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GROWTH, YIELD AND OIL CONTENT OF SPRING SUNFLOWER AS INFLUENCED BY NPK FERTILIZER APPLICATION

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A study to determined the effect of NPK application at 0-0-0, 75-0-0, 0-50-0, 0-0-50, 75-50-0, 75-0-50-, 0-50-50 and 75-50-50 Kg NPK/ha, on the seed yield and oil content of spring sunflower was conducted on sandy clay loam soil having on an average 0.063 % N, 8.8 ppm available P_2O_5 and 224 ppm available K_2O during the year 1984. The whole of N, P_2O_5 and K_2O in the form of urea, SSP and SOP, respectively were applied at sowing in the respective treatments. The results revealed that the average seed yield increased from 18.84 quintals/ha without N to 26.45 quintals/ha with 75 Kg N/ha and a further increase to 27.77 quintals/ha with 50 Kg K_2O/ha alongwith N was not significant. On the other hand seed oil content were reduced by 5.63 percent with the application of 75 Kg N/ha alone while addition of P, K or PK each at the rate of 50 Kg/ha to 75 Kg N improved the seed oil content almost to the level of unfertilized one. However, increase in seed yield as a result of N application led to an increase in oil yield/ha. It was further observed that addition of P&K to N did not contribute considerably towards increasing 1000-seed weight over N alone, while K application in combination with N played significant role in increasing the number of seed per head. The plant height increased significantly in plots fertilized with N, NP, NK and NPK over plots treated with P, K, PK or no fertilizer.

Key words: Halianthus annus, Agronomic characters, oil content, yield, Pakistan.

INTRODUCTION

Pakistan has been facing acute shortage of edible oil for some time and consequently the Government has constituted an oil seed development board to formulate comprehensive programme for the production of oil seed to ease the situation in the country. Since the production potential of our traditional oil seed crops such as cotton seed, rape and mustard is limited, efforts must be made to supplement the local production through the cultivation of non-traditional oil seed crops such as sunflower, safflower and soybean. Out of these crops sunflower has shown a great promise under our agro-climatic conditions and seems to be the only crop which can play a vital role in supplementing our local oil production and substituting the imports due to the fact that it has a high yield potential, drought resistance, well adjustment in the present cropping pattern, wider range of adaptability and the highest seed oil content ranging from 40-50 percent. Moreover, it being a short duration crop can be grown successfully twice a year. However, its agronomic requirements under our soil and climatic conditions are still undertermined and need to be properly worked out in order to make its cultivation a success.

Marton and Fekete (1974) tested three sunflower cultivars at NPK combination and concluded that oil content was influenced more by climatic variation from year to year rather than the fertilizer treatments. They further revealed that fertilizer had only a slight effect on acid number and the effect of N and P being greater than that of K.

Borisov and Nikalov (1975) obtained the highest seed yield of sunflower at a fertilizer dose of 100-180-120 NPK Kg/ha. Monotti (1975) tried various combinations of 0, 50, 100, 150 Kg N, 0.75, 150 kg P_2O_5 and 0, 100 kg K_2O/ha on sunflower and found that the average seed yield increased from 2.32 t/ha without N to 2.69 t/ha with 100 kg N/ha and a further increase to 2.73/ha with 150 kg N/ha was found to be non-significant. He further noted that the application of 150 Kg N/ha decreased seed oil content by 2 % over control but the increase in seed yield led to an increase in oil yield/ha. Application of N increased plant height, head diameter and number of seeds per head but did not affect seed yield per head or 1000-seed weight, while application of P and K did not at all affect the seed yield and other plant characteristics. Srinivas (1975) found that Sunflower grown in the pattern of 45 x 20 cm and fertilized at the rate of 80 kg N, 100 kg P_2O_5 and

40 kg K_2O/ha produced the highest seed and oil yields. Stamboliev and Borisov (1975) reported that application of N alone or in combination with PK resulted in significant increase in seed yield of Sunflower. The seed oil content decreased by N alone but increased when N was applied in combination with P and K. They further observed that the inclusion of P and K in fertilizer combination, increased the effectiveness of N uptake and P gave the largest increases in oil content. Sreeramulu and Rao (1980) in a field trial on Sunflower applied (a) no fertilizer (b) 20 kg N+ 13.1 kg P_2O_5+ 16.5 Kg K_2O (c) 40 kg N+ 26.2 kg P_2O_5 + 33 Kg K_2O and (d) 60 Kg N + 39.3 Kg P_2O_5 + 49.56 kg K_2O/ha. Nitrogen was applied in 3 split dressings. The results revealed that increasing the fertilizer rate from (a) to (b), (c) and (d), increased seed yield from 0.71 to 0,91, 1.15 and 1.46 ton/ha. Tripathi and Kalra (1981) obtained the highest seed yield of summer sunflower with 40 kg N/ha in 1974 and 120 kg N/ha in 1975, while the higher N rate delayed the developmental stages. They further observed that phosphorus and potash each at 60 kg/ha increased the head diameter, seeds/head and yield besides accelerating the developmental stages. Muthuvel and Manickam (1982) tested NPK combinations of 20-30-20, 40-60-40, and 60-90-60 kg/ha in Sunflower crop against check on red sandy loam soil and observed that seed and oil yields were increased with NPK application over check but the differences among the rates were not-significant. Iliev and Dimitrov (1983) found that optimum NPK fertilizer rate on a slightly chernozem soil was 120 kg of each nutrient per hectare giving seed and oil yield responses of 11.5 and 10.20 %, respectively.

Among the several agronomic factors, determination of appropriate dose of atleast the three essential nutrient elements is of primary importance. The present study, therefore, aimed at evaluating the response of spring sunflower to NPK application in different combinations under the irrigated conditions at Faisalabad.

MATERIALS AND METHODS

Investigations into the effect of different NPK combinations on the growth, yield and oil content of a Cargil Sunflower variety were carried out at the Agronomic Research area, University of Agriculture, Faisalabad on a sandy clay loam soil having on an average 0.063 % nitrogen, 8.8 ppm available P_2O_5 and 224 ppm K_2O during the spring of 1984. The experiment was laid out in Randomized Complete Block Design with four replications using a net plot size of 2.40 x 6.30 m. The different NPK rates comprised 0-0-0, 75-0-0, 50-0-0, 0-0-50, 75-50-0, 75-0-50, 0-50-50, 75-50-50 kg per hectare. The crop was sown on 20th of March in 90 cm, apart paired row strips (30/90 cm) on a well prepared seed-bed with the help of single row hand drill. The whole of Nitrogen (N), Phosphorus (P_2O_5) and Potash (K_2O) in the form of urea, SSP and SOP were applied at sowing in the respective treatments. Thinning was done at 3-4 leaf stage keeping 30 cm distance between the plants within the rows. The crop was earthed up after second irrigation. First irrigation was given 32 days after planting while the subsequent irrigations were applied as and when needed. In all six irrigations of 7.5 hectare centimeters each were given in addition to 26.2 mm rainfall received during the growing period of the experimental crop. The crop was kept free of weeds with two hoeings before the earthing up operation. Observations were recorded on plant density/unit area at harvest, plant height at harvest, number of seed per head, 1000-seed weight, seed yield per plot and oil contents in seed. The data collected were statistically analysed by using analysis of variance technique and Duncan's New Multiple Range Test at 5 % level of probability was used to test the differences among the treatment means (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

It is evident from Table 1 that seed yield/ha was increased significantly by the various combination over no fertilizer. However, within the NPK combination significantly higher seed yield of 27.77 quintals/ha was obtained from the treatment of 75-0-50 kg NPK/ha than plots receiving 0-0-50, 0-50-0, 0-50-50, or 75-50-0 kg NPK/ha but was the same with those receiving 75-0-0 and 75-50-50 kg NPK/ha. It was also observed that application of K in combination with N increased the seed yield by 132 kg/ha over N alone and 214 kg/ha over NP application thereby indicating the special role of K in Sunflower production. Higher seed yield in case of 75.0.50 kg NPK/ha treatment was attributed to significantly higher number of filled seed per head and 1000-seed weight. The results led to the conclusion that for a soil having an initial productive potential of 18.84 quintals/ha and nutrient status of 0.063 % Nitrogen, 8.8 ppm available P_2O_5 and 224 ppm available K_2O, a fertilizer dose of 75-0-50 kg NPK/ha is required to raise the seed yield to the level of 27.77 quintals/ha. It is interesting to point out that Sunflower appears to be more responsive to NK rather than NP or NPK application. Almost similar results were reported by Stamboliev and Borisov (1975), Monotti (1975), Srinivas (1975), Seeramula and Rao (1980). The data on seed oil content indicated highly significant differences among all the treat-

Table 1. Seed yield, yield components of spring sunflower as affected by NPK application

NPK rates (kg/ha)	No. of plants per meter square	Plant height at harvest	No. of seed per head	1000-seed weight (gm)	Seed yield (Q/ha.)	Oil content (%)
0-0-0	5.48^{NS}	186.75 bc	964.25 c	39.28 b	18.84 d	47.97 a
75-0-0	5.50	202.00 a	1151.75 ab	44.83 a	26.45 ab	42.34 c
0-50-0	5.49	190.75 abc	1052.00 bc	41.00 b	21.65 c	47.99 a
0-0-50	5.41	186.00 c	1050.00 bc	42.00 b	21.49 c	46.73 ab
75-50-0	5.65	198.50 ab	1093.50 b	45.63 a	25.63 b	45.35 ab
75-0-50	5.46	193.00 abc	1249.75 a	45.70 a	27.77 a	46.78 ab
0-50-50	5.52	191.50 abc	1085.75 b	40.85 b	22.15 c	47.07 a
75-50-50	5.59	199.50 a	1121.50 b	47.15 a	26.45 ab	46.35 ab

NS = Non-significant (1) Any twomeans not sharing a letter differ significantly at 5 % level of probability (DMRT).

ments under study. Application of N alone reduced the seed oil content significantly over rest of the NPK treatments including unfertilized one. However, plots given P, K, NK, PK or NPK improved the seed oil content to the level of unfertilized. It was further observed that application of P and K alone or in combination with N helped maintaining normal level of seed oil content in seed by counteracting the negative effect of N. However, the highest seed oil content of 47.99 per cent was recorded in plots fertilized with 50 Kg P_2O_5 alone as against 47.97, 47.07, 46.78, 46.73, 46.35, 45.34, and 42.34 percent for 0-0-0, 0-50-50, 75-0-50, 0-0-50, and 75-50-50, 75-50-0 and 75-0-0, Kg NPK/ha treatments, respectively. Considerable reduction in oil contents with the application of N alone was also reported by Monotti (1975), Stamboliev and Borisov (1975). The data pertaining plant height revealed that plant height increased significantly in plots fertilized with N, NP, NK and NPK over plots treated with P, K, PK or no fertilizer. However, the maximum plant height of 202 cm was recorded in plots treated with 75 Kg N/ha only as against 199.5, 198.5 and 193 cm for plots fertilized with 75-50-50, 75-50-0, 75-0-50 Kg NPK/ha, respectively. Increase in plant height with the application of N was also reported by Monotti (1975).

Similarly there were highly significant differences among the different NPK treatment under study with regards to 1000-seed weight. Application of 75-0-0, Kg NPK/ha increased 1000-seed weight significantly over the treatments of 0-50-0, 0-0-50, and 0-50-50 Kg NPK/ha including unfertilized but was at par with treatments of 75-50-0, 75-0-50 and 75-50-50 kg NPK/ha. The results further indicated that addition of P and K to N did not contribute considerably towards increasing the 1000-seed weight over N alone. However the highest 1000-seed weight of 47.15 g was recorded in plots fertilized with 75-50-50 Kg NPK/ha as against 39.28 g in unfertilized plots. These findings are not in agreement with those of Monotti (1975) who reported that application of N did not affect 1000-seed weight to a significant extent. This was probably attributed to variable soil and climatic conditions under which experiments were conducted.

The differences among the various fertilizer rates in respect of seeds per head were highly significant. Plants given 75 Kg N + 50 Kg K_2O/ha produced significantly greater number of seeds per head than rest of the treatments except plots fertilized with 75 Kg N alone with which it was at par. However, the lowest number of seeds per head with no fertilizer was the same as with the fertilizer treatment of 50 kg P_2O_5 or 50 Kg K_2O/ha alone. The results further indicated that application of K in combination with N played significant role in increasing the number of seeds per head compared to P indicating thereby that interaction of NK is greater than that of NP towards seed formation. in sunflower. These results are in line with those reported by Monotti (1975). It was also observed that NPK application in different combination did not significantly effect the final plant stand over unfertilized plots. The number of plants per unit area at harvest on an average ranged between 81.75 to 85.5. The non-significant differences in plant population among all the treatments under study were attributed to uniformally maintained plant population per unit area at the completion of seedling emergence.

In conclusion, a fertilizer dose of 100-0-50 Kg NPK/ha should be applied to spring sunflower when planted on a soil with initial productive potential of 18.84 quintals/

ha and fertility status of 0.063 percent N, 8.8 ppm available P_2O_5 and 224 ppm available K_2O, for obtaining seed yield as high as 27.77 quintals/ha and best economic returns.

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