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Effect of organic, inrganic & biofertilizers on quality attributes of cabbage (*Brassica oleracea* var. *capitata*)

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Abstract
The field experiment was conducted during *Rabi* season of 2016-17 at the Horticulture Research cum Instructional farm, BTC CARS, Bilaspur (C.G.). The treatments consisted of eleven combination of different agro input management practices viz., treatments 100 % RDF (Control) (T_1), 75 % RDF + 25 % N through FYM (T_2), 75 % RDF + 25 % N through VC (T_3), 50 % RDF + 50 % N through FYM (T_4), 50 % RDF + 50 % N through VC (T_5), 125% RDF (T_6), 100 % RDF + 25% N through FYM (T_7), 100 % RDF + 25% N through VC (T_8), 100 % RDF + 25% N through FYM + *Azotobacter* @ 2 kg ha^{-1}+PSB @ 2 kg ha^{-1} (T_9), 100 % RDF + 25% N through VC+ *Azotobacter* @ 2 kg ha^{-1}+PSB @ 2 kg ha^{-1} (T_{10}), 100 % from organic FYM+VC+AZ+PSB (T_{11}). The significantly maximum tss was recorded 5.10 ^{0}Brix (T_{10}) and minimum tss was recorded 3.50 ^{0}Brix (T_6).Was recorded at harvest. The maximum nitrogen, phosphorous and potassium content 1.90, 0.34 and 1.6 % (T_{10}) and minimum nitrogen, phosphorous and potassium uptake 0.96, 0.18 and 0.9 % (T_{11}), at harvest.

Keywords: organic, inorganic, biofertilizer combination, azotobacter and cabbage

Introduction
Cabbage (*Brassica oleracea* var. *capitata* L.) is an important winter vegetable crop. From the nutritional point of view, it is a rich source of vitamin A, B & C, mineral, minor in fibers and carbohydrates. The major cabbage producing states are U.P., Odisha, Bihar, Assam, West Bengal, Maharashtra and Karnataka. In India annual production of the cabbage is 9039.2 Mt (5.5% of total vegetables production) from an area of about 0.400ha (4.3% of total vegetable area) with the productivity of 22.6 Mt /ha (Anon. 2014) [1].

In Chhattisgarh, 403.4 '000 hectare area is under the vegetable cultivation with production of 5565.9'000 MT with productivity of 13.5 Mt/ha out of which cabbage is cultivated in an area of 18.6 '000 hectare producing 338.6 '000 Mt with productivity of 18.2 Mt/ha (Anon. 2014) [1]. It is cultivated in almost all districts of Chhattisgarh viz., Gariabandh, Baloda Bazar, Mahasamund, Dhamtari, Raipur, Durg, Balod, Bemetara, Jagdalpur, Kondagoan, Kanker, Bilaspur, Janjgir-Champa, Korba, Raigarh, Surguja, Surajpur, Koriya and Balrampur.

Cabbage is a heavy feeder and removes the N, P and K from soil to a larger extent. In modern agriculture, continuous and indiscriminate use of chemical fertilizers, pesticides, herbicides etc. affect`s the biodiversity, quality of the produce and human health. There are also evidences that the intensive agriculture has resulted in decline in vitamin and mineral content of fresh fruits and vegetables over last six decades. Use of organic manures along with bio-fertilizers is not only helpful in improving soil health, growth, yield and quality but also avoids chemical based farming (Bahadur *et al.*, 2003) [2]. Use of organic, inorganic & biofertilizers help in mitigating multiple nutrient deficiencies. Application of organic manures to acidic soil reduces the soluble and exchangeable Al temporarily by forming complex and provides better environment for growth and development by improving physical, chemical and biological properties of soil.

Material and Methods
The total Soluble Solid (TSS) present in head juice was measured by using Erma Hand Refractometer (0.31 ^{0}B) (ERMA, Japan) and nutrient content measured by All the plant samples were analysed for total nitrogen content by Micro Kjeldahl's method (AOAC, 1995). Phosphorus and potassium content were estimated by using tri-acid digestion (Jackson, 1973) in the ratio of 10: 4: 1 (HNO_3: $HCLO_4$: H_2SO_4).

Results and Discussion
1. TSS (^{0}Brix)
The observation on TSS in cabbage was recorded on at harvest and presented in Table 1and

depicted through. The data indicated significant influence of integrated nutrient management on TSS of Cabbage.

From the table it is clear that maximum TSS was recorded 5.10 under treatment T_{10}: Application of 100 % RDF+ 25% N through VC+ *Azotobacter* @ 2 kg ha^{-1}+ PSB @ 2 kg ha^{-1}. Which is followed by treatment T_{11} 4.76 and T_8 4.60 while the recorded minimum TSS 3.50 recoded under treatment T_6: 125% RDF.

TSS (^{0}Brix) content was found higher with combined application of organic manures and biofertilizers and also in the treatment with organic manures alone than the treatment with inorganic fertilizer the negative relationship between nitrogen levels and vitamin-C content can be seen. This might be due to exposure of plant with more of nitrogen, which increases protein production but reduces carbohydrate. Since vitamin-C is made from carbohydrate, the synthesis of vitamin-C is also reduced. This result similar finding has been reported earlier Chatterjee, *et.al*. (2012) [6].

Table 1: Effect of organic, inorganic and biofertilizers on TSS (^{0}Brix) of cabbage.

Treatments	Treatments details	TSS (^{0}Brix)
T_1	100 % RDF (Control)	4.43
T_2	75 % RDF + 25 % N through FYM	3.83
T_3	75 % RDF + 25 % N through VC	4.53
T_4	50 % RDF + 50 % N through FYM	4.10
T_5	50 % RDF + 50 % N through VC	4.03
T_6	125% RDF	3.50
T_7	100 % RDF + 25% N through FYM	4.60
T_8	100 % RDF + 25% N through VC	4.33
T_9	100 % RDF + 25% N through FYM + *Azotobacter* @ 2 kg ha^{-1}+ PSB @ 2 kg ha^{-1}	4.50
T_{10}	100 % RDF + 25% N through VC + *Azotobacter* @ 2 kg ha^{-1} +PSB @ 2 kg ha^{-1}	5.10
T_{11}	100 % from organic FYM+VC+AZ+PSB	4.76
SEm±		0.23
CD(P=0.05)		0.66

2. Nutrient content (%)

The observation on Nitrogen, Phosphorous and Potassium in cabbage was recorded on presented in Table 2. The data indicated significant influence of organic, inorganic & biofertilizers on Nutrient uptake of cabbage.

It is clear that the table nitrogen Content from ranges 0.96 % (T_{11}) to 1.90 % (T_{10}) and shows significantly difference between the treatments. Application 100 % RDF + 25% N through VC+ *Azotobacter* @ 2 kg ha^{-1}+ PSB @ 2 kg ha^{-1} (T_{10}) obtained maximum nitrogen Content (0.96 %) which was followed by T_9 (1.75 %) and T_6 (1.63 %), where as recorded minimum nitrogen Content (0.96 %). Under treatmentT_{11}: 100 % from organic FYM+VC+AZ+PSB. This result similar finding has been reported earlier Lavelle and Martin, 1992 [5].

Vermicompost is a potential source of readily available nutrients, growth enhancing substance and a number of beneficial micro organism like N fixing, and cellulose decomposing organism.

The maximum phosphorous Content 0.34 % under the treatment T_{10}: application of 100 % RDF + 25% N through VC+ *Azotobacter* @ 2 kg ha^{-1}+ PSB @ 2 kg ha^{-1} followed by T_9 (0.32 %) and T_8 (0.31 %), However on the other hand treatment T_{11}:100 % from organic FYM+VC+AZ+PSB resulted minimum phosphorous content (0.18 %). This result similar finding has been reported earlier Dixit and Gupta, 2000 [3].

Vermicompost is a important source of readily available nutrients, growth enhancing substance and a lot number of beneficial microorganism like P solubilizing and cellulose decomposing organism.

From the table it is clear that maximum potassium content was recorded 1.6 % under treatment T_{10}: Application of 100 % RDF+ 25% N through VC+ *Azotobacter* @ 2 kg ha^{-1}+ PSB @ 2 kg ha^{-1} which is followed by treatment T_9 (1.5 %) and T_8 (1.4

Table 2: Effect of organic, inorganic and biofertilizers on nutrient content of cabbage.

Treatments	Treatment s details	Nutrient content (%)		
		N_2	P_2O_5	K_2o
T_1	100 % RDF (Control)	1.36	0.26	1.20
T_2	75 % RDF + 25 % N through FYM	1.10	0.19	1.10
T_3	75 % RDF + 25 % N through VC	1.15	0.21	1.00
T_4	50 % RDF + 50 % N through FYM	1.25	0.25	1.00
T_5	50 % RDF + 50 % N through VC	1.32	0.26	1.20
T_6	125% RDF	1.63	0.27	1.30
T_7	100 % RDF + 25% N through FYM	1.41	0.29	1.40
T_8	100 % RDF + 25% N through VC	1.52	0.31	1.40
T_9	100 % RDF + 25% N through FYM + *Azotobacter* @ 2 kg ha^{-1}+ PSB @ 2 kg ha^{-1}	1.75	0.32	1.50
T_{10}	100 % RDF + 25% N through VC + *Azotobacter* @ 2 kg ha^{-1} +PSB @ 2 kg ha^{-1}	1.90	0.34	1.60
T_{11}	100 % from organic FYM+VC+AZ+PSB'/;	1.96	0.18	0.90
SEm±		0.40	0.82	0.34
CD(P=0.05)		1.14	2.35	0.98

(%) while the recorded minimum potassium content 0.9 % recoded under treatment T_{11}: 100 % from organic FYM+VC+AZ+PSB. This result similar finding has been reported earlier Klara, 1998.

The effect of VC application favorable than the effect of the application of chemical fertilizers in case of both yield and content and uptake of nutrients of crops.

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