



Seed Yield and Some Yield Components of Sunflower (*Helianthus annuus* L.) Genotypes in Kahramanmaras (Turkey) Conditions

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Abstract Oilseeds production of Turkey is not available to meet domestic requirements. Turkey has been facing a recurring shortage of vegetable oils for many years. Presently, about 50% of vegetable oil being consumed in Turkey has to be imported. To improve our country sunflower production, it should be increased sunflower sowing area and used high yielding varieties in the production. Therefore, there is need to study determining high-yielding varieties. This research was conducted to determine the seed yield with some yield components of sunflower (*Helianthus annuus* L.) genotypes in Kahramanmaras (Turkey) conditions using a randomized complete block design with four replications in 2013. In the study, twelve sunflower genotypes (Sanbro, Imera C5, DT3017IR, Pactol, P-4223, Aitana, Isera, Armada, Tunca, C70165, Pactol F1 and Sanay) were used as the plant material. These twelve sunflower genotypes were evaluated for plant height, head diameter, 1000-seed weight, dehulled seed ratio and seed yield. The results showed that plant height, head diameter, 1000-seed weight, dehulled seed ratio and seed yield for twelve sunflower genotypes ranged between 134.36-181.70 cm, 11.05-15.14 cm, 36.85-58.69 g, 54.65-73.51 % and 1838.07-3417.07 kg ha⁻¹ respectively. The highest head diameter and seed yield were obtained from the variety P-4223 while Pactol variety had the lowest seed yield.

Keywords Sunflower, *Helianthus annuus* L., seed yield, yield components.

Introduction

Sunflower (*Helianthus annuus* L.) is an important crop among oil seeds and as a source of edible oil in the world. Turkey is facing an acute shortage of edible oil while, demand is increasing with increase in population. Millions of dollars are being spent on the import of crude oil and oilseeds. Despite the efforts of the government to increase oilseeds production, Turkey continues to be import dependent due to a net deficit of oilseeds and products. Turkey, in 2014 the realized crude vegetable oil production around 1.5 million tones, but the total crude oil supply in the market has been around 3 million tons. The highest crude oil supply in Turkey is seen in sunflower and palm oil. Approximately 75% of the total supply of crude oil are provided from abroad (crude oil imports directly and domestic crude oil production from imported oilseeds) [1]. In order to increase our production of vegetable oil, it should be utilize from our different ecological areas. In this context, to establish field experiment with different varieties in different regions has a vital importance.

Various studies have been conducted to evaluate the agronomic performances of commercially available sunflower cultivars in different areas of Turkey and other countries [2-10]. A study was conducted in Diyarbakir (Turkey) conditions in order to determine potential sunflower cultivars for irrigated conditions by Karaaslan et al. [11]. They reported that the highest seed yield per hectare (4110.7 kg) was obtained from Pioneer-4223, while the lowest seed yield per hectare was found in Tr-3080 (1790.6 kg). The experiment was laid out with eight Turkish cultivars and two German cultivars by Canavar et al. [12]. It was determined that the differences among all the sunflower cultivars were statistically significant for plant height, head diameter, 1000 seed weight, dry matter, harvest index and seed yield. These studies suggested that the cultivars showed wide differences in their agronomic characteristics and seed yield. In this study, seed yield with some yield components of 12 sunflower genotypes were investigated in Kahramanmaras conditions.



Materials and Methods

Twelve sunflower genotypes (Sanbro, Imera C5, DT3017IR, Pactol, P-4223, Aitana, Isera, Armada, Tunca, C70165, Pactol F1 and Sanay) were used plant material. Seeds of all these varieties were kindly provided by the Agricultural Research Institute (Adana - Turkey). These twelve sunflower genotypes were sown at 15 April in 2013 at the Agricultural Research Institute of Kahramanmaraş province, Turkey. Kahramanmaraş province is located in the East-Mediterranean region of Turkey between 37° 36' north parallel and 46° 56' east meridians. The studies were established on alluvial clay loam with the following mean properties; pH = 7.5, organic matter = 1.7%, N = 0.05%, CaCO₃ = 19.8%, available P = 51.5 kg ha⁻¹, and available K = 73 kg ha⁻¹. Based on soil test conducted in test year, nitrogen and phosphorus at the rate of 70 kg N and P₂O₅ ha⁻¹ were applied, respectively. Cultural practices, control of insects and weeds and furrow irrigation were given as needed during the growth season according to the local recommendations. All other receded production practices were followed. The trials were conducted using a randomized complete block design with four replications. Each plot consisted of four rows 6 m in length with 70 cm between rows and 25 cm hill spacing. Individual plots were spaced 2.8 m apart. The sunflower seeds were sown by putting three seeds to hills by hand. Plants were thinned to one plant per hill 15 days after sowing. Ten randomly tagged plants from each plot were evaluated plant height, head diameter, 1000-seed weight, dehulled seed ratio and seed yield. Seed yield were obtained from an area 1.4 m wide and 5 m long of the center two rows of each plot. Seed samples were collected from each plots and dehulled seed ratio was determined following the procedure reported by Urie et al. [13]. In the experiment, sunflower genotypes were harvested 13th September by hands. All data were analyzed using the MSTAT-C statistical software. Significant differences among mean values were compared by protected least significant difference (Protected LSD, P < 0.05).

Results and Discussion

As a result of variance analyses, highly significant cultivar effects were noted on plant height, head diameter, 1000-seed weight, dehulled seed ratio and seed yield (Table 1). According to genotypes, significant differences in plant height values were found (p<0.01). The comparison of the plant height values of twelve sunflower genotypes shows that Imera C5, DT3017IR, Aitana, Armada, C70165 and Sanay present the higher plant height values while Tunca presents the lower value. Sunflower plant height values of the twelve genotypes ranged from 134.36 cm (Tunca) to 181.70 cm (DT3017IR). A study to evaluate comparative performance of various sunflower hybrids was conducted by Sarwar et al. [2], and they indicated that Hysun-33 gave the maximum plant height (148.4 cm), followed by DK- 4040 (144.73 cm) and minimum plant height (123.20 cm) was recorded in case of Ausigold-62. In a study related with sunflower cultivars in the same ecological conditions, Killi [3] reported that plant height values of sunflower cultivars ranged from 123.49 cm to 155.14 cm. These differences are due to variability in environmental conditions and genetic makeup [8]. Our results are also in accordance with Özer et al. [4] and Bakht et al. [5], they reported that sunflower cultivars significantly differed in plant height and this difference might be due to varietal behavior and environmental conditions.

Table 1: Mean values of investigated characters for 12 tested sunflower genotypes.

Cultivars	Plant height (cm)	Head diameter (cm)	1000-seed weight (g)	Dehulled seed ratio (%)	Seed yield (kg ha ⁻¹)
Sanbro	154.46 ab	13.60 ab	49.73 abc	65.43 abcd	2852.37 b
Imera C5	179.63 a	13.89 ab	38.76 de	68.70 ab	2008.77 ef
DT3017IR	181.70 a	12.99 bc	44.65 bcde	56.76 cd	1953.73 efg
Pactol	169.17 ab	11.05 c	47.45 bcd	54.65 d	1838.07 g
P-4223	151.37 ab	15.14 a	45.99 bcde	67.54 abc	3417.07 a
Aitana	170.90 a	13.37 ab	42.13 cde	64.63 abcd	1909.93 fg
Isera	160.66 ab	13.47 ab	51.26 abc	61.93 bcd	2287.60 d
Armada	179.23 a	13.30 ab	36.85 e	66.48 abc	1876.83 fg
Tunca	134.36 b	12.78 bc	50.72 abc	66.77 abc	2080.73 e
C70165	176.57 a	14.53 ab	46.81 bcd	73.51 a	2961.43 b
Pactol F1	169.43 ab	13.61 ab	52.61 ab	65.49 abcd	2607.53 c
Sanay	175.10 a	14.22 ab	58.69 a	73.26 a	2355.70 d
LSD (0.05)	36.26	2.08	9.46	11.19	163.23

Mean values in the same column without a common letter are significantly different ($P < 0.05$) according to the Least Significant Difference (LSD) multiple range test.

Significant differences in head diameter values were found (p<0.01).The cultivar P-4223 had the highest head diameter (15.14 cm) while the Pactol had the lowest (11.05 cm). Head diameter is an important characteristic



affecting to number of seeds per head and seed yield directly [4]. Yield is positively correlated with the number of seeds per head, head diameter and seed weight [14-15]. In the present study, head diameter of 11.05-15.14 cm was similar to those obtained previously Sarwar et al. [2]. The eight cultivars Sanbro, Imera C5, Aitana, Isera, Armada, C70165, Pactol F1 and Sanay had similar head diameter (13.60, 13.89, 13.37, 13.47, 13.30, 14.53, 13.61 and 14.22, respectively). Previous literature reported head diameter of 18.23-21.19 cm [3], 19.72-20.14 cm [4], 17.0-21.5 cm [16], 16.18-18.19 cm [8], 9.50-13.30 cm [7], and 14.67-18.87 cm [9]. Head diameter of sunflower genotypes ranged from 11.05 to 15.14 cm was similar previous literature mentioned above.

Among the genotypes, significant differences in thousand seed weight were observed ($p < 0.01$). Cultivar Sanay had the highest (58.69 g) thousand seed weight while the cultivar Armada had the lowest (36.85 g). In studies related with sunflower, different results of thousand seed weight values have been reported by the researchers. Killi [3], Özer et al. [4], Canavar et al. [12], Ali et al. [8], Fetri et al. [9], Sarwar et al. [2], and Ion et al. [16] reported thousand seed weight of 54.34 – 74.53 g, 61.87 – 61.98 g, 53.40-69.77 g, 56.38 – 65.01 g, 43.76 – 52.18 g, 48.37 – 49.11 g, 50.90 – 60.50 g, respectively.

Significant differences were observed among the cultivars for dehulled seed ratio (Table 1). Genotypes C70165 and Sanay had higher dehulled seed ratio, while Pactol had the lowest. In the present study, dehulled seed ratio ranged from 54.65-73.51%. High dehulled seed ratio is an important characteristic and it can be affected by factors such as cultivar, growing conditions and plant nutrition [12, 14]. Our obtained dehulled seed ratio results were close to those reported by [3]. There is a strong negative correlation between hull ratio and dehulled seed ratio [12]. Most findings indicate that hullability increases with increased hull content of the seed [17-19]. The highest dehulled seed ratio (73.26%) and the highest thousand seed weight (58.69 g) were obtained from Sanay cultivar. Besides C70165 genotype with high dehulled seed ratio had the low thousand seed weight.

The differences for seed yields of sunflower genotypes were statistically significant (Table 1). Seed yield of P-4223 cultivar were significantly higher than those of the other eleven cultivars. Seed yield of this variety ($3417.07 \text{ kg ha}^{-1}$) was the highest as compared with the other genotype under study. Pactol cultivar was shown to have the lowest ($1838.07 \text{ kg ha}^{-1}$) value of seed yield. In the present study, seed yield of 1838.07 - $3417.07 \text{ kg ha}^{-1}$ were similar to those obtained previously in Turkey and the other countries [4-8-10-11-12] but lower than those reported by some other authors [2,9,20]. Previous literature reported seed yield values change from 1662 to 5563 kg ha^{-1} . The high variations in seed yield values can be due to environmental conditions or to the genetic potential for seed yield of the tested genotypes. Significant differences were found between cultivars for seed yield as already reported by Ada and Tamkoç [20]. High yielding cultivar P-4223 was shown to have the high head diameter while low yielding cultivar Pactol was shown to have the low head diameter. Killi and Gençer [21] and Anandhan et al. [6] reported that seed yield of sunflower plant were directly affected by head diameter, number of seeds per head and 1000-seed weight. Fida Hassan et al. [22] reported that three important selection criteria affected on seed yield were head diameter, number of seed per head and seed weight.

Conclusion

In the present study, which was conducted under the conditions of Kahramanmaraş (Turkey) province to determine the performance of 12 sunflower genotypes, demonstrated that all investigated characteristics were significantly affected by genotypes. Among the tested genotypes, seed yield of 1838.07 - $3417.07 \text{ kg ha}^{-1}$ were changed and the highest seed yield were obtained from cultivar P-4223, but Pactol gave the lowest. The results obtained in the study suggest that genotype, environmental factors and cultivation techniques had influence on the variation among cultivars for seed yield. Significant differences were observed between cultivars for plant height, head diameter, 1000-seed weight and dehulled seed ratio. Based on the study, the highest head diameter was produced by P-4223 (15.14 cm). In conclusion, in this study, which was conducted to demonstrate the performance of 12 sunflower cultivars, the cultivar P-4223 were shown to have the highest seed yield.

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