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GENOTYPIC RESPONSE OF SESAME TO NITROGEN AND PHOSPHORUS APPLICATION

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A field experiment was conducted to determine the effect of variable rates of nitrogen and phosphorus on yield and yield components of two sesame genotypes. Grain yield was significantly increased by increasing rate of N application over the control or lower rate of application. The increase in yield was associated with significant increase in branches per plant, pods per. plant an seeds per unit area. Cultivar TS3 was superior in yield and components of yield over cv. 92001.

Key words: genotypic response, nitrogen and phosphorus application, sesame

INTRODUCTION

Sesame is a short duration crop and is capable of utilizing solar energy very efficiently. It is potentially capable of producing large quantities of seed per unit area, but low yield ha:' in Pakistan is due to its sowing on the marginal lands, low plant density, high insect pests and disease incidence, heavy weed infestation, non-availability of promising genotypes and improper fertilization of crop. The latter two factors limit the sesame yield considerably (Rao et al., 1994).

Inspite of its multidimensional uses, the cultivation of sesame in Pakistan is very discouraging since its yield is highly in consistent. It is grown as a Kharif oilseed crop on a total area of 96 thousand hectares with a total production of 42 thousand tonnes, giving an average yield of 438 kg ha:', which is much lower than its average yield in other countries such as Egypt (II72 kg ha'), Mexico (497 kg ha') and China (527 kg ha") (Anonymous, 1998). The positive effect on growth, yield and quality of sesame by increased Nand P levels may be attributed to increased growth and yield components. Adequate supply of nitrogen is beneficial for both carbohydrates and protein metabolism, promoting cell division and cell enlargement, resulting in more leaf area and productive sink (capsules), and thus ensuring good seed and dry matter yield. Similarly, a good supply of P is usually associated with increased root density and proliferation, which aid in extensive exploration and supply of nutrients and water to the growing plant parts, resulting in increased growth and yield traits, thereby ensuring more seed and dry matter yield (Maiti and Jana, 1985).

The present study was thus planned to evaluate the effect of different rates of nitrogen and phosphorus on seed yield an yield components of two sesame genotypes, under the irrigated conditions at Faisalabad.

MATERIALS AND METHODS

The experiment was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad in the Kharif seasons of 1996 and 1997. The treatments were four rates of nitrogen (0, 40, 80, 120 kg/ha) and phosphorus (0, 40, 80, 120 kg/ha) and two sesame genotypes (92001, TS3). The experiment was laid out in a randomized complete block design with split-split plot arrangement, keeping nitrogen in main plots, phosphorus in subplots and genotypes in sub-subplots. Net plot size was 2.4m x 7m.

The crop was sown in July 1996 and 1997. For each genotype seed rate was 4 kg ha:' during both years. Toe plant population was maintained uniform through thinning at four leaf stage. Nitrogen and phosphorus were applied as per treatment along with a basal dose of potash Le. 60 kg ha", Nitrogen, phosphorus and potash were applied as urea, triple super phosphate an SOP (K_2SO_4) Half of N and whole of the phosphorus and potash were applied at the time of sowing. Remaining *112* of N was applied at Ist irrigation. Insect pests and weeds were kept under control through chemical and mechanical means.

The crop was harvested manually at its physiological maturity in late November in 1996 an 1997 respectively. Since seed shattering from the capsule at harvesting/threshing can cause substantial losses in the seed yield of sesame, special care was taken to minimize such losses. For this purpose, crop plants were tied into small bundles in each experimental unit and placed vertically for sun drying and afterwards threshing was done manually. Seed was cleaned after threshing the crop plants from each experimental unit and seed yield of each plot was recorded separately. The data on plant height, number of branches plant:', number of seeds capsule-'; test seed weight etc. were recorded by taking a subsample of 10 plants from each experimental unit. All sets of data were analysed using Fisher's analysis of variance technique to differentiate the treatment effects. Treatment means were separated using least significant difference (LSD) test at P = 0.05 (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Plant Height: Increasing rate of nitrogen application significantly enhanced plant height over control {NJ or N! (40 kg ha") treatment in 1997 season only. Maximum plant height (120 cm) was recorded in N) (120 kg ha") treatment, which, was statistically at par with N_2 (80 kg ha") (Table 1). Minimum plant height (106 cm) was noted in control treatment. Phosphorus application did not affect plant height in both the seasons, and it varied from 108 cm to 111 cm among various rates of phosphorus application. In both the seasons, cv. TS3 produced substantially taller plants than cv. 92001. Overall, mean plant height was 105 cm in 1996 and 115 cm in 1997.

Branches Plaar": Application of nitrogen significantly affected the number of branches plant ı in 1997. Maximum number of branches plant" was produced by N_2 (80 kg ha') at 2.08 and N) (120 kg ha') at 2.10 than N! (40 kg ha") or NO(nil) and the response was cubic. The average number of branches was 1.67 to 2.48 plant" among different rates of nitrogen application during both the seasons. Increasing rates of phosphorus application did not affect branch number plant ı, which varied from 1.85 to 2.55 among various rates of phosphorus application in the two seasons. Cultivar TS3 produced 4.85 and 3.86 branches plant" during 1996 and 1997 growing seasons respectively. The cultivar 92001 was branchless which could be attributed to its genetic characters. By contrast, cv. TS3 was genetically a bushy and branched genotype. These results substantiate the findings of Rao et al. (1994) who also reported 2-4 branches with variable rates of nitrogen and phosphorus application.

Capsules Plant"; There were significant differences in the number of capsules plant" during both the seasons. In 1996, increasing rate of nitrogen application over control significantly increased the number of capsules plant". Differences among various rates of nitrogen were lower and non-significant. During 1997, maximum number of capsules plant! was recorded at 80 kg N ha:' which was statistically similar to 120 kg N ha", This response to capsule number was cubic in 1996 and quadratic in 1997. Averaged over two years, number of capsules plant! ranged between 22.97 and 28.34 among different rates of nitrogen. Application of phosphorus at different rates also affected significantly the number of capsules plant" in 1996 but not in 1997 and this response to phosphorus was quadratic in nature. Maximum number of capsules plant ı (21.95) was recorded in 120 kg PP5 ha", followed by 80 kg PP5 ha' ı rate. This treatment was, however, at par with PI (40 kg ha:'). Average number of capsules" varied from 25.4 to 27.2 among different rates of phosphorus application. Cultivar differences in the number of capsules were also significant in both the seasons. The cv. TS3 produced 127.38% (37.95 vs 16.69) more capsules in 1996 and 88.98% (33.26 vs 17.60) in 1997. These results conform to those of Rao et al. (1994). Similar results were also reported in canola by Cheema (1999) who recorded higher number of capsules (pods) .plant! with different rates of N-P application.

Seeds Capsule" was 29.15, 31.30, 33.25 and 34.54 in No, NI' N_2 and N) respectively. Equivalent values in 1997 were 27.42, 30.03, 31.10 and 33.94 respectively. Application of phosphorus at different rates also significantly affected the number of seeds capsule' ı but the response was quadratic in both the seasons. The cv. TS3 produced. more. seeds (46.12 vs 18.01) in 1996 and (44.33 vs 16.92) in 1997, showing an increase by 156.68 and 161.99% during the respective years. Overall, average seeds capsule" were 32.06 in 1996 and 30.62 in 1997.

lOOO-Seed Weight: Increasing rate of nitrogen application significantly increased the mean seed weight, and this response was cubic in both the seasons. In 1996, maximum 1000-seed weight was recorded with the application of 120 kg N ha", which was followed by NI (40 kg N ha") and N_2 (80 kg N ha'!) treatments. Both these treatments were statistically at par with each other. In the following year, there were no significant differences in the 1000-seed weight of NI, N2 and N3 treatments, but all these treatments gave statistically higher seed weight than did control. The average seed weight, on two-year basis, varied from 3.85 to 4.19 g/1000 seeds among various rates of nitrogen. Application of different rates of phosphorus also significantly enhanced mean seed weight, and the response was cubic in nature in both the seasons. Averaged over two seasons the mean seed weight varied from 3.96 to 4.13 g/1000 seeds at different rates of phosphorus application. However, both 80 or 120 kg ha" application of phosphorus led to almost similar mean seed weight. The mean seed weight was significantly different between the two cultivars. The cv. TS3 achieved more seed weight than cv. 92001 in both the seasons. The seed weight in cv. TS3. was 4.54 g in 1996 and 4.30 g/IOOO seeds in 1997. Corresponding values in cv. 92001 were 3.81g in 1996 and 3.60g in 1997. The differences in average seed weight are generally related to a short period between anthesis and maturity. At this time supply of assimilates to the pod (seed) plays a crucial role in the development of seed and probably the plants with better supplies of. nutrients are rather at advantages than those under poor nutrition. These results substantiate the findings of Rao et al. (1994) who also reported average seed weight of 2.90 - 3.47 g/1000 seeds in sesame.

St*d Yield: In both seasons, .increasing rate of nitrogen 'application significantly and linearly enhanced seed yield. The average seed yield in 1996 was 610, 690, 710 and 750 kg ha'! in No, NI' N_2 and N) rates of application, respectively, while in 1997 the values were 460, 510, 560 and 600 kg ha:'. Averaged over two years mean seed yield varied from 530 to 670 kg ha". Increasing rates of phosphorus application also increased seed yield and this response was also linear in nature. The PI' P_2 and P_3 rates of phosphorus application were, however, statistically at par in seed yield during 1997. PO also showed fairly similar yield as PI' However, during the first year; there was no significant difference in the seed yield between 40 and 80 kg *Pps* application rates. Seed yield was markedly influenced by cultivar. The cv. TS3 enhanced seed yield by 245.16% (1070 vs 310 kg) in 1996 and 196.30% (800 vs 270 kg) in 1997. Averaged over two years, seed yield was 290 kg in cv. 9200 I compared to 930 kg ha". in cv. TS3.

In the present study, sesame seed yield increased in response to N fertilizer application over control (No) or lower rate (N2) of application with maximum yield of 880-1100 kg ha"[1], being attained with N_3 rate of application in both the seasons. Similar yield levels were also reported by other (Gnanamurthy et al., 1992; Thakuriaand Saharia, 1994) who obtained higher seed yield up to 1165 kg ha"I with application of 80 kg N ha' I and 13 kg P ha".

HarvestIndex: In 1996, NI (40 kg ha:') rate of application significantly enhanced harvest index over other rates of application. Both N2 (80 kg ha") and N3 (120 kg ha") as well as control were, however, at par in harvest index. In contrast, harvest index increased with increasing rates of nitrogen application during 1997, and N3 (120 kg ha:') treatment gave the maximum harvest index (Table I). Application of various rates of phosphorus significantly affected harvest index in 1996 season only. The cv. TS3 also enhanced harvest index over cv. 92001 in both the seasons. Overall, harvest index was 205 in 1996 and 12% in 1997, about 61% higher in the former than the latter (Table 1). Final seed yield was significantly an linearly (r = 0.975**, N = 20) related with TDM yield, indicating that seed yield will increase with increase in TDM provided harvest index does not change substantially among treatments.

Conclusion: Sesame may be a potential oilseed crop for Faisalabad (Punjab) under the present cropping system. High yields are possible when the crop is given 120 kg N and 40 kg P ha-1. There is, however, a need for further studies including a range of sowing dates and plant populations to obtain higher grain yield, particularly with free-branching, cultivars.

Table 1. Effect of various nitrogen and phosphorus application rates on yield and yield components of two genotypes of sesame.

	Plant height (cm)		Branches plant		Capsules plant		1000-seedd weight		Seed yield (kg ha")		Harvest index (%)	
Treatment	1996	1'97	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997
Nitrogen												
No = 0 kg ha"	104[NS]	106c	2.29	1.86ab	23.78b	22.17c	3.95c	3.75b	610c	460d	0.19b	0.12b
NI = 40 kg ha"	105	113b	2.52	1.67b	28.12a	24.83bc	4.21b	4.02a	690b	SlOe	0.21a	0.12b
N_2 = 80 kg ha')	105	119a	2.48	2.08a	28.49a	28.20a	4.20b	3.97a	710b	560b	0.19b	0.12b
N3 = 120 kg ha"	106	120a	2.40	2.10a	28.90a	26.50ab	4.35a	4.04a	750a	600a	0.19b	0.13a
Phosphorus												
Po = 0 kg ha-I	103[NS]	113[NS]	2.31	1.85	26.44c	24.45	4.12b	3.92b	650c	SlOb	0.19c	O.12[NS]
PI = 40 kg ha-I	105	115	2.32	1.98	26;61bc	25.69	4.06b	3.86b	690b	530ab	0.21a	0.12
P2 =80 kg ha-1	106	116	2.55	1.98	27.28b	26.02	4.26a	4.00a	700b	540a	0.20b	0.12
P_3 = 120 kg ha"	105	114	2.51	1.90	28.95a	25.52	4.27a	4.00a	720a	540a	0.20b	0.13
Cultivar												
92001	97 b	102b	O.OOb	O.OOb	16.69b	17.60b	3.81b	3.60b	310b	270b	0.13b	0.1Ob
TS3	IBa	127a	4.85a	3.86a	37.95a	33.26a	4.54a	4.30a	1070	800a	0.26a	0.15a
Mean	105	115	2.42	1.93	27.32	25.43	4.19	3.94	690	530	0.20	0.12

Values in the same column having different letters differ significantly (P ::::0.05); NS = Non-significant

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