

## Effects of NPK Fertilizers on Growth and Yield of Cabbage cv. September

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A study on the fertilizer requirement of cabbage, cv. September, was conducted with 3 levels each of N (0, 50 and 100 kg/ha), P (0, 25 and 50 kg/ha) and K (0, 50 and 100 kg/ha). The polar diameter, equatorial diameter and weight of head showed linear response to the increasing levels of N and P, while response to K was only moderate. Among the first order interactions, the interaction effects of N and P were more pronounced than the effects of N and K and P and K interactions. The shape of head was not altered due to application of varying levels of N, P and K. Application of N at 100 kg, P at 50 kg and K at 50 kg per hectare was found to be optimum, recording the highest weight of 2.280 kg per head with an estimated yield of 67.66 tonnes per hectare.

Cabbage is an important leafy vegetable cultivated throughout the year on the hills. It needs a moderate amount of fertilizers and responds well to nitrogen (Macgillivray, 1961). Studies conducted in different places revealed high response of cabbage to N application (Haworth, 1962, Som *et al.*, 1976, Anon., 1978 and Rowell *et al.*, 1978) and moderate response to P and K application (Vlcek and Polach, 1977 and Rowell *et al.*, 1978). However, the optimum nutritional requirements of cabbage for Upper Palney hills, where it is extensively grown, have not so far been determined. Therefore, this study was undertaken with the objective of fixing optimum levels of N, P and K to maximise the yield of cabbage, September, a cultivar that is best suited for cultivation at Kodaikanal.

### MATERIAL AND METHODS

The investigation was carried out at the Horticultural Research Station,

Kodaikanal during summer, 1980. The soil of the experimental plots is slightly acidic (pH 6.0) with medium to high available N and low available P and K. The trial was laid out in a randomised block design with two replications. Seeds were sown in raised nursery beds and seedlings were transplanted in rows in plots of 2.25 m × 2.25 m with inter and intra-row spacings of 75 cm and 45 cm respectively. The treatments consisted of 27 combinations of 3 levels each of N, P and K as follows.

N : 0, 50 and 100 kg/ha

P : 0, 25 and 50 kg/ha

K : 0, 50 and 100 kg/ha

Half the quantity of N and full doses at the time of planting and the other half of N applied as topdressing 30 days after planting. Urea, Superphosphate and Muriate of potash formed the nutrient sources for N, P and K respectively. Other cultural operations and

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plant protection measures were followed uniformly to all the treatment plots as per recommendations.

Observations on the number of non-wrapper leaves, height of stump, polar and equatorial diameters of head and weight of head were made on ten plants selected at random from each plot. The shape index of head was worked out as suggested by Odland and Noll (1954). Data were subjected to statistical analysis adopting the procedure followed by Panse and Sukhatme (1967).

## RESULTS AND DISCUSSION

### Effects of N :

The effects of increasing levels of N on the production of non-wrapper leaves, height of stump were inconsistent and the maximum number of leaves was observed in the control, while height of stump was the maximum at 100 kg N which was significantly higher than that of control (Table I). The polar and equatorial diameters of head increased correspondingly with increase in the levels of N with inconclusive results, although the differences were highly significant. Similar results were reported by Som *et al.*, 1976. Increasing N levels did not alter the head shape index. A linear significant increase in weight of head was noticed with the increasing levels of N, and the weight was the maximum at the highest N level. The results corroborate the findings of Haworth (1962), Som *et al.*, (1976),

and Vlcek and Polach (1977). The effect of N in promoting the vegetative growth is well known and the yield response to inner leaves leading to formation of larger heads. This is also evident from the polar and equatorial diameters of head.

### Levels of P :

The increasing levels of P did not produce significant differences in the number of non-wrapper leaves. However, the maximum number was noticed at 50 kg of P. The height of stump was significantly high at 50 kg of P. The polar and equatorial diameters of head and weight of head gradually increased with the increasing levels of P application and were the maximum at 50 kg P. The results were in accordance with the earlier findings (Anon., 1978). This might be due to low availability of P in the soil, with full utilization of applied P.

### Levels of K :

The maximum number of non-wrapper leaves, height of stump and polar diameter was recorded at 100 kg K, while the equatorial diameter was the highest at 50 kg K. The increasing levels of K failed to influence the shape index and weight of head. However, the weight of head was the maximum at 50 kg K and further increase to 100 kg did not promote the yield. Low response to K application was also reported by Zomanova and Burdenkov (1976) and moderate level of K was found adequate for higher yields as found by Rowell



TABLE I Effects of levels of N, P and K in cabbage cv. September

Treatment	Number of non-wrapper leaves	Height of stump (cm)	Polar diameter of head (cm)	Equatorial diameter of head (cm)	Shape index of head	Weight of head (kg)	Yield of heads/hectare (Tonnes)
N <sub>0</sub>	17.30	14.37	14.31	15.32	0.933	1.813	53.80
N <sub>1</sub>	16.68	13.82	14.61	15.56	0.938	1.946	57.75
N <sub>2</sub>	16.72	14.66	15.23	16.59	0.918	2.111	62.64
SE	0.181	0.223	0.151	0.108	0.007	0.070	—
CD							
(P=0.05)	0.524	0.647	0.437	0.314	NS	0.201	—
P <sub>0</sub>	16.89	13.91	14.27	15.44	0.923	1.846	54.78
P <sub>1</sub>	16.60	14.14	14.66	15.64	0.936	1.974	58.58
P <sub>2</sub>	17.21	14.81	15.23	16.38	0.930	2.050	6.380
SE	0.181	0.223	0.151	0.108	0.007	0.070	—
CD							
(P=0.05)	NS	0.647	0.437	0.314	NS	NS	—
K <sub>0</sub>	17.20	13.69	14.34	15.44	0.927	1.909	56.65
K <sub>1</sub>	16.30	14.42	14.88	16.14	0.922	1.994	59.17
K <sub>2</sub>	17.20	14.74	14.93	15.88	0.940	1.968	58.40
SE	0.181	0.223	0.151	0.108	0.007	0.070	—
CD							
(P=0.05)	0.524	0.647	0.437	0.314	NS	NS	—

et. al., (1978) and Vlcek and Polach (1977).

#### Interactions of N, P and K :

In the first order interactions (Table II), the N and P interactions did not significantly affect any of the characters studied. The number of non-wrapper leaves and height of stump were the maximum at N<sub>0</sub> P<sub>2</sub> and N<sub>2</sub> P<sub>1</sub> respectively, while the polar and equatorial

diameters and weight of head were the maximum at N<sub>2</sub> P<sub>2</sub> with 100 kg N and 50 kg P. N and K interactions also failed to show significant influence in all the characters, except height of stump and equatorial diameter which were significantly higher at N<sub>2</sub> K<sub>1</sub> (100 kg N and 50 kg K). Although the weight of head did not differ significantly, it was the maximum at N<sub>2</sub> K<sub>1</sub>. Among the six characters, the number of non-wrapper



TABLE II Effects of interactions of N and P, N and K and P and K in Cabbage cv. September

Treat- ment	Number of non- wrapper leaves	Height of stump (cm)	Polar diameter of head (cm)	Equatorial diameter of head (cm)	Shape index	Weight of head (kg)	Yield of heads/ hectare (Tonnes)
N <sub>0</sub> P <sub>0</sub>	17.30	14.20	13.70	15.03	0.910	1.766	52.40
N <sub>0</sub> P <sub>1</sub>	17.23	13.95	14.30	15.13	0.944	1.841	54.63
N <sub>0</sub> P <sub>2</sub>	17.37	14.97	14.93	15.78	0.946	1.833	54.39
N <sub>1</sub> P <sub>0</sub>	16.30	13.27	14.17	15.00	0.943	1.817	53.92
N <sub>1</sub> P <sub>1</sub>	16.63	13.27	14.50	15.45	0.938	1.954	57.98
N <sub>1</sub> P <sub>2</sub>	17.10	14.93	15.17	16.23	0.935	2.068	61.37
N <sub>2</sub> P <sub>0</sub>	17.07	14.25	14.93	16.39	0.915	1.956	58.04
N <sub>2</sub> P <sub>1</sub>	15.93	15.20	15.17	16.35	0.927	2.128	63.15
N <sub>2</sub> P <sub>2</sub>	17.17	14.53	15.60	17.12	0.911	2.248	66.71
SE	0.314	0.388	0.262	0.187	0.012	0.122	—
CD(P=0.05)NS		NS	NS	NS	NS	NS	—
N <sub>0</sub> K <sub>0</sub>	17.50	13.75	14.03	15.02	0.933	1.823	54.10
N <sub>0</sub> K <sub>1</sub>	16.73	13.48	13.98	15.08	0.926	1.842	54.66
N <sub>0</sub> K <sub>2</sub>	17.67	15.88	14.92	15.85	0.941	1.775	52.67
N <sub>1</sub> K <sub>0</sub>	17.30	13.75	14.28	15.28	0.934	1.854	55.02
N <sub>1</sub> K <sub>1</sub>	15.93	13.80	14.77	15.87	0.931	1.967	58.37
N <sub>1</sub> K <sub>2</sub>	16.80	13.92	14.78	15.53	0.951	2.019	59.21
N <sub>2</sub> K <sub>0</sub>	16.80	13.58	14.70	16.03	0.916	2.051	60.86
N <sub>2</sub> K <sub>1</sub>	16.23	15.97	15.90	17.47	0.910	2.173	64.48
N <sub>2</sub> K <sub>2</sub>	17.13	14.43	15.10	16.27	0.928	2.109	62.58
SE	0.314	0.388	0.262	0.187	0.012	0.122	—
CD(P=0.05)NS		1.126	NS	0.544	NS	NS	—
P <sub>0</sub> K <sub>0</sub>	17.93	13.32	13.42	14.82	0.905	1.743	51.72
P <sub>0</sub> K <sub>1</sub>	15.53	14.48	14.58	15.68	0.929	1.905	56.53
P <sub>0</sub> K <sub>2</sub>	17.20	13.92	14.80	15.83	0.934	1.890	56.08
P <sub>1</sub> K <sub>0</sub>	16.87	13.08	14.17	15.22	0.930	1.955	58.01
P <sub>1</sub> K <sub>1</sub>	16.17	14.50	15.00	16.20	0.925	2.014	59.76
P <sub>1</sub> K <sub>2</sub>	16.77	14.83	14.80	15.52	0.953	1.954	57.98
P <sub>2</sub> K <sub>0</sub>	16.80	14.68	15.43	16.30	0.948	2.029	60.21
P <sub>2</sub> K <sub>1</sub>	17.20	14.27	15.07	16.53	0.911	2.062	61.19
P <sub>2</sub> K <sub>2</sub>	17.63	15.48	15.20	16.30	0.932	2.059	61.10
SE	0.314	0.388	0.262	0.187	0.012	0.122	—
CD(P=0.05)0.910		NS	NS	NS	NS	NS	—



leaves alone showed significant differences due to interactions of P and K. However, the weight of head was the maximum at  $P_2 K_1$  (50 kg P and 50 kg K). Among the first order interactions, N and P interaction was marked due to their main effects, while the interactions of N and K and P and K were not appreciable.

It could be seen from Table III that three factor interactions (N, P and K) had no significant influence on any of the characters except the number of non-wrapper leaves which was the highest at the highest levels of N, P and K ( $N_2 P_2 K_2$ ). The height of stump, polar diameter and equatorial diameter were maximum at  $N_0 P_2 K_2$ ,  $N_1 P_2 K_0$  and  $N_2 P_2 K_1$  respectively. Data on the head shape index showed that application of N, P and K at different combinations had no influence on the shape of head and the heads were round to slightly flat in all the treatments. Although the weight of head did not show significant differences, the maximum weight of head (2.280 kg) with an estimated yield of 67.66 tonnes per hectare was obtained at  $N_2 P_2 K_1$  (100 kg N 50 kg P and 50 kg K) followed by  $N_2 P_2 K_2$  (100 kg N 50 kg P and 100 kg K) (2.269 kg and 67.33 tonnes per hectare respectively). The interactions of N, P and K showed that cabbage responds well to combination of high levels of N and P and medium level of K by producing larger heads.

The study thus, reveals that the main and interaction effects of high levels of

N and P and medium level of K were effective in increasing the yield and application of 100 kg N, 50 kg P and 50 kg K per hectare is optimum for higher yields in cabbage.

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