Indian J. Hort. 68(1), March 2011: 66-70

Evaluation of INM options on crop performance and soil fertility under tomato-green manure-brinjal cropping system

B.K. Srivastava*, M.P. Singh, Sobaran Singh, U.P. Shahi, Pankaj Srivastava*** and Shashi Lata**

Department of Vegetable Science, G.B. Pant University of Agriculture and Technology, Pantnagar 263 145 (Uttarakhand)

ABSTRACT

Integrated nutritional treatments were applied in tomato and the effect was observed on the performance of instant as well as rotational crop of brinjal, alongwith residual soil fertility, in tomato-green manure-brinjal cropping system. There were several integrated treatments which showed marginal superiority over the sole chemical NPK fertilizers applications with respect to certain vegetative characters, *viz.*, mean fruit weight and yield of tomato as well as on brinjal. The application of PSB + 75% P + full N and K through fertilizers proved to be the highest yielder in both the crops. The residual organic carbon and potassium content in the soil, assessed after the completion of each rotational crop during three consecutive years, were significantly higher under some integrated treatments when compared with the sole chemical fertilization. Although P content was not influenced significantly, it also showed marginal increase under majority of integrated treatments. The treatments having FYM integration proved overall best terms of improving soil fertility and reducing the chemical fertilization.

Key words: Tomato-green manure-brinjal cropping system, INM crop performance, residual soil fertility.

INTRODUCTION

Escalating cost of fertilizers, their short supply and declining soil fertility due to multiple cropping coupled with balanced fertilizer use is drawing attention to promote organic manuring. However, easy availability of traditional bulky organic manures is also a problem in modern era of mechanized farming. Therefore, better option would be to utilize both the organic sources and chemical fertilizers in appropriate combination for crop nutrition. Bio-fertilizers are required in smaller quantity, yet are capable of reducing the nitrogenous or phosphatic fertilizers in reasonably good amount, besides exhibiting other beneficial effects. However, the response varies from crop to crop. With this view, the present experiment was planned to study the effect of integrated application of various organic sources of nutrition and chemical fertilizers on the performance of tomato-green manure-brinjal cropping system alongwith the impact on residual soil fertility.

MATERIALS AND METHODS

Studies were conducted for three years at the Horticultural Research Centre, G.B. Pant University of Agriculture & Technology, Pantnagar. Ten nutritional treatments, *viz*. T_1 - recommended dose of NPK (150:90:90) through fertilizers, T_2- FYM (20 t/ha) + rest NPK through fertilizers. T_3- neem cake (3 q/ha) + rest NPK through fertilizers. T_4 - Poultry manure (3 t/ha) + rest NPK through fertilizers, T_5 - *Azotobacter* + 75% N and full P, K through fertilizers, T_6- VAM + 50% P and full N, K through fertilizers, T_7 - PSB + 75% P and full N, K through fertilizers, T_8 - *Azotobacter* + VAM + PSB + rest NPK through fertilizers, T_9 - Micronutrients + recommended NPK through fertilizers and T_{10} FYM + *Azotobacter* + VAM + PSB + rest NPK through fertilizers were applied in tomato and their effect was observed on the performance of the instant as well as rotational crop of brinjal alongwith the residual soil fertility. In brinjal only, recommended dose of NPK was applied through fertilizers in all the plots. The green manuring, using *Sesbania* was done to avoid the possible ill effects to taking Solanaceous after Solanaceous crop. The above treatments were tested in a randomized block design with three replications at a permanent site all through the three years. The transplanting of tomato was done in the month of February using hybrid 'Naveen'. The sowing of *Sesbania* was done around mid June and the transplanting of brinjal was done in the second fortnight of August, 'Pusa Hybrid-6' each year. Soil samples were collected after harvest of each crop and analysis was done for organic carbon, and available P and K contents.

The pooled means of three years data with respect to vegetative and yield characters of tomato and brinjal are given in Tables 1 and 2, while the data with respect to residual soil fertility are presented year-wise in Tables 3-5 which was determined by standard procedure as described by Jackson (5).

*Corresponding author's E-mail: profbks1607@rediffmail.com
**Department of Soil Science, SVBP University of Agriculture & Technology, Modipuram, Meerut
***Surya Vinayak Industries Ltd., Majhagawan, Kanti, MP

Table 1. Effect of integrated nutrition on the performance of tomato in tomato-green manure-brinjal cropping system.

Treatment	Plant height (cm)	No. of branches /plant	Per plant fresh shoot weight (cm)	No. of fruits/plant	Mean fruit weight (g)	Yield (q/ha)
T_1	120.23	7.90	364.4	24.30	56.00	292.67
T_2	110.30	7.37	292.5	16.60	53.37	194.47
T_3	118.93	8.37	421.3	21.17	57.00	233.37
T_4	117.03	8.07	354.5	18.43	57.75	196.57
T_5	118.37	7.67	384.6	17.57	58.33	247.23
T_6	118.33	8.23	372.3	21.33	52.43	286.07
T_7	128.10	8.07	424.3	20.67	57.13	309.77
T_8	127.87	8.33	459.4	16.90	57.80	218.37
T_9	124.07	8.10	424.3	17.67	54.13	212.33
T_{10}	106.07	8.63	280.7	15.20	55.43	162.53
CD (P = 0.05)	7.99	0.60	30.1	3.80	NS	18.11

Table 2. Residual effect of integrated nutrition on the performance of brinjal.

Treatment	Plant height (cm)	No. of branches /plant	Plant fresh weight shoot (cm)	Plant dry weight shoot (g)	Mean per fruit weight (g)	Mean per fruit volume (ml)	Yield (q/ha)
T_1	99.13	5.13	351.2	109.90	176.2	215.3	265.3
T_2	92.90	4.93	262.8	88.70	187.9	222.3	242.4
T_3	97.27	5.37	298.5	97.53	195.4	217.5	268.5
T_4	96.13	5.40	268.4	86.13	184.9	229.5	243.2
T_5	92.00	5.20	278.1	88.33	206.5	241.4	234.1
T_6	95.83	4.80	322.0	93.63	150.4	228.7	253.3
T_7	105.33	5.80	291.7	98.90	177.9	228.7	274.1
T_8	100.93	4.40	279.1	94. 30	175.9	222.8	211.9
T_9	96.13	5.17	250.1	84.73	185.6	221.3	206.3
T_{10}	92.60	5.07	273.5	89. 37	169.8	207.2	194.4
CD (P = 0.05)	7.80	0.86	31.7	5.75	34.4	30.7	75. 9

RESULTS AND DISCUSSION

All the observed vegetative and yield characters of tomato showed significant effect of the treatments but the integrated nutritional treatments displayed significant superiority over the control (T_1) only with respect to the per plant fresh weight, which was much higher in T_3, T_7, T_8 and T_9 (Table 1). Slightly better plant height, branching and mean fruit weight were also observed with several integrated treatments in comparison to the T_1. While sole chemical fertilization (T_1) produced higher number of fruits/plant compared to all the other treatments, it was the T_7 (PSB + 75% P and full dose of N and K through fertilizers), which resulted in maximum yield followed by T_1. Srivastava *et al.* (10) observed almost similar effect of integrated nutrient management on the performance of crops under brinjal-pea-okra cropping system. While, Sainju *et al.* (8) studied effect of nitrogen on growth, yield, and soil properties of tomato and observed similar trend but variation at higher doses of nitrogen. Marginal improvement in the yield of okra with the application of phosphate solubilizing micro-organism (PSM) was also earlier reported by Bahadur and Manohar (2), and Singh *et al.* (9).

The nutritional treatments applied in tomato also exhibited significant residual effect on the performance of brinjal crop (Table 2). Some integrated treatments differed significantly among themselves, while showing marginal superiority over the sole chemical fertilization (T_1). Like tomato, the brinjal yield was also maximum

with the application of PSB + 75% P + full N and K through fertilizers T_7. It may be attributed to the enhanced availability of inorganic phosphorus from insoluble or otherwise fixed form to soluble or readily plant available form, which also resulted in increased plant height and branching in this treatment. This trend corroborates the earlier observations of Bahadur *et al*. (3), and Kumar and Srivastava (6).

The residual soil fertility, as measured in terms of organic carbon and P and K contents after harvest of each rotational crop, was found to be significantly influenced by nutritional treatments in case of former and latter but not in case of P (Tables 3, 4 & 5). During first year, compared to control T_1, the organic carbon content was significantly higher in T_2, T_9 and T_{10} after the green manuring (before planting of brinjal) and T_2, T_8 and T_{10} after the harvest of brinjal. The available K content was significantly higher in T_3, after the green manuring and in T_{10} besides T_3 after the harvest of brinjal (Table 3). The second year data indicated significantly higher organic carbon content in T_4 and T_8 after the harvest of the tomato in T_8 after the green manuring and T_2, T_4, T_8 and T_{10} after the harvest of brinjal, while the K content was significantly higher in T_5 after tomato, in T_3, T_5, T_6, T_9 and T_{10} after green manuring and in T_{10} after brinjal. In the third year,

Table 3. Residual effect of IPNM treatments on the nutritional status of soil in tomato-green manure-brinjal cropping sequence (I year).

Treatment	Organic carbon (%)		Available P (kg/ha)		Available K (kg/ha)	
	After green manuring	After harvest of brinjal	After green manuring	After harvest of brinjal	After green manuring	After harvest of brinjal
T_1	0.60	0.65	21.00	22.47	225.77	194.60
T_2	0.65	0.87	23.09	24.21	203.70	182.60
T_3	0.63	0.64	24.17	22.20	240.17	209.77
T_4	0.60	0.67	25.11	23.27	223.80	188.50
T_5	0.62	0.67	23.22	22.28	239.57	202.20
T_6	0.58	0.64	23.20	24.27	233.70	181.43
T_7	0.60	0.65	22.57	24.30	209.60	188.50
T_8	0.63	0.69	25.26	24.27	211.07	158.67
T_9	0.64	0.64	22.32	21.57	214.37	180.53
T_{10}	0.65	0.78	23.50	25.15	216.37	206.60
CD (P = 0.05)	0.034	0.033	NS	NS	14.13	8.46

Table 4. Residual effect of IPNM treatments on the soil nutritional status in tomato-green manure-brinjal cropping sequence (II year).

Treatment	Organic carbon (%)			Available P (kg/ha)			Available K (kg/ha)		
	After tomato	After green manure	After brinjal	After tomato	After green manure	After brinjal	After tomato	After green manure	After brinjal
T_1	0.66	0.67	0.67	23.77	24.50	23.40	230.83	210.40	200.20
T_2	0.71	0.67	0.75	25.67	26.57	24.10	207.73	200.43	190.73
T_3	0.68	0.67	0.69	24.50	24.30	25.47	246.50	225.40	213.50
T_4	0.75	0.64	0.72	25.60	26.60	24.53	220.33	215.43	200.17
T_5	0.70	0.67	0.68	24.40	23.43	25.10	250.40	240.23	210.23
T_6	0.63	0.61	0.67	25.53	27.40	24.27	240.77	250.27	201.77
T_7	0.60	0.67	0.70	26.70	26.70	24.50	212.40	215.50	210.60
T_8	0.75	0.72	0.78	25.73	27.63	26.70	213.60	218.73	179.70
T_9	0.60	0.60	0.63	22.76	24.53	22.30	229.77	225.10	200.60
T_{10}	0.69	0.65	0.87	26.50	26.07	24.30	231.23	233.27	222.50
CD (P = 0.05)	0.05	0.02	0.02	NS	NS	NS	17.77	13.43	21.22

Table 5. Residual effect of IPNM treatments on the nutritional status of soil in tomato-green manure-brinjal cropping sequence (III year).

Treatment	Organic carbon (%)			Available P (kg/ha)			Available K (kg/ha)		
	After tomato	After green manure	After brinjal	After tomato	After green manure	After brinjal	After tomato	After green manure	After brinjal
T_1	0.54	0.93	1.02	27.89	21.71	30.19	207.81	203.74	134.70
T_2	0.99	1.02	1.09	30.16	26.41	26.88	211.60	224.70	143.20
T_3	0.51	0.94	0.98	30.55	24.27	32.16	213.25	202.49	133.70
T_4	0.55	0.89	1.01	29.54	22.91	29.86	221.01	202.79	140.52
T_5	0.62	0.86	1.06	26.96	22.55	26.88	208.32	218.62	133.80
T_6	0.62	0.94	0.94	31.81	21.16	29.61	197.27	202.94	140.82
T_7	0.54	0.79	1.07	28.11	26.60	30.60	208.47	188.96	134.99
T_8	0.60	0.88	1.00	25.12	21.13	30.37	200.55	199.96	120.51
T_9	0.58	0.89	1.09	28.79	21.29	27.46	208.91	204.59	146.05
T_{10}	0.56	0.86	1.00	27.34	23.39	31.17	203.69	205.93	129.17
CD (P = 0.05)	0.09	0.11	NS	NS	NS	NS	NS	10.32	NS

compared to T_1, the organic carbon was significantly higher only in T_2 after the harvest of tomato and only in T_2 and T_4 after the green manuring. However, there were some other integrated treatments also, which even though marginally, did exhibit comparatively higher contents or organic carbon and K after the completion of any rotational crop in all the 3 years. The residual phosphorus content never showed significant improvement owing to integration of organic sources with chemical fertilizers but marginal increase did occur in majority of treatments when compared with the sole chemical fertilization. The above trends indicate that out of different treatments, those having FYM integration, *i.e.* T_2 and T_{10} proved best in improving the soil fertility. Incidentally the dependence of chemical fertilizer was also least under above treatments. Improvement in organic carbon content in the presence of FYM has also been earlier reported by Bhandari *et al.* (4). Similar trend on organic carbon and available P and K was also found in okra-pea-tomato cropping system by Singh *et al*. (9) and brahmi-wheat cropping system by Mehra and Singh (7), and Adak *et al*. (1).

ACKNOWLEDGEMENTS

The authors are grateful to the Associate Director, Horticulture Research Centre and Director, Experiment Station for providing the facilities and to the UPCAR for providing financial assistance.

REFERENCES

1. Adak, Tarun, Singh, Sobaran and Sachan, R.S. 2006. Influence of integrated management of bio-fertilizers and chemical fertilizers on post-harvest soil fertility status in fenugreek on a Mollisol. *Env. Ecol.* **24**: 4, 796-802.

2. Bahadur, A. and Manohar, R.K. 2001. Response of okra to bio-fertilizers. *Veg. Sci.* **28**: 197-98.

3. Bahadur, A. Singh, J. and Singh., K.P. 2004. Response of cabbage to organic manures and bio- fertilizers. *Indian J. Hort.* **61**: 278-79.

4. Bhandari, A.L., Kolar, J.S. and Walia, S.S. 1997. Effect of FYM, green manuring and fertilization on productivity of crops and soil in combine harvested rice-wheat system. **In**: *Proceedings-3rd Agricultural Science Congress* (Vol. 2), PAU, Ludhiana. pp. 32.

5. Jackson, M.L. 1973. *Soil Chemical Analysis*. Prentice Hall of India Pvt. Ltd., New Delhi.

6. Kumar, R. and Srivastava, B.K. 2006. Residual effect of integrated nutrient management on growth, yield and yield attributes of tomato. *Indian J. Hort.* **63**: 98-100.

7. Mehra, Menka and Singh, S. 2006. Effect of INM on the post harvest soil fertility under Brahmi-wheat cropping system. *Pantnagar J. Res.* **4**: 106-9.

8. Sainju, U.M., Singh, B.P. and Whitehead, W.F. 2001. Comparison of the effect of cover crops and N fertilization on tomato yield, root growth and soil properties. *Scientia Hort.* **91**: 201-14.

9. Singh, T.R., Singh, S., Singh, S.K., Singh, M.P. and Srivastava, B.K. 2004. Effect of integrated nutrient management on crop nutrient uptake and yield under okra-pea-tomato cropping system in a Mollisol. *Indian J. Hort.* **61**: 4, 312-14.

10. Srivastava, B.K., Singh, M.P., Singh, Sobaran., Shahi, U.P., Shashi, Lata and Srivastava, P. 2009. Effect of integrated nutrient management on performance of crops under brinjal (*Solenum melongena*)- pea (*Pisum sativum*) - okra (*Hibiscus sesculentus*) cropping system. *Indian J. Agric. Sci.* **49**: 2, 1-5.

Received: April, 08; Revised: January, 2011;
Accepted : February, 2011