

Effect of organic manures and biofertilizers on growth, yield and quality of cabbage (*Brassica oleracea* L. var. *capitata*)

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ABSTRACT

An investigation was carried out during rabi season of 2017-18 at Horticulture farm, College of Agriculture, Sehore RVSKVV, Gwalior to study experiment "Effect of organic manures and bio fertilizers on growth and yield of cabbage (*Brassica oleracea* L. var. *capitata*)". Experiment was carried out in randomized block design with three replications. The experiment was comprised of ten treatments viz., T₁: V₁ (Green galaxy) + FYM @20t/ha + Azotobacter@2.5kg/ha, T₂: V₁ (Green galaxy) + Vermicompost @5t/ha+Azotobacter @2.5kg/ha, T₃: V₁ (Green galaxy) - Poultry Manure @5t/ha + Azotobacter @2.5kg/ha, T₄: V₁ (Green galaxy) + Pig Manure@5t/ha + Azotobacter @ 2.5kg /ha, T₅: V₁ (Green galaxy) + Recommended doses of manure and fertilizer (NPK@ 100:60:80 kg/ha respectively), T₆: V₂ (Green ball) + FYM @20t/ha + Azotobacter@2.5kg/ha, T₇: V₂ (Green ball) + Vermicompost@5t/ha + Azotobacter @2.5kg/ha, T₈: V₂ (Green ball) + Poultry Manure@5t/ha +Azotobacter@2.5kg/ha, T₉: V₂ (Green ball) + Pig manure@5t/ha + Azotobacter@2.5kg/ha, T₁₀: V₂ (Green ball) + Recommended doses of manure and fertilizer (NPK). The maximum plant height, stalk length, maximum number of non-wrapper leaf per plant, plant spread, maximum head size, head diameter, gross head weight, head compactness, head yield per plot, head yield per hectare, maximum self life (11.54 days), highest benefit cost ratio (1:1.41) and maximum net return (229244 Rs./ha) under the treatment T₈ (Green ball + Poultry Manure@5t/ha + Azotobacter@2.5kg/ha) closely followed by T₉ (10.22 days) for all the characters. Whereas minimum growth and yield parameters was recorded under the treatment T₅ (Green galaxy + Recommended doses of manure and fertilizer).

Key Words: Cabbage, organic manure, poultry manure (PM), vermicompost (VC), Azotobacter

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INTRODUCTION

Cabbage (*Brassica oleraceae* L. Var *capitata*) is a cole crop and belongs to the family Cruciferae or Brassicaceae having chromosome number $2n=2x=18$. Cabbage is a cool season crop but adapted to a wide range of climates and soils but best results are obtained in a cool environment with a monthly temperature of 13°C to 16°C and where soil is well supplied with nutrients and irrigation water. In India the productivity is low as compared to other countries. Therefore there is a need to increase productivity [3-5]. There are many factors involve in overall growth of cabbage viz., nutrient management, irrigation, plant protection measures, varieties etc [30, 20-22]. Among these factors nutrient management is an important factor to increase productivity of cabbage. Since long term use of inorganic fertilizer reduces soil fertility therefore there is a need to maintain soil fertility through

organically. Growing of crops by the combined package of organic manures and bio fertilizers brings forth the Organic farming which is in vogue today.

MATERIAL AND METHODS

The investigation was carried out at research field, department of Horticulture, College of Agriculture, Sehore campus of RVSKVV, Gwalior during *rabi* season 2016-17. The experiment was comprised of ten treatments viz., T₁:V₁ (Green galaxy) + FYM @20t/ha + Azotobacter@2.5kg/ha, T₂: V₁ (Green galaxy) + Vermicompost @5t/ha+Azotobacter @2.5kg/ha, T₃: V₁ (Green galaxy) - Poultry Manure @5t/ha + Azotobacter@2.5kg/ha, T₄: V₁ (Green galaxy) + Pig Manure@5t/ha + Azotobacter @ 2.5kg /ha, T₅: V₁ (Green galaxy) + Recommended doses of manure and fertilizer (NPK), T₆: V₂ (Green ball) + FYM @20t/ha + Azotobacter@2.5kg/ha, T₇:V₂ (Green ball) + Vermicompost @5t/ha + Azotobacter @2.5kg/ha, T₈ : V₂ (Green ball) + Poultry Manure@5t/ha +Azotobacter@2.5kg/ha, T₉:V₂ (Green ball) + Pig manure@5t/ha + Azotobacter@2.5kg/ha, T₁₀ : V₂ (Green ball) + Recommended doses of manure and fertilizer (NPK).

Experiment was laid out in Randomized Completely Block Design with three replications. Full dose of phosphorus, potash and ½ dose of nitrogen were applied respectively according to treatments. Full quantity of vermicompost, phosphorus and potash along with one third of nitrogen was applied as par treatment plot before transplanting the seedling. While, the rest of the nitrogen was applied in two equal splits doses at 25 and 50 days after transplanting. Well decomposed vermicompost was incorporated in soil thoroughly as per treatment as basal dose. Transplanting of healthy seedlings was done with spacing of 60 cm × 45 cm. All cultural operations were done as per recommendations. Observations were recorded from five random healthy plants of each treatment on growth, yield and its attributes. The experimental data recorded were subjected to statistical analysis using analysis of variance technique suggested by Panse and Sukhtame [18].

RESULTS AND DISCUSSION

Growth parameters:

The data (Table 1 and Table 2) for Growth parameters viz., plant height, stalk length, number of non wrappers leaves per plant recorded at 20, 40, 60 and 80 DAT. Treatment T₈ produced significantly the highest plant height at (16.40cm to 39.46 cm), stalk length per plant (3.00 cm to 9.03 cm), number of non-wrapper leaf per plant (10.03 to 16.60 per plant), plant spread (26.60 cm² to 75.53 cm²). The treatment T₅ attained lowest plant height at 20 DAT (13.60cm) while The treatment T₇ attained lowest plant height at 40, 60 and 80 DAT (21.96, 32.73, 34.83 cm) where, lowest stalk length (2.33 cm to 7.86 cm), whereas at 20 DAT treatment T₁ produced lowest non wrapper leaf per pant (8.70) while at 40,60,80 DAT treatment T₅ produced lowest non-wrapper leaf per plant (10.80, 14.73, 14.86), at 20 DAT treatment T₆ have lowest plant spread, at 40 DAT treatment T₁₀ have plant spread(39.36cm²).at 60 and 80 DAT treatment T₅ have lowest plant spread (63.70 to 68.50 cm²). Similar results were reported by Bahadur *et al.* [6], Anant *et al.* [3], Goswami *et al.* [11], Raghav and Shashi [19] for plant height, stalk length and plant spread. Singh *et al.* [28] and Upadhyay *et al.* [29] reported similar findings for number of non wrappers leaves per plant.

Yield parameters: The Data (Table 3 and Table 4) related to Yield attributing characters viz, head diameter, head size, net head weight, gross head, head compactness, head yield per plot, head yield per hectare, varied significantly due to treatments. Treatment T₈[combined application of Green ball + Poultry Manure (5t/ha) + Azotobacter (2.5kg/ha)] produced maximum head diameter (23.23 cm), head size (17.93 cm), Similar results were reported by Singh and Singh [27], Chatterjee *et al.* [7], Choudhary *et al.* [9]. Maximum net head weight (1,052 g), gross head weight (2,097 g) head compactness (43.57). These findings are in agreement with findings of Singh and Singh [26], Chatterjee *et al.* [8], Chaudhary *et al.* [9]. Treatment T₈[combined application of Green ball + Poultry Manure (5t/ha) + Azotobacter (2.5kg/ha)] produced maximum head yield per plot (33.49 kg per plot). These findings are in agreement with the findings of by Chatterjee *et al.* [7], Singh and Singh [25], Hasan and Solaiman [12], Chatterje *et al.* [7], Acharya *et al.* [1], Sajib *et al.* [12], Alam *et al.*, [2], Devi *et al.*, [10], Kumar *et al.*, [13], Chaudhary *et al.* [9],

Treatment T₈[combined application of Green ball + Poultry Manure (5t/ha) + Azotobacter (2.5kg/ha)] produce maximum head yield per hectare (404.70 q ha⁻¹).These findings are in agreement with the findings of by Singh and Singh [24], Chatterjee *et al.* [9], Hasan and Solaiman [12], Chatterje *et al.* [9], Acharya *et al.* [2], Sajib *et al.* [22], Alam *et al.*, [2], Devi *et al.*, (2017), Kumar *et al.*, [14], Chaudhary *et al.* [9], Pandey *et al.*, [16], Pandey *et al.*, [15, 17].

Treatment T₅ produced minimum head diameter (15.80 cm), head size(13.53 cm), head weight (639 g), less compact of head (33.62) lowest yield per plot (17.66 kg per plot), lowest head yield per hectare (217.82 q ha⁻¹).

Quality parameters

The self life was also influenced significantly due to applied treatments. Amongst the treatments, T₈ (Green ball + Poultry Manure@5t/ha + Azotobacter@2.5kg/ha) recorded maximum self life (11.54 days), closely followed by T₉ (10.22 days). The minimum shelf life (7.44 days) was noted from the treatment T₅ (Green galaxy + Recommended doses of manure and fertilizer). These finding related to shelf life are in agreement with the finding of Kumar and Khare (2015), and Chaudhary *et al.* (2018) in cabbage. The colour of head was dark green in treatments likes T₁, T₂, T₃, T₄, T₆, T₇, T₈, The head colour is light green in treatments T₅ and T₁₀. The colour of head was dark green in combine application of organic manures and bio-fertilizers in all recommended treatment whereas, the application of inorganic fertilizers the head colour is light green.(Table 5)

Economics

It is evident from the data (Table 6) that a significantly maximum marketable head yield of cabbage 404.7 q /ha was recorded in T₈ (V₂ (Green ball) - Poultry Manure (5t/ha) + Azotobacter (2.5kg/ha)) along with net return of Rs 229244 kg / plot and cost benefit ratio 1:1.41 followed by T₉ (V₂ (Green ball) - Pig Manure (5t/ha) + Azotobacter (2.5kg /ha)) (344.4 q / ha, Rs. 196598 q/ha and 1: 1.40 head yield, net return and cost benefit ratio, respectively). While, minimum cost benefit ratio 1: 28 was obtained in the T₁ (V₁ (Green galaxy) - FYM (20t/ha) + Azotobacter (2.5kg/ha)) due to head yield 229.59 q/ha and net return Rs 178465 q/ha is lower as compared to other treatments.

Table 1: Growth and growth attributes of cabbage as influenced by organic manures and bio-fertilizers

Treatment	Plant height (DAT)				Stalk length (DAT)			
	20 DAT	40 DAT	60 DAT	80 DAT	20 DAT	40 DAT	60 DAT	80 DAT
T ₁	16.0000	23.10	32.66	37.70	2.46	5.43	7.56	8.46
T ₂	15.30	22.33	34.23	37.66	2.53	5.53	7.46	8.50
T ₃	15.53	22.93	33.60	35.80	2.53	5.53	7.20	8.40
T ₄	16.13	24.40	33.36	37.13	2.53	5.20	7.46	8.26
T ₅	13.73	20.46	31.93	34.83	2.33	5.16	6.93	7.86
T ₆	14.30	22.06	31.96	38.93	2.86	5.86	7.80	8.76
T ₇	13.60	21.96	32.73	38.13	2.80	5.66	7.73	8.60
T ₈	16.40	23.30	33.76	39.46	3.00	6.00	7.83	9.03
T ₉	14.83	22.66	33.66	39.16	2.46	5.40	7.20	8.40
T ₁₀	15.67	22.13	33.56	36.46	2.53	5.46	7.23	8.43
S.Em±	0.758	0.69	0.802	0.553	0.18	0.20	0.23	0.19
CD (P=0.05)	2.28	2.075	2.401	1.657	0.53	0.62	0.70	0.58

Table 2: Growth and growth attributes of cabbage as influenced by organic manures and bio-fertilizers

Treatment	No. of non wrapper leaf/plant (DAT)				Plant spread (cm ²) (DAT)			
	20 DAT	40 DAT	60 DAT	80 DAT	20 DAT	40 DAT	60 DAT	80 DAT
T1	8.70	12.43	15.13	15.36	21.86	44.96	64.86	71.83
T2	8.73	11.53	15.43	15.60	24.20	46.36	62.70	71.66
T3	9.16	11.83	14.90	14.93	24.33	43.10	63.93	71.33
T4	9.23	12.66	15.96	15.76	23.73	42.83	67.70	74.10
T5	8.50	10.80	14.73	14.86	23.60	41.86	61.83	68.50
T6	9.36	11.90	15.86	15.23	21.20	42.96	63.70	68.70
T7	9.40	12.33	15.26	16.00	23.76	47.10	64.10	69.86
T8	10.03	13.06	16.43	16.60	26.60	50.03	67.43	75.53
T9	9.70	12.63	16.23	16.36	24.90	47.33	65.27	74.36
T10	9.16	12.36	15.83	15.93	21.33	39.36	63.46	70.16
S.Em±	0.44	0.48	0.59	0.59	1.17	2.63	1.19	2.04
CD (P=0.05)	1.31	1.43	1.75	1.76	3.49	7.89	3.57	6.12

Table 3: Yield and yield attributes of cabbage as influenced by organic manures and bio-fertilizers

Treatment	Head diameter (cm)	Head size (cm)	Net head weight (g)	Gross head weight (g)
Varieties				
T1	15.96	14.03	647	1525
T2	16.30	14.53	706	1666
T3	16.76	14.70	755	1870
T4	17.06	15.50	814	1744
T5	15.80	13.53	639	1372
T6	18.90	15.36	865	1659
T7	17.83	15.43	867	1750
T8	23.23	17.93	1052	2097
T9	19.20	15.76	949	1907
T10	17.23	14.13	848	1621
S.Em±	0.84	0.42	27.12	13.07
CD (P=0.05)	2.50	1.25	81.22	39.14

Table 4: Yield and yield attributes of cabbage as influenced by organic manures and bio-fertilizers

Treatment	Head compactness	Head yield plot ⁻¹ (kg)	Head yield ha ⁻¹ (q)
Varieties			
T1	37.67	18.68	229.59
T2	37.77	21.64	267.78
T3	39.09	24.62	302.64
T4	38.81	22.41	275.66
T5	33.62	17.66	217.82
T6	36.09	25.45	317.50
T7	35.75	25.86	321.97
T8	43.57	33.49	404.70
T9	39.27	27.40	344.44
T10	33.75	24.83	307.30
S.Em±	1.42	0.25	5.66
CD (P=0.05)	4.27	0.75	16.97

Table 5: Quality attributes of cabbage as influenced by organic manures and bio-fertilizers

Treatment	Self life (days)	Head colour
Varieties		
T1	8.24	Dark green
T2	8.73	Dark green
T3	8.81	Dark green
T4	8.40	Dark green
T5	7.44	Light green
T6	9.47	Dark green
T7	9.31	Dark green
T8	11.54	Dark green
T9	10.22	Dark green
T10	9.74	Light Green
S.Em±	0.18	
CD (P=0.05)	0.54	

Table 6 : Economics of cabbage as influenced by organic manures and bio-fertilizers

Treatments	Yield (q/ha)	Gross income (Rs/ha)	Expenditure (Rs/ha)	Net return (Rs/ha)	B:C ratio
T1	229.59	229590	51125	178465	1:1.28
T2	267.78	214224	56841	157383	1:1.36
T3	302.64	242112	58546	183566	1:1.31
T4	275.66	220528	61245	159283	1:1.38
T5	217.82	174256	48956	125300	1:1.39
T6	317.5	254000	60253	193747	1:1.31
T7	321.97	257576	65489	192087	1:1.34
T8	404.7	323760	94516	229244	1:1.41
T9	344.44	275552	78954	196598	1:1.40
T10	307.3	245840	64596	181244	1:1.35

CONCLUSION

On the basis of present investigation, it may be concluded that cabbage responded well in terms of growth, yield and quality to treatment T8 having Green ball + Poultry Manure@5t/ha + Azotobacter@2.5kg/ha. This treatment resulted in maximum head diameter (23.23 cm), head size(17.93 cm), net head weight (1,052 gm), Head yield plot⁻¹ (33.49 kg), head yield (40.47 ton ha⁻¹), head compactness (43.57),self life (11.54 days) net return Rs 229244 and B:C.ratio (1.41) followed by T₉ (Green ball + Pig Manure@5t/ha + Azotobacter@2.5kg /ha) and T7 (Green ball + Vermicompost@5t/ha + Azotobacter @2.5kg/ha) , net return Rs 196598 with B:C ratio 1.40 . So these varieties with fertilizer dose can be recommended for commercial cultivation in Sehere condition.

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