Asian Journal of Plant Sciences

ISSN 1682-3974

science alert

ANSInet
an open access publisher
http://ansinet.com

Asian journal of plant Sciences
Volume 1 Number 5: 599-601, 2002

Influence of Various Levels of Nitrogen and Phosphorus on the Growth and Yield of Chilli (*Capsicum annuum* L.)

[1]Nisar Naeem,[2]Irfan Muhammad, [1]Jehangir Khan, [1] Ghulam Nabi, [1]Niaz Muhammad and [2]Noor Badshah.
[1]Horticulture Section, Agricultural Research Institute Tarnab, Peshawar, Pakistan
[2] Department of Horticulture, NWFP Agricultural University, Peshawar, Pakistan

Abstract: An experiment on the effect of different levels of nitrogen (0, 30, 60, 90 kg ha^{-1}) and phosphorus (0, 30, 60 kg ha^{-1}) with a constant dose of potash (30 kg ha^{-1}) on the growth and yield of chilli cultivar sanam. The fertilizers used for nitrogen, phosphorus and potash were urea (46% N), single super phosphate (18% P_2O_5) and potassium sulphate (50% K_2O). The data recorded revealed that there was a significant difference in days to flowering, days to fruiting, number of branches per plant, plant height (cm), number of fruits per plant, length of fruit (cm) and total yield (kg ha^{-1}). Minimum days to flowering (42 days) and days to fruiting (54 days) were recorded in plots fertilized with (30-60-30 kg NPK ha^{-1}) and (30-30-30 kg NPK ha^{-1}) respectively. Maximum number of branches per plant (10.00), plant height (98.27 cm), number of fruits per plant (51.73) and total yield (7679.66 kg ha^{-1}) was recorded in plots fertilized with 90-60-30 kg NPK ha^{-1}. However, maximum length of fruit was recorded at fertilizer level of 60-30-30 kg NPK ha^{-1}. The differences in survival %age and single fruit weight were non significant. It is suggested that chilli cv. sanam should be fertilized with 90-60-30 kg NPK ha^{-1} under the agroclimatic conditions of Peshawar.

Key words: Levels, NPK, chillies, growth, yield

Introduction

Chillies (*Capsicum annuum* L.) belong to the family Solanaceae and is closely related to the most important vegetable like tomato. The total area under chillies cultivation in Pakistan was 90400 hectares with total production of 140200 tonnes in which the NWFP contributed the total area of 400 hectares with a total production of 400 tonnes during 1997-98. The interest in peppers extends to their nutritive and medicinal value as peppers are a recognized source of vitamin C, E and are high in antioxidants. These compounds are associated with chemoprevention of cardiovascular disorders, cancers, and cataracts. In Pakistan and especially in NWFP the yield per unit area of chillies is very low as compared to the advanced countries of the world. There are several factors, which are responsible for low, yield i.e unavailability of approved varieties, lack of modern technology and technical guidance. Among the various factors affecting the yield, the most important one is to supply an adequate amount of chemical fertilizers. Sharma *et al.* (1996) investigated the effects of N (0, 60, 90 or 120 kg ha-1) and P (0, 30 or 60 kg ha-1) on the growth of chilli (cv. Jawahar Mirch 218) at Jabalpur, India, during 1991-92. K (40 kg K2O ha-1) was applied to all plots. The yield of fruits significantly increased with increasing rates of N. The highest yield (10.72 q ha-1) was recorded at the highest N rate. In the P treatments, the highest yield (8.38 q ha-1) was observed following treatment with 30 kg P2O5 ha-1. They further concluded that the best treatment to promote yield and profitability was 120 kg N + 30 kg P2O5 ha-1. Nigri *et al.* (1997) determined the response of *C. annuum* cv. Elisa. The crop response was positive to the N, P and K applications. The model selected from the results explained about 73% of yield variations. The maximum yield estimated by this model was 109 tons ha-1, with rates of 317 kg N, 47 kg P and 450 kg K ha-1. Singh *et al.* (1997) evaluated the performance of Capsicum cv. Scotch Bonnet in response to farmyard manure, NPK (150:75:75 kg ha-1) or vermicompost at Saklespur, Karnataka, India. No significant differences in yields were observed due to the different fertilizer treatments. It was concluded that Capsicum could be successfully grown using vermicompost. Russo (1998) applied the NPK fertilizers at the recommended rate (based on soil tests) and 1.5-times that rate to chilli crops. Yields of all cultivars were higher in 1996 than in 1998 when day and night temperatures were much above normal. In 1996, increasing fertilizer rate caused decreases in green and total yield of bell peppers, but had no effect on red fruit yield. In 1998, additional fertilizer increased total yield of Melody and decreased that of red beauty.

Therefore, the present study "Influence of various levels of nitrogen and phosphorus with a constant dose of potash" was conducted to determine the optimum dose of fertilizers for the highest yield of chillies.

Materials and Methods

The experiment was conducted at Agricultural Research Institute Tarnab, Peshawar during the year 2000 with a view to find out the most suitable level of nitrogen and phosphorus with a constant dose of potash for the optimum growth and yield of chilli variety sanam. Seed bed was prepared for raising seedlings. The seed of chilli cultivar sanam were broadcast in the seed bed on 31st January 2000. Polyethylene (Plastic) sheet was placed on nursery to protect the nursery plants from frost injury. The nursery was irrigated by sprinkler. Plastic sheet was removed as the danger of frost was over. Weeding was done accordingly after the removal of plastic sheet. The experiment was laid out in Randomized Complete Block (RCB) design. There were two rows per treatment and total number of plots were 30. Row to row and plant to plant distance was kept 75 and 30 cm respectively. The number of seedlings per treatment were 24. The seedlings of equal height and vigour were transplanted from the nursery bed to the field on March 28, 2000. The fertilizers used as sources of N, P_2O_5 and K_2O were urea (46% N), single super phosphate (18% P_2O_5) and potassium sulphate (50% K_2O), respectively. Nitrogen was applied in two split doses. First half dose of N along with full doses of P_2O_5 and K_2O were applied before transplanting the seedlings, while the remaining half dose of the N was applied at the flowering stage.

The detail of treatments are as under:

Treatments	Nitrogen N (kg ha^{-1})	Phosphorus P_2O_5 (kg ha^{-1})	Potash K_2O (kg ha^{-1})
N_0P_0 (control)	0	0	30
N_1P_0	30	0	30
N_1P_1	3	30	30
N_1P_2	30	60	30
N_2P_0	60	0	30
N_2P_1	60	30	30
N_2P_2	60	60	30
N_3P_0	90	0	30
N_3P_1	90	30	30
N_3P_2	90	60	30

The experiment was laid out in Randomized Complete Block (RCB) design with three replications and ten treatments. Data were subjected to analyses of variance (ANOVA) and comparison of means with control was made (Steel and Torrie, 1980).

The Data were recorded on survival percentage, days to flowering, days to fruiting, number of branches per plant, plant height, single fruit weight, number of fruits per plant, length of fully matured fruits and yield per hectare.

Results and Discussion

Data regarding the effect of Nitrogen and phosphorus on the growth and yield of chillies with a constant dose of potash are recorded. Data on survival percentage reveals that minimum survival %age (56.94) was recorded at fertilizer level of 60-60-30 kg NPK kg ha^{-1}, followed by (59.71) at fertilizer level of 90-60-30 kg NPK ha^{-1}, while maximum survival percentage (84.72) was recorded at fertilizer level of 0-0-30 kg NPK ha^{-1}. The survival parentage was nearly uniform and there was no effect of nitrogen and phosphorous on survival parentage. There are several factors which are responsible for low yield i.e unavailability of approved varieties, lack of modern technology and technical guidance etc. Data on days to flowering shows that minimum days to flowering (42 days) were recorded in plots where fertilizer level was 30-60-30 NPK ha^{-1}, followed by (43 days) at fertilizer level of 30-30-30 kg NPK ha^{-1}, while maximum days to flowering (52 days) were recorded where NPK were applied at the rate of 60-0-30 kg ha^{-1}. This may be due to the fact that high doses of nitrogen delayed flowering and enhanced vegetative growth in early stages while phosphorus helps in flowering. Similarly Covarelli (1977) concluded that phosphorus enhance flowering and fruiting. There was early flowering where nitrogen was less and phosphorus was greater; as more nitrogen delayed flowering. Data (Table 1) on days to fruiting that fertilizer at the rate of 60-0-30 kg NPK ha^{-1} took maximum (57.66) days to fruiting, followed by (57.33) days to fruiting at fertilizer level of 30-0-30 kg NPK ha^{-1}, while minimum days (54.00) were taken by plants at fertilizer level of 30-30-30 kg NPK ha^{-1} This is because of nitrogen as the application of nitrogen delays flowering so results in delay fruiting. Due to high nitrogen the days to flowering and days to fruiting were delayed. These results are in close conformity to that of Shrivastava (1996) who reported that lst flowering and 50% flowering were delayed by 4-6 days to plants receiving the highest rate of fertilizer. First fruit set was also delayed in these plants.

Data on number of branches that maximum number of branches (10.00) were recorded at fertilizer level of 90-60-30 kg NPK ha^{-1}, followed by (9.60) number of branches at fertilizer level of 60-60-30 kg NPK ha^{-1}, while minimum number of branches (7.53) were obtained in control treatment.Nitrogen has a significant effect on number of branches per plant as it activate vegetative growth. These results agree with the findings of Manchanda and Singh (1991). They conclude that branches per plant increasing with increasing nitrogen rate. The data pertaining to plant height shows that maximum plant height (98.27 cm) was obtained where NPK fertilizers were applied at the rate of 90-60-30 kg/ha, followed by the plant height (96.40 cm) at fertilizer level of 60-60-30 kg NPK ha^{-1}, while minimum plant height (74.47 cm) was observed in control treatment. It might be due to the increase in nitrogen and phosphorous levels which enhanced the vegetative growth. Minimum plant height in control may be due to its poor nutritional status which resulted in retarded growth and reduced plant height. The results resembles with that of Lal and Pundrink (1973), Damke *et al.* (1990) and Nicola *et al* (1995) who found an improvement in plant height with increasing nitrogen application. The data (Table 1) pertaining to the number of fruits per plant shows that the maximum number of fruits (51.73) per plant were obtained where plants received fertilizer level of 90-60-30 kg NPK ha^{-1}, followed by (50.60) fruits per plant at fertilizer level of 60-60-30 kg NPK ha^{-1}, while minimum number of fruits per plant (40.13) were observed in control treatment. It might be due to the effect of nitrogen which increase vegetative growth and branches, so if there are more branches there may be more number of fruits. These result agree with the findings of Manchanda and Singh (1991) and Nicola *et al.* (1995) who obtained the maximum fruits per plant at higher rate of nitrogen and phosphorous. Data on fruit length show that maximum fruit length (8.067 cm) was recorded at fertilizer level of 60-30-30 kg NPK ha^{-1}, while minimum fruit length (6.067 cm) was recorded in control treatment. These results are in line with that of Lal and Pundrik (1973) and Ludilov and Ludilova (1977). Lal and Pundrik (1971) obtained highest yield due to an improvement in fruit size in response to 80 kg N, 90 Kg P and 50 kg K. It means that recommended fertilization will may affect the fruit size and other growth parameters as well. Data (Table 1) on fruit yield shows that maximum yield (7679.66 kg ha^{-1}) was recorded at fertilizer level of 90-60-30 kg NPK ha^{-1}, followed by (7396.33 kg ha^{-1}) at fertilizer level of 60-60-30 kg NPK ha^{-1}, while minimum yield (5255.33 ha^{-1}) was observed in control treatment. The high yield is due to high nitrogen and phosphorous rate. Nitrogen helps in vegetative growth, due to which branches increased and if there are more branches there may be more fruits and intern yield will be high. Phosphorus also

Table 1: Influence of various levels of nitrogen and phosphorus on different growth and yield parameters of chilli per hectare

Treatments	Survival percentage	Days to flowering	Days to fruiting	Number of branches plant^{-1}	Plant height (cm)	Single fruit weight (g)	Length of fruit	Number of fruits plant^{-1}	Total yield (kg ha^{-1})
N_0P_0 (control)	84.720	50.333bc	56.667ab	7.533e	74.467g	4.457	6.067e	40.133g	5255.33e
N_1P_0	68.053	51.333ab	57.333a	7.533e	77.133f	3.917	7.600ab	40.200g	5310.66e
N_1P_1	73.607	43.333g	54.000d	8.200d	82.933d	4.550	7.133abcd	43.133e	5743.33d
N_1P_2	76.383	42.000h	54.333d	9.133c	92.467b	4.650	6.133de	47.200c	6683.00b
N_2P_0	83.330	52.000a	57.667a	7.800e	79.600e	4.317	7.400abc	41.467f	6117.66c
N_2P_1	76.387	47.000e	55.000cd	8.400d	83.933cd	4.603	8.067a	43.600e	6213.66c
N_2P_2	56.943	44.667f	54.333d	9.600b	96.400a	5.483	6.400cde	50.600b	7396.33a
N_3P_0	66.667	50.667bc	57.000a	7.667e	75.667fg	4.457	6.067e	41.667f	6046.00cd
N_3P_1	59.717	49.667cd	55.667bc	8.467d	85.200c	5.600	7.533ab	45.200d	6699.33b
N_3P_2	69.443	48.667d	55.667bc	10.000a	98.267a	4.883	6.867bcde	51.733a	7679.66a
Mean	71.525	1.291	1.316	0.286	2.055	4.6917	1.065	0.945	316.031
LSD value	NS	1.291	1.316	0.286	2.055	NS	0.945	1.065	316.031

Level of significance = 5%,

Means with different letter differ significantly at P≤ 0.05

along with nitrogen and potash helps in improving fruit quality and enhancing flowering due to which yield increase. These results are in line with that of Lal and Pundrik (1973) and Ludilov and Ludilova (1977). Lal and Pundrik obtained highest yield due to an improvement in fruit size in response to 80 kg N, 90 Kg P and 50 kg K. It means that recommended fertilization will may affect the fruit size and other growth parameters as well.

It is concluded from this trial that fertilizer level 90-60-30 kg NPK ha^{-1} had significantly affected the yield and growth of chillies. The above level of fertilizer had good effect on most of the parameters and also increased yield significantly.

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