Environment and Ecology 42 (2B) : 891—896, April—June 2024
Article DOI: https://doi.org/10.60151/envec/YGAY8010
ISSN 0970-0420

Effect of Different Organic Sources and Time of Manuring on the Growth, Yield and Quality of Cabbage (*Brassica oleracea* var. *capitata*)

Mhabeni N. Kikon, S. P. Kanaujia, Moakala Changkiri, Sentirenla Jamir

Received 9 November 2023, Accepted 10 April 2024, Published on 3 June 2024

ABSTRACT

A field experiment was conducted during the *rabi* season of 2022-2023 at the Instructional cum Experimental Farm, Nagaland University, School of Agricultural Sciences, Medziphema campus to evaluate the "Effect of different organic sources and time of manuring on the growth, yield and quality of cabbage (*Brassica oleracaea* var. *capitata*). The experiment consisted of 15 treatments laid out in RBD with three replications. Result of the experiment clearly revealed that application of 75% N through VC one day before transplanting + 25% N through VC 20 DAT obtained maximum growth parameters, quality parameters and yield parameters with plant height (29.69 cm), stem diameter (2.73 cm), plant spread (50.37 cm), head compactness (34.70 cm), ascorbic acid content (9.16 mg 100^{-1}g) and protein content (2.53%), head diameter (13.48 cm), head size (152.41 cm^2), gross head weight (1416.67 g), net head weight (865.03 g), yield per plot (10.36 kg) and projected yield per hectare (24.03 t). Highest available N (301.66 kg ha^{-1}) was recorded in T_{15} (RDF) while T_4 (100% N through FYM 10 days before transplanting) recorded the maximum available phosphorous (49.45 kg ha^{-1}). Maximum available potassium (218.89 kg ha^{-1}), organic carbon (2.63%) and CEC (14.66 meq 100^{-1}g) were recorded from T_3 (75% N through VC one day before transplanting + 25% N through VC 20 DAT). Economics of treatments was calculated and T_3 (75% N through VC one day before transplanting + 25% N through VC 20 DAT) recorded highest net return (Rs 5,03,900).The above findings suggest that the application of vermicompost can be effectively used for obtaining higher yield, improve soil fertility and higher net returns for organic cabbage cultivation.

Keywords Organic sources, Time of manuring, Cabbage, Yield, Quality, Economics, Vermicompost.

INTRODUCTION

Cabbage (*Brassica oleracea* var. *capitata*) is a member of cole crops belonging to the family Cruciferae. Cabbage is one of the most popular vegetable grown in India and is believed to have originated from the Mediterranean region. The area under cabbage in India is about 3.99 lakh ha with the total production of 90.37 lakh m tons and average productivity of 22.68 t ha^{-1} (NHB 2018).The major cabbage producing

Mhabeni N. Kikon[1], S. P. Kanaujia[2], Moakala Changkiri[3]*, Sentirenla Jamir[4]

[2]Professor, [3]Scientist, AICRP on Vegetable Crops,
[4]Assistant Professor
[1,2,3,4] Department of Horticulture, School of Agricultural Sciences, Medziphema Campus, Nagaland University, Nagaland 797106, India

Email: moaka88@gmail.com
*Corresponding author

states are Uttar Pradesh, Odisha, Bihar, Assam, West Bengal, Maharashtra and Karnataka. From nutritional point of view, it contains adequate amount of vitamin A (2000 IU/100 g), vitamin C (124 mg/ 100 g). It also has anti-carcinogenic properties (Kanaujia *et al* 2020). It contains 90% moisture, 1.8% protein, 0.1% fat, 0.6% minerals. Productivity of cabbage is influenced by several factors such as soil fertility, varieties and climatic condition.

Utilizing organic resources properly will allow an increase in production of high value crops that are in high demand. Application of fertilizers at the right time guarantees that they are available when the crop needs them. Additionally, this will prevent nutrient losses that may occur before and after times when crops are in demand and, in the long run, lead to resource waste. Application when N is fixed, a process, it becomes inaccessible for the plants, hence timing is essential to maximizing N use efficiency. Because manure and other organic fertilizers are affected by handling during storage and application as well as timing of integration and distribution, managing manures is far more challenging than managing mineral fertilizers.

To get the maximum production of cabbage, proper management of nutrients, which are the main contributing variables is necessary. Poor growth and yield in terms of cabbage quality and quantity may result from under and over fertilization under integrated nutrient management. Also, the information on the use of different organic sources in cabbage under agro climatic condition of Nagaland is meager. Time is also an important factor in application of manures because manures take time to release nutrients to the crop. Hence, keeping in view the above fact, the present investigation on the "Effect of different organic source and time of manuring on growth, yield and quality of cabbage (*Brassica oleracea* var. *capitata*)" was carried out.

MATERIALS AND METHODS

The research work entitled "Effect of different organic sources and time of manuring on growth, yield and quality of cabbage (*Brassica oleracea* var. *capitata*)" was conducted in the instructional cum experimental farm, School of Agricultural Sciences, Medziphema campus, Nagaland, during November 2022 to March 2023. The field is located at an altitude of 304.8 m above the mean sea level and is positioned geographically at latitude of 20º 45' 43" and a longitude of 93º 53' 04" E. The climatic condition of this region is sub-tropical with high humid and medium high rainfall. The initial status of the soil was highly acidic with a pH of 5.47, OC of 1.47%, available NPK of 129.03 kg ha^{-1}, 30.87 kg ha^{-1} and 112.8 kg ha^{-1} respectively and CEC of 11.32 meq 100^{-1}g. The experiment comprises of 3 replications and 15 treatments viz. T_1 (100% N through vermicompost one day before transplanting) T_2 (50% N through vermicompost one day before transplanting + 50% N through vermicompost 20 days after transplanting)T_3 (75% N through vermicompost one day before transplanting + 25% N through vermicompost 20 days after transplanting as top dressing), T_4 (100% N through FYM 10 days before transplanting), T_5 (50% N through FYM 10 days before transplanting + 50% N through vermicompost 1 day after transplanting), T_6 (75% N through FYM 10 days before transplanting + 25% N through vermicompost 1 day after transplanting), T_7 (50% N through FYM 10 days before transplanting + 50% N through vermicompost 20 days after transplanting),T_8 (75% N through FYM 10 days before transplanting + 25% N through vermicompost 20 days after transplanting), T_9 (100% N through pig manure 10 days before transplanting), T_{10} (50% N through pig manure 10 days before transplanting + 50 % N through vermicompost one day before transplanting), T_{11} (50% N through pig manure 10 days before transplanting + 50% N through vermicompost one day after transplanting), T_{12} (50% N through pig manure 10 days before transplanting + 50% N through vermicompost 20 days after transplanting), T_{13} (75% N through pig manure 10 days before transplanting + 25% N through vermicompost 20 days after transplanting), T_{14} (Control), T_{15}(RDF). The experiment was laid out in a Randomized Block Design and replicated thrice. The variety, Rareball was used for the experiment. Seeds were sown in line at a depth of 2-3 cm depth @ 400- 500 kg seeds ha^{-1}. Plant to plant and row to row spacing was maintained at 60 × 45 cm respectively. RDF (120 N: 60 P: 60 K kg ha^{-1}) were applied through Urea, SSP and MOP respectively. Half dose of N along with full dose of P and K were applied as basal dose and the

remaining half dose of N was applied 30 days after transplanting. Vermicompost, FYM and pig manure were incorporated into the soil according to time of manuring for each treatments. The treatments were evaluated on the basis of growth, yield and quality attributes, soil nutrient status and economics. Crude protein was determined by adopting procedure of nitrogen estimation (Kjeldahl method) and worked out using formula % crude protein = % nitrogen × 6.25. Ascorbic acid was determined by 2,6 dicholorophenol indophenyl method suggested by AOAC (1984). Soil samples were analyzed for available NPK, organic carbon, soil pH and cation exchange capacity (Jackson 1973). Economics of the treatments were also calculated as per prevailing market price of input and output. Benefit cost ratio was worked out by dividing net income from total cost of cultivation. Five healthy plants were selected randomly in each plot and their observations were recorded. The mean of each treatment was worked out statistically by the method of analysis of variance using RBD. The data obtained during the period of investigation were analyzed by the variance method (Panse and Sukhatme 1989) and the significant sources of variation were tested by error mean square using Fisher Shedecor 'F' test of probability at 5% level.

RESULTS AND DISCUSSION

Growth parameters

The data on growth parameters are presented in Table 1. Maximum plant height (26. 69 cm), stem diameter (2.73 cm) and plant spread (50.37 cm) were recorded from treatment T_3 (75% N through VC one day before transplanting + 25% N through VC 20 DAT) which was found to be statistically similar with the application of T_7 (50% N through FYM 10 days before transplanting + 50% N through VC 1 DAT). Improved soil nutrient status, water holding capacity and structure may have accelerated the growth of taller plants in vermicompost treated plots (Walker and Bernel 2004) by supplying more balanced nutrient levels to plant roots, increasing the amount of organic matter in the soil, and introducing helpful microbes to enhance soil biology and fertility. Kedino *et al.* (2009) and Adhikari *et al.* (2022) reported similar findings in their experiment on effect of different organic fertilizers on crop growth and yield of cabbage.

Table 1. Effect of different organic sources and time of manuring on growth parameters of cabbage.

Treatments	Plant height (cm)	Stem diameter (cm)	Plant spread (cm)
T_1	24.66	2.26	45.39
T_2	23.36	2.21	40.01
T_3	26.69	2.73	50.37
T_4	24.06	2.23	41.61
T_5	24.83	2.46	47.18
T_6	22.96	1.83	41.86
T_7	25.03	2.53	47.69
T_8	23.36	2.17	45.01
T_9	22.36	2.16	39.33
T_{10}	22.03	1.93	37.64
T_{11}	23.47	1.96	43.16
T_{12}	24.76	2.36	46.67
T_{13}	22.96	1.83	39.33
T_{14}	20.13	1.64	34.12
T_{15}	22.26	2.06	40.88
SEm ±	0.75	0.17	2.3
CD (p= 0.05)	2.18	0.48	6.8

Yield and yield attributes

Table 2 describes the effect of different organic sources and time of manuring on yield and yield attributing characters which shows a significant difference between the treatments. T_3 (75% N through VC one day before transplanting + 25% N through VC 20 DAT) recorded maximum head diameter, head size, gross head weight, net head weight, yield per plot and projected yield per hectare with 13.48 cm, 152.41 cm^2, 1416.66 g, 865.03 g, 10.36 kg and 24.03 t ha^{-1} respectively. Vermicompost application improved nutrition and water absorption and higher rate of photosynthetic activity resulting in heavier head weight of cabbage. It is revealed from Table 2 that the yield parameters are significantly improved with the application of 75% N through VC one day before transplanting + 25% N through VC 20 DAT. Addition of VC in soil increases soil microbial activity resulting in addition of nutrients for crop growth and ultimately results in obtaining more yield. The above findings are in conformity with Indira *et al.* (2016) who recorded highest yield with the application of VC @ 10 t ha^{-1}. Similar findings were also reported by Reza *et al.* (2016), Kumar *et al.* (2022) and Johnson *et al.* (2023).

Table 2. Effect of different organic sources and time of manuring on yield and yield attributes of cabbage.

Treatments	Head diameter (cm)	Head size (cm^2)	Gross head weight (g)	Net head weight (g)	Yield per plot (kg)	Projected yield per hectare ($t\ ha^{-1}$)
T_1	11.69	127.16	1133.32	658.33	7.96	18.46
T_2	11.37	110.34	1103.33	598.33	7.16	16.56
T_3	13.48	152.41	1416.66	865.03	10.36	24.03
T_4	11.30	112.35	1038.33	656.67	7.86	18.20
T_5	12.16	138.09	1166.67	693.32	8.33	19.30
T_6	11.24	115.97	1131.66	546.65	6.56	15.20
T_7	12.44	147.10	1307.67	750.00	9.00	20.83
T_8	11.23	134.91	1098.33	638.31	7.66	17.66
T_9	10.73	104.61	945.01	553.33	6.67	15.33
T_{10}	10.22	101.79	885.00	490.00	5.90	13.66
T_{11}	11.37	107.85	1078.33	595.00	7.36	17.06
T_{12}	11.87	134.68	1155.03	680.03	8.23	18.83
T_{13}	10.56	122.74	1003.33	596.68	7.13	16.50
T_{14}	9.37	94.64	831.66	443.34	5.33	12.33
T_{15}	11.55	115.34	1105.00	566.67	6.80	15.66
SEm±	0.59	11.18	25.89	9.69	0.12	0.3
CD (p=0.05)	1.71	32.39	74.99	28.06	0.35	0.8

Table 3. Effect of different organic sources and time of manuring on quality parameters of cabbage.

Treatments	Head compactness (cm)	Ascorbic acid ($mg\ 100^{-1}\ g$)	Protein content (%)
T_1	30.11	7.60	2.15
T_2	28.26	6.40	1.80
T_3	34.70	9.16	2.53
T_4	28.83	7.16	1.71
T_5	31.26	7.90	2.02
T_6	27.36	5.73	1.82
T_7	32.46	8.60	1.72
T_8	28.66	6.16	2.16
T_9	25.26	4.83	1.81
T_{10}	23.86	4.50	1.50
T_{11}	28.50	6.86	1.84
T_{12}	31.26	7.80	2.23
T_{13}	27.60	5.83	1.93
T_{14}	22.66	3.40	2.40
T_{15}	27.86	5.93	1.82
SEm±	1.33	0.56	0.16
CD (p=0.05)	3.84	1.63	0.47

Quality parameters

A significant difference on quality parameter between the treatments was recorded which has been presented in Table 3. Maximum head compactness, ascorbic acid content and protein content with 34.70 cm, 9.16 $mg\ 100^{-1}g$ and 2.53% respectively was observed in T_3 (75% N through VC one day before transplanting + 25% n through VC 20 DAT). The increase in protein content and ascorbic acid content may be due to increased activity of microbes resulting in addition of growth regulators, vitamins and hormones to the plants. Similar findings have also been observed by Devi *et al.* (2017) in cabbage. Similarly, Meena *et al.* (2023) reported higher protein content with the application of VC @ 10 $t\ ha^{-1}$.

Fertility status of soil after harvest

The data on fertility status of soil are presented in Table 4. Maximum available N in soil after harvest was recorded in T_{15} (RDF) with 301.66 $kg\ ha^{-1}$. Treatment T_4 (100% n through FYM 10 days before transplanting) recorded maximum available P (49.45 $kg\ ha^{-1}$) whereas maximum available K, organic carbon and CEC with 218.89 $kg\ ha^{-1}$, 2.63% and 14.66 meq $100^{-1}g$ were found highest in treatment T_3 (75% N through VC one day before transplanting + 25% N through VC 20 DAT) . However pH was found non significant among the treatments. Based on the data, it shows that the plots treated with higher dose of vermicompost accelerated in improving soil properties leading to improved soil nutrient status. Higher content of K_2O, organic carbon and CEC in

Table 4. Effect of different organic sources and time of manuring on fertility status of soil after harvest.

Treatments	Available N (kg ha^{-1})	Available P_2O_5 (kg ha^{-1})	Available K_2O (kg ha^{-1})	Organic carbon (%)	Soil pH	Cation exchange capacity (meq 100^{-1} g)
T_1	239.00	42.60	190.33	2.43	5.66	13.81
T_2	250.89	41.50	191.51	2.55	5.65	14.11
T_3	291.33	44.90	218.89	2.63	5.79	14.66
T_4	176.34	49.45	168.75	2.42	6.33	13.66
T_5	180.41	49.41	168.00	2.30	6.22	12.78
T_6	139.00	40.43	157.66	2.33	6.13	14.33
T_7	176.22	47.10	213.66	2.10	6.04	14.10
T_8	143.33	38.22	203.86	2.21	6.10	13.53
T_9	147.21	33.60	120.00	2.06	6.22	11.44
T_{10}	180.40	41.52	123.23	1.79	6.23	12.74
T_{11}	188.55	43.80	134.44	2.10	6.03	12.66
T_{12}	174.52	38.30	168.00	2.00	5.83	12.95
T_{13}	172.33	38.23	184.36	1.79	6.03	13.00
T_{14}	113.55	32.61	78.36	0.91	5.22	10.9
T_{15}	301.66	35.92	178.66	1.11	5.47	11.00
SEm±	0.19	1.43	1.79	0.32	0.2	0.01
CD (p=0.05)	0.55	4.14	5.18	0.93	NS	0.03

the treatment T_3 (75% N through VC one day before transplanting + 25% N through VC 20 DAT) may be due to ability of VC to introduce beneficial microbes and maintain nutrients over time. Similar findings were revealed by Indira *et al.* (2016) who reported an increase in soil organic carbon content, N, P, K and WHC when vermicompost was applied @ 10 t ha^{-1}. Chaudhary *et al.* (2018) also reported that application of VC @ 15t ha^{-1} recorded the highest increase in N, P, K and organic carbon in soil. Highest available P_2O_5 content and soil pH was recorded in T_4 where 100% N through FYM 10 days before transplanting were incorporated. Sindhu *et al.* (2021) reported similar findings who reported an increase in NPK content of the soil when FYM was applied @ 20 t ha^{-1}.

Economics

The effect of different treatments on economics has been presented in Table 5 shows the net return and

Table 5. Effect of different organic sources and time of manuring on economics of different treatments.

Treatments	Cost of cultivation (Rs)			Net yield (t ha^{-1})	Gross income (Rs 30 kg^{-1})	Net income (Rs)	B:C ratio
	Fixed cost	Treatment cost	Total				
T_1	97000	120000	2,17000	18.46	5,53,800	3,36,800	1.55
T_2	97000	120000	2,17000	16.56	4,96,800	2,79,800	1.29
T_3	97000	120000	2,17000	24.03	7,20,900	5,03,900	2.32
T_4	97000	24000	1,21,000	18.20	5,46,000	4,25,000	3.51
T_5	97000	42000	1,39,000	19.30	5,79,000	4,26,750	3.07
T_6	97000	48000	1,45,000	15.20	4,56,000	2,97,750	2.05
T_7	97000	42000	1,39,000	20.83	6,24,900	4,85,900	3.49
T_8	97000	48000	1,45,000	17.66	5,29,800	3,71,550	2.56
T_9	97000	15000	1,12,000	15.33	4,59,900	3,34,650	2.98
T_{10}	97000	37500	1,34,500	13.66	4,09,800	2,62,050	1.95
T_{11}	97000	37500	1,34,500	17.06	5,11,800	3,64,050	2.71
T_{12}	97000	37500	1,34,500	18.83	5,64,900	4,17,150	3.10
T_{13}	97000	41250	1,38,250	16.50	4,95,000	3,43,500	2.49
T_{14}	97000	0	97,000	12.33	3,69,900	2,59,650	2.67
T_{15}	97000	16220	10,6220	15.66	4,69,800	3,43,330	3.23

FYM- ₹ 1000 tons^{-1}, Vermicompost- ₹ 20000 tons^{-1}, Pig manure- ₹ 1000 tons^{-1} .

B:C ratio of different treatment combinations. Highest net return of ₹5,03,900 was obtained from T_3 (75% N through VC one day before transplanting + 25% N through VC 20 DAT) followed by T_7 (50% N through FYM 10 days before transplanting + 50% N through VC 20 DAT) with net return of ₹ 4,85,900. Treatment T_3 (75% N through VC one day before transplanting + 25% N through VC 20 DAT) obtained higher net return as compared to other treatments because of high yield. However, the cost benefit ratio was found higher in T_4 (100% N through FYM 10 days before transplanting) followed by T_7 (50% N through FYM 10 days before transplanting + 50% N through VC 20 DAT) with 3.51 and 3.49 respectively. T_3 obtained less cost benefit ratio due to higher cost of vermicompost as compared to FYM and poultry manure.

CONCLUSION

Based on the above findings, it may be concluded that treatment T_3 (75% N through VC one day before transplanting+ 25% N through VC 20 DAT) emerged as significantly superior over control for organic cabbage cultivation. Also T_7 (50% N through FYM 10 days before transplanting +50 % N through VC 20 DAT) was found statistically at par with T_3 and may be suggested as the second best option for cultivation of organically grown cabbage. The above treatment combinations will help to achieve desired growth, yield and quality of cabbage as well as improve soil fertility and reducing the reliance on chemical fertilizers and pesticides. The results suggest that application of VC either alone or in combination with other organic manures such as FYM and pig manure significantly influenced the growth and yield of cabbage. Thus we can conclude that VC can be recommended for promoting sustainable agriculture practices, providing economic benefits to farmers and communities.

REFERENCES

AOAC (1984) Official Methods of the Analysis of the association of Official Analytic Chemist Washington DC.

Adhikari R, Katel S, Chhetri PK, Simkhada P, Chaudahari P, Yadav SPS (2022) Effect of different organic fertilizers on crop growth and yield of cabbage. *Journal of Agriculture and Applied Biology* 4 (1): 83- 94.

Chaudhary SK, Yadav SK, Mahto DK, Sharma RP, Kumar M (2018) Response of growth, yield attributes and yield of cabbage (*Brassica oleracea* var. *capitata*) to different organic and inorganic sources of nutrients in Magadha plain of Bihar. *Journal of Current Microbiology and Applied Sciences Special Issue* 7: 474- 475.

Devi S, Choudhary M, Jat PK, Singh SP, Rolaniya MK (2017) Influence of organic and biofertilizers on yield and quality of cabbage (*Brassica oleracea* var. *capitata*). *International Journal of Chemical Studies* 5(4): 818-820.

Indira S, Birjeet Y, Devarishi SL, Linthoi W, Nivedita O (2016) Effect of different doses of vermicompost on soil quality, yield and uptake of nutrient by Cabbage var Rareball. *International Journal of Agricultural Sciences* 8(50): 2163-2165.

Jackson Mil (1973) Soil chemical analysis. Prentice Hall of India Pvt Ltd New Delhi.

Johnson N, Sarkar A, Kanaujia SP, Adhikary NK, Maiti CS, Hemanta L, Singh AK (2023) Influence of bulky organic inputs on growth, yield and biochemical attributes of broccoli (*Brassica oleracea* var. *Italica*). *Annals of Plant and Soil Research* 25 (3): 390- 403.

Kanaujia SP, Maiti CS, Narayan R (2022) Textbook of vegetable production. Today and Tomorrow's printers and publishers, New Delhi.

Kedino Z, Kanaujia SP, Singh VB, Singh PK (2009) Effect of organic manures and biofertilizers on growth, yield and quality of cabbage (*Brassica oleracea* var. *capitata*) under foothills condition of Nagaland. *Environment and Ecology* 27 (3): 1127- 1129.

Kumar P, Baksh H, Singh R, Srivastav A, Pandey R (2022) Impact of organic manures and biofertilizers on growth, yield and quality of cabbage. *Journal of Agric Search* 9(4): 300-302.

Meena AK, Bunker RR, Singh SP, Meena RL, Chouhan R, Meena SK (2023) Repercussion of different levels of vermicompost and foliar application of micronutrients on quality of cabbage (*Brassica oleracea* var. *Capitata*). *The Pharma Innovation* 12(3): 2247-2251.

NHB (2018) Indian horticulture database. National Horticulture Board, Gurgaon, Haryana.

Panse VG, Sukhatme PV (1989) Statistical Methods for Agricultural Workers. ICAR, New Delhi.

Reza MS, Islam AK, Raham MA, Miah MY, Akhter S, Rahaman MM (2016) Impact of organic fertilizers on yield and nutrient uptake of cabbage (*Brassica oleracea* var. *capitata*). *Journal of Science, Technology and Environmental Informatics*, pp 231-244.

Sindhu V, Chatterjee R, Mishra S (2021) Response of different organic nutrient management schedules on productivity, head quality, nutrient uptake and economics of organic cabbage. *Vegetable Science* 48(1): 56-61.

Walker DJ, Bernel MP (2004) Plant mineral nutrition and growth in a saline Mediterranean soil amended with organic wastes. *Commun Soil Science Plant Analysis* 35: 2495- 2514.