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Research Article

A COMPARISON OF GROWTH AND YIELD PRODUCTION OF THREE TURKISH SUNFLOWER VARIETIES IN MOGADISHU, SOMALIA

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ABSTRACT. Sunflowers (*Helianthus annuus*) are one of the most significant annual crops that are produced all over the globe for extracting edible oil from the plant's seeds. This study investigated and compared the growth and yield output of three Turkish sunflowers (Metinbey, Deray, and Reyna) cultivated in Somalia-Mogadishu. As well as to choose a high-yield variety of sunflowers that is ecologically adapted to Somalia's environment and to determine the morphological characteristics of these three imported sunflower crops. The experiment was conducted at the Research Center of the Faculty of Agriculture at Zamzam University of Science and Technology. The experiment began at the beginning of the winter (Jiilaal) season in January- 2018 and continued until July of the same year. In terms of morphological characteristics, Metinbey demonstrated the best among the varieties, followed by Reyna, which displayed promptly; nevertheless, Deray recorded the lowest morphological parameters among the varieties. Regarding yield and yield components, the Reyna variety was documented as having the best yield and yield components among the varieties. The Deray variety followed this, while the variety of Metinbey was documented as having the lowest yield and yield component among the varieties.

Keywords: *Sunflower, morphological characteristics, high yield variety*

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is an important agricultural crop in most sunflower-growing countries. It is grown for its edible oil and fruits for human and livestock consumption. The sunflower seed is the fruit of the sunflower. Ukraine, Russia, the European Union, and Argentina are major producing countries. Ukraine and Russia produce almost half of the world's sunflower seeds. The total production of sunflowers is approximately 45 million metric tons, and the area under cultivation is 26 million hectares in the world. [1]. Sunflower, native to North America, grows wild in many areas of the U.S. Sunflower has a long and varied history as an economic plant. Still, the time and place of its first cultivation is uncertain. The cultivated sunflower is one of the 67 species of *Helianthus*. The basic chromosome number for the Helianthus genus is 17. Diploid, tetraploid and hexaploid species are known [2]. It has been the principal source of edible

vegetable oil due to its high oil content, high content of non-saturate fatty acids, and absence of cholesterol. Sunflower appears to be well adapted for growth under moderately saline soil conditions [3]. In the Trakya region, sunflowers are the main crop in the rotation system together with wheat. Although the sunflower price has been stable in recent years, the cost of sunflower inputs kept increasing both in Türkiye and elsewhere in the world. These increases influenced both the sunflower acreage in Türkiye and the sunflower yield performance due to a lower use of inputs [4]. The common sunflower seed, cultivated and consumed worldwide, is a source of a broad variety of nutritive components. Some of these components include protein, unsaturated fats, fiber, vitamins (particularly vitamin E), selenium, copper, zinc, folate, and iron [5].

The development of novel genetic structures that are distinguished by their high capacity to generate large yields of this crop is essential to the improvement of the local production of sunflowers. At the same time, the commercial distribution of high-yield hybrids is essential to this development. The only way that the distinguishing hybrids will be able to be brought into the country is if the degree to which they can adapt to the climatic conditions of the country is researched and the circumstances that are most suitable for them are identified [6]. The majority of farmers evaluate sunflower hybrids based on their seed output. Since seed yield is highly influenced by environmental variables, just like any other quantitative trait, it varies from year to year depending on the climatic conditions [7]. The differences between the genotypes in yield and the components of yield are mostly caused by variations in the physiological processes that occur in different genotypes after blooming [8].

As sunflower is frequently planted after the optimal planting period at different conditions and regions, a new breeding formulation is needed to improve yield under these conditions. Since early spring frost and late summer cool conditions are common, sowing dates can play a major role in determining the seed yield and quality in regions with short growing seasons [9]. The recent use of sunflower hybrid seeds has increased the yield and oil production per unit area. Seed yield and price increases of sunflowers positively affected farmers preference for sunflower cultivation, while playing an important role in meeting the vegetable oil demand of Türkiye [10]. Sunflower is both tolerant to water stress caused by deficit irrigation and capable of bearing high yield in response to irrigation inputs. Where precipitation and soil water supply are limited, most crops, including sunflowers, respond positively to irrigation concerning growth and yield. For sunflowers, the amount and timing of irrigation are important for efficient use of the applied water and for maximizing crop yields [11]. Sunflower is one of the four most important oil crops in the world. Because of its moderate cultivation requirements and high oil quality, its acreage has increased in both developed and undeveloped countries. sunflower oil is highly demanded not only for human consumption but also for chemical and cosmetic industries [12].

Sunflower seed husks have been traditionally used as feed additives in a variety of animal production systems—from broilers to dairy cattle. As an effective and cheap source for dye adsorption in water media or burned to produce heat power in oil-producing refineries [13]. Over the years this seed cake has been used as animal feed, organic fertilizer, and soil compost but from past years, considering the nutritional potential of sunflower seedcake as it remains with multifarious nutrients, various research is being conducted for its human consumption [14]. Sunflower oil is an excellent source of vitamin E /tocopherol which neutralizes free radicals, scavenges them, and prevents oxidative damage to cellular and molecular components exhibiting anti-inflammatory, cardioprotective, and anti-tumour action. Due to the presence of a wide variety of nutritional components, Sunflower seeds possess wide therapeutic dimensions with multifaceted actions [15]. Sunflower is one of the most important oilseed crops grown in the world.

Sunflower is an annual plant that originated from America and belongs to the family Asteraceae. Its production was started in Europe in the early sixteenth century. As explained earlier sunflower is an oilseed crop cultivated worldwide for oil and protein contents [16].

The production of sunflower is hindered in Somalia and elsewhere due to, among other things, a lack of access to improved seed varieties, harsh weather, low and unpredictable rainfall, a high cost of farm input, a dearth of farm machinery, and a lack of knowledge and awareness that is the biggest problem because most of the farmers are not aware that they can plant sunflower, as well as inadequate extension services [17]. The purpose of this research was to evaluate the morphological attributes of the three imported sunflower crop varieties to select a high-yield variety of sunflowers suited to Somalia's environment and to identify their morphological traits.

MATERIALS AND METHODS

Experimental Site and Period

This experiment was conducted at the Agricultural Experimental and Research Center in the Faculty of Agriculture at Zamzam University of Science and Technology, which is located around the Garasbaaleey area. Garasbaaleey is geographically located in the West direction of Mogadishu, Somalia. According to the soil test conducted by SATG, the experimental site's soil is classified as sandy loam in texture and has a pH of 7.31. Additionally, it contains 66 mg/kg of total nitrogen, 0.50 mg/kg of phosphorus, 28 mg/kg of potassium, and 0.43 mg/kg of organic matter. The Benadir region, located along the coast of Somalia, is characterized by a hot and arid climate with high year-round temperatures averaging between 25°C to 35°C (77°F to 95°F). Coastal areas, including the capital city of Mogadishu, experience elevated humidity levels due to their proximity to the Indian Ocean. Seasonal winds, such as the southwest monsoons during the wet season, influence the local climate. Rainfall varies seasonally, with the long rains (Gu) typically occurring from April to June and the short rains (Deyr) from October to December, crucial for sustaining ecosystems and agriculture. Conversely, the dry season, from July to September, brings minimal precipitation and potential drought conditions, impacting various sectors in the region. The experiment started at the beginning of the winter (Jiilaal) season during January- 2018 up to July 2018.

Research Design and Treatment

The experiment was laid out in a randomized complete block (RCB) design with three replications. The land measurement started on January 4, 2018. Using tape, the length of the area was 17.5 m the width was 9.5 m, and the total area was 166.25 m2. The land preparation was started on the same day that land measurement began up to January 10, 2018, using hand hoes to remove shrubs and residue from the previous crop and then plowing with hand hoes, shovels, and rakes. The soil type in which sunflowers were grown was a loam. Each replication consists of three plots, which generally makes nine plots in all the replications. Each plot consists of five rows with a row length of 5 m and a width of 3 m, which brings the plot area to 15 m2. Between row and plant 60cm×30cm. The experiment consisted of three new sunflower varieties (‘Metinbey’, ‘Deray’, And ‘Reyna’) which were imported from Türkiye.

Experimental Procedure

The installation of the irrigation system was done on January 13, 2018, and it was a drip irrigation system. Application of farmyard manure (FYM) was done on the same as a basal

application with the amount of 24 kg, as well as the application of diammonium phosphate (DAP) and urea on February 22, 2018, with the amounts of 223 g per plot as a side dressing before sowing. The first irrigation was done on February 25, 2018, to mix DAP and urea with the soil. The Sowing was done on February 26, 2018, as direct sowing with a manual method. The germination sequence was different, where the 'Metinbey' variety began on February 30, 2018, the 'Reyna' variety began on March 01, 2018, and the Derya variety germination on March 01, 2018. The first hoeing was done on March 09, 2018, and the second hoeing was done on March 24, 2018, and the last hoeing was on April 04, 2018. There was one thinning process done on March 5, 2018, during the cultivation of sunflowers. On March 12, 2018, a weevil attacked the sunflowers; to get rid of them, we sprayed them with Radiant 120 SC insecticides at a rate of 30ml per tank of 20L of water. On April 14, 2018, Mealy Bugs/white bugs attacked the sunflower crop, and we sprayed them with Coragen 20 SC insecticides at a rate of 208 ml per tank of 20 L of water. The disease that affected the sunflower was rust, which was controlled by a fungicide called Piper Tox84.0 at the rate of 330g in one tank of 100 of water.

Data Collection Method

Ten mature plants were randomly picked from each plot and measured for height, diameter, head weight, 1000-seed weight, seed count, grain yield, straw yield, biological yield, and harvest index. The average height of each plant was recorded in centimeters, from the ground to the top of the plant's head. Ten plants were chosen at random from each plot, and their stem diameter was measured in centimeters. Ten plants were chosen at random, and their heads were measured for their width to get an average head diameter in centimeters. The average head weight was calculated in grams by weighing the head weight of individual plants.

1000-seed weights were counted randomly from each sample and weighed by using Digital Electric Balance and recorded in grams. The number of seeds per head was determined by randomly counting each sample's seed heads. After threshing, cleaning, and weighing using a digital electric balance, grain yield was recorded for each plot in kilograms per plot and then converted to tons per hectare. Each plot's straw harvest was recorded and weighed using a digital electric scale. The biological output was recorded in kilograms per plot and then transformed into tonnes per hectare. Using the following formula, the biological yield was calculated:

Biological yield = Grain yield+ Straw yield.

Harvest Index was recorded in percentage by using the following formula:

$$\textbf{HI (\%)} = \frac{\textbf{Grain Yield}}{\textbf{Biological yield}} \times \mathbf{100}$$ After the measuring of parameters finished the data was analyzed using Statistics 8.0.

RESULTS AND DISCUSSION

In Table 1. Shows that the plant height there were highly significant variations among the varieties. 'Metinbey' variety had the highest plant height while 'Deray' had the lowest plant height at 129.63cm and 97.37 cm respectively. ([18) Studied the yield performances of some confectionery sunflower hybrids in the Trakya region they used the 'Metinbey' variety and other varieties, the plant height of 'Metinbey' was 190 cm. [19] a study to compare the performance of different sunflower hybrids. They found that Hysun-33 gave the highest plant height (148.4 cm), followed by DK-4040 (144.73 cm), and that Ausigold-62 gave the lowest plant height (123.20 cm).

Table 1. *Morphological parameter*

Variety	Plant height(cm)	Stem diameter(cm)	Head diameter(cm)	Head weight(g)
Reyna	123.33 A	5.3333 A	12.100 B	255.73 A
Deray	97.37 B	6.4667 A	14.867 A	263.93 A
Metinbey	129.63 A	6.2000 A	14.067 AB	254.97 A
Se±	3.5008	0.6101	0.6518	4.7523
Level of Significance	**	NS	NS	NS
Cv (%)	5.19	17.61	8.25	3.19

**= highly significant at 1% level, NS= non-significance, SE±= Standard Error of a Mean, CV= coefficient variation

Stem diameter There were non-significant variations among the varieties (Table 1) the highest stem diameter was observed from the ‘‘Deray’’ variety at 6.45cm followed by ‘The Metinbey’ variety at 6.2 cm while the smallest plant diameter was recorded from ‘Reyna’ variety at 5.3 cm. [20] showed that the mean value of stem diameter was (3.52) cm. In a study done by [21], a hybrid named SMH-0927 had the thickest stem 4.52 cm followed by SMH-1001, SMH-1401, and SMH-0917 which were 4.13, 3.92, and 3.91 cm thick In respectively. The hybrid named SMH-1208 had the thinnest stem diameter of 2.67 cm followed by SMH-0932, Hysun-33, and SMH-1215 having 3.01, 3.03, and 3.08 cm.

In head diameter, there were non-significant variations among the varieties (Table 1) the highest head diameter was observed from the ‘Deray’ variety at 14.9 cm followed by the ‘Metinbey’ variety at 14.1 while the smallest head diameter was recorded from ‘Reyna’ variety at 12.1 cm. [22].This study shows that 12.1-14.9 head diameter was close to those obtained previously by. [23] , Head diameters have been reported as 17.0–21.5 cm [13], 14.67–18.87 cm [14], 19.72-20.14 cm [15], 9.50-13.30 cm [16], and 16.18-18.19 cm [22].

In the head weight, there were non-significant variations among the varieties. The heaviest head weight was observed from the Deray variety at 263.9g followed by the Reyna variety at 255.7g the minimum head weight was recorded from the Metinbey variety at 254.9g. In head weight these results are in full agreement with these obtained by [24].

Table 2. *Yield parameters*

Variety	1000-seed Weight (g)	Grain Yield (t/h)	Straw Yield (t/h)	Number of Seed per head	Biological Yield	harvest index %
Metinbey	14.513 B	1.2667 A	2.3400 B	385.76 C	3.6067 B	35.407 B
Reyna	21.333 A	1.3600 A	1.2433 A	749.17 A	6.7800 A	59.493 A
Deray	15.000 B	1.2433 A	5.4200 A	455.13 B	2.0900 C	20.157 C
SE±	0.6532	0.0354	0.1357	3.9202	0.1061	1.2150
Level of Significance	**	Ns	**	**	**	**
Cv [%]	5.49	1.28	4.42	4.76	8.20	6.68

**= highly significant at 1% level, NS= non-significance, SE±= Standard Error of a Mean, CV= coefficient variation

The 1000-seed weight there was highly significant variation among the varieties, according to the 1000-seed weight presented in Table 2. Metinbey Variety (14 gr), Reyna Variety (21 gr), and finally Deray Variety (15 gr). [25] found a regional variation in sunflower output of 8.69% as measured by 1000 seed weight and concluded that all interactions between regions were crucial to maximizing output. [26] found that in 2015 the greatest 1000 seed weight for L1 was 77.65 g, while for L2 it was 70.07 g, and in 2016 it ranged from 61.48 g to 71.20 g. In the same calendar year, the smallest thousand weights at Level 2 (L2) ranged from 43.45 to 53.23 grams. The annual averages show that the G9 genotypes whose 1000 seed weight is the greatest (between 61.39 and

70.13 g) are the L1 and L2 varieties. [27], Other various values for the weight per thousand seeds have been recorded in investigations conducted on sunflowers. 61.87 – 61.98 g [25], 56.38 – 65.01 g, [17], 43.76 –52.18 g, [14] , 48.37 – 49.11 g, [9], 50.90 – 60.50 g, [13]. Our research had the lowest 1000-seed weight of similar studies, which may be attributable to climatic or genotypic variances.

The Grain yield there were non-significant variations among the varieties (Table 2), the maximum grain yield among the varieties (1.3600 t/h) was recorded from the variety Reyna Variety followed by 'Metinbey Variety (1.2667t/h), while the minimum grain yield (1.2433t/h) was documented from 'Deray' Variety. [28] showed Grain yield was changed between 313,5 and 474,8 kg/da (da: Dacares) in the Edirne location and 187,3 and 279,4 kg/da in Tekirdağ location. The highest yield was obtained from the TG-400 candidate hybrid and the lowest seed yield was obtained from the TRÇ107 control hybrid in both locations. Many studies have supported our research in grain yield, but we have found different results that may be attributable to different climatic factors.

Straw yield there was highly significant variation among the varieties, according to Straw yield. Metinbey Variety (2.3400t/h), Deray Variety (5.4200t/h), and finally Reyna Variety (5.4200 t/h). The straw yield of this study ranged from 2.3- 5.4 while Deray and Reyna had the highest straw yield. Similarly, [29] straw yield ranged from 1.7 to 8.3 tons/ha.

The biological yield there were highly significant variations among the varieties (Table 2), the most biological yield among the varieties (6.7800t/h) was recorded from the 'Reyna' Variety, followed by the 'Metinbey' Variety (3.6067t/h), whereas the least biological yield among the varieties was recorded by 'Deray' Variety (2.0900t/h). [30] recorded their highest biological yield was achieved at 14300 kg/h, and the lowest biological yield was related to 13790 kg/ha). Also, the study of [31] showed a significant increase in biological yield by 19.7%.

The number of seed per head there were highly significant variation among the varieties (Table 2), the maximum number of seed per head among the varieties (749.17t/h) was recorded from the 'Reyna' Variety, followed by 'Deray' Variety (455.13t/h), while the minimum number of seed per head (385.76 t/h) was documented from 'Metinbey' Variety.

Harvest index there were highly significant variations among the varieties (Table 2). The maximum harvest index among the varieties (59.493%) was recorded from 'Reyna' Variety, followed by 'Metinbey' Variety' Variety' Variety (35.407%) while the lowest harvest index (20.157%) among the varieties was verified by 'Deray' Variety. In the study of [32] the highest harvest index was related to (29.26A) and the lowest harvest index was achieved in (0.914A). also [33] showed 38.57% for the highest harvest index and 34.81% for the lowest harvest index.

CONCLUSION

Sunflower is a major oilseed crop in Somalia and across the globe. Oil production falls short of demand because of rising populations and associated increases in per-person consumption; the resulting gap is filled by imports. There is a reliance on imported sunflower seeds in Somalia. The oil sector and the nation of Somalia both benefit greatly from an increase in Sunflower output. Sunflower seed production should be prioritized so that we may become food self-sufficient and lessen our reliance on foreign suppliers. As a result, farmers would benefit from a reduction in the cost of inputs if they could raise sunflowers more efficiently. Researchers found that 'Reyna' and 'Deray' were the most productive because of their ability to thrive in the harsh conditions of the Somalian countryside. Sunflower cultivation is an important skill for farmers to acquire. In terms

of morphological characteristics, Metinbey (129.63cm) had the tallest height parameters among the varieties, followed by Reyna, while Deray recorded the lowest morphological parameters respectively. Reyna (59.493%) had the best yield and yield component among the cultivars according to the harvest index in terms of yield and yield component. Deray came in second, with Metinbey having the lowest yield and yield component of all the kinds, according to the data.

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