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Suitable Level of N, P and K for Harvesting the Maximum Economic Returns of Sunflower (*Helianthus annuus* L.)

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ABSTRACT

The study was undertaken to determine suitable levels of N, P and K fertilizers for harvesting the maximum economic returns of hybrid sunflower. Experiment comprised of three N levels (0, 110, and 130 kg ha^{-1}), four P levels (0, 70, 90 and 110 kg ha^{-1}) and four K levels (0, 70, 90 and 110 kg ha^{-1}). Increasing levels of N, P and K levels increased yield and yield components but decreased the seed oil content. Although, the highest seed yield (1231.47 kg ha^{-1}) was recorded when the crop was fertilized @ 130-90-90 kg NPK ha^{-1} and highest net benefit (Rs. 10792.00) was obtained when N, P and K fertilizers were applied @ 110-70-0 kg ha^{-1}, respectively.

Key Words: Sunflower; NPK combinations

INTRODUCTION

Pakistan has made an impressive progress in the development of Agriculture sector but it is still facing an acute shortage of edible oil. The statistics reveal that the domestic production of edible oil was only 0.58 million tones while 1.42 million tones was imported worth US $ 800 million to meet the total requirements of 2.0 million tones of edible oil in the country during 2001-2002 (Govt. of Pakistan, 2002). It has greater potential for bridging up the gap between the supply and demand of edible oil in the country (PARC, 1994). Sunflower oil has an ideal combination of saturated and poly-unsaturated fatty acids, which are important for the reduction of high serum cholesterol levels, and its oil cake contains higher amount of protein (40-44%) and balanced amino acids (Balasubramaniyan & Palaniappan, 2001). The main reason of low seed yield in our country is lack of proper production technology. Sunflower responds relatively better to management factors and biomass accumulation in sunflower is correlated with nutrient uptake throughout its life span (Singh & Singh, 1980). Growth, seed yield and seed oil content are increased with increasing rates of nitrogen (Cheema, 1996). Fertilizer treatment of 100-75 NP ha^{-1} proves to be the most favorable in improving the oil content of sunflower (Munir, 1990). Potassium had no effect on plant height but affected seed and oil yields (Al-Nawaz, 1988). Gu and Gao (1998) reported that deficiency of N, P and K decreased seed yield of hybrid sunflower by 19.4, 15.3 and 22.7%, respectively. Khan *et al.* (1984) also stated that sunflower hybrids respond well to application of fertilizers and they recorded significant increase in its seed yield by applying N, P, K in combination. Keeping all this in view, the present study was conducted to determine a suitable level of N, P and K for harvesting the maximum economic returns of hybrid sunflower under irrigated conditions of Faisalabad.

MATERIALS AND METHODS

An experiment was conducted to determine a suitable level of N, P and K for harvesting the maximum economic returns of sunflower (*Helianthus annuus* L.) cv. FH 81 at the Agronomic Research Area, University of Agriculture, Faisalabad during autumn 2001. The experiment was laid out in a randomized complete block design (RCBD) with three replications and net plot size was 6m x 3m. The experiment comprised of nine treatments viz. 0-0-0, 110-0-0, 110-70-0, 110-70-70, 110-90-70, 110-90-90, 130-90-90, 130-110-90 and 130-110-110 Kg ha^{-1} NPK, respectively. Crop was sown on well-prepared seedbed in 75 cm spaced rows with the help of single row hand drill using seed rate of 6 Kg ha^{-1}. The whole of Phosphorus and Potash along with half of Nitrogen fertilizer in the form of TSP, SOP and Urea, respectively were applied at sowing time and remaining Nitrogen was applied with first irrigation after 20 days of sowing. Thinning was done when the crop was at 3-4 leaf stage to maintain plant to plant distance. All other agronomic practices were kept normal and uniform. Observations on various agronomic traits were recorded by using standard procedures. The seed oil contents were determined by using Soxhlet Fat Extraction Method with the help of Soxhlet Apparatus in Animal Nutrition Laboratory, University of Agriculture, Faisalabad. Economic Analysis (Table II) was worked out on the basis of cost of production using prevailing market prices. The data collected were tabulated and analyzed statistically by using the Fisher's Analysis of Variance Technique. Duncan's Multiple Range (DMR) Test at 5% probability level was employed to test the significance of differences among the treatments' means (Steel & Torrie, 1984).

RESULTS AND DISCUSSION

Data given in Table I show that plant height at maturity was affected significantly by different levels of nitrogen, phosphorus and potassium over control. Maximum plant height of 117.93 cm was recorded in plots fertilized at the rate of 130-110-90 Kg NPK ha^{-1} and it was statistically at par with T_5, T_7 and T_9 treatments. Whereas, minimum plant height of 76.94 cm was recorded in check plots, where no fertilizer was applied. These results are in line with those of Robinson (1979) and Osman (1980) who reported that nitrogen alone or in combination with phosphorus and potash increased plant height.

The head diameter was affected by varying levels of nitrogen, phosphorus and potassium (Table I). Results show that most of the fertilizer treatments produced higher head diameter and differed significantly from the control. The plants in plot fertilized @ 130-90-90 Kg NPK ha^{-1} produced heads of maximum size (13.27 cm) which was statistically at par with T_5, T_6, T_8 and T_9 treatments. The lowest head diameter of 8.57 cm was recorded in control plots, which, however, did not differ statistically from T_2 and T_3 treatments. These results are quite in line with the work of Osman (1980) and Akram (1989) who reported that nitrogen alone or in combination with phosphorus and potash increased head diameter over control.

Table I substantiates that the effect of N, P and K applications on the number of achenes $head^{-1}$ was highly significant. Maximum number of achenes per head (284.3) was recorded in plots fertilized @ 130-110-90 Kg NPK ha^{-1}. It, however, did not differ statistically from treatments where 130-90-90, 130-110-110 and 110-90-90 Kg NPK ha^{-1} were applied, respectively. The lowest number of achenes (161.7) per head were observed in case of control. Singh *et al.* (1975), Kamal *et al.* (1980) and Munir (1990) stated that number of achenes per head was significantly affected by nitrogen application with phosphorus.

Table I reveals significant increase in 1000-achene weight by the application of N, P and K combinations over control. Application of 130-90-90 Kg NPK ha^{-1} produced the heaviest achenes (74.63 g/1000 achenes), which however, remained statistically at par with T_8 and T_9 treatments. Lowest 1000-achene weight (39.33 g) was obtained in control plots. These findings are supported by the results of Singh *et al.* (1975), Nur (1975) and Kamal (1980) who reported increase in achenes' weight with increasing fertilizer dose.

A perusal of the Table I indicates that achene yield was increased significantly by various N, P and K applications over control. The maximum achene yield (1231.47 Kg ha^{-1}) was obtained from the plots treated with 130-90-90 Kg NPK ha^{-1} but remained statistically at par

Table I. Net Benefit and agronomic traits of sunflower as affected by different NPK levels

TreatmentsN-P-K(Kg ha^{-1})	Plant height(cm)	Head diameter(cm)	No. of achenes $head^{-1}$	1000-achene weight(g)	Achene yield(Kg ha^{-1})	Achene oil content(%)	Net benefit (Rs.ha^{-1})
T_1 (0-0-0)	94.97c*	8.57e	161.7c	39.33e	498.17d	42.17a	7172.55
T_2 (110-0-0)	97.67b	9.77de	242.3b	59.50d	831.47c	41.83ab	9981.05
T_3 (110-70-0)	98.67b	10.27cde	247.0b	64.03c	985.20abc	41.00bc	10792.00
T_4 (110-70-70)	100.20b	10.73bcd	247.3b	68.43b	942.60bc	40.00cd	7913.00
T_5 (110-90-70	113.33ab	11.97abc	244.7b	68.20bc	1101.87abc	40.83bc	9802.05
T_6 (110-90-90)	101.53b	12.50ab	274.3a	69.13b	1103.70abc	40.00cd	9189.50
T_7 (130-90-90)	106.47ab	13.27a	278.3a	74.63a	1231.47a	41.50ab	10754.05
T_8 (130-110-90)	117.93a	12.63a	284.3a	71.10ab	1135.17ab	39.00de	8809.55
T_9 (130-110-110)	108.73ab	11.57abc	276.0a	72.43ab	1101.83abc	38.50e	7669.45

* Any two means not sharing a letter in common differ significantly at 5% probability level

Table II. Economic analysis

	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	Remarks
Seed yield	498. 17	814.47	985.20	942.60	1101.87	1103.7 0	1231.47	1135.17	1101.83	kg ha^{-1}
Gross income	7472.55	12217.05	14778	141.39	16528.05	16555.5	18472.05	17027.55	16527.43	@Rs.600/40kg
Fertilizer cost	0	1936	3686	5926	6426	7066	7418	7918	8558	Urea, TSP and SOP @ Rs.405,565 and 800 per bag respectively
Herbicide cost	230	230	230	230	230	230	230	230	230	Dual gold @ Rs. 230/lit.
Rent of sprayer	20	20	20	20	20	20	20	20	20	@ Rs. 20 ha^{-1}
Labour charges	50	50	50	50	50	50	50	50	50	@Rs.50/man/day
Total cost	300	2236	3986	6226	6726	7366	7718	8218	8858	
Net benefit	7172.55	9981.05	10792	7913	9802.05	9189.5	10754.05	8809.55	7669.45	

T_1 = Control; (No NPK) T_6 = 110-90-90 NPK $Kgha^{-1}$
T_2 =110-0-0 NPK $Kgha^{-1}$ T_7 = 130-90-90 NPK $Kgha^{-1}$
T_3 = 110-70-0 NPK $Kgha^{-1}$ T_8 = 130-110-110 NPK $Kgha^{-1}$
T_4 = 110-70-70 NPK $Kgha^{-1}$ T_9 =130-110-110 NPK $Kgha^{-1}$
T_5 = 110-90-70 NPK $Kgha^{-1}$

with most of the fertilizer treatments. The lowest achene yield (498.17 Kg ha^{-1}) was recorded in the control. The highest achene yield in case of 130-90-90 Kg NPK ha^{-1} may be attributed to significantly higher head diameter, higher number of achenes per head and 1000-achene weight. Zubriski and Zimmerman (1974), Ahmad (1985), Akram (1989) reported that nitrogen alone or in combination with phosphorus and potash significantly increased the achene yield against control.

Different combinations of NPK had highly significantly affected achene oil contents (Table I). The maximum oil contents (42.17%) were produced in achenes from check plots. However, it was, statistically at par with those of T_2 (110-0-0 Kg NPK ha^{-1}) and T_7 (130-90-90 Kg NPK ha^{-1}) treatments, respectively. The plot fertilized at the rate of 130-110-110 Kg NPK ha^{-1} produced the minimum (38.50%) oil contents in achenes. The results are in line with that of Ahmad (1985) but contrary with that of Aslam (1982). Ahmad reported that oil contents were not affected by fertilizer applications, but Aslam (1982) maintained that oil contents in achenes were significantly decreased over control by the application of fertilizer.

Table I reflects that highest net benefit (Rs.10792.00 ha^{-1}) was obtained from T_3 (110-70-0 Kg NPK ha^{-1}) followed by T_7 (130-90-90 Kg NPK ha^{-1}) while control resulted in least net benefit (Rs. 7172.55 ha^{-1}). Although application of 130-90-90 Kg NPK ha^{-1} gave more yield as compared to the other treatments and also gave considerably higher returns but this is not economical due to higher cost of fertilizers. So, it can safely be concluded that a fertilizer dose of 110-70-0 Kg NPK ha^{-1} was the most appropriate and economical level for harvesting a good sunflower crop.

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