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**Ray PK**  
Subject Matter Specialist  
(Horticulture), Krishi Vigyan  
Kendra, Saharsa, Bihar, India

**Adarsh A**  
Farm Manager, Krishi Vigyan  
Kendra, Saraiya, Bihar, India.

**Chaudhary A**  
Subject Matter Specialist (Plant  
Breeding & Genetics), K. V. K.,  
Saharsa, Bihar, India

## Effect of organic and inorganic fertilizers on yield and economics of cabbage (*Brassica oleracea* var. *capitata*)

Ray PK, Adarsh A and Chaudhary A

### Abstract

A field experiment was conducted during *Rabi* 2015-16 and 2016-17 to study economics of cost of cultivation of head yield of cabbage as influenced by different sources of organic and inorganic fertilizers. The experiment was laid in a randomized block design with three replications. Pooled data of two years showed seedling treatment with Trichoderma @ 5 gram per litre of water and soil application of Trichoderma @ 1.25 kg per hectare with compost @ 5 ton per hectare recorded maximum head yield 274.07 q/ha with the highest net return of Rs 2,74,819/ha. The highest B:C ratio obtained was 5.08. However, the second best treatment was seedling treatment with Trichoderma @ 10 gram per litre of water and soil application of Trichoderma @ 2.5 kg per hectare with compost @ 5 ton per hectare, which gave the highest net return up to Rs 2,47,523/ha while second highest B:C ratio (4.13) was obtained in recommended dose of fertilizers (N<sub>100</sub>:P<sub>60</sub>:K<sub>80</sub>). Economic studies indicated that seedling treatment with Trichoderma @ 5 gram per litre of water and soil application of Trichoderma @ 1.25 kg per hectare with compost @ 5 ton per hectare gave maximum net returns of 2,74,819 /ha with B:C ratio of 5.08 for cabbage head production.

**Keywords:** Cabbage, fertilizer, vermicompost, trichoderma, economics and yield

### Introduction

Cabbage (*Brassica oleracea* L. var. *capitata* L.) belongs to the cole group of vegetables which has originated from a single wild ancestor *Brassica oleracea* L. var. *oleracea* (syn. *sylvestris*) commonly known as wild cabbage, cliff cabbage or 'Colewart', through mutation and introgression from wild species, human selection and adaptation. Historical evidences indicate that modern hard headed white cabbages evolved in Germany are descended from wild non-heading leafy cabbage that originated in the eastern Mediterranean and Asia Minor (De Candolle, 1883) and were probably brought into Western Europe by the Celts. It is the most popular vegetable around the world in respect of area, production and availability, almost round the year and occupies the pride place among cole crops due to its delicious taste, flavour and nutritive value. It is grown for heads which are used as vegetable, eaten raw and frequently preserved as sauerkraut or pickle. Cabbage is an excellent source of vitamin C, some B vitamins, potassium and calcium (Hasan and Solaiman, 2012) [7]. Cabbage has several medicinal properties. The American Cancer Society and the National Research Council have recommended increased consumption of cabbage to lower down risk of certain types of cancer (Birt, 1988) [2]. Application of vermicompost in crop production is an important aspect of organic farming and it finds a wide range of applications in various types of agricultural plants. Vermicompost can be used as effective manure in crop production as well as biofertilizer in maintaining soil health. Vermicompost is a rich nutritive organic fertilizer due to rich in humus, micronutrients, beneficial soil microbes-'nitrogen fixing and phosphorous solubilizing bacteria' and actinomycetes and growth hormones 'auxins', 'gibberlins' and 'cytokinins'. Vermicompost contains several nutrient elements such as N -1.9 %, C- N-13.6, P -2 %, K- 0.8 %, Zn- 100 ppm, Cu- 48 ppm and Mn-500 ppm. Trichoderma is rich in various nutrients. Trichoderma contained as much as 20 % organic carbon and considerable amount of 11 different nutrient elements i.e. N- 1.2 %, P- 0.61 %, K -0.77 %, S- 0.24 %, Ca- 1.71 %, Mg- 0.4 %, B- 0.01 %, Cu- 0.01 %, Fe- 0.12 %, Mn- 0.026 % and Zn- 0.02 %. In Bihar, the productivity of cabbage per unit area is quite low as compared to other states of the country. This low yield may be attributed to the method of production practices followed by the farmers especially use of poor quality seeds, maintenance of lower soil fertility, inadequate irrigation and use of imbalanced fertilizers. Among the various factors involved judicious nutrient supply is an important inputs for realizing higher cabbage yield and its Nutrient content.

**Correspondence**  
**Ray PK, Adarsh**  
Subject Matter Specialist  
(Horticulture), Krishi Vigyan  
Kendra, Saharsa, Bihar, India

The increasing land use intensity without adequate and balanced use of chemical fertilizers and with little or no use of organic manures have caused severe fertility deterioration of soils resulting in stagnating or even declining of crop productivity.

### Materials and Methods

The experiment was conducted at the farmers' field of Saharsa district, Bihar as 'On Farm Trial' mode for two years during 2015-16 and 2016-17 in Rabi season. The planting was

done during October and the variety BC 76 is used for this experiment. The experiment was conducted in a Randomized Block Design with 3 replication and 4 treatments with recommended agronomic practices. The plot size of each treatment was 5m x 5m and spacing was maintained 60cm x 45cm each for row to row and plant to plant. The crop was harvested during last week of January. The details of technologies assessment/refinement, farming situation, area of intervention and technology option was presented in table-1.

**Table 1:** Technology option assessed during 2015-16 and 2016-17

Problem area	Important cause	Production system	Micro farming situation
Low productivity of Cabbage	imbalanced used of fertilizers	Rice based	Irrigated medium land with clay to sandy clay loam soil
<b>Intervention plan</b>			
Farmers' practice-I	No use of Trichoderma and vermicompost in cabbage cultivation.		
Technology option – II	Recommended dose of fertilizers (N <sub>100</sub> :P <sub>60</sub> :K <sub>80</sub> )		
Technology option – III	Seedling treatment with Trichoderma @ 5 gram per litre of water and soil application of Trichoderma @ 1.25 kg per hectare with compost @ 5 ton per hectare.		
Technology option – IV	Seedling treatment with Trichoderma @ 10 gram per litre of water and soil application of Trichoderma @ 2.5 kg per hectare with compost @ 5 ton per hectare.		

### Results and Discussion

#### Growth parameters

The plant height, number of open leaves and length and width of leaves of cabbage were, in general, increased with the successive growth and age of plant up to 45 days after transplanting (DAT). All these characters increased by more than two fold right from initial 15 DAT stage up to the advanced growth of 45 DAT stage in all the treatments (Table 2). The steady or consistent rise in these parameters in case of cabbage may be due to fact that the growth of plant is genetically governed and this may vary in different varieties due to variable genetic inheritance among the varieties. As regards with the treatments effect, plant height, numbers of open leaves/plant as well as length and width of leaves were influenced significantly due to various treatments at every stage of observation. Among the organic manures and inorganic fertilizer treatments Seedling treatment with Trichoderma @ 5 gram per litre of water and soil application of Trichoderma @ 1.25 kg per hectare with vermi compost @ 5 ton per hectare resulted in significantly higher in these growth characters over rest of the treatments. Accordingly, the maximum height, leaf number, length and width of leaves were recorded due to Seedling treatment with Trichoderma @ 5 gram per litre of water and soil application of Trichoderma @ 1.25 kg per hectare with compost @ 5 ton per hectare. The increased vegetative growth may be due to increased availability of heavy nutrients obtained through organic fertilizers as well as trichoderma which promote plant growth by ensuring higher number of greener leaves with increased photosynthesis and forming longer and stronger roots to absorb sufficient water and nutrients. Similar findings have been reported by several workers Bharadwaj *et al.* (2000), Samawat *et al.* (2001)<sup>[12]</sup>, Jayathilake *et al.* (2002)<sup>[9]</sup>, Subba Rao and Ravi Sankar (2001), Prabhakaran and Pitchai (2002)<sup>[10]</sup>, Choudhary *et al.* (2003) and Tripathy *et al.* (2004)<sup>[16]</sup>.

#### Yield attributing parameters

The results on yield attributing parameters are also summarized in the Summary Table-3. The circumference of head, dry matter of head, weight of untrimmed and trimmed head were recorded maximum due to Seedling treatment with Trichoderma @ 5 gram per litre of water and soil application

of Trichoderma @ 1.25 kg per hectare with compost @ 5 ton per hectare. This may be due to nutritional effect and improved soil physical environment which is responsible to enhancing the yield attributing characters. The beneficial effect of earthworms on plant growth may be due to the presence of macro as well as micro nutrients in vermicompost and in their secretions in considerable quantities. It is also the effect of metabolites produced by the earthworms, which are responsible for stimulating the plant growth. It is also believed that the earthworm release certain vitamins and similar substances into the soil which may be vitamins B or some pro-vitamins D or free amino acids. The beneficial effect of vermicompost are in close conformity with the findings of many workers (Samawat *et al.*, 2001<sup>[12]</sup>; Jayanthilake *et al.*, 2002; Gunadi *et al.*, 2002<sup>[6]</sup>; Prabhakaran *et al.*, 2002; Renuka and Ravi Sankar, 2001; Choudhary *et al.*, 2003 and Tripathy *et al.*, 2004).

#### Grading of heads

Among the organic manures and inorganic fertilizers, Seedling treatment with Trichoderma @ 5 gram per litre of water and soil application of Trichoderma @ 1.25 kg per hectare with compost @ 5 ton per hectare performed the best and resulted in maximum per cent of A grade cabbage heads (74.6 %) and the minimum B and C grade heads (Table-4). This may be due to the fact that the sufficient supply of N, P and K nutrients resulted in accumulation and translocation of more photosynthates from source *i.e.* vegetative parts towards the sink (reproductive organs). Thus the stronger sink resulted in the largest size and weight of heads.

#### Head yield and net return

The Table-5 indicates that the Seedling treatment with Trichoderma @ 5 gram per litre of water and soil application of Trichoderma @ 1.25 kg per hectare with compost @ 5 ton per hectare performed equally the best and resulted in significantly higher yield of cabbage over all the rest of the treatments (274.07 q/ha). This may be due to regular and increased supply of plant nutrients in proper available forms as well as other added advantages provided by these organic sources of nutrients. Consequently the growth and yield components were enhanced up to the higher extent and

thereby resulted in higher productivity. However, the best treatment in terms of net return was T<sub>3</sub>, which gave the highest net return up to Rs 2, 74, 819 ha. Benefit cost ratio varied significantly among the treatments. The highest benefit cost ratio (5.08) was found in T<sub>3</sub> which was statistically similar to T<sub>2</sub> (4.13). On the other hand, the lowest benefit cost ratio (3.12) per hectare was obtained from T<sub>1</sub> treatment. T<sub>3</sub> treatment produced the highest benefit cost ratio because

organic manure mainly vermicompost and trichoderma combinedly create good soil environment increased the production. As a result, for good yield performance and for good marketable selling price influenced the highest benefit cost ratio is T<sub>3</sub> treatment. These findings are in close conformity with those of Ghuge *et al*, 2007<sup>[5]</sup>; Sarma *et al*, 2011<sup>[13]</sup>; Islam, 2011<sup>[8]</sup>; Upadhyay *et al*, 2012<sup>[12]</sup> and Shahi, 2013<sup>[14]</sup>.

**Table 2:** Growth parameters

Treatments	Plant height (cm)			Number of open leaves per plant			Length of leaf (cm)			Width of leaf (cm)		
	15 DAT	30 DAT	45 DAT	15 DAT	30 DAT	45 DAT	15 DAT	30 DAT	45 DAT	15 DAT	30 DAT	45 DAT
Farmers' practice-I	11.26	19.33	23.6	6.40	10.93	15.00	7.23	14.56	18.60	6.25	13.99	17.55
Technology option – II	17.37	26.53	32.33	8.92	15.67	17.60	10.59	20.16	23.50	9.35	19.17	22.78
Technology option – III	18.21	27.11	34.56	9.72	16.47	18.80	11.74	21.13	25.68	10.63	20.40	24.57
Technology option – IV	11.96	19.47	25.67	6.13	10.87	15.00	7.04	14.62	19.87	5.95	14.51	19.25
SEm+	0.05	0.09	0.07	0.12	0.13	0.19	0.18	0.14	0.18	0.13	0.18	0.11
C.D. (5%)	0.13	0.21	0.15	0.29	0.32	0.44	0.44	0.34	0.41	0.31	0.44	0.27

**Table 3:** Yield attributing parameters

Treatments	Days to first head initiation	Circumference of head (cm)		Weight of untrimmed head (kg/head)	Weight of trimmed Head (kg/head)	Dry matter of head (%)	Yield of heads q/ha
		Days after initiation of heads					
		15	30				
Farmers' practice I	42.67	18.80	39.60	1.38	0.58	4.31	214.81
Technology optio-II	37.33	23.02	47.63	1.90	0.95	6.24	229.13
Technology option – III	36.33	25.23	51.40	2.11	1.12	7.62	274.07
Technology option – IV	41.67	19.40	40.00	1.37	0.62	4.66	260.49
SEm+	0.20	0.39	0.30	0.12	0.17	0.43	1.01
C.D. (5%)	0.48	0.93	0.72	0.28	0.39	1.03	2.39

**Table 4:** Grading of heads

Treatments	Grading of heads (%)		
	A	B	C
Farmers' practice-I	30.95	32.54	36.5
Technology option – II	56.35	25.4	18.26
Technology option – III	74.6	16.67	9.52
Technology option – IV	33.33	30.95	35.71
SEm+	0.43	0.19	0.19
C.D. (5%)	1.03	0.44	0.46

**Table 5:** Net profit and benefit cost (B:C) ratio under different treatments

Treatments	Head yield (q/ha)	Gross income (Rs/ha)	Cost of fertilizer & manure (Rs/ha)	Cost of cultivation Without fertilizer and manure (Rs/ha)	Total cost of cultivation Including fertilizer & manure (Rs/ha)	Net profit (Rs/ha)	Benefit Cost ratio (B:C)
Farmers' practice-I	214.81	2,57,772	34,835	27,580	62,415	1,95,357	3.12
Technology option – II	229.13	2,74,956	25,985	27,580	53565	2,21,391	4.13
Technology option – III	274.07	3,28,884	26,485	27,580	54065	2,74,819	5.08
Technology option – IV	260.49	3,12,588	37,485	27,580	65065	2,47,523	3.80

## Conclusion

Among the organic manures and inorganic fertilizers, seedling treatment with Trichoderma @ 5 gram per litre of water and soil application of Trichoderma @ 1.25 kg per hectare with compost @ 5 ton per hectare proved the most beneficial for growing cabbage var. BC-76 in this region. It yielded the Maximum up to 274.07 q/ha cabbage heads with the highest net return of Rs 2, 74, 819/ha. The highest B:C ratio obtained was 5.08. However, the second best treatment in terms of net return was seedling treatment with Trichoderma @ 10 gram per litre of water and soil application of Trichoderma @ 2.5 kg per hectare with compost @ 5 ton per hectare, which gave

the highest net return up to Rs 2, 47, 523/ha while second highest B:C ratio (4.13) was obtained in recommended dose of fertilizers (N<sub>100</sub>:P<sub>60</sub>:K<sub>80</sub>).

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