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Quantitative and Qualitative Traits of Sunflower (*Helianthus annus* L.) as Influenced by Planting Dates and Nitrogen Application

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ABSTRACT

An experiment was undertaken to study the effects of planting dates and nitrogen fertilizer application on growth, yield and oil contents of sunflower at the Agronomic Research Area, University of Agriculture, Faisalabad during 1999. Two sowing dates i.e. 10 and 30 August were compared with five nitrogen levels viz. 0, 50, 100, 150 and 200 kg N ha^{-1}. Results on growth and yield (i.e. leaf area per plant, plant height, head diameter, number of filled achenes per head, 1000-achene weight, biological and achene yields) were reported significantly higher in the crops sown earlier on 10 August with the treatment 150 kg N ha^{-1} and lower yield was attributed in case of late sowing crops on 30 August.

Key Words: Achene; Biological yield; Growth; Oil contents; Nitrogen; Sunflower

INTRODUCTION

Sunflower (*Helianthus annus* L.), because of its quantity and high quality of edible oil enjoys an important position in the world among the new oil-seed crops. Amongst factors responsible for increasing yield, judicious use of nitrogen fertilizer and proper sowing time are of prime importance. Increased intensity of cropping and introduction of high yielding varieties have caused considerable drain of nitrogen and crops showed a positive response to added nitrogen in the soil (Malik *et al*., 1989; Ranjha *et al*., 1990). Information about the nutritional requirements and sowing time are required for available new high yielding hybrid cultivars. Hiray *et al*. (1992) reported that sunflower grown on deep black soil produced mean seed yield of 1.28, 1.75, 1.89 and 1.93 tons ha^{-1} with nitrogen fertilizer at the rate of 0, 40, 80 and 120 kg N ha^{-1} respectively. Khan (1995) produced the highest seed yield of 3.40 tons ha^{-1} along with improvement in the oil contents of sunflower in the treatment where fertilizers were applied at the rate of 100 kg N and 150 kg P_2O_5 ha^{-1}. Similar findings were also observed by Tahir (1996) as he found the highest seed yield of 3.45 tons ha^{-1} with a combination of nitrogen and phosphorus fertilizers at the on 150 kg N and 100 kg P_2O_5 ha^{-1}.

Ishaque (1997) studied that application of nitrogen at the rate of 125 kg ha^{-1} produced large size heads, more number of seeds per head, 1000-grain weight and higher yield as compared to nitrogen treatments of 190 and 250 kg ha^{-1}. Lupa *et al*. (1990) conducted a field experiment and studied sunflower cultivars with different planting dates ranging between 28 March and 10 May; he reported that seed yield decreased from 3.57 to 3.27 tons ha^{-1} with delay in sowing. Similar results as 1.32 tons ha^{-1} of seed yield decreased with late sowing (Jadhar, 1991) and decrease in seed yield were also reported by other scientists (Millar *et al*., 1984; Hussain, 1985; Hosmani *et al*., 1989). However, Razzaq (1994) concluded in different way that in autumn planting dates did not affect the seed yield statistically. Experiment was planned with the aim to study the appropriate sowing time of sunflower in relation to nitrogen fertilizer application.

MATERIALS AND METHODS

The experiment was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad during 1997 on a sandy clay loam, having 0.96% organic matter, 0.06% nitrogen, 6.20 ppm phosphorus and 118 ppm potassium. The treatments were allocated in a randomized block design with factorial arrangement with four replicates having a net plot size of 2.4m × 5m. The experiment comprised of the following treatments viz planting dates; 10 August & 30 August and nitrogen fertilizer levels of 0, 50, 100, 150 and 200 kg N ha^{-1}. Sunflower hybrid (FH_1) was sown with the help of a single-row hand drill in 60 cm apart rows spacing using recommended seed rate of 8 kg ha^{-1}.

Side placement of total phosphorus and potassium and half of the nitrogen fertilizers were applied at the time of sowing, while the remaining half nitrogen at the time of first irrigation. The crop was kept weed free by hoeing twice during the growth period. Thinning was done at 4-5 leaf stage maintaining plant to plant distance of 25 cm. Earthing up was done after second irrigation to protect the crop from lodging. All other agronomic practices were kept normal and uniform for all treatments throughout the growth of crops.

Observations were recorded by using standard procedures. The data collected were analyzed statistically using Fisher's analysis of variance technique and Least Significant Difference (LSD) test at 0.05 probability levels to compare the differences among treatment's means (Steel & Torrie, 1984).

RESULTS AND DISCUSSION

Results (Table I) indicate that interactive effects of sowing dates and nitrogen application and individual effects of the two factors significantly influenced the leaf area per plant. Treatment where the highest rate of nitrogen was applied i.e. 200 kg N ha^{-1} produced the highest leaf area of 5366.1 cm^2 when sown on 10 August (S_1) which was significantly different from all other combinations and it was followed by the treatment where Nitrogen was applied at the rate of 150 kg ha^{-1} that was produced the leaf area of 4986.4 cm^2. Treatments with lower levels of nitrogen fertilizer (0, 50 and 100 kg N ha^{-1}) sown 10 August produced the leaf area of 2413.7, 3786.7 and 4062.3 cm^2, respectively.

Nitrogen fertilizer levels also gave a similar trend when sown on 30 August. It is evident from the results that nitrogen fertilizer increased the leaf area significantly with each increment of fertilizer application. Both the planting dates differed significantly from each other, however, planting on 10 August (early) significantly produced the higher leaf area than late planting on 30 August. It is obvious from the results that delayed sowing and low nitrogen fertilizer application significantly decreased the leaf area as compared with the early sown crops with higher levels of nitrogen fertilizer. It might be due to increased vegetative growth caused by nitrogen application. Similar findings were also reported by other scientists (Faizani *et al*., 1990; Hiremath, 1990; Ahmad, 1996).

Plant height of plants is a function of the combined effect of genetic make-up, environmental influences and nutritional status of the soil. Data on plant height (Table I) showed significant differences among the treatments. Crop sown on 10 August significantly produced the taller plants (123.7 cm) than that sown on 30 August showing a plant height of 120.2 cm. This may be attributed to better growth of plants in early sown crops. A significant increase in plant height occurred with the application of nitrogen fertilizer to crops as compared to the control where nitrogen was not applied. However, increase in plant height was consistent with increase in the nitrogen rates and the maximum plant height of 127.6 cm was recorded with the treatment where 200 kg N ha^{-1} was applied and the minimum (112.6 cm) was recorded in the control treatment. The increase in plant height due to nitrogen application to sunflower crop was also reported by Tahir (1996). The interactive effect of nitrogen and planting dates on plant height of sunflower was found to be non-significant.

Production potential of sunflower crop is determined by the size of its heads which is the most important yield contributing component. It is more or less a genetically controlled character but also influenced by the environment of the plant. The head diameter was the maximum (48.5 cm) when the crop was treated with 200 kg N ha^{-1} and sown on 10 August and it was at par with that of 150 kg N treatment. Similar trend of nitrogen was achieved when sown on 30 August but responses were not like that sown earlier. Result (Table I) shows that addition of nitrogen fertilizer up to 150 kg ha^{-1} and early sowing significantly increased the head size over delayed sowing and low N addition. Similar promotive effects of sowing and N fertilizer application on head size of sunflower have also been reported by Ishaque (1997).

Weight per 1000-achenes is a king pin in the formulation of final seed yield of sunflower. 1000-achene weight was significantly higher in early sown crop (10 August) than that sown on 30 August. The weight per 1000-achenes was statistically the same with either 200 or 150 kg N ha^{-1} added to the crop and the mean weight recorded was

Table I. Effect of inoculation and different levels of phosphorus fertilizer on growth, yield and oil contents of sunflower crop

Treatments	Leaf Area per plant (cm^2)	Plant height (cm)	Head diameter (cm)	1000-seed weight (g)	Biological yield (tons ha^{-1})	Seed yield (kg ha^{-1})	Seed oil contents (%)
10 August							
0 kg N ha^{-1}	2413.7f	114.9	29.6e	37.9	6.8e	614.6g	36.9c
50 kg N ha^{-1}	3786.7d	121.5	38.7c	38.7	11.0b	939.4c	38.8ab
100 kg N ha^{-1}	4062.3c	124.3	42.9b	40.7	12.0a	960.9c	39.9a
150 kg N ha^{-1}	4986.4b	129.0	47.9a	43.7	12.6a	992.5a	39.3a
200 kg N ha^{-1}	5366.1a	130.2	48.5a	42.4	10.2c	965.2b	39.0a
Mean	**4123.0**	**123.9a**	**41.5**	**40.6a**	**10.5**	**894.5**	**38.8**
30 August							
0 kg N ha^{-1}	1757.9h	110.4	22.8f	33.6	4.9f	477.9h	37.3c
50 kg N ha^{-1}	2176.1g	118.3	33.3d	37.6	7.9d	789.8f	37.7bc
100 kg N ha^{-1}	2555.3f	121.9	38.4c	37.9	9.8c	838.5e	38.8ab
150 kg N ha^{-1}	3588.4e	125.6	43.1b	39.9	10.0c	910.1d	37.0c
200 kg N ha^{-1}	3608.2e	125.0	43.8b	39.3	10.3c	905.5d	36.8c
Mean	**2737.2**	**120.2b**	**36.32**	**37.7b**	**8.6**	**784.4**	**37.5**
LSD	**156.40**	**1.026**	**1.717**	**1.170**	**0.648**	**24.29**	**1.298**

40.6 g. Similarly, the lower N levels (50 & 100 kg ha^{-1}) were at par with each other but both differed significantly from the treatment where zero N was applied. Thus, 1000-achenes weight decreased with delayed sowing and addition of N caused a significant increase in this characteristic. These results support the findings of Hosmani *et al*. (1989), Razzaq (1994) and Ishaque (1997).

Biological yield is an important parameter to determine the photosynthetic activity of a crop. However, in early sown crop, nitrogen fertilizer increased the total biomass significantly uptil 150 kg N ha^{-1} but in late sown crop (30 August) nitrogen increase the biomass significantly uptil 100 kg ha^{-1}. It is again evident from the Table I that early sown crop produced significantly higher biological yield than late sown crop. Increase in biological yield from the early sown crop fertilized at the rate of 150 kg N ha^{-1} is attributed to increase in leaf area, plant height and head diameter.

Achene yield is a function of integrated effects of various yield components like number of plants per unit area, head size, number of seeds per head and 1000-seed weight developed under a particular set of environmental conditions. The treatment receiving 150 kg N ha^{-1} sown on 10 August gave maximum seed yield of 992.5 kg ha^{-1} and it differed significantly from all other combinations. In late sown crop, the treatments where the higher N levels (150 & 200 kg ha^{-1}) were applied produced significantly higher yield than rest of the combinations. However, the minimum seed yield of 477.9 kg ha^{-1} was observed in the control treatment sown on 30 August. Increase in seed yield from the early sown crop with 150 kg N ha^{-1} is attributed to increase in number of filled seeds per head, 1000-achene weight and biological yield. These results are in agreement with the findings of Patil *et al.* (1992) and Ishaque (1997).

An oil seed crop rich in oil contents of high quality is the ultimate goal of a grower. Quality of sunflower seed is determined from the oil contents. It is revealed from the data that sowing dates and nitrogen levels produced highly significant effect on achene oil contents where as the interaction between the two factors was significant at 0.05 level of probability. Maximum oil percentage (39.9) was recorded with in treatment where nitrogen was applied at the rate of 100 kg ha^{-1} sown on 10 August. The result led to the conclusion that early-planted crop had higher oil percentage in grains under added nitrogen conditions to the crop as compared to the control. Delayed sowing, on the other hand showed a decrease in the oil contents even in the nitrogen added treatments. It might be due to better plant growth and better utilization of added nutrition by the plants in early planting. These results are in conformity with the findings reported by Kasem and Mesilby (1992b) and Ishaque (1997)

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