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EVALUATION of SOME SESAME (*Sesamum indicum* L.) VARIETIES' PERFORMANCES UNDER MICRO-CLIMATE CONDITIONS of IGDIR-TURKEY

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Abstract

The yield of any crop is directly or indirectly a function of the interaction between the crop's genotype and the existing climatic and ecological factors. This study was carried out to determine the performances of some sesame cultivars under Igdir plain ecological conditions in Igdir - Turkey, 2012. Cumhuriyet-99, Kepsut-99, Muganlı-57, Orhangazi-99, Osmanlı-99, Tan-99, Tur-S-90 and Tur-S-203 varieties were used as trial materials. The study was conducted in the Randomized Blocks Experimental Design with three replications to investigate plant height, number of branch per plant, first pod height, pod length, pod width, number of pod per plant, number of seed per pod, 1000 seed weight and seed yield. Results of experiment revealed that all investigated properties showed significant differences among the genotypes. Plant height varied among 121.0-147.1 cm, number of branch 3.6-7.2, first pod height 43.6-67.1 cm, pod length 25.3-28.6 mm, pod width 4.8-6.5 mm, number of pod per plant 56.1-125.5, number of seed per pod 53.2-72.3, 1000 seed weight 2.85-3.67 g and seed yield 523.3-1005.9 kg ha^{-1}. The highest seed yields were obtained from Orhangazi-99 while the lowest seed yield was recorded from Tan-99.

Keywords: *Sesame, Sesamum indicum, variety, yield, yield components*

Introduction

Sesame (*Sesamum indicum* L., Pedaliaceae) is an important ancient annual spice and oilseed crop which is widely cultivated all over the world for its seeds. Sesame seeds contain about 40-60% (Doğan and Zeybek, 2009) oil and 20-30% of protein (Öz and Karasu, 2010). In general, it has high stability and quality oil which contains about 47% oleic acid (C18:1), 39% linoleic acid (C18:2), 9.0% palmitic acid (C16:0), 4.1% stearic acid (C18:0), and 0.7% arachidic acid (C20:0) (Weiss, 1983). As a "queen of oilseeds" (Al-Yemeni *et al.*, 2000), it was cultivated during ancient Harappan, Mesopotamian, and Anatolian eras, and throughout the Graeco-Roman world (Bedigian, 2003) for its high oil yield, mildness and pleasant taste (Al-Yemeni *et al.*, 2000) and also because of its rich and nutty flavor it is a common ingredient in cuisines across the world (Obiajunwa *et al.*, 2005). As a good source of protein and fat for humans and livestock (Adebisi *et al.*, 2005) sesame seeds are also used in baking and making candy, while its oil in addition to cooking is used in the manufacture of perfumes, pharmaceuticals, soaps, insecticides, paints (Alege *et al.*, 2013; Amara *et al.*, 2008).

Sesame has many species, most of them are wild and native to Turkey. The cultivated type is *Sesamum indicum which* originated in India and is tolerant to drought-like conditions, where other crops fail in Turkey. Sesame is known as a medicinal and spice oilseed crop in Turkish culture. Because of its high production cost and low yield, it has a limited production, therefore, its oil is not commonly used in meals in Turkey, instead, its seeds are mostly used in tahini and halvah production and also, sesame is the only condiment of world famous the Turkish bagel (simit). Despite, its most and widely consumption, the sesame production is far below the need of the country. Turkey sesame production deficit are tried to close by imports whereas even the half of annual needs of Turkey cannot be provided (Doğan and Zeybek, 2009; Şahin, 2014).

It is one of warm-season crops, and must be sown after last frost days; it adapts well to high temperatures, but it cannot tolerate waterlogged soil (Bedigian and Harlan, 1986). It need optimum 20-25 ^{o}C of soil temperature for germination. So in eastern Anatolia only some plain which has microclimate conditions ensure this temperature during germination in spring months. Therefore, it is necessary to determine the varieties with high seed yield in ecology where it can grow well. Iğdır plain is one of the most suitable one where sesame can easily be cultivated.

The aim of this study was to evaluate the best sesame cultivar which could be well adapted to conditions of Iğdır Plain (Turkey).

Material and Methods

Iğdır is a province in eastern Anatolia-Turkey, located along closed border with Armenia which follows Aras River, Azerbaijan (the area of Nakhichevan Autonomous Republic), and Iran. Its adjacent provinces are Kars to the northwest and Ağrı to the west and south. It occupies an area of 3.587 km². Because of its mountains, Eastern Anatolia average altitude is approximately 2 000-2 200 m. Therefore, it was called as "Roof of Turkey". Turkey's highest mountain, Mount Ararat (Ağrı Dağı) is in Iğdır, but much of the land is a wide plain far below the mountain which has lowest altitude (850 m) of Eastern Anatolia Region-Turkey. Therefore, it has a warmest climate in this part of Turkey where cotton can be grown.

The study was carried out at the trial field of Agricultural Research and Training Center (lat. 39° 55'-N, long. 44° 5'-E and the alt. 851 m above sea level) of the Iğdır University, Turkey during 2012 growing season in order to compare the sesame varieties adaptation performance according to some quantitative properties (plant height, number of branch per plant, first pod height, pod length, pod width, number of pod per plant, number of seed per pod, 1000 seed weight and seed yield).

The soil samples, where the research took place, were taken to identify physical and chemical characteristics of the research field which results are presented in Table 1.

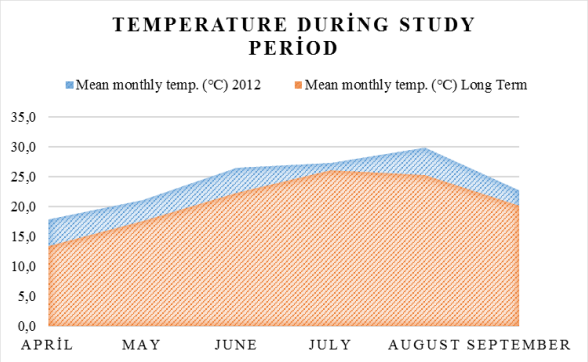
Table 1. The soil characteristics of the research field

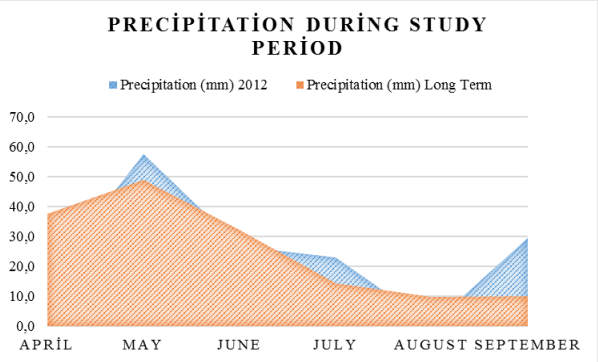
Soil texture (Type)	**EC** (mmhos/cm)	**pH**	**Lime** ($CaCO_3$) (%)	**Total N** (%)	**Organic matter** (%)	**Available plant nutrients (kg ha^{-1})**	
						P_2O_5	K_2O
Clay - Loam	1.85	7.99	11.81	0.98	2.1	34	271

As can be seen in Table 1, the soil type is clay-loam with a pH of 7.99 and low organic matter.

The meteorological data during the study periods in 2012 are presented in Figure 1. The averages of monthly mean temperatures during the growing period (April-September) consistently higher than Long Term (LT). The higher temperatures were observed during the reproductive stages. As

seen in Figure 2, the total precipitation (153.2mm) of 2012 was approximately similar to the long-term. Monthly precipitation differed in 2012 at the growth stages. During the vegetative stages (May, July and September), the crops received higher precipitation in 2012 than in LT. However, the plants received lower precipitation during reproductive stages (April, June and August) in 2012 compared to LT (Figure 2). The average of relative humidity (64.2 %) of 2012 was higher than the LT average (48.4).





The study was conducted with a total of 8 varieties containing yellow (Tur-S-90, Tur-S-203, Muganlı-57 and Orhangazi-99) and white (Cumhuriyet-99, Kepsut-99, Osmanlı-99 and Tan-99)(Tan, 2011) sesame groups in 2012 growing season in Iğdır Plain based on Randomized Complete Block Design with three replications. The experimental plots consisted of four rows 4 m in length 65 cm apart and were sown by hand at 30 May in 2012. Sprinkler irrigation was maintained immediately after sowing and thereafter used when necessary based on soil and plants conditions. Nitrogen, phosphorus and potassium were applied at a rate of 70kg ha^{-1} at sowing. The half of nitrogen fertilizer was applied during seedbed preparation, and the other was applied while the plant height was approximately 30 cm. After emergence, thinning was done to obtain row distances (15 cm) and weeding was applied before stem elongation manually.

Yield and yield components data were determined on 10 plants randomly selected from two middle rows in each plot where the harvesting areas determined after deletion of the plot sides and 30cm from the top and bottom of two middle rows.

The variance analysis of data for each properties and analysis of the randomized complete block design were computed using the IBM SPSS computer program (v.23.0). The LSD multiple range tests were used to test the significance of main effects at the 5 % level of probability. The Spearmen correlation equation between the traits mean as the dependent variables of sesame as the independent variable are calculated.

Results and Discussion

Table 2 shows the comparisons of varieties according to the plant height, number of branch per plant, first pod height, pod length, pod width, number of pod per plant, number of seed per pod, 1000 seed weight and seed yield.

Plant height: The means comparison for this trait (Table 2) indicated that sesame in 2012 was faced a more favorable thermal and moisture regime (Figure 1 and 2). The plant height had a significant (%5) difference among the varieties. This could be due to the differential response of varieties to environmental conditions based on their genetic variations (de la Vega, 1996). The plant heights differed from 121.0-147.1 cm. The highest plant was observed from Tur-S203

which had no statistically difference with Muganlı-57, Tur-S-90, Orhangazi-99 and Kepsut-99 (146.63, 146.50, 145.87 and144.47 cm), respectively and the shortest plants were obtained from Tan-99. Supporting evidences were reported by Öz and Karasu, (2010) who showed that Orhangazi-99 had maximum plant heights among 7 varieties and Tan, (2011) monitored that the plant heights changed between 110 – 128.9 cm.

Number of branch per plant: As can be seen in Table 2, number of branch/plant significantly (%5) varied among varieties. According to the means comparison, the maximum number of branches (7.17) was observed from Orhangazi-99 which had no statistically significant difference with the other varieties except Tan-99 which had the minimum number of branch/plant (3.63). These results are in concordance with Sağır *et al.*, (2010). Contrasting results were obtained by Öz and Karasu, (2010) who stated that the number of branch didn't changed according to the genotypes.

First pod height: Results obtained from the 8 varieties indicate that there exist wide variations among the varieties. The distance from the first pod down to the base of the plant was between 43.60 - 67.07 cm (Table 2) and was significant at %5 statistical level. The maximum height was observed from Tan-99 where the shortest plants were obtained from Orhangazi-99. The study results agree with the previous findings of Ansah *et al.*, (2015). The maximum height observed from Muganlı-57 while the minimum height determined from Cumhuriyet-99.

Pod length: The remaining one of morphological traits; pod length had significant (%5) differences among the varieties. The pod length was between 25.33-28.07 mm which had a good line Öz and Karasu, (2010) findings. The longest pods were screened from Orhangazi-99 while the shortest pods were observed from Tan-99. These differentials were in accordance with Alege *et al.*, (2013) who reported the pod length is stable to variations in soil fertility condition and are therefore under strong genetic influence.

Pod width: Table 2 shows that there were significant (5%) differences in the pod widths of varieties. As seen in Table 2, the highest pod width value (6.50 mm) was obtained from Orhangazi-99 while the lowest determined from Tan-99 (4.83 mm). These results has good line with Alege *et al.*, (2013) and Öz and Karasu, (2010) findings.

Number of pod per plant: In the present study, significant (5%) differences were occurred among varieties regards to number of pod/plant (Table 2). The highest number of pod/plant value (125.50) was obtained in plots of Orhangazi-99, where the lowest number of pod/plant (56.07) was produced from Muganlı-57 sown plots which had no statistically significant (5%) difference with Tan-99 (58.27) (Table 2). The results of study are in accordance with Öz and Karasu, (2010) who stated the number of pod had a significant effect on seed yield.

Number of seed per pod: According the data presented in the Table 2, the number of seed per pod had a significant (5%) differential among the varieties. The highest value (72.37) was obtained from Orhangazi-99 while the minimum values (53.20) were produced by Tan-99 variety (Table 2). Supporting evidence were reported by Lal *et al.*, (2016) who stated the number of seed per pod increased with increasing of pod length and width under optimum conditions as a morphologically reality.

1000 seed weight: In the present experiment, 1000 seed weight exerted significant (5%) differences among varieties (Table 2). The highest values (3.67 g) was obtained in Muganlı-57, where the minimum value (2.85 g) was observed in Kepsut-99 (Table 2). The supporting evidence had been reported by Li *et al.*, (2015) who stated the 1000 seed weight was mainly controlled by the maternal genotype under optimum conditions.

Seed yield: Seed yield is directly related to the number of branches, but the total number of pod/plant and the number of seed/pod has the greatest direct effect on seed yield (Lal *et al.*, 2016). The number of pod/plant is directly related to the number of flowers, but climatic conditions can affect the percentage of fertilized flowers. The short photoperiods can increase the number of pod/plant on early and medium-late genotype (Söğüt, 2009). The direct effect of the number of fruiting branches on seed yield in sesame was considerable, as shown by (Uzun *et al.*, 2002). On the bases of this, there was a highly significant (5%) difference in seed yield among eight varieties (Table 2). The maximum seed yield (1005.87 kg ha^{-1}) obtained from Orhangazi-99 variety where minimum seed yield (523.33 kg ha^{-1}) obtained from Tan-99 (Table 2). The supporting data were reported by Öz and Karasu, (2010).

Table 2. The multi-comparison test of LSD's mean for the effects of varieties on observed quantitative characters of sesame

Varieties	Plant height (cm)	Number of branch per plant	First pod height (cm)	Pod length (mm)	Pod width (mm)	Number of pod per plant	Number of seed per pod	1000 seed weight (g)	Seed yield (kg ha^{-1})
Cumhuriyet-99	135.97 ab	5.77 a	48.37 cd	26.83 ab	5.63 abc	122.40 a	68.50 ab	3.07 bc	949.73 b
Kepsut-99	144.47 a	5.47 a	53.33 bc	26.13 ab	5.90 ab	94.27 bc	64.43 b	2.85 d	834.93 d
Muganl-57	146.63 a	5.47 a	50.50 cd	26.63 ab	5.83 ab	56.07 d	69.30 ab	3.67 a	889.83 c
Orhangazi-99	145.87 a	7.17 a	43.60 d	28.07 a	6.50 a	125.50 a	72.37 a	3.01 bcd	1005.87 a
Osmanl-99	130.57 ab	5.57 a	48.63 cd	26.23 ab	5.80 ab	90.03 c	66.87 ab	3.03 bcd	947.23 b
Tan-99	121.03 b	3.63 b	67.07 a	25.33 b	4.83 c	58.27 d	53.20 c	2.91 cd	523.33 e
Tur-S-203	147.10 a	5.50 a	59.70 b	26.53 ab	5.50 bc	71.70 cd	63.50 b	2.91 cd	903.30 c
Tur-S-90	146.50 a	6.50 a	59.73 b	26.73 ab	5.93 ab	119.77 ab	65.93 b	3.11 b	874.03 c
LSD 0.05	**15.454**	**1.526**	**6.443**	**1.793**	**0.881**	**25.571**	**5.846**	**0.172**	**32.776**
CV %	**6.314**	**15.464**	**6.830**	**3.855**	**8.749**	**15.828**	**5.096**	**3.205**	**2.161**

Means with similar letters within each column for each treatment are not significantly different (LSD 5%).

The seed yield is the most important target in sesame cultivation, but also, the seed yield is under effect of lots of factors such as genotype, environmental (climatic and soil) conditions and the traits factors of farmers. Because of these reasons, the results of most sesame agronomic studies can be different.

Traits Correlations

The studied traits correlations are shown in Table 3. The correlations between plant height and number of seed/pod, pod length, pod width were observed positive and significant (5%). Number of branch/plant showed positive and highly significant (1%) correlation with number of pods/plant, number of seed/pod, pod width, seed yield and also significant (5%) correlation with pod length and 1000 seed weight but, had negative and highly significant (1%) correlation with first pod height. These results suggest that improvement in these properties could be with an increase in number of branch/plant (Lal *et al.*, 2016) with less first pod height.

The correlations of number of pod/plant with number of seed/pod, pod length and pod width are positive and significant (5%) and also had a positive and significant (1%) correlation with seed yield which suggest that the increase in these yield components could be with an increase in the number of seed/pod. But, a negative and significant (5%) correlation was screened with first pod height which suggested that an increase in number of pod/plant could be obtain with low first pod height.

The number of seed/pod was positive and significantly (1%) correlated with length of pods and seed yield while it had negative and significant (1%) correlation with first pod height. This indicates that the maximum length of pods and seed yield can be determined with a high number of seed/pod and low height of first pod.

The correlation of first pod height with pod length, pod width and seed yield was significantly (5% and 1%) negative which suggests that the first pod height could bring decrease in yield and yield parameters. Therefore, it will be a good step to improve a balance between these important components when breeding for high yield improvement in sesame (Lal *et al.*, 2016).

Pod length, pod width and 1000 seed weight were positive and significantly (5% and 1%) correlated with seed yield. This means that an increase in these parameters will occur high yield in sesame.

Table 3. The correlation values of plant parameters based on means of 8 varieties in 2012 growing seasons at Spearman

	Plant height (PH)	Number of branch/plant (NB/P)	Number of pod/plant (NP/P)	Number of seed/pod (NS/p)	First pod height (FPH)	Pod length (PL)	Pod width (PW)	1000 seed weight (TSW)	Seed yield (SY)
PH	1	0.220	0.190	0.355 *	-0.040	0.383 *	0.359 *	0.160	0.180
NB/P		1	0.645 **	0.512 **	-0.540 **	0.425 *	0.640 **	0.350 *	0.489 **
NP/P			1	0.461 *	-0.466 *	0.471 *	0.423 *	0.110	0.519 **
NS/p				1	-0.607 **	0.747 **	0.310	0.330	0.547 **
FPH					1	-0.376 *	-0.676 **	-0.320	-0.787 **
PL						1	0.320	0.010	0.413 *
PW							1	0.180	0.535 **
TSW								1	0.362 *
SY									1

**. Correlation is significant at the 0.01 level

*. Correlation is significant at the 0.05 level

Conclusions

According to results of the study, it can be concluded that to increase seed yield in sesame, the attributes like number of branch/plant, number of pods/plant number of seed/pod, pod length, pod width and 1000 seed weight should be increased to achieve potential yield of sesame in Iğdır plain conditions. And also, in order to cultivate sesame as an oil crop in conditions similar to the region of this experiment, Orhangazi-99 was recommended.

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