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EFFECT OF NITROGEN AND PHOSPHORUS ON CROP GROWTH, HEAD YIELD AND QUALITY OF BROCCOLI (*Brassica oleracea* L. *var. italica*)

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ABSTRACT: An experiment was conducted at Department of Vegetable Science, C.S. Azad Univ. of Agri. & Tech., Kalyanpur, Kanpur during *Rabi* season of 2005-06 to find out the effect of nitrogen (30, 60, 90, 120 kg ha ^{1}), phosphorus (30, 60, 90 kg ha ^{1}) on crop growth, head yield and quality of broccoli. The significant result was obtained in growth and yield parameter, *i.e.,* height of plant, days to central head, head yield per plant and per plot, plant frame, head size, harvest duration and compactness of the head. The most of the characters and optimum head yield of broccoli were favoured by applying 90 kg nitrogen and 90 kg phosphorus per hectare.

Keywords: *Broccoli, nitrogen, phosphorus.*

Broccoli (*Brassica oleracea* L. var. *italica*) belongs to family Cruciferae (*Brassicaceae*). Latin *Brachium* meaning an arm or branch (Choudhury, 1). It contains, iron an calcium and also. It is marketed as fresh, frozen and also used in salads (Peirce, 7). It also have protein 3.3 per cent, thiamine and riboflavin. There are three types of broccoli viz., Green, White, and Purple. Green type is the most nutritive and popular Das (3) because it contains the anticancer property sulphoruphane. Broccoli head resembles cauliflower consisting of clusters of green flower buds. Near to city farmer can fetch more money by cultivating broccoli. The head is harvested along with a few leaves and stem (10-15 cm). Yield of this crop ranges between 5-15 t ha^{-1} depending upon the variety, time of planting and harvesting duration.

MATERIALS AND METHODS

The experiment was conducted at Departmental Farm of Vegetable Science, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur during the *rabi* season. Four treatments of nitrogen (30, 60, 90, 120 kg ha ^{1}) and three treatments of phosphorus (30, 60, 90 kg ha ^{1}) with a total of twelve treatment combinations were tested. Farm yard manure @ 20 t ha ^{1} as a common dose in all treatments and entire quantity of phosphorus and one third of nitrogen as per treatment was applied in the form of single super phosphate and urea, respectively before transplanting at the time of field preparation. Remaining nitrogen was given in two splits at 30 and 45 days after transplanting. The trial was laid out in randomized block design with three replications. Total number of treatment combination were 12 with one control and total number of plants / plot were 48. The observations were recorded at appropriate stage of plant.

RESULTS AND DISCUSSION

The present data (Table 1) revealed that the nitrogen levels upto 90 kg ha ^{1} significantly increased plant height. Similarly, with increasing level of phosphorus, the plant height was also increased significantly. Maximum plant height (51.75 cm) was recorded with 90 kgN ha^{-1} over 30 and 60 kg N ha ^{1}. Highest plant height (52.07 cm) was recorded when phosphorus was applied @ 90 kg ha ^{1}. Application of 90 kg ha ^{1} nitrogen and phosphorus separately showed significant responses for days to central head over 30 kg ha ^{1} nitrogen and phosphorus. Findings are supported with Kowalenko and Hall (5) in broccoli and Khurana *et. al.* (4) in cauliflower. The minimum days (58.44) for appearance head was recorded with the 90 kg ha ^{1}. Same level of phosphorus

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Table 1: Effect of nitrogen and phosphorus on different characters of broccoli.

Treatment	Plant height (cm)	Days to central head	Head yield (q ha^{-1})	Plant frame	Head size (cm^2)	Harvest duration days
(A) Nitrogen levels (kg ha^{-1})						
30	78.71	59.67	136.10	64.26	84.08	36.22
60	50.99	59.11	149.13	67.52	85.88	36.69
90	51.75	58.44	170.15	68.54	90.77	37.56
120	50.47	59.44	159.60	66.38	86.55	36.56
C.D. (P=0.05)	1.11	1.23	5.23	1.26	3.09	0.66
(B) Phosphorus levels (kg ha^{-1})						
30	49.09	60.16	145.97	63.71	80.25	35.50
60	50.27	59.17	154.87	65.65	84.15	36.83
90	52.07	58.17	160.38	70.67	96.04	38.08
C.D. (P=0.05)	0.96	1.07	4.53	1.09	2.68	0.57
(C) Control v/s treatment	46.12	62.67	83.10	58.42	74.38	28.33
C.D. (P=0.05)	1.41	1.57	6.67	1.60	3.94	0.8462

Table 2: Effect of nitrogen and phosphorus on compactness of the head.

Treatment	Number of heads		
	Loose	Medium	Compact
N_1P_1	9	11	10
N_1P_2	8	12	10
N_1P_3	7	12	11
N_2P_1	8	12	10
N_2P_2	10	11	9
N_2P_3	8	12	10
N_3P_1	8	12	10
N_3P_2	6	13	11
N_3P_3	7	10	13
N_4P_1	7	11	12
N_4P_2	9	10	11
N_4P_3	10	11	9
N_0P_0	13	10	7
Average	8.46	11.31	10.23
Total number of heads examined for each treatment = 3X 10 = 30			

No = 0kgN N_1 = 30kgN N_2 = 60kgN N_3 = 90kgN N_4 = 120kgN;

Po = 0kgP P_1 = 30kgP P_2 = 60kgP P_3 = 90kgP

showed minimum days of 58.17. Head yield increased significantly upto level of 90 kgN ha^{1} and higher yield 170.15 q ha^{1} was recorded. In case of phosphorus application, increasing trend was found. Treatment of 90 kg P_2O_5 ha^{1} significantly yielded 160.38 q ha^{1}. Application of nitrogen and phosphorus individually significantly influenced plant frame. Maximum plant spread (68.54 cm) with nitrogen application was noticed at 90 kg ha^{1} which was higher than 60 and 30 kg N ha-1 (Table 1). Maximum plant spread (70.67 cm) was significantly recorded at the treatment of 90 kg

P_2O_5 ha ^{1} over 60 and 30 kg P_2O_5 ha ^{1} where plant spread was 65.65 cm and 63.7 cm, respectively Claypool (2) working with lettuce also observed that nitrogen stimulated vegetative growth and thus giving significant increase in plant size.

As in the case of head size nitrogen application @ 90 kg ha ^{1} produced largest size (90.77 cm^2) which was superior over all the level of nitrogen and higher level of P_2O_5 (90 kg ha ^{1}) was also produced bigger sized head (96 cm^2) over the lower levels of phosphorus. Interaction of nitrogen and phosphorus also influenced the head size significantly confirming to results of Mishra (6) and Sharma and Arora (9) in cauliflower.

The nitrogen and phosphorus applied individually were effective in exerting their impact on harvest duration. Period of availability of produce was increased with 90 kg ha ^{1} level of nitrogen. Phosphorus applied @ 90 kg ha ^{1} gave significant response at harvest duration resulting 38.08 days which was higher over the days 36.83 and 35.50 at the level of 60 and 30 kg P_2O_5 ha^{-1} respectively. In the case of compactness, none of nitrogen and phosphorus either alone or in combination was able to respond effectively (Table 2).

Plant height increased linearly by the application of nitrogen and 90 kg N ha ^{1} produced significantly taller plant than 30 and 60 kg N ha ^{1}. Nitrogen showed its significance in enhancing the plant spread upto 90 kg ha ^{1}.The increase in yield contributing characters like plant spread and head size ultimately affected the head yield and the highest yield / hectare was recorded at 90 kg N ha ^{1}. Harvest duration increased significantly with every increment in level of nitrogen upto 90 kg ha^{-1}. The reduction in the produce availability with increased size of the central heads at this nitrogen rate was also observed. Randhawa and Khurana (8) have also reported non significant impact of this element on curd compactness of cauliflower.

In the case of phosphorus the tallest plants produced by 90 kg P_2O_5 ha ^{1} differ significantly from other levels. No effect on days to central head formation was recorded by phosphorus application. Maximum plant spread by the application of 90 kg P_2O_5 ha ^{1} in comparison to 30 and 60 kg P_2O_5 ha ^{1} might be due to its role in photosynthesis, energy storage, cell division and enlargement (Singh 10). As plant spread and head size were increased by the application of phosphorus upto 90 kg P_2O_5 ha ^{1}, harvest duration was significantly enhanced by the ascending phosphorus levels upto the highest levels (90 kg P_2O_5 ha ^{1}).

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