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Effect of Nitrogen, Phosphorus and Potassium on Growth, Yield and Quality of Cabbage (*Brassica oleracea* var *capitata* L.)

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Abstract

A field experiment on cabbage (*Brassica oleracea* var *capitata* L.) variety Golden Acre was conducted during winter season of 2008-2009 to study the nutritional requirement of cabbage. Observation on plant height, number of open leaves, number of folded leaves, cross sectional diameter of head, vertical length of head, TSS and yield per hectare were recorded. It was concluded that the treatment T_{10} (180 kg N, 80 kg P_2O_5 and 40 kg K_2O/ha) recorded the highest plant height (28.93 cm), number of open leaves (23.33), number of folded leaves (57.66), cross sectional diameter (17.90 cm), vertical length of head (16.76), T.S.S. (5.38%) and yield (129.66 q/ha) followed by T_{11} (180 kg N, 60 kg P_2O_5 and 60 kg K_2O/ha) as 28.53 cm, 22.66, 56.66, 15.66, 5.28% and 127.06 q/ha, respectively. These results were significantly superior to the other treatments including control.

Key words : Cabbage, Nitrogen, Phosphorus, Potassium, Yield.

Cabbage (*Brassica oleracea* var *capitata* L., 2n = 2x = 18) is one of the most important cole crops grown under temperate to tropical climate conditions for its head in more than ninety countries throughout the world (1) and the leading countries are China, India, Russia, Korea, Japan and the USA. In India, it is next only to cauliflower with acreage and production statistics of 240 thousand hectares and 43,000 thousand metric tones, respectively (2). It is a rich source of protein comprising all essential amino acids, especially sulfur containing amino acids, minerals such as calcium, iron, magnesium, sodium, potassium, phosphorus and antioxidant and is reported to have anti-carcinogenic properties. It is also rich source of ascorbic acid, carotene (pro Vitamin A) and has high fiber content and calcium which reduces the risk of colon cancer. Nitrogen encourages the vegetative growth and development of plants by imparting the healthy green color of the leaves.Phosphorus is an equally essential nutrient as a constituent of nucleoproteins, enzymes and high energy bonds. It encourages the formation of new cells, promotes root growth and hastens leaf developed, the evergreen of buds, the formation of heads and maturation of crops. While the potassium plays an important part in the formation of starch and in the production and translocation of sugars. The judicious use of chemical fertilizers is one of the well known tools for the maximization of yield through their proper, rational and optimum doses. Therefore, keeping these in view, an experiment was conducted to ascertain the optimum dose of nitrogen, phosphorus and potassium on growth, yield and quality of cabbage under Lucknow conditions.

Methods

The present research work was conducted at the Horticultural Research Farm, Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, Lucknow during the rabi season of 2008-2009. The experiment comprised four levels of nitrogen i.e. 0 (N_0), 120 (N_{120}), 150 (N_{150}) and 180 (N_{180}) ; two levels of phosphorus i.e. 60 (P_{60}) and 80 (P_{80})P_2O_5, two levels of potassium i.e. 40 (K_{40}) and 60 (K_{60}) kg K_2O/ha. Thus, having a total of 12 treatment combinations i.e. T_1(control),T_2 (120 kg ha), T_3 (120 kg N + 60 kg p/ha), T_4 (120 kg N + 60 kg P + 40 kg. K/ha), T_5 (150 kg N + 60 kg P + 40 kg K/ha, T_6 (150 kg N + 80 kg P + 40 kg K/ha), T_7 (150 kg N + 60 kg P + 60kg K/ha), T_8 (150 kg N + 80 kg P + 60 kg K/ha), T_9 (180 kg N + 60 kg P + 40 kg K/ha), T_{10} (180 kg N + 80 kg P + 40 kg K/ha), T_{11} (180 kg N + 60 kg P + 60 kg K/ha) and T_{12} (180 kg N + 80 kg P + 60 kg K/ha). The quantity of

Table 1. Effect of N, P, and K on growth, yield and quality of cabbage var Golden Acre.

Treatments	Plant height (cm)	Number of open leaves/ plant	Number of folded leaves/ plant	Cross sectional diameters (cm)	Vertical length of head (cm)	Fresh weight of head (kg)	Dry weight of head (g)	TSS (%)	Yield (q/ha)
$T_1(N_0P_0K_0)$	20.40	15.66	47.66	12.45	12.27	1.06	5.66	4.50	70.90
T_2 $(N_1P_0K_0)$	21.10	16.66	48.33	12.65	12.40	1.22	7.00	4.54	73.00
T_3 $(N_1P_1K_0)$	21.66	17.00	49.00	12.85	13.00	1.33	7.33	4.67	85.16
T_4 $(N_1P_1K_1)$	22.73	16.66	48.66	13.29	13.18	1.58	7.66	4.80	88.02
T_5 $(N_2P_1K_1)$	24.46	19.33	50.00	16.52	13.50	1.70	8.00	4.87	95.15
T_6 $(N_2P_2K_1)$	25.00	20.00	53.60	16.80	14.46	1.82	8.33	5.00	103.03
T_7 $(N_2P_1K_2)$	25.93	21.00	55.00	17.11	15.32	1.77	8.33	5.10	110.46
T_8 $(N_2P_2K_2)$	26.50	21.66	55.30	17.32	15.66	2.02	7.66	5.22	108.41
T_9 $(N_3P_1K_1)$	27.26	22.33	57.00	17.45	16.00	2.15	8.00	5.28	120.31
T_{10} $(N_3P_2K_1)$	28.93	23.33	57.66	17.90	16.76	2.22	9.00	5.38	129.66
$T_{11}(N_3P_1K_2)$	28.53	22.66	56.66	17.28	15.66	2.17	8.66	5.09	127.06
T_{12} $(N_3P_1K_2)$	28.06	21.66	55.00	16.52	15.41	2.00	7.33	4.62	122.16
SE ±	1.040	1.267	1.270	0.156	0.147	0.039	0.281	0.065	2.060
CD (5%)	1.193	2.628	2.634	0.459	0.305	0.117	0.584	0.135	6.043

fertilizers was given based on treatment. The entire amount of phosphorus and potassium along with half dose of nitrogen were applied as basal dose during the field preparation and rest amount of nitrogen was applied as top dressing in two- equal split doses at 30 and 60 days after transplanting. The transplanting was done in the second week of November 2008 and the seedlings were transplanted at 45 × 30 cm spacing. Each genotype was planted in a plot having 3.60 × 2.7 m area in randomized block design with three replications. Thus, there were total 65 plants in each plot planted at row and plant spacing of 30 × 45 cm. All the standard package of practices and plant protection measures were timely adopted to raise the crop successfully. Five randomly selected plants from each replication were utilized for recording observations viz., plant height (cm), number of open leaves/plant, number of folded leaves/plant, cross sectional diameter (cm), vertical length of head (cm), dry weight of head (kg), TSS (%) and yield (q/ha). Statistical analysis of the data was done as per standard method (3).

Results and Discussion

All the growth yield and quality parameters, viz., plant height (cm), number of open leaves/plant, number of folded leaves/plant, cross sectional diameter (cm), vertical length of head (cm), dry weight of head (kg), TSS (%) and yield (q/ha) showed significant increase with the application of N, P and K (Table 1). The N, P and K showed interaction effect on different growth, yield and quality characters presented in Table 1 indicated that the maximum plant height, number of open leaves and number of folded leaves i.e. (28.93 cm), (23.33) and (57.66) with the application of 180 kg N + 80 kg P + 40 kg K/ha (T_{10}) than the other treatments. Mangal et al. (4) reported that the application of same amount of nitrogen in cabbage for plant height. Growther (5) also observed that phosphorus and nitrogen are responsible for leaves development in potato. Maximum cross sectional diameters (17.90 cm) and vertical length of head (16.76 cm) was obtained with the application of 180 kg N + 80 kg P + 40 kg K/ha (T_{10}) which however, were at par with 180 kg N + 60 kg P + 40 kg K/ha (T_9) i.e. (17.32 cm) and (16.00 cm). Crizinszky and Schuster (6) reported that fertilizer rate 257 kg N, 99 kg P_2O_5 and 261 kg K_2O/ha increased head size in cabbage. Roy and Choudhary (7) also observed that the maximum vertical length of the cabbage head with the recommended doses of N, P and K fertilizer.

The mean values summarized in Table 1 show that the plants under T_{10} (180 kg N + 80 kg P + 40 kg K/ha) produced greater fresh weight (2.22 kg) and dry weight in cabbage head (9.00 g) which however, at par with T_{11} (180 kg N + 60 kg P + 60 kg K/ha) i.e. fresh weight (2.17 kg) and dry weight (8.66 g). The plants under control (T_1) showed poorest weight at all the

treatments. Sharma et al. (8) observed that 180 kg N/ha increased dry matter and curd yield in cauliflower. The maximum percentage of TSS (5.38%) was recorded under treatment T_{10} (180 kg N+ 80 kg P + 40 kg/ha) as compared to control (T_1 4.50%). Similar results were obtained by Mahendran and Kumar (9) in cabbage.

More yield was obtained with the application of 180 kg N + 80 kg P + 40 kg K/ha (T_{10}) followed by 180 kg N + 60 kg P + 60 kg K/ha (T_{11}). (Table 1). Both the combinations gave significantly higher yield than the rest of the treatments. However, the plants under control (T_1) and lower level of nitrogen (T_2) were significantly at par in this regard. These results tallied with the findings of Lixandry et al. (10) in vegetable crops and Politanskaya (11) in cauliflower, respectively.

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