 and 2004 years are presented in Tab. 1.

During the growing seasons of 2003 and 2004, field evaluation of the 25 soybean genotypes were conducted by randomized complete blocks design (RCBD) with three replication. Each genotype was sown in four row plots with 6 m long with 70 cm inter-row spacing and intra-rows spaces of 4-5 cm. Sowing was carried out on June, 21 for the first year and June, 22 for the second year. Additionally, 70 kg ha⁻¹ pure N and P were applied to treatment plots at sowing and 50 kg ha⁻¹ of N (ammonium nitrate: %33) with the second irrigation (when plants height is about 20-25 cm). Plots were hoed two times by hand and two times by tractors. All plants were grown under irrigation conditions. In both years, seed germination and plant emergence were aided by light sprinkler irrigation. Furrow irrigation was applied to plots throughout the growing period when necessary. Harvesting was done by hand on October 10, for the first year and on October 12, for the second year. Before harvesting, 0.5 m was left in each plot's top and bottom and one row was left as side effect from each side of every plot.

In the research, agronomical traits were measured considering the methods used in INTSIOY (Jackops ve ark., 1983). Pod Number (PN: number per plant), Plant Height (PH: cm), Fruit Branch (FB: number per plant), Seed Number (SN: number per pod) and First Pod Height (FPH: number per plant) were measured on 20 plants randomly selected from the mid-row of each plot. After harvesting, 1000 SW (1000 SW: g) was determined using 0.01 g sensitive balance. Hundred seeds were counted and repeated four times at each plot and average seed weight was multiplied by 10 to obtain 1000 SW. Seed yield (SY: kg ha⁻¹) was calculated by adding the seed from 20 plants

Tab. 1. Climatic data of the study area during soybean crop growing season of 2003 and 2004

	June	July	August	September	October
	2003				
Min. air temperature (°C)	21.4	25.8	26.0	20.2	16.0
Max. air temperature (°C)	35.5	39.7	40.3	34.0	28.4
Average air temperature (°C)	28.6	32.5	32.7	26.4	21.5
Relative humidity (%)	35.1	28.5	32.2	42.4	51.5
Wind Speed (ms ⁻¹)	2.6	2.9	2.3	2.5	1.8
Solar radiation (cal cm ⁻²)	623.7	636.8	545.5	470.3	332.8
	2004				
Min. air temperature (°C)	21.8	25.6	23.6	20.7	16.5
Max. air temperature (°C)	35.7	39.7	38.1	35.3	28.7
Average air temperature (°C)	29.0	32.8	30.8	27.3	21.7
Relative humidity (%)	35.5	27.0	40.7	34.8	48.7
Wind Speed (ms ⁻¹)	3.0	2.5	2.5	2.0	1.7
Solar radiation (cal cm ⁻²)	642.0	621.5	561.9	463.9	314.9

to the seeds from each plot after harvesting collectively the 7.00 m² area. For the seed yield, all weights were done at 13% seed moisture. The oil content (OC) of the seeds was determined by a Soxhlet extraction method (IUPAC 1987). The protein content (PC) of soybean samples was determined according to the Kjeldahl procedure (Anonymous, 1984).

MSTATC statically program was used for statistical analyses (Michigan State University, East Lansing, MI) for combining the experimental years. Means were separated using Fisher's protected least significant differences (LSD) test. Correlation was calculated by using TARIST (Açıkgöz et al., 1994) statistic program.

Results and discussion

According to the two years' results, for all traits (excepting the seed number per pod for 2003 and the first

pod height for 2004) were found statistically significant differences.

Means values of 2003, 2004 and combined years about seed yield, number of fruit branch per plant and seed number per pod obtained from some soybean genotypes are presented in Tab. 2.

Seed Yield (SY): According to Tab. 2, seed yield (SY) values were ranged between 2471.6 - 4053.7 kg ha⁻¹, 2340.0- 3836.6 kg ha⁻¹, in 2003 and 2004, respectively and combined values of two years were also changed between 2482.5-3945.2 kg ha⁻¹. Seed yield showed differences among the soybean genotypes and years and it was lower in 2004. Some of the reasons were the climatic and soil conditions changing year by year. According to results, Irogious Macon and Alhow have higher seed yield than other genotypes. These three soybean genotypes can be recommend for farmers.

Tab. 2. Mean values of SY (kg ha⁻¹), FB (number per plant) and SN (number per pod) in some soybean [*Glycine max* (L.) Merr.] genotypes in 2003 and 2004 years

Cultivars	SY (kg ha ⁻¹)			FB (number per plant)			SN (number per pod)		
	2003	2004	CY	2003	2004	CY	2003	2004	CY
Irogious	4053.7	3836.6	3945.2	3.17	2.50	2.83	2.33	2.50	2.42
Macon	3513.8	3317.7	3415.7	3.20	1.97	2.58	2.50	2.40	2.45
SXW 7	3167.7	3241.3	3204.5	2.57	1.87	2.22	2.80	2.70	2.75
Ataem 29	2994.8	2749.0	2871.9	1.60	1.53	1.57	2.80	2.57	2.68
LN89-3264	3509.0	3286.7	3397.8	3.43	2.87	3.15	2.60	2.57	2.58
SA 88	2777.0	2340.0	2558.5	3.30	2.10	2.70	2.50	2.73	2.62
AXW 3	2856.7	2662.5	2759.6	2.30	2.07	2.18	2.53	2.70	2.62
TÜRKSOY	2590.7	2605.7	2598.2	2.57	1.77	2.17	2.53	2.43	2.48
ATA 84	2471.6	2575.2	2523.4	2.03	2.13	2.08	2.43	2.73	2.58
Araem 7	2963.5	2653.3	2808.4	1.73	1.53	1.63	2.43	2.67	2.55
ATA 83	2953.7	2833.3	2893.7	2.43	1.70	2.07	2.80	2.37	2.58
Mavercik	2853.6	2916.7	2885.2	1.80	1.43	1.62	2.40	2.40	2.40
Omaha	3193.0	3096.3	3144.7	2.07	1.83	1.95	2.30	2.60	2.45
A-3935	2520.7	2643.4	2582.1	2.53	1.77	2.15	2.43	2.57	2.50
Mitchell	2666.3	2652.0	2659.2	2.33	1.97	2.15	2.67	2.37	2.52
Araem 6	2708.7	2733.3	2721.1	1.43	1.50	1.47	2.47	2.63	2.55
LG91-7350	3346.7	3136.0	3241.3	2.33	2.10	2.22	2.63	2.67	2.65
Amsoy 71	3019.3	3113.7	3066.5	2.80	1.67	2.23	2.73	2.80	2.77
Cisne	3065.6	3139.3	3102.5	2.30	1.97	2.13	2.67	2.67	2.67
Nazlıcan	2868.7	2609.3	2739.0	3.03	2.17	2.60	2.67	2.53	2.69
KS 4694	2856.4	2580.7	2718.5	1.70	1.87	1.78	2.33	2.50	2.42
Alhow	3449.0	3454.7	3451.8	2.03	1.73	1.88	2.43	2.40	2.42
Apollo	2495.0	2470.0	2482.5	2.90	2.40	2.65	2.50	2.67	2.58
Stresland	3250.2	3251.0	3250.6	2.20	1.80	2.00	2.57	2.53	2.55
SXW 3	2953.0	2948.7	2950.9	3.30	2.50	2.90	2.63	2.50	2.57
Grand Mean	3003.9	2912.9	2958.4	2.44	1.95	2.20	2.55	2.57	2.56
LSD 5%	202.1	287.7	173.6	0.53	0.62	0.40	ns	0.26	0.21
CV (%)	4.10	6.01	5.12	13.22	19.38	16.0	8.14	6.21	7.23

CY: Combined Year; SY: Seed Yield (kg ha⁻¹); FB: Fruit Branch (number per plant); SN: Seed Number (number per pod); ns: no significant

Fruit Brach Number per Plant (FB): FB values ranged between 1.43- 3.43 in 2003 and 1.43- 2.87 in 2004 number per plant. Combined values of two years were ranged between 1.47- 3.15 number per plant (Tab. 2). FB values of soybean genotypes in 2003 were higher than in 2004. Furthermore, FB was positively and significant ($r=+0.232^{**}$) correlated with SY and pod number per plant ($r=+0.296^{**}$) (Tab. 5). This situation explains the fact that FB is important for SY. LN89-3264, SXW 3 and Irogious can be used as parent in breeding for higher fruit branch number per plant.

Seed Number per Pod (SN): SN values ranged between 2.33-2.80, 2.37-2.80, and 2.40-2.75 in 2003, 2004 and combined years, respectively (Tab. 2). SN per pod showed that there were no differences among the genotypes in 2003 but, there were differences in 2004 and combined year analysis. The highest SN per pod was obtained from SXW 7 and Atame 29 in 2003 and Amsoy 71 in 2004.

One of the reasons was that the climate and soil condition were not similar in both years. In addition, there were no positive and significant relationships between SN and SW, FPH, OC, PC in this research. These results are in agreement with the study carried out by Karasu *et al.* (2001) and Yılmaz *et al.* (2005).

Mean values and groups of 2003, 2004 and combined years about 1000 seed weight, number per pod and plant height obtained from some soybean genotypes are given in Tab. 3.

1000 Seed Weight (SW): As seen in Tab. 3, 1000 SW values ranged between 136.5- 186.9, 133.8-173.6, 135.2- 180 g in 2003, 2004 and combined years, respectively. 1000 SW showed that there were differences among the genotypes in 2003, 2004 and combined years. The highest 1000 SW was obtained from ATA-83 followed by Cisne and Irogious in 2003 and 2004. Differences observed for 1000 SW among the soybean varieties were probably

Tab. 3. Mean values of 1000 SW (g), PN (number per plant) and PH (cm) in some soybean [*Glycine max* (L.) Merr.] genotypes in 2003 and 2004 years

Cultivars	1000 SW (g)			PN (number per plant)			PH (cm)		
	2003	2004	CY	2003	2004	CY	2003	2004	CY
Irogious	180.9	172.2	176.5	96.8	82.4	89.6	101.0	92.5	96.8
Macon	179.8	170.0	174.9	83.6	70.7	77.2	81.4	76.9	79.2
SXW 7	146.3	138.2	142.3	79.3	66.4	72.9	79.9	75.0	77.5
Ataem 29	165.4	150.5	157.9	76.0	66.8	71.4	94.9	90.2	92.6
LN89-3264	160.8	162.0	161.4	82.3	75.7	79.0	58.9	60.2	59.5
SA 88	146.8	137.8	142.3	76.0	65.3	70.7	72.2	67.0	69.6
AXW 3	145.9	140.5	143.2	71.3	64.7	68.0	60.9	66.3	63.7
TÜRKSOY	160.3	154.0	157.2	68.7	63.7	66.2	101.8	89.7	95.7
ATA 84	178.9	156.4	167.7	66.7	58.9	62.8	85.7	82.3	84.0
Ataem 7	150.9	152.8	151.9	70.3	65.1	67.7	100.5	89.3	94.9
ATA 83	186.9	173.2	180.0	66.0	60.7	63.3	102.5	90.0	96.3
Mavercik	145.9	135.1	140.5	75.0	72.4	73.7	93.3	91.9	92.6
Omaha	169.1	167.8	168.5	62.3	63.0	62.7	79.3	78.3	78.9
A-3935	139.3	144.7	142.0	66.2	58.5	62.4	75.3	79.5	77.4
Mitchell	149.2	151.1	150.1	72.3	67.1	69.7	104.7	89.1	96.8
Ataem 6	168.3	158.3	163.3	71.3	63.3	67.3	81.2	75.0	78.1
LG91-7350	146.1	142.6	144.4	70.2	68.4	69.3	84.1	78.3	81.2
Amsoy 71	159.3	151.8	155.6	69.2	62.7	66.0	80.9	76.7	78.8
Cisne	186.0	173.6	179.8	72.3	65.0	68.7	79.1	81.3	80.2
Nazlıcan	171.8	166.7	169.3	63.6	61.3	62.5	80.4	71.5	75.9
KS 4694	166.9	160.6	163.8	64.3	61.3	62.8	90.1	84.4	87.2
Alhow	152.6	160.2	156.4	79.3	69.7	74.5	66.8	70.3	68.5
Apollo	149.3	150.3	149.8	63.7	57.0	60.3	71.0	73.3	72.2
Stresland	136.5	133.8	135.2	68.0	62.2	65.1	82.1	71.8	76.9
SXW 3	146.5	141.9	144.2	64.0	54.8	59.4	72.5	71.7	72.1
Grand Mean	159.6	153.9	156.7	71.9	65.1	68.5	83.2	78.9	81.0
LSD 5%	12.27	5.28	6.60	6.57	5.06	4.09	6.93	8.30	5.32
CV (%)	4.68	2.09	3.67	5.56	4.74	5.21	5.07	6.38	5.73

CY: Combined Year; SW: Seed Weight (g); PN: Pod Number (number per plant); PH: Plant Height (cm)

related to genetic variation and ambient conditions. The obtained 1000 SW values in this research were found similar to the values reported by Yang and Wang (2000); Karasu *et al.* (2001); Yılmaz *et al.* (2005) and Bayraktar *et al.* (2007). Also, positive and significant relationships were found between SY and 1000 SW. For that reason, ATA-83, Cisne and Irogious varieties can be used as parent in breeding programme for 1000 SW.

Pod Number per Plant (PN): The pod number per plant of the soybean genotypes are presented in Tab. 3. PN values were found between 62.3-96.8 per plant in 2003, between 54.8-82.4 in 2004 and between 59.4-89.6 per plant in combined years. Average pod number per plant was 71.9 in 2003, 65.1 in 2004 and 68.5 in combined years. These results are in agreement with the studies carried out by Yılmaz *et al.* (2005) and Bayraktar *et al.* (2007). The highest pod number per plant value was found for Irogious in 2003, they followed by Macon, LN89-3264, SXW 7 and Alhow. In 2004, the highest pod number per pod value

was obtained by Irogious, followed by LN89-3264. Similar results were obtained for combined years. Also positive and significant relationships were found between SY and PN. For that reason, the pod number per plant trait is one of the most important seed yield components. This may explain the fact that Irogious, Macon and LN89-3264 cultivars should be used as parent in breeding programme for higher pod number per plant.

Plant Height (PH): While average PH was 83.2 cm, the highest one was 104.7 cm (Mitchell) and the lowest one was 58.9 cm (LN89-3264) in 2003. In 2004, the average was 78.9 cm, while the highest one was 92.5 cm (Irogious) and the lowest one was 60.2 cm ((LN89-3264). While average of the combined years of PH value was 81.0 cm, the highest one was 96.8 cm (Irogious and Mitchell) and the lowest one was 63.7 cm (AXW 3). PH values of genotypes in 2003 were higher than the 2004. Because of the high temperature at the flowering in 2004, the vegetative development of the plants was lower than in the first

Tab. 4. Mean values of FPH (cm), OC (%) and PC (%) in some soybean [*Glycine max* (L.) Merr.] genotypes in 2003 and 2004 years

Cultivars	FPH(cm)			OC (%)			PC (%)		
	2003	2004	CY	2003	2004	CY	2003	2004	CY
Irogious	12.6	13.4	13.0	18.5	18.9	18.7	40.2	39.9	40.1
Macon	8.9	12.0	10.4	18.6	18.0	18.3	39.0	39.5	39.3
SXW 7	11.2	12.5	11.8	17.8	17.1	17.5	40.1	38.9	39.5
Ataem 29	14.6	14.3	14.4	21.6	19.8	20.7	41.5	42.1	41.8
LN89-3264	7.5	12.7	10.1	18.1	17.8	17.9	38.6	37.8	38.2
SA 88	10.3	12.8	11.6	17.6	16.4	17.0	41.3	41.4	41.4
AXW 3	8.6	11.3	9.9	18.3	17.6	17.9	40.1	39.9	40.1
TÜRKSOY	13.2	12.8	13.0	19.0	18.6	18.8	41.8	41.8	41.8
ATA 84	12.7	14.4	13.6	16.7	17.5	17.1	40.4	39.7	40.0
Ataem 7	13.9	14.6	14.3	16.8	16.9	16.9	41.6	40.9	41.3
ATA 83	10.8	14.7	12.8	23.8	23.4	23.6	39.8	38.4	39.1
Mavercik	15.5	12.5	14.0	18.7	17.6	18.2	40.3	40.1	40.2
Omaha	12.3	17.8	15.1	23.3	22.5	22.9	41.0	40.9	40.9
A-3935	11.4	14.6	13.0	21.6	20.9	21.2	40.2	39.7	39.9
Mitchell	12.0	13.8	12.9	19.3	18.4	18.9	39.2	39.3	39.2
Ataem 6	14.4	14.7	14.3	21.9	20.9	21.4	40.3	40.3	40.3
LG91-7350	10.2	14.7	12.5	25.8	24.7	25.3	38.8	39.5	39.1
Amsoy 71	7.6	11.9	9.7	20.1	21.10	20.6	36.9	37.6	37.3
Cisne	12.2	14.0	13.1	18.8	17.6	18.2	40.3	40.8	40.5
Nazlıcan	10.1	13.4	11.8	16.5	17.3	16.9	38.3	39.0	38.6
KS 4694	17.1	16.3	16.7	19.6	19.20	19.4	39.6	39.7	39.6
Alhow	8.9	10.7	9.5	16.7	17.1	16.9	37.1	36.9	37.0
Apollo	8.7	13.4	11.1	25.3	24.3	24.8	36.6	36.2	36.4
Stresland	11.8	13.3	12.5	20.6	20.9	20.7	40.1	39.2	39.7
SXW 3	13.2	15.2	14.2	18.7	19.4	19.1	39.1	39.1	39.1
Grand Mean	11.6	13.6	12.6	19.8	19.3	19.6	39.7	39.6	39.4
LSD 5%	1.73	ns	1.96	1.26	1.20	1.96	0.91	1.11	3.83
CV (%)	9.08	15.94	13.5	3.90	3.77	3.83	1.39	1.71	1.56

CY: Combined Year; FPH: First Pod Height (cm); OC: Oil Content (%); PC: Protein Content (%); ns: no significant

Tab. 5. Correlation coefficients of yield components for the soybean production

Traits	1. SY	2. PN	3. PH	4. FB	5. SN	6. SW	7. FPH	8. OC
2. PN	0.605**							
3. PH	-0.034ns	0.128						
4. FB	0.232**	0.296**	-0.204*					
5. SN	-0.063ns	-0.126ns	-0.113ns	0.088ns				
6. SW	0.245**	0.250**	0.272**	0.116ns	-0.098ns			
7. FPH	-0.234**	-0.320**	0.318**	-0.447**	-0.111ns	0.032ns		
8. OC	-0.047ns	-0.244**	0.101ns	-0.051ns	0.041ns	0.002ns	0.073ns	
9. PC	-0.167*	0.061ns	0.404**	-0.232**	-0.019ns	0.015ns	0.359**	-0.167*

150_{n2}=148, r0.05=0.159, r0.01=0.208, ns: no significant, *: 0.01≤p<0.05, **: 0.01≤p<0.01; SY: Seed Yield; PN: Pod Number; PH: Plant Height; FB: Fruit Branch; SN: Seed Number; SW: Seed Weight; FPH: First Pod Height; OC: Oil Content; PC: Protein Content

year. Mitchell genotype in 2003 and Irogious and Maverick genotypes in 2004 had the highest PH values, but, the combined years Mitchell and Irogious genotypes had the highest value. These findings are higher than Yılmaz *et al.* (2005) values, but they are similar to Bilgili *et al.* (2005) and Bayraktar *et al.* (2007) results. This may be explained by the differences between climatic factors, ambient conditions and genotypes. Mean values and groups of 2003, 2004 and combined years about first pod height, oil content and protein content obtained from 25 soybean genotypes are given in Tab. 4.

First Pod Height per Plant (FPH): It is desirable to have FPH at high to decrease yield loss by machine harvest. FPH values were found between 7.5- 17.1 cm in 2003; between 10.7-17.8 cm in 2004 and 9.5-16.7 cm in combined years (Tab. 4). Many researchers stated that FPH ranged from 7.5 to 17.1 cm (Karasu *et al.*, 2001; Yılmaz *et al.* 2007; Bayraktar *et al.* 2007). FPH values of genotypes were higher in second year than the first year. There were positive and significant correlations between FPH and PH and PC and negative and significant correlation between FPH and SY, PN and FB (Tab. 5). In terms of mentioned character, while KS 4694 genotype ranked as the first in 2003 and combined years and Omaha cultivar ranked as the first in 2004. There were no differences among the genotypes in the 2004.

Oil Content (OC): OC was ranged between 16.5-25.8% in 2003. In 2004, it was found between 17.1-24.7% and combined years of value was found between 16.9-25.3% (Tab. 4). Mean OC of the genotypes in 2003 was 19.8%, 19.3% in 2004 and combined years of value was 19.6%. These results are in agreement with the results obtained by Yılmaz *et al.* (2005); Bilgili *et al.* (2005) and Bayraktar *et al.* (2007). Maximum OC was observed for the LG91-7350 followed by Apollo genotypes in 2003, 2004 and combined years. LG91-7350 and Apollo cultivars had a low seed yield, but on the other hand, these varieties should be used as parent in breeding programme for oil content.

Protein Content (PC): OP was ranged between 36.6-41.5% in 2003. In 2004, it was found between 36.2-42.1% and combined years value was found between 36.4-41.8%

(Tab. 4). Mean PC of the genotypes in 2003 was 39.7%, in 2004 was 39.6% and combined years of value was 39.4%. Maximum PC was observed for the TÜRKSOY followed by Ataem 29 and Ataem 7 genotypes in 2003, 2004 and combined years. TÜRKSOY, Ataem 7 and Ataem 29 cultivars had low seed yield, but these varieties should be used as parent in breeding programme for protein content.

Simple correlation coefficients among the examined traits are shown in Tab. 5.

Seed yield was positively correlated with pod number per plant, number of fruit branches per plant and 1000 seed weight. Also, this trait was negatively correlated to first pod height and protein content. Malik *et al.* (2007) and Tayyar (2007) showed that the seed yield was positively and significantly correlated with pod number, fruit branch and 1000 seed weight. Haliloglu *et al.* (2007) reported that seed yield showed positive correlation with plant height, first pod height and seed number per plant. Pod number was positively and significantly correlated with fruit branches, 1000 seed weight. Plant height had a significant positive correlation with 1000 seed weight, first pod height and protein content and first pod height had a significant positive correlation with protein content.

Conclusions

Result of this study showed that Irogious, Alhow and Macon genotypes were found preferable for the Southeast Anatolia of Turkey. Because of their high yield capacity, they are considered promising genotype. Also, PN per plant, FB per plant and 1000 SW have direct effect on seed yield. For that reason, soybean breeding for high SY, PN per plant should be considered as a worthy character following SW and FB.

References

- Açıkgöz, N., M. E. Akkaş, A. F. Moghaddam and K. Özcan (1994). A PC software program for assessment of agricultural research. The First National Field Crops Congress of Turkey, Proceedings of Crop Production, University of Ege, Faculty of Agriculture, Department of Field Crops, Izmir-Turkey

- (Turkish). 2:120-124.
- Anonymous, (1984). Association of official analytical chemists. Official methods of analysis, method 47.021. 14th ed. Washington, DC: Association of Official Analytical Chemists.
- Anonymous, (2003). Analysis of soil results. Harran University, Faculty of Agriculture, Department of Soil Science Laboratory, Şanlıurfa-Turkey.
- Anonymous, (2009). Ministry of Agriculture, TUGEM official record, Ankara.
- Arshad, M., N. Ali and A. Ghafoor (2006). Character correlation and path coefficient in soybean (*Glycine max* (L.) Merrill). Pak. J. of Botany. 38(1):121-130.
- Bayraktar, N., V. Eser and M. Mert (2007). Determination of yield and yield components of some soybean cultivars (*Glycine max* (L.) Merrill) under middle Black Sea. The 7th National Field Crops Congress of Turkey, Proceedings of Industry Plant, University of Atatürk, Faculty of Agriculture, Department of Field Crops, Erzurum-Turkey (Turkish). 2:502-505.
- Bilgili, U., M. Sincik, A. T. Göksoy, Z.M. Turan and E. Açıkgöz (2005). Forage and grain yield performance of soybean lines. Journal of Central European Agriculture. 6(3): 397-402.
- Çopur, O. and M. Oğlakçı, (1997) A research on determining the yield and yield components of 12 cotton cultivars relating to *Gossypium hirsutum* L. at the Harran Plain conditions. The Second National Field Crops Congress of Turkey, Proceedings of Plant Production and Breeding, University of Ondokuz Mayıs, Faculty of Agriculture, Department of Field Crops, Samsun-Turkey (Turkish). 310-314.
- Haliloğlu, H. V. Beyyavaş, C. İ. Cevheri, E. Boydak and A. Yılmaz (2007). Correlation and path analysis of yield and some effective characters at four soybeans (*Glycine max* (L.) Merrill) varieties in different sowing dates. The 7th National Field Crops Congress of Turkey, Proceedings of Industry Plant, University of Atatürk, Faculty of Agriculture, Department of Field Crops, Erzurum-Turkey (Turkish). 2:707-710.
- IUPAC (1987) Standard methods for the analysis of oils, fats and derivatives method 1.123. 7th ed. Oxford: Blackwell Jevent Publishers.
- İşler, N., E. Boydak and İ. Hacıkamiloğlu (1995). A study on determining the important agricultural and plant characteristics of soybean cultivars which can be grown as a double-cropped in Şanlıurfa conditions. University of Harran (Şanlıurfa-Turkey), Journal of the Faculty of Agriculture. 1(3):53-66.
- İşler N. and M. E. Çalışkan (1998). The correlation and path coefficient analysis for yield and some yield component of soybean (*Glycine max* (L.) Merrill) in Southeastern Anatolia ecological conditions. Tr. J. of Agriculture and Forestry. 22:1-5.
- Jackops, A. J., M.D. Staggs and D. R. Erickson (1983). International soybean variety experiment seventh report of results 1979 INTSOY Series Number 24. Collage of Agriculture University Illinois at Urbana-Champaign.
- Karasu, A., M.Öz. and A. T. Göksoy (2001). A study on the adaptation of some soybean (*Glycine max* (L.) Merrill) cultivars under Bursa conditions. The Fourth National Field Crops Congress of Turkey, Proceedings of Industry Plant, University of Trakya, Faculty of Agriculture, Department of Field Crops, Tekirdağ-Turkey (Turkish). 2:123-128.
- Malik, M. F. A., M. Ashraf, A. S. Qureshi and A. Ghafoor (2007). Assessment of genetic variability, correlation and path analyses for yield and its components in soybean. Pakistan Journal of Botany. 39(2):405-413.
- Tanrıverdi, M., A. Yılmaz and R.Ş. Güvercin (2000). Determination of yield and important agricultural characteristics of some soybean cultivars (*Glycine max* (L.) Merrill) under second crop conditions in Harran Plain. University of Harran (Şanlıurfa-Turkey), Journal of the Faculty of Agriculture. 4(1-2):87-96.
- Tayyar, Ş. (2007). Performance of some soybean (*Glycine max* (L.) Merrill) genotypes as main crop in Biga conditions. University of Yüzüncüyıl (Van-Turkey), Faculty of Agriculture, Journal of Agriculture Science. 17(2):55-59.
- Yang, Q. and J. Wang (2000). Agronomic traits correlative analysis between interspecific soybean crosses. Soybean Genetic Newsletters 27 [Online Journal] <http://www.soygenetics.org/articles/sgn2000-003htm>
- Yılmaz, A., V. Beyyavaş, C. İ. Cevheri and H. Haliloğlu (2005). Determination of some soybean (*Glycine max* (L.) Merrill) cultivars and genotypes as second crop under Harran Plain ecological conditions. University of Harran (Şanlıurfa-Turkey), Journal of the Faculty of Agriculture. 9(2):55-61.