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COMPARATIVE PERFORMANCE OF VARIOUS SUNFLOWER HYBRIDS FOR YIELD AND ITS RELATED ATTRIBUTES

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ABSTRACT. An experiment to evaluate comparative performance of various sunflower hybrids for yield and its related attributes was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad, Pakistan, during autumn 2008. Twelve sunflower hybrids, i.e. G-101 (H_1), DK-4040 (H_2), SF-187 (H_3), S-278 (H_4), Hysun-33 (H_5), FH-37 (H_6), Ausigold-61 (H_7), Ausigold-62 (H_8), FSS-50 (H_9), NX-00989 (H_{10}), NX-00997 (H_{11}) and XIYU-12 (H_{12}) were included in the trail. The experiment was laid out in randomized complete block design (RCBD), having three replicates with plot size of 5m x 3m. Statistical analysis of the data showed significant differences for all the parameters. It was observed that Hysun-33 showed greater plant height (148.47 cm) and achene per head (682.70) than all other hybrids, however in case of yield (3891.0 kg ha^{-1}) and other related traits such as number of plants m^{-2}, leaf area index, head diameter and 1000-achene weight SF-187 displayed better performance by recording values (6.87), (4.33), (18.62) and (49.11g), respectively, following Hysun-33 for most of the traits. From the results of experiment it can be concluded that the hybrids SF-187 and Hysun-33 showed high productivity and are best adapted to the climatic conditions of Faisalabad.

Key words: Sunflower; Hybrid; Performance; Yield.

INTRODUCTION

Pakistan is the seventh most densely inhabited country of the planet with predictable population of 160.50 million which is still multiplying @ 2.10 % per annum (Govt. of Pakistan 2008). So, it is a matter of deep concern to manage

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with the edible oil needs of such a huge population due to presented vast gap between population and consumption. Edible oil is determinedly scarce in Pakistan which spends an enormous amount of foreign exchange on its importation. In Pakistan the utilization of edible oil and fats was 12.2 kg per year per capita during 1996 - 1998, that increased to 13.1 kg per year during 1999-2001 (FAO, 2003). The entire accessibility of edible oils in 2006-2007 was 2.796 million tons. Local production stood at 0.857 million tons, which accounts for 28 % of total availability. The left over 72 % was made available through imports.

Sunflower can play an important role in narrowing the wide gap between production of edible oils in the country and its import (Khan *et al*., 2003). Sunflower is one of the four major oilseed crops (soybean, peanut, rapeseed and sunflower), grown for edible oil in the world. As a plant of economic importance sunflower seed contains 25-48% oil and 20-27 % protein (Hatam and Abbasi, 1994). Sunflower is grown on an area of 1250 thousand acres in Pakistan, with a production of 755 thousand tones sunflower seed and 287 thousand tones oil (Govt. of Pakistan 2009). Average achene yield of sunflower in Pakistan is very low (1810 kg ha^{-1}), as compared with other sunflower growing countries, with yield of 3015 kg ha^{-1} (Bilal, 2004). Its expansion since its introduction remained restricted due to the absence of systematic market mechanism, non-availability of seed adaptation to local environmental conditions and development of cultivars/hybrids locally. Almost all the seed of hybrid sunflower is imported and due to different agro-ecological circumstances of their development, evaluation and production, so full potential of yield is not achieved in our climatic conditions. Furthermore, there is always potential danger and threat of new insect pests and diseases. All this necessitates rising well adapted, high yielding sunflower genotypes under local agro-ecological conditions (Khokhar *et al*., 2006).

Growth analysis has been applied to sunflower on a number of occasions (McWilliam *et al*., 1974; Harris *et al*., 1982; Fereres *et al*., 1983; Danuso *et al*., 1985). Valero *et al*. (1994a) applied functional growth analysis to study with a variety of hybrids. In a comparative study, Eva and Andrei (1990) observed that seed yield and seed oil yield ranged from 4.3 to 4.72 t ha^{-1} and 2.2 to 2.55 t ha^{-1} in hybrid Festive, correspondingly when compared with hybrid Fundulea 206. Maddonni and Satorre (1992) reported that hybrid Contiflor-3 had the uppermost seed yield and dry matter production in the early sown trial. In the same way, Mancuso (1992) reported that hybrid Cargill S400 had the maximum oil content (46.2%), but the most appropriate cultivar for use across favorable environments was Peredovick (43.9%). Likewise, Hanif *et al*. (1996) worked out that variety NK-212 was the most excellent for plant height and 1000-grains weight while, Hysun-44

gave maximum grains per plant. Except stem thickness, leaf area and 1000-grain weight the varietals means were significantly different for all the parameters.

Sunflower production is greatly affected by choice of hybrid. When selecting a hybrid, we should carefully consider seed yield potential, oil content, oil composition, maturity, stalk strength, and disease resistance. Choose hybrids with characteristics that best suit our needs and production practices. Keeping all this in view, present study was designed to investigate comparative yield of different hybrids of sunflower so as to choose best hybrid under irrigated conditions of Faisalabad.

MATERIALS AND METHODS

Experiment was conducted at the research area of Agronomy Department, University of Agriculture, Faisalabad, Pakistan. The experimental area lies between 30.35-31.47^0 N latitude and 72.08-73^0 E longitude, at an elevation of 150 m from the sea level. The experiment was laid out in randomized complete block design with triplicate run and a net plot size of 5 x 3 m. Experimental treatments comprised of twelve sunflower hybrids: G-101 (H_1), DK-4040 (H_2), SF-187 (H_3), S-278 (H_4), Hysun-33 (H_5), FH-37 (H_6), Ausigold-61 (H_7), Ausigold-62 (H_8), FSS-50 (H_9), NX-00989 (H_{10}), NX-00997 (H_{11}) and XIYU-12 (H_{12}).

Seedbed was prepared by cultivating soil for 2-3 times with cultivator followed by planking. The crop was sown on well prepared seed bed with the help of dibbler and seed rate of 6 kg ha^{-1} maintaing row to row (RxR) distance of 75 cm and plant to plant (PxP) distance of 22 cm. Thinning was done at growth stage of 2-4 leaf. Fertilizer was applied @ 150 kg N and 100 kg P_2O_5/ha. Half of the N and all the phosphorous were applied at sowing in the form of urea and diammonium phosphate (DAP), while the remaining nitrogen was applied with first irrigation after 20 days of sowing and irrigation thereafter were applied according to need of the crop. The crop was kept weed free by hoeing twice during the growth period. All other agronomic practices were kept normal and uniform for all the treatments during the entire growth period. Observations regarding the number of plant m^{-2}, plant height at maturity (cm), leaf area index, head diameter (cm), number of seed head^{-1}, 1000 - achene weight (g), achene yield (kg ha^{-1}) were recorded using standard procedures during the course of study. The number of plants was determined from whole plot and then converted into plant m^{-2}. Height of ten plants randomly selected from the central two rows in each treatment was measured from ground level to the top edge of the collar disc and then their average was calculated. Leaf area index was measured with the help of leaf area meter. Head diameter was measured from one edge of the head to the other in five head and their average was worked out. Similarly, five representative discs were chosen from each plot and then total grains disc^{-1} was counted. Three samples of 1000 grains from each plot were counted and their average weight was recorded. Two central rows from each treatment were harvested, threshed and weighted to record achene yield plot^{-1} then converted into kg ha^{-1}. The data collected during the experiment was analyzed according to RCB design and upon obtaining significant differences; least significant differences (LSD) test at 5% probability was applied (Steel *et al.*, 1997).

Table 1 - Yield and yield components of various hybrids of sunflower

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Treatments / Hybrids	Parameters						
	Number of plants m^{-2}	Plant height (cm)	Leaf area index	Head diameter (cm)	Achene per head	1000 grain weight (g)	Achene yield (kg ha^{-1})
H_1= G-101	6.78 d	141.87 c	2.83 j	15.85 f	566.00 ab	48.76 cd	3647.0 f
H_2= DK-4040	6.85 b	144.73 b	3.73 d	18.50 b	582.30 ab	48.96 b	3560.0 g
H_3= SF-187	6.87 a	142.53 c	4.33 a	18.62 a	678. 70 a	49.11 a	3891.0 a
H_4= S-278	6.82 c	138.23 d	3.34 f	15.32 i	527.60 abc	48.62 e	3507.0 i
H_5= Hysun-33	6.87 a	148.47 a	4.14 b	16.60 c	682.70 a	48.96 b	3759.0 b
H_6= FH-37	6.83 c	137.27 d	3.13 g	15.17 j	517.70 bc	48.78 c	3486.0 j
H_7= Ausigold-61	6.82 c	131.37 e	2.95 i	18.60 a	548.00 ab	48.74 d	3486.0 j
H_8= Ausigold-62	6.82 c	123.20 h	3.30 f	16.42 e	515.40 bc	48.64 e	3466.0
H_9= FSS-50	6.73 e	127.50 g	3.05 h	15.36 h	574.30 ab	48.54 f	3555.0 h
H_{10}= NX-00989	6.83 c	126.50 g	3.91 c	15.32 i	516.40 bc	48.55 f	3744.0 c
H_{11}= NX-00997	6.83 c	129.50 f	3.45 e	15.81g	382.44 c	48.12 h	3666.0 e
H_{12}= XIYU-12	6.83 c	126.37 g	3.67 d	16.55 d	602.80 ab	48.37 g	3717.0 d
LSD	0.011	1.561	0.069	0.039	155.28	0.032	4.168

RESULTS AND DISCUSSION

Number of plants m^{-2}

Statistical analysis of the data indicated (*Table 1*) that number of plants m^{-2} was significantly affected by various hybrids of sunflower. It can be inferred from the data that Maximum plant population was observed in SF-187 (6.87 m^{-2}) and Hysun-33 (6.87 m^{-2}), which were statistically similar with each other. Minimum plant population was recorded in FSS-50 (6.73 m^{-2}). Differences among hybrids for plant population per unit area may be attributed to the better germination percentage. These findings are in line with Bakht *et al*. (2006) as they found significant differences for plant population among various sunflower hybrids due to variable germination percentage. Contrary to the present findings, some scientists have reported non-significant differences among sunflower hybrids (Barros *et al*., 2004).

Plant height at maturity

Analyzed data about the plant height at maturity of different hybrid, presented in *Table 1*, show significant differences among the various treatments. Comparison of treatment means indicated that Hysun-33 gave the maximum plant height (148.4 cm), followed by DK- 4040 (144.73 cm) and were statistically different from all other treatments. Minimum plant height (123.20 cm) was recorded in case of Ausigold-62. These differences are due to variability in environmental conditions and genetic makeup. These results are supported by Espinosa *et al*. (1992) and Bakht *et al*. (2006), who observed significant differences for plant height among sunflower hybrids.

Leaf area index

Significantly higher, leaf area index was recorded in case of SF-187 (4.33) (*Table 1*). It was trailed by Hysun-33 and NX-00989 by giving (4.14; 3.91) leaf area index, respectively, while the lowest leaf area index was recorded in G-101 (2.83). Wahab *et al*. (1992) and Ali *et al*. (2000) also observed different leaf area index for different hybrids, possibly due to different genetic makeup of hybrids. The leaf area index of sunflower was lower during early growth period, with a gradual increase over the time and achieved maximum value at flowering stage. Similarly, Mirallas *et al.* (1997) also observed that there was a gradual increase in LA1 with the advance in the age of the crop, the greatest value reached during full flowering.

Head diameter

Comparative performance of head diameter in sunflower hybrids depicted that head diameter was affected significantly by different hybrids (*Table 1*). The largest head diameter (18.62 cm) was recorded in case of SF-187, which was statistically at par with Ausigold-61 (18.60 cm), while smallest head diameter (15.17 cm) was observed in FH-37. The results were in

accordance with Khan (2003), Sassikumar and Gopalan (1999) and Goksoy *et al*. (1999), who reported significant genetic differences for head diameter among hybrids. On the other hand, Yousaf *et al*. (1989) found non-significant differences among seven sunflower cultivars.

Number of achene per head

Statistical analysis of the data showed that various sunflower hybrids had significantly influenced number of seed head^{-1} (*Table 1*). Highest number of achene per head (682.7) was recorded in Hysun-33, which did not significantly differ from SF-187, XIYU-12, DK-4040, FSS-50, G-101, Ausigold-61 and S-278 by recording (678.70; 602.80; 582.30; 574.30; 566.0; 548.0; 527.60) achene per head, respectively. However statistically, the lowest number of achene per head (382.44) was recorded in NX-0097. Above results are in accordance with those of Bakht *et al*. (2006) and Hanif *et al*. (1996), who also reported significant differences among sunflower hybrids for number of achenes per head.

1000-achene weight

Statistically analyzed data on 1000-achene weight showed highly significant differences among various hybrids (*Table 1*). The data demonstrated that the hybrid SF- 187 generated the maximum 1000-grain weight (49.11 g). It was trailed by Hysun-33 and DK- 4040, that were statistically at par with each other recording (48.96 g) weight each, while minimum 1000-achene weight was found in NX-0097 (48.12 g). These findings are in accordance with Ahmad (2001) and Bakht *et al*. (2006), who also reported significant differences among sunflower hybrids for hundred seed weight.

Achene yield

The comparative performance of different hybrids is ultimately determined by the level of achene yield per hectare, which, in turn, is a function of cumulative behavior of all the yield components. Comparison of treatments means (*Table 1*) shown that the statistically highest achene yield (3891 kg/ha) was obtained in SF-187, followed by Hysun-33 and NX-00989, which produced achene yields of 3759 and 3744 kg/ha, respectively, whereas Ausigold-62 provided least achene yield of 3466 kg/ha. Highest yield in SF-187 was might be due to higher plant population, leaf area index, head diameter and 1000 grain weight than all other hybrids under study, which might be due to its higher genetic potential and its better adaptability under present climatic conditions. These results are in line with those of Paradisi (1983), Beg and Aslam (1984) and Ali *et al*. (2007) reported that achene yield was affected significantly by different plant population, head diameter, number of achene per head and 1000-achene weight.

CONCLUSION

From the above experimental data, we concluded that under the agro-climatic conditions of Faisalabad, Pakistan, the hybrids SF-187 and Hysun-33 performed best for yield and most of its related traits, so these can be successfully planted to sustain or improve sunflower productivity.

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