Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.5286

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **5 (5):** 217-221 (2017)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Response of Tomato (*Lycopersicon esculentum* Mill.) to Integrated Nutrient Management

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Received: 23.07.2017 | Revised: 4.08.2017 | Accepted: 5.08.2017

ABSTRACT

A field experiment with thirteen treatments including control was conducted at Research Farm of the Department. of Vegetable Science, CCS Haryana Agricultural University, Hisar during spring summer 2006-07 to find out the most appropriate integrated nutrient management system for sustainable tomato production. It was found that application of 43.5 tonnes Farm yard manure (FYM) and 50% of recommended dose of fertilizers (RDF) gave maximum fruit yield (284.81 q ha^{-1}) over control (198.6 q ha^{-1}) which was significantly higher over all the treatments except green manuring and 100% recommended dose of fertilizer (T_{13}). The organic sources of nutrition along with inorganic sources showed incremental effect for almost all parameters including yield over inorganic sources alone. Maximum net return (Rs.40203 ha^{-1}) and B: C ratio (1.29) was also recorded with application of 43.5 tonnes FYM and 50% RDF over control (Rs.25650 ha^{-1}) and (1.06), respectively.

Key words: *Tomato, Manure, Fertilizers, Fruit quality, Yield, Economics*

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is one of the most popular vegetable crop grown all over the world due to its wider adaptability to various agro-climatic conditions. Being a nutrient exhaustive, this crop requires ample supply of plant nutrients for satisfactory growth, yield and quality. The productivity of a crop is controlled by many factors of which mineral nutrition is by and large the most important one but the application of all the needed nutrients through chemical fertilizers had deleterious effect on soil fertility leading to unsustainable yield. It has been realized worldwide that chemical fertilizers while increasing crop yield may have adverse effect on soil health and its fertility in case of imbalance use. Further, indiscriminate use of chemicals, on account of environmental concern and high cost, could not sustain vegetable production[1]. The judicious integrated use of both nutrient sources provides an ideal environmental conditions for the crop, as the organic source improves soil properties and enhance the activity of soil biota, immobilize nutrients and slowly releases them, while the inorganic sources made available nutrients immediately, avoiding nutrient depression periods and hastens the decomposition of organic material[2].

Cite this article: Kumar, R., Batra V.K., Kumar V., Kumar A., Response of tomato (*Lycopersicon esculentum* Mill.) to integrated nutrient management, *Int. J. Pure App. Biosci.* **5(5):** 217-221 (2017). doi: http://dx.doi.org/10.18782/2320-7051.5286

It has been acknowledged that organic and inorganic fertilizer inputs cannot be substituted entirely by one another and are both required for better and sustainable crop production [3&4]. Hence, an alternate technology is the use of organic manure in conjunction with inorganic fertilizers, which still sustain high yield over years and ensure environmental safety. Therefore, the present study was undertaken to study the effect of application of organic and inorganic sources of nutrition on growth, yield, nutrients uptake and fruit quality of tomato.

MATERIALS AND METHODS

A field experiment was conducted at Vegetable Research Farm, Department of Vegetable Science, CCS Haryana Agricultural University, Hisar during spring summer 2006-07 on tomato cv. Hisar Arun. The soil of experimental field was sandy loam with pH 8.3, organic carbon 0.39%, available nitrogen 100 kg ha^{-1}, available phosphorus 22.0 kg ha^{-1} and available potassium 370 kg ha^{-1}.

The experiment comprised of thirteen treatments viz. T_1- Control (no organic manure and inorganic fertilizer), T_2- 100% recommended dose of fertilizers (RDF) i.e. 100 kg N, 62.5 kg P and 50 kg K ha^{-1}, T_3- 25 tonnes farmyard manure (FYM) ha^{-1}, T_4- 37.5 tonnes FYM ha^{-1}, T_5- 43.5 tonnes FYM ha^{-1}, T_6- 25 tonnes FYM ha^{-1} and 100% RDF, T_7- 37.5 tonnes FYM ha^{-1} and 75% RDF, T_8- 43.75 tonnes FYM ha^{-1} and 50% RDF, T_9- green manuring (GM), T_{10}- GM and 12.5 tonnes FYM ha^{-1}, T_{11}- GM and 25 tonnes FYM ha^{-1}, T_{12}- GM and 50% RDF, T_{13}- GM and 100% RDF. The treatments were laid out in Randomized Block Design with three replications. FYM (0.68% N, 0.36% P and 1.2% K) was applied fifteen days before transplanting tomato seedlings. *Dhaincha* was used as green manure crop in *Kharif* season i.e. preceding to tomato. Half dose of nitrogen and full dose of phosphorus and potassium were applied as basal dose, whereas, rest amount of nitrogen was applied in split doses after transplanting. One month old seedlings of tomato were transplanted at a spacing of 60 x 45 cm. Proper package and practices were followed throughout the crop period. Data on growth parameters like plant height and branches per plant were taken after 90 days of transplanting of tomato seedlings. The data on yield were recorded at picking and totalled to get total yield. Other parameters like fruit quality were recorded at fruit picking and economics estimated based on yield and prevailing market price.

RESULTS AND DISCUSSION

Growth, yield attributes and yield

The experimental results revealed that the growth characteristics like plant height and branches per plant were significantly influenced by various treatments (Table1). Application of 43.5 tonnes of FYM and 50% RDF (T_8) gave taller plants (60.0cm) than other treatments, which was at par with treatment T_2, T_6, T_7, T_{11}, T_{12} and T_{13}. The shortest plants were recorded with control. Similarly maximum number of branches was also noticed with T_8 and least in control. Though all the treatments proved statistically nonsignificant for days to 50% flowering but they showed earliness than the control.

The minimum days required for first harvesting (81.50 days) from DAT was recorded in T8 while maximum days required for first harvesting (92.00 days) were recorded in T1. Renuka and Sankar[5] also reported earliness in flowering and fruiting in tomato

Earliness of flowering and fruiting is an important trait in tomato crop and in these cases; it could be attributed to the faster enhancement of vegetative growth and storing sufficient reserved food material for differentiation of buds into flower buds.

Yield attributes such as fruits number and average fruit weight were recorded maximum in T_8 (43.75 tonnes FYM and 50% RDF) which resulted in the highest yield of 0.800 kg $plant^{-1}$ and 284.81 q ha^{-1} followed by application of GM and 100% RDF (T_{13}) gave yield of 270.44 q ha^{-1}, The lowest yield (198.6 q ha^{-1}) was recorded with control plots in which no fertilizers was applied. It is clear that integration of organic with inorganic sources of nutrition proved superior over

recommended dose of fertilizer. The results are in the close agreement with the findings of Bagale *et al*.[6] and Nanthakumar and Veeraragavetatham[7] who observed similar increase in yield of tomato and brinjal, respectively when organic and inorganic sources were applied together than inorganic sources alone. This might be due to the availability of more plant nutrients by improving soil physical conditions and solubilizing the nutrients in soil by applying organic sources of nutrition which ultimately reflected in terms of yield attributing characters and yield.

Table 1: Effect of Integrated nutrient management on growth, yield attributing characters and yield

Treatments	Plant height (cm)	No. of branches plant^{-1}	Days to 50% flowering	Days to 1st harvesting	No. of fruits plant^{-1}	Average fruit weight (g)	Yield plant^{-1} (kg)	Yield (q ha^{-1})
T_1 Control (no manure/fertilizer)	54.40	5.20	43.06	92.00	22.96	24.76	0.700	198.60
T_2 100% RDF	58.40	6.56	41.00	82.10	32.56	40.54	0.760	260.00
T_3 25 tonnes FYM ha^{-1}	54.50	5.73	42.06	86.50	30.46	28.92	0.740	218.50
T_4 37.5 tonnes FYM ha^{-1}	55.66	5.66	42.40	85.96	31.20	36.62	0.750	227.00
T_5 43.75 tonnes FYM ha^{-1}	57.06	5.90	42.06	84.20	32.26	39.16	0.790	233.10
T_6 25 t FYM and 100% RDF	57.80	6.00	41.30	83.53	33.66	38.28	0.830	244.50
T_7 37.5 t FYM and 75% RDF	57.46	6.80	41.00	82.63	35.00	40.83	0.800	262.53
T_8 43.75 t FYM and 50% RDF	60.00	7.23	41.93	81.50	36.46	73.76	0.850	284.81
T_9 Green Manuring (GM)	54.73	5.90	42.00	85.93	30.33	34.95	0.690	215.20
T_{10} GM and 12.5 t FYM	56.86	6.00	41.86	84.93	31.70	38.37	0.780	229.03
T_{11} GM and 25 t FYM	57.63	6.36	41.40	82.93	32.33	39.33	0.820	240.00
T_{12} GM and 50% RDF	57.53	6.80	41.20	82.73	34.36	39.68	0.830	250.23
T_{13} Gm and 100% RDF	58.60	7.00	40.76	82.10	33.56	41.69	0.840	270.44
CD (P=0.05)	2.60	0.44	NS	1.90	2.73	2.63	0.070	14.40

Table 2: Effect of Integrated nutrient management on fruit quality and nutrient uptake by plant

Treatments	Pericarp thickness (mm)	Lycopene (mg/100 g of juice)	TSS (%)	Ascorbic acid (mg/g)	Titratable acidity (%)	N content (g plant^{-1})	P content (g plant^{-1})	K content (g plant^{-1})
T_1 Control (no manure/fertilizer)	3.33	1.93	3.96	19.57	0.42	0.70	0.05	0.03
T_2 100% RDF	3.60	2.18	4.13	23.18	0.50	0.72	0.16	0.33
T_3 25 tonnes FYM ha^{-1}	4.10	2.19	4.46	20.19	0.46	0.71	0.12	0.32
T_4 37.5 tonnes FYM ha^{-1}	3.83	2.10	4.50	20.76	0.47	0.70	0.11	0.32
T_5 43.75 tonnes FYM ha^{-1}	4.40	2.12	5.00	21.14	0.48	0.70	0.11	0.32
T_6 25 t FYM and 100% RDF	4.06	2.13	4.60	23.76	0.56	0.82	0.12	0.33
T_7 37.5 t FYM and 75% RDF	4.63	2.13	4.70	23.59	0.57	1.10	0.17	0.33
T_8 43.75 t FYM and 50% RDF	4.83	2.22	4.80	25.38	0.61	1.20	0.19	0.35
T_9 Green Manuring	3.63	2.10	4.30	20.15	0.49	0.70	0.11	0.30
T_{10} GM and 12.5 t FYM	4.00	2.19	4.10	20.14	0.52	0.78	0.10	0.31
T_{11} GM and 25 t FYM	4.33	2.17	4.20	20.03	0.53	0.98	0.11	0.31
T_{12} GM and 50% RDF	4.23	2.15	4.00	22.53	0.52	1.10	0.12	0.32
T_{13} Gm and 100% RDF	4.60	2.20	4.20	23.16	0.51	1.15	0.13	0.33
CD (P=0.05)	0.47	NS	0.29	1.76	0.05	0.05	0.02	0.03

Fruit quality & Nutrients uptake

It is evident from the Table 2 that various organic sources of nutrition significantly influenced different quality parameters of tomato. All treatments increased the pericarp thickness of tomato significantly over control except RDF (T_2) and green manuring (T_9). No treatment showed statistically significant influence over control for lycopene content, however, the treatment T_8 showed maximum lycopene content. Application of 43.75 tonnes FYM ha^{-1} (T_5) gave maximum total soluble solids which was at par with treatment T_8. It is also observed that the application of 43.75 tonnes FYM and 50% RDF (T_8) gave maximum ascorbic acid content (25.38 mg g^{-1}) and titratable acidity (0.61%) over control (19.57 mg g^{-1}) and (0.40%), respectively. Fruit quality enhancement were also observed organic sources alone or in combination with inorganic components[8]. The increase in titratable acidity might be due to the increased activity of the enzyme acetone.

It is clear from the data given in Table 2 that different treatments also significantly influenced the nutrients uptake in tomato. Application of 43.75 tonnes FYM and 50% RDF (T_8) showed maximum nitrogen uptake (1.2g plant^{-1}) followed by the application of green manuring and 100% RDF (T_{13}) which

were at par with each other. All treatments increased the uptake of phosphorous significantly over control but maximum uptake (0.19 g plant^{-1}) was recorded with T_8, which was at par with T_7. Similarly, all the treatments increased potassium uptake significantly over control. These findings are in close agreement with findings of Nair and Peter[9] in chilli. The combined effect of organic and inorganic fertilization enhanced P uptake in elephant foot yam[10]. Organic sources when added to the soil, with the action of micro-organisms, complex nitrogenous compounds slowly breakdown and its availability in the form of nitrate is steady throughout crop growth whereas, increase in phosphorus availability may be attributed to more solubility of native phosphorus from the soil due to the action of various organic acids liberated during the decomposition of organic matters.

Economics

The data presented in Table 3 clearly indicated that though the cost of cultivation is higher with application of 43.75 tonnes FYM and 50% RDF (T_8) but it gave higher yield and net profit (Rs.40203 ha^{-1}) over control (Rs.25650 ha^{-1}). This treatment also gave highest B: C ratio (1.29) compared to control (1.06). Other two treatments gave almost equal B: C ratio while least was from control. The present results are also confirmed by the finding of Singh *et. al.*[11] where high benefit cost ratio was found in the treatments where organic source of fertilizers were used in the combination of inorganic fertilizers.

Table 3: Comparison of economics of yield for the best treatment with control in tomato cv. Hisar Arun under integrated nutrient management system

Treatment	Total yield q ha^{-1}	Gross income (Rs.)	Approx. cost of cultivation (Rs. ha^{-1})	Net profit (Rs. ha^{-1})	B: C ratio
100% RDF	260.00	65,000	29,200	35,800	1.23
43.75 t FYM and 50% RDF	284.81	71,203	31,000	40,203	1.29
GM and 100% RDF	270.44	67,610	30,500	37,110	1.22
Control (no manure and fertilizer)	198.60	49,650	24,000	25,650	1.06

CONCLUSION

Results of study thus clearly indicated that various treatments significantly influenced the growth, yield, fruit quality and nutrient uptake in tomato. Application of organic and inorganic sources of nutrition together showed superiority over inorganic alone. It is found that application of 43.75 tonnes FYM and 50% RDF (T_8) gave maximum fruit yield (284.81 q ha^{-1}) and also showed superiority over other treatments for fruit quality. Application of green manure and 100% RDF (T_{13}) gave fruit yield (270.44 q ha^{-1}) which was at par with treatment T_8. Maximum net return (Rs.40203 ha^{-1}) and B: C ratio (1.29) was obtained from treatment T_8.

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