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Effect of organic and inorganic fertilizers on growth parameters of cabbage (*Brassica oleracea* var. *capitata* L.)

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Abstract
The field experiment was conducted to effect of organic and inorganic fertilizers on growth parameters of cabbage (*Brassica oleracea* var. *capitata* L.). The field experiment carried out at the Rajaula Agricultural Farm, Department of Horticulture, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya (MGCGV), Chitrakoot, Satna, Madhya Pradesh, India during the Rabi season of 2019-2020. The experiment was laid down under randomized block design with three replication and fourteen treatments. Growth attributing parameters *viz*., plant height (cm), number of opened leaves per plant, length of leaf and width of leaf. Superior results exhibited in the treatment $T_6$50% RDF +50% FYM followed by T_8 50% RDF +50% Vermicompost and T_7 50% RDF +50% GM in the case of all growth parameters. While the minimum was found in T_{14} Farmer practices.

Keywords: Cabbage, organic, inorganic, growth

Introduction

Cabbage (*Brassica oleracea* var. *capitata* L.) is most widely cultivated cole crop in the world belongs to the family cruciferae. It is delicious taste, flavor and nutritive, can be used for salad (as a fresh vegetable) or cooked vegetable and frequently preserved as sauerkraut or pickle, sandwiches, burgers, noodles, pasta etc (Chatterjee *et al*. 2012) [4]. Cabbage is an excellent source of vitamin C, some B vitamins, potassium and calcium (Hasan and Solaiman, 2012) [7] as well as food fiber. India is the second largest producer of cabbage in the world, next to China, accounting for 17.55 per cent of the world area and 13.79 per cent of the world production (Anonymous, 2019) [1]. Crop yields were the primary focus in the past, awareness of increasing population growth and limited potential to bring more land into production led to the notion of cropping sustainability or sustainable intensification, i.e. consistently achieving high crop yields without damaging the soil's capacity to produce such yields. Thus, the current focus in soil and crop management is on maintenance of soil quality or soil health. Low or unbalanced fertilization leads to depletion of soil nutrients and degradation due to lower soil organic matter (SOM) contents from lower root biomass associated with reduced crop yields. Throughout the production cycle, cabbage mostly requires nutrients such as nitrogen, phosphorus and potassium in varying quantities to support optimal growth (Ceronio *et al*., 2012, Nurhidayati *et al*., 2016) [3, 9]. Food security and sustainable crop production by small and subsistence producers relies heavily on organic fertilizers as an alternative to inorganic fertilizers. Organic fertilizers can be used to reduce the amount of toxic compound (such as nitrates) produced by conventional fertilizers in vegetables like cabbage, hence, improving the quality of vegetable as well as human health. There is little information available on organic production of cauliflower (Prabhakar *et al*., 2015; Velmurugan *et al*., 2008) [10, 14].

The problem is more severe under acidic soils which are under intensive cropping. However, the viable option lies on maintaining soil health to increase in fertilizer use to achieve sustainable agriculture. Soil organic matter (SOM) plays a key role in soil fertility sustenance. Association of organic matter and nutrient availability has been confirmed by the high coefficients of correlation between the soil attributes (Sakal *et al*., 1996) [11] and use of chemical fertilizers in combination with organic manure is essentially required to improve soil health (Bajpai *et al*., 2016; Chingak and Swami, 2018) [2, 5].

Materials and Methods

The field experiment carried out at the Rajaula Agricultural Farm, Department of Horticulture, Mahatma Gandhi Chitrakoot *Gramodaya* Vishwavidyalaya (MGCGV), Chitrakoot, Satna, Madhya Pradesh, India during the *Rabi* season of 2019-2020, situated at an altitude of 306 m above sea level at 24^0 31'N latitude and 81^0E15'E latitude. The soil was Sandy loam (Sand, Silt and Clay percentage 61%, 26% and 15% respectively).

Treatment were selected sole and combined application of different treatment, thus 14 treatment combinations were laid out in Randomized Block Design (RBD) with three replications. The treatment were T_1 FYM @ 20 tons ha^{-1}, T_2 Goat manure @ 3.5 tons ha^{-1}, T_3 Vermicompost @ 7 tons ha^{-1}, $T_,$ SPNF (Zero budget farming) practices, T_5 Biofertilizers consortium + Panchgavay spray two time $T_{6,}$ 50%RDF +50% FYM, T_7 50% RDF +50%GM, T_8 50%RDF +50% Vermicompost, T_9 50% RDF + Biofertilizer consortium and panchgavya spray, T_{10} 25%RDF +75% FYM, T_{11} 25%RDF +75% GM, T_{12} 25% RDF +75% Vermicompost, T_{13} 25% RDF + 75% Biofertilizer consortium and panchgavya spray and T_{14} Farmer practices applied in experimental plot at the time of field preparation.

The seed of cabbage cultivar Golden Acre were sown in nursery bed under polyhouse condition and transplanted in the field after five weeks. Cabbage seedlings of thwas transplanted in 2 m × 2 m plots with both ways spacing of 50 cm. The recommended doses of inorganic fertilizers were applied in the experiment field form of urea (N- 46%), single super phosphate (P- 16%) and muriate of potash (K- 60%). Full dose of P and K along with half N were applied as basal before transplanting of seedling and rest N was top dressed in two equal splits at 25 and 50 days after transplanting. The crop was raised adopting standard cultural practices in experimental plot.

The effect of different treatment and combination of treatment is determined by the sampling of different growth parameters *viz*., Plant height (cm), Number of opened leaves per plant, Length of leaf, Width of leaf. Sampling was done at 15 days up to till harvest for growth analysis, since observation was recorded of selected at 30, 45, 60 and 75 days after transplanting. Five plants were randomly selected from each treatment and replication for the study in net plot. The data collected during the course of investigation were subject to statistical analysis by adopting appropriate method of analysis of variance as described by Fisher (1950) [6]. The critical difference for the treatment comparison was worked out, wherever the F test was found significant at 5% level of significance. Summary tables along with SEm± and C.D. at 5%.

Results and Discussion

Effect of organic and inorganic fertilizers on growth parameters

1. Plant height (cm)

The data relating to plant height (cm), recorded at 30, 45, 60 and 75 DAS are presented in Table 1, which clearly shows that Integrated Nutrient Management significantly influenced the plant height (cm) of cabbage at 30, 46, 60 and 75 DAS. The maximum plant height (cm) (22.25,30.1535.45,40.13) at 30, 45, 60, and 75 DAS was recorded in the treatment T_6 50% RDF +50% FYM followed by T_8 50%RDF +50% Vermicompost and T_7 50% RDF +50% GM. Whereas the minimum plant height (14.17,20.56,26.99,29.33) was found in T_{14} Farmer practices.

The more availability of nutrient leads to more uptakes of nutrients in the plant which is essential for the proper growth and development of plants. Nitrogen is the part of chlorophyll pigment which helps in photosynthesis. More photosynthesis leads to more plant growth in terms of more plant height. The same results were also reported by Kanwar *et al*. (2002) [8], Singh and Khare (1998) [13] and Singh *et al*. (2009) [12] in cole crops.

2. Number of opened leaves per plant

The data relating to number of opened leaves per plant recorded at 30, 45, 60 and 75 DAS are presented in Table 1, which clearly shows that Integrated Nutrient Management significantly influenced the number of opened leaves per plant of cabbage at 30, 46, 60 and 75 DAS. The maximum number of opened leaves per plant (17.21,19.37,21.51,23.22) at 30, 45, 60, and 75 DAS was recorded in the treatment T_6 50% RDF +50% FYM followed by T_8 50% RDF +50%Vermicompost and T_7 50% RDF + 50% GM. Whereas the minimum number of opened leaves per plant (9.56,11.62,13.69,15.66) was found in T_{14} Farmer practices. The more availability of nutrient leads to more uptakes of nutrients in the plant which is essential for the proper growth and development of plants. Nitrogen is the part of chlorophyll pigment which helps in photosynthesis. More photosynthesis leads to more plant growth in terms of more plant height. The same results were also reported by Kanwar *et al*. (2002) [8], Singh and Khare (1998) [13] and Singh *et al*. (2009) [12] in cole crops.

3. Length of leaf

The data relating to Length of leaf (cm) was recorded at 75 DAS are presented in Table 1, which clearly shows that Integrated Nutrient Management significantly influenced the Length of leaf (cm) of cabbage at 75 DAS. The maximum Length of leaf (cm) (34.25) at 75 DAS was recorded in the treatment $T_6$50% RDF +50% FYM followed by T_8 50% RDF +50% Vermicompost and T_7 50% RDF +50% GM. whereas the minimum Length of leaf (cm) (18.74) was found in T_{14} Farmer practices. The more availability of nutrient leads to more uptakes of nutrients in the plant which is essential for the proper growth and development of plants. Nitrogen is the part of chlorophyll pigment which helps in photosynthesis. More photosynthesis leads to more plant growth in terms of more plant height. The same results were also reported by Kanwar *et al*. (2002) [8], Singh and Khare (1998) [13] and Singh *et al*. (2009) [12] in cole crops.

4. Width of leaf

The data relating to width of leaf (cm) was recorded at 75 DAS are presented in Table 1, which clearly shows that Integrated Nutrient Management significantly influenced the width of leaf (cm) of cabbage at 75 DAS. The maximum width of leaf (cm) (34.25) at 75 DAS was recorded in the treatment T_6 50% RDF +50% FYM followed by T_8 50% RDF +50% Vermicompost and T7 50% RDF +50% GM, whereas the minimum width of leaf (cm) (16.82) was found in T14 Farmer practices. The more availability of nutrient leads to more uptakes of nutrients in the plant which is essential for the proper growth and development of plants. Nitrogen is the part of chlorophyll pigment which helps in photosynthesis.

More photosynthesis leads to more plant growth in terms of more plant height. The same results were also reported by Kanwar *et al*. (2002) [8], Singh and Khare (1998) [13] and Singh *et al*. (2009) [12] in cole crops.

Table 1: Effect of organic sources and inorganic fertilizers on different growth parameters

S. No.	Treatment No.	Plant height (cm)				Number of opened leaves per plant				Leaf length (cm) at 75 DAS	Width length (cm) at 75 DAS
		30 DAS	45 DAS	60 DAS	75 DAS	30 DAS	45 DAS	60 DAS	75 DAS		
1	T_1	18.14	26.16	30.28	37.00	17.88	19.10	22.34	24.10	29.48	25.41
2	T_2	19.88	27.36	31.36	38.32	18.28	21.26	22.45	25.64	31.67	29.61
3	T_3	16.52	23.56	29.41	35.36	11.52	13.72	15.88	17.47	28.77	26.46
4	T_4	16.13	23.69	27.23	34.37	16.16	17.66	19.69	21.82	22.83	20.80
5	T_5	17.07	22.13	29.22	31.41	14.55	16.82	18.42	20.77	23.16	21.96
6	T_6	22.25	30.15	35.45	40.13	17.21	19.37	21.51	23.22	34.25	36.52
7	T_7	20.81	27.88	33.71	38.41	16.49	18.19	20.84	24.19	32.11	34.66
8	T_8	21.63	28.45	34.17	39.44	14.37	16.46	18.97	20.39	33.25	35.15
9	T_9	16.14	23.43	27.10	31.55	14.33	16.62	18.46	20.30	27.68	26.65
10	T_{10}	17.28	22.57	27.47	32.58	16.11	18.43	20.52	21.76	26.64	25.86
11	T_{11}	15.13	24.38	27.49	36.66	16.69	18.54	20.11	22.13	25.56	24.71
12	T_{12}	16.81	23.51	29.65	31.28	16.59	18.74	20.39	22.55	23.86	22.82
13	T_{13}	16.36	24.71	28.48	34.41	17.63	18.93	21.15	23.48	23.60	21.91
14	T_{14}	14.17	20.56	26.99	29.33	9.56	11.62	13.69	15.66	18.74	16.82
	F-test	S	S	S	S	S	S	S	S	S	S
	C.D. at5%	1.452	0.539	0.720	0.426	0.454	0.550	0.650	1.025	1.225	2.126
	S.Ed. (±)	0.706	0.262	0.350	0.207	0.221	0.268	0.316	0.498	0.596	1.034

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