

Short communication

Effect of organic manures, bioinoculants and inorganic fertilizers on yield, nutrient uptake and nutrient recovery by broccoli

S.K. Mohapatra*, P. Mahapatra** and P.S. Munsi***

Krishi Vigyan Kendra, Orissa University of Agriculture and Technology, Keonjhar 758002 Bhubaneswar, Odisha

ABSTRACT

An experiment was carried out on nutrient management in broccoli at Regional Research and Technology Transfer Station, Keonjhar, Odisha for two years. The test crop received four manure treatments: namely (i) no manure, (ii) FYM @10 t/ha, (iii) vermicompost (VC) @ 5 t/ha, (iv) FYM @ 5 t/ha + VC @ 2.5 t/ha, which are super imposed with six treatments, namely: (i) control (ii) bioinoculants (BI) alone (iii) 75% NPK (iv) 100% NPK, (v) 75% NPK + BI (vi) 100% NPK + BI. The maximum yield of curd (139.49 q /ha) was recorded at 100% NPK + bioinoculants along with FYM @ 5 t/ha and vermicompost (VC) @ 2.5 t/ha. The N uptake varied between 3.5-98.8 kg/ ha, phosphate 0.4-12.0 kg/ ha and potash 2.0-53.3 kg/ ha. The highest amount of nutrients was removed at optimum dose of fertilizers and the lowest in absolute control. The highest recovery of nutrients (58.6% N, 47% P, and 17.6% K) was when the crop applied with VC alone or 50% each of FYM and VC.

Key words: Broccoli, FYM, vermicompost, inorganic fertilizers.

The cultivation of broccoli is now gaining popularity with Indian growers for the last couple of years obviously due to increasing awareness of its organoleptic and nutritional qualities. The crop is rich in vitamins and minerals and is a good source of sulphoraphane, a compound associated in reducing the risk of cancer (Kalia, 2). However, due to lack of knowledge, majority of the vegetable growers are indiscriminately using unbalanced fertilizers leading to deterioration of soil health, and ultimately, not getting the potential yield of the crop. Therefore, efforts should be made to augment nutrient supply through combined use of fertilizers, crop residues, organic manures and bio-fertilizers. Sole dependence on chemical fertilization is not sustainable in the long run. Thus, integrated nutrient management system using a combination of chemical fertilizers, green manures, crop residues, organic manures and bio-fertilizers are necessary to maintain soil health and sustain crop productivity. The effect integrated use of organic manures and inorganic fertilizers in broccoli and its agronomic efficiency is not well known. Hence, the use of bio-fertilizers in combination with chemical fertilizers and organic manures offer a great opportunity for increasing the economic production of broccoli.

The test crop broccoli was grown in the Regional Research and Technology Transfer Station, Keonjhar, Odisha during *rabi* season for two consecutive years. The soil of the experimental site was heavy textured. The organic carbon content was low (4.6 g kg/soil)

available N and K were medium and phosphorus was high in status. The test crop received four manure treatments: namely (i) no manure, (ii) FYM @ 10 t/ha, (iii) vermicompost (VC) @ 5 t/ha, (iv) FYM @ 5 t/ha +VC @ 2.5 t/ha, which is super imposed with six treatments, namely: (i) control, (ii) bioinoculants (BI) alone, (iii) 75% NPK, (iv) 100% NPK, (v) 75% NPK + BI, (vi) 100% NPK + BI. The soil test based 100% recommended dose of fertilizers was 150:45:80 kg N-P₂O₅-K₂O/ha. The *Azotobacter* + *Azospirillum* and PSB (2+2+2) kg/ha was applied after incubation with well decomposed FYM in 1:25 ratio for seven days at 30% moisture content. The crop was transplanted in the field adopting a spacing of 50 cm x 40 cm. Organic (FYM and vermicompost), inorganic (NPK) and bioinoculants (*Azotobacter*, *Azospirillum* and PSB) were applied according to the treatments. Half of nitrogen and full doses of phosphorus and potassium were added at the time of transplanting of broccoli seedlings. The remaining dose of nitrogen was broadcasted 30 days after transplanting. The source of N, P and K were urea, single super phosphate and muriate of potash, respectively. The data recorded on yield, uptake and recovery were analyzed statistically.

The curd yield of broccoli (Table 1) receiving different combinations of fertilizers, manures and BI treatments varied significantly between 8.8 and 139 q /ha, lowest yield due to absolute control (no manure, no chemical fertilizers and no bioinoculants application) and the highest yield due to the application of both the sources of manures (at 50% each) with optimum dose

*Corresponding author's E-mail sunil_horti@yahoo.com

Table 1. Curd yield (q/ha) of broccoli as influenced by integrated use of organic manures, bioinoculation and chemical fertilizers (pooled).

Inorganic + BI organic	F ₀	F ₁	F ₂	F ₃	F ₄	F ₅	Mean
	Control	BI	75% NPK	100% NPK	75% NPK + BI	100% NPK + BI	
M ₀ - No-manure	8.67	11.63	61.08	72.33	87.32	92.85	55.64
M ₁ - FYM	13.48	16.84	92.95	119.05	125.28	129.30	82.81
M ₂ - VC	17.69	22.17	107.85	124.27	128.60	131.89	88.74
M ₃ - FYM + VC	29.50	33.58	111.01	128.75	131.87	139.49	95.70
Mean	17.33	21.05	93.22	111.10	118.27	123.38	
	Manure	Fertilizer	M × F				
CD _(0.05)	2.01	2.46	4.93				

of chemical fertilizers integrated with bioinoculants. The mean curd yield with or without organic manures indicated that FYM alone increase the curd yield by 49%, VC alone by 59% and combination of both the sources at half rates by 71%. Use of bioinoculants alone did not influenced the curd yield significantly, however, use of chemical fertilizers at suboptimal and optimal doses increase the curd yield significantly (Figs. 3 & 4). Further, significant increase in curd yield was observed when both suboptimal and optimal doses of chemical fertilizers were integrated with BI. The increase in yield could be ascribed to higher and continuous availability of nutrients from combined source at vital growth period that might have enhanced growth and yield parameters. This resulted in better photosynthetic activities of the plant that helped in better translocation of carbohydrates to the storage organ and ultimately, enhanced biomass production (Sangeeta Shree *et al.*, 5). The increase in yield might be due to the solubilizing effect of the nutrients as well as chelating effect of bio-fertilizers on metal ions, thereby, the availability of essential nutrients got increased. The result is in confirmation with the findings in broccoli (Kumar *et al.*, 3) as well as (Ranwat *et al.*, 4)

The uptake of N, P and K by the broccoli indicated that it was very much responsive to the application of chemical fertilizers (Tables 2, 3 & 4). The N uptake varied between 3.5 and 98.8 kg/ ha, Phosphate uptake varied between 0.4 and 12.0 kg/ ha and K uptake between 2.0 and 53.3 kg/ ha. Lowest amount of nutrients were removed by the crop under absolute control (with no manure, no BI and no chemical fertilizers). The highest amount of nutrients was removed by the crop receiving all the sources of nutrients at optimum doses. The increase in N uptake could be attributed to an added supply of nutrients and well developed root system under balanced nutrient application resulting in better absorption of water and nutrients that increased the dry matter as well as higher N and P concentration in plants (Sharma *et al.*, 6). Phosphorus absorbed by PSB infected roots was utilized efficiently increasing the N in the plants. Increase in phosphorus uptake might be due to the solubilizing of native and applied phosphorus by PSB. Yildirim *et al.* (7) found that higher N supply increased the N uptake by the broccoli.

It can be concluded from this experiment that maximum curd yield of 140.0 q/ha over both years

Table 2. Nitrogen uptake by broccoli crop as influenced by manure, bioinoculation and chemical fertilization (pooled).

Inorganic + BI organic	N uptake (kg/ ha)						Mean
	Control	BI	75% NPK	100% NPK	75% NPK + BI	100% NPK + BI	
M ₀ - No-manure	3.5	4.4	37.4	43.9	55.5	61.6	34.6
M ₁ - FYM	5.9	7.4	58.7	78.9	86.7	92.3	55.0
M ₂ - VC	3.5	9.8	72.2	85.1	89.1	94.1	59.8
M ₃ - FYM + VC	13.7	11.6	72.7	87.3	91.7	98.8	63.4
Mean	7.9	9.4	60.3	73.9	80.8	86.7	
	Manure	Fertilizer	M × F				
CD _(0.05)	2.12	2.13	4.2				

Table 3. Phosphorus uptake by broccoli crop as influenced by manure, bioinoculation and chemical fertilization (pooled).

Inorganic + BI organic	P uptake (kg/ ha)						Mean
	Control	BI	75% NPK	100% NPK	75% NPK + BI	100% NPK + BI	
M ₀ - No-manure	0.4	0.5	3.7	4.8	6.2	7.1	3.8
M ₁ - FYM	0.7	0.9	5.5	8.2	8.1	10.1	5.6
M ₂ - VC	0.9	1.1	7.2	9.3	9.0	10.8	6.4
M ₃ - FYM + VC	1.7	2.9	7.5	9.6	10.8	12.0	7.3
Mean	0.9	1.2	6.0	8.0	8.6	10.0	
	Manure	Fertilizer	M × F				
CD _(0.05)	0.41	0.47	0.90				

Table 4. Potassium uptake by broccoli crop as influenced by manure, bioinoculation and chemical fertilization (pooled).

Inorganic + BI organic	K uptake (kg/ ha)						Mean
	Control	BI	75% NPK	100% NPK	75% NPK + BI	100% NPK + BI	
M ₀ - No-manure	2.0	2.4	19.5	24.0	31.0	34.4	18.9
M ₁ - FYM	3.1	3.9	28.7	40.0	45.1	48.3	28.2
M ₂ - VC	4.5	5.1	35.2	44.9	46.2	49.2	30.9
M ₃ - FYM + VC	7.2	8.4	35.6	45.0	49.4	53.3	33.2
Mean	4.2	5.0	29.8	38.5	42.9	46.3	
	Manure	Fertilizer	M x F				
CD _(0.05)	0.89	0.83	1.66				

was recorded with 100% NPK + BI along with 50% each of FYM and VC. The highest amount of nutrients was removed when the crop received all the sources of nutrients at the optimum dose, and lowest was

in absolute control. The recovery of nutrients was highest when the crop was grown under suboptimal dose of chemical fertilizers as compared to optimal dose. Integration of BI further increased the recovery of the nutrients (Figs. 3 & 4).

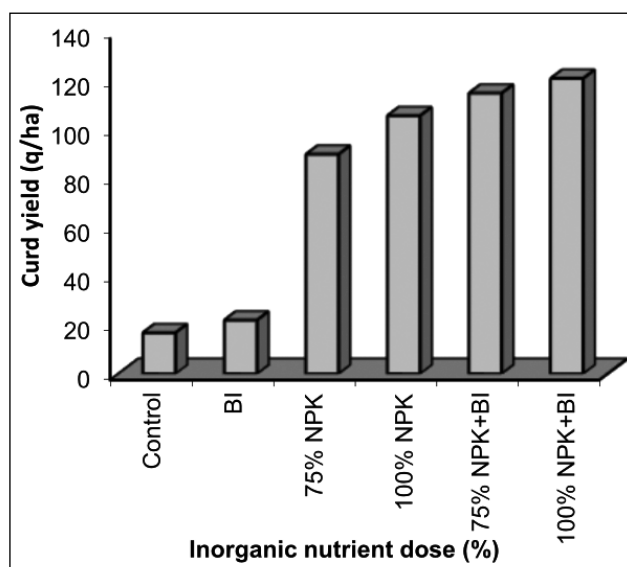


Fig. 1. Influence of graded dose of inorganic nutrients on curd yield (q/ha) of broccoli crop (pooled).

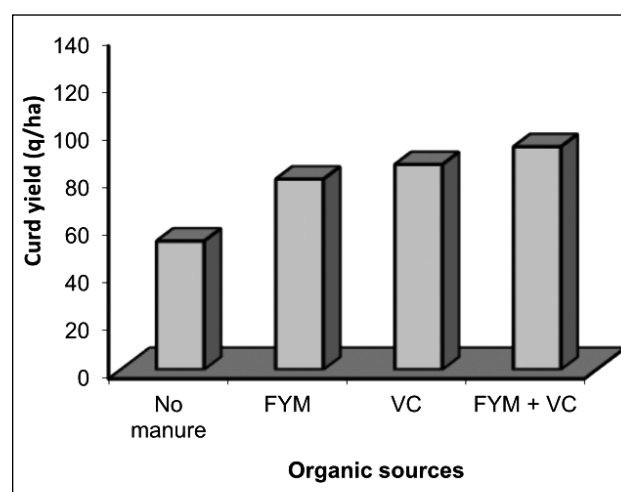


Fig. 2. Influence of organic sources on curd yield (q/ha) of broccoli crop (pooled).

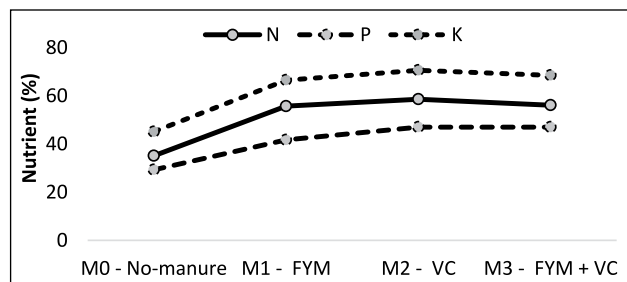


Fig 3. Apparent recovery of major fertilizer nutrients (%) as influenced by organic sources of nutrients.

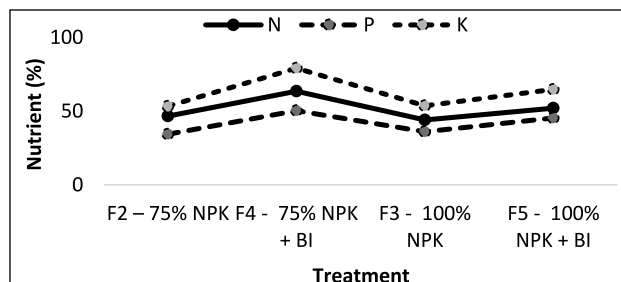


Fig. 4. Apparent recovery of major fertilizer nutrients (%) as influenced by chemical fertilization and bio-inoculation.

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Received : November, 2012; Revised : August, 2014;
Accepted : November, 2014