Effect of Integrated Nutrient Management on the Growth, Bio-chemical Constituents, and Yield of Tomato (*Lycopersicon esculentum* Mill)

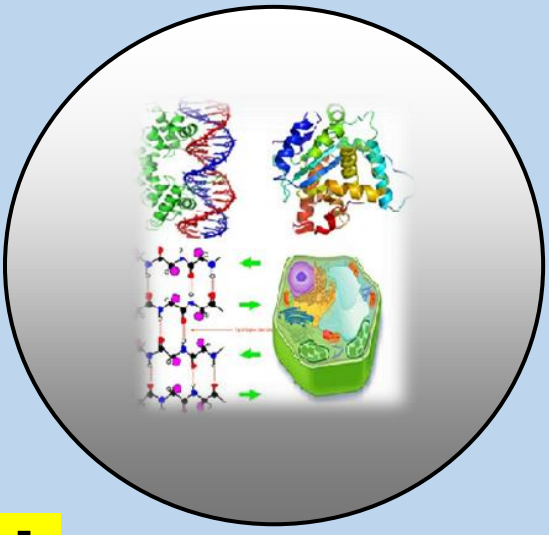
By

Amalesh Yadav and S.N. Pandey

ISSN 2319-3077 Online/Electronic
ISSN 0970-4973 Print

Global Impact factor of Journal: 0.756
Scientific Journals Impact Factor: 3.285
InfoBase Impact Factor: 2.93
Index Copernicus International Value
IC Value of Journal 6.01 Poland, Europe

J. Biol. Chem. Research
Volume 32 (2) 2015 Pages No. 835-841



Journal of Biological and Chemical Research

(An International Refereed/Peer Reviewed Journal of Life Sciences and Chemistry)

Indexed Abstracted and Cited in about 25 different Scientific Databases around the World

Published by Society for Advancement of Sciences®

J. Biol. Chem. Research. Vol. 32, No. 2: 835-841, 2015
(An International Refereed/Peer Reviewed Journal of Life Sciences and Chemistry)
Ms 32/2/98/2015

ISSN 0970-4973 (Print)
ISSN 2319-3077 (Online/Electronic)


Dr. S. N. Pandey A. Yadav
http:// www.sasjournals.com
http:// www.jbcr.in
jbiolchemres@gmail.com
info@jbcr.in

RESEARCH PAPER
Received: 15/08/2015 Revised: 15/09/2015 Accepted: 16/09/2015

Effect of Integrated Nutrient Management on the Growth, Bio-Chemical Constituents, and Yield of Tomato (*Lycopersicon esculentum* Mill)

Amalesh Yadav and S.N. Pandey
Botany Department, University of Lucknow, Lucknow-226007, U.P. India

ABSTRACT

A soil-pot culture experiment was conducted under controlled glass house conditions at the Botany Department, Lucknow University, Lucknow, during 2010 to scrutinize the effect of integrated nutrient management on the bio-chemical parameters, growth and yield of tomato (Lycopersicon esculentum L.) and nutrient status of soil. Seven treatments (T_0-T_7)were applied to the soil: T_0 -native soil; T_1 -100% NPK @ 100N:50P_2O_5:50K_2O; T_2 -poultry manure @ 10g Kg^{-1} soil; T_3 –vermi compost @ 10 g Kg^{-1} soil; T_4 -farmyard manure @ 5g Kg^{-1};T_5 -75% NPK+ poultry manure @ 5g Kg^{-1} soil; T_6 -75% NPK+ vermi compost @ 5g Kg^{-1} soil; T_7 -75% NPK+ farmyard manure @ 5g Kg^{-1} soil. These were laid out in a randomized complete block design and replicated three times. The study revealed that the integration of organic manures in combination with inorganic fertilizers was found significant in improving the overall bio-chemical parameters, plant growth, and yield and macro nutrient status than the sole application of either of the fertilizers. Maximum plant height, number of leaves per plant and number of fruits per plant were observed with treatment T_6 where 75% NPK+ vermi compost @ 5g Kg^{-1} soil was applied in soil. Maximum pigment content, highest number of fruit clusters, maximum fruit weight and fruit yield per plant were recorded at treatment T_5 where 75% NPK+ Poultry manure @ 5g Kg^{-1} was applied in soil. The application of organic manures improved soil conditions and reduced, 25% use of chemical fertilizers for growth and yield of tomato

Key words: Integrated nutrient management, growth, NPK, organic manures, biochemical constituents.

INTRODUCTION

For maintaining high crop yields under intensive cultivation is possible only with the use of fertilizers. But continuous use of inorganic fertilizers for increasing crop production resulted in deficiency of micronutrients, imbalance in soil physicochemical properties and

unsustainable crop production (Jayathilake *et al*., 2006). However excess use of chemical fertilizers causes adverse toxic effects on the production potential of the land (Anitha *et al*., 2014) by aggravating the problem of soil acidity. Over use of these chemicals have severe effects on environment that may lead to an immediate and long term effects (Govinda Bhandari, 2014). Inorganic fertilizers are usually not available and are always rather expensive for the low–income, small scale farmers. It is therefore necessary to reduce the dependence on chemical inputs in agriculture. On other hand large quantities of organic waste are being generated each day which are facing disposal problems. Hence organic waste, such as poultry manure, vermi compost and farm yard manure can be used as an alternative for the inorganic fertilizers, which contains large amounts of organic matter. In accordance with sustainable agriculture and reducing the consumption of chemical fertilizer it is necessary to change the outlook and instead of using chemical or organic fertilizer alone, judicious integration of inorganic fertilizers with organic residues, composts, bio fertilizers and other plant tonics may help to improve crop yield and soil productivity (Shahin and Seyed, 2011; Rana *et al*., 2012). Integrated nutrient management is considered as best option for better utilization of resources and crop production with less expenditure. In this approach all the possible sources of plant nutrients are applied based on economic consideration and the balance required for the crop is supplemented with chemical fertilizers. The combined use of organic and inorganic sources of plant nutrients not only pushes the production and profitability of field crops, but also it helps in maintaining the permanent fertility status of the soil. Integrated use of chemical fertilizer along with composted organic materials could be more effective, economical and sustainable for both agriculture and environment (Muhammad *et al*., 2008; Reddy and Reddy, 2011). It also sustains fertility and productivity of soils (Gabhane *et al*., 2013). Integrated nutrient management has a potential for carbon sequestration (Kharche *et al*., 2013) which can reserve the losses of SOC that is mainly caused by intensive cultivation. Integrated nutrient management have shown promising results not only in sustaining the productivity but also to be effective in maintaining soil fertility (Chesti *et al*., 2013), enhancing nutrient use efficiency (Thakur *et al*., 2011). It also helps in correcting nutrient deficiencies i.e. macro, micro and secondary, favorably by improving the physical, chemical and biological environment of soil. Organic manures in proper blend with chemical fertilizers will predictably support crop growth.

MATERIAL AND METHODS

A soil-pot culture experiment was conducted under controlled glass house conditions at the Botany Department, Lucknow University, Lucknow, during 2010 to study the effect of integrated nutrient management on the bio-chemical parameters, growth and yield of tomato (*Lycopersicon esculentum* L.) and nutrient status of soil grown in nutrient deficient alluvial soil. Before amendment of fertilizers, some physico-chemical properties of the farmyard manure, vermi compost and poultry manure (Table 1) and soil were analysed. Native soil is formed by alluvial deposits and was sandy loam in texture, pH 7.19, EC 0.18dS m^{-1}, showed low organic carbon content (0.28 %), slightly calcareous (0.77% $CaCO_3$), water holding capacity 41.67%, available nitrogen 92.62 mg kg^{-1}, available phosphorus 17.89 $mgkg^{-1}$, available potassium 206.32 mg kg^{-1}, available zinc and available cupper were 1.42 and 1.01 ppm respectively.

The 100 % NPK recommended dose of fertilizer for tomato was 100 kg N, 50 kg P_2O_5 and 50 kg K_2O ha^{-1}, respectively. The experiment was conducted in a randomized block design with three replication of each treatment viz.T_0 -native soil; T_1 -100% NPK @ 100N:50P_2O_5:50K_2O; T_2 -poultry manure @ 10g Kg^{-1} soil; T_3 –vermi compost @ 10 g Kg^{-1} soil; T_4 -farmyard manure @ 5g Kg^{-1};T_5 -75% NPK+ poultry manure @ 5g Kg^{-1} soil; T_6 -75% NPK+ vermi compost @ 5g Kg^{-1} soil; T_7 -75% NPK+ farmyard manure @ 5g Kg^{-1} soil.The organic manures was incorporated 15 days before sowing as per treatment on oven dry basis. Half of the N and entire dose of P_2O_5 and K_2O as basal dose in the form of urea, di-ammonium phosphate (DAP) and muriate of potash (MOP) applied respectively. The remaining N was applied at flower initiation stage. Crop was observed for growth (plant height, fresh weight and dry weight) and pigment content (chlorophyll a, b and total) contents at 45 days of growth. Chlorophyll content was estimated by the method (Lichtenthaler and Welburn, 1983). For fresh and dry weight, the plant was taken and weighed then the samples were oven-dried at 60 ^{0}C for 48 hours, thereafter dry weight was determined. The crop was harvested at maturity and number of clusters per plant, individual fruit weight, and number of leaves per plant, number of fruits per plant and fruit yieldwere recorded. Data presented in the table are the mean $\pm$ SE value of five replicates and statistically tested using students't' test of significance.

RESULTS

Pigment contents

Application of organic manures with NPK and 100% NPK fertilizers enhanced chlorophyll contents of tomato observed at 45 days of growth. The improvement in chlorophyll contents such as chlorophyll a, chlorophyll b total chlorophyll was maximum at treatment T_5 and followed by treatment T_6 where poultry manure and vermi compost applied along with 75% NPK, respectively.

Table 1. **Physico-chemical properties of organic manures used in the experiment.**

Type of manure	pH	Organic carbon (%)	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Zinc (mg Kg^{-1})	Copper (mg Kg^{-1})
Farmyard manure	7.0	26.45	0.78	0.32	1.01	2.30	1.20
Vermicompost	6.8	39.87	2.12	0.56	1.18	1.23	0.94
Poultry manure	7.2	10.90	1.06	1.34	1.88	0.88	0.48

Growth

Maximum plant height was observed at treatment T_6 where 75% NPK+ vermi compost @ 5g Kg^{-1} was applied in soil. Equal increase in plant height was observed at treatments where 75% NPK was applied with farmyard manure and poultry manure.The maximum fresh and dry weight was observed at treatment T_5 (Table 3).

Yield

Maximum number of leaves per plant and maximum fruit yield was recorded at treatment T_6where75% NPK with vermi compost@ 5g Kg^{-1} soil (Table 4) was amended in soil. Data of the present study clearly indicated that vegetative growth was higher in plots that received integrated (organic and inorganic) fertilizer supply. The maximum number of fruit clusters per plant and number of fruits per plant were recorded at treatment T_5 (Table 4) where 75% NPK+ poultry manure @ 5g Kg^{-1}amended in the soil. The maximum individual fruit weight was observed attreatment T_5 where 75% NPK with vermicompost was applied in soil.

Table 2. Effect of integrated nutrient management on the pigment content of tomato (*Lycopersicon esculentum* Mill).

Treatments	Chlorophyll a (mg g^{-1} fresh weight)	Chlorophyll b (mg g^{-1} fresh weight)	Chlorophyll total (mg g^{-1} fresh weight)
T_0	1.43±0.02	0.52±0.01	2.10±0.02
T_1	1.53±0.01	0.58±0.03	2.23±0.04
T_2	1.51±0.16	0.57±0.13	2.23±0.01
T_3	1.50±0.02	0.54±0.02	2.19±0.02
T_4	1.47±0.03	0.53±0.01	2.15±0.06
T_5	1.56±0.12	0.61±0.04	2.27±0.02
T_6	1.56±0.04	0.58±0.01	2.24±0.01
T_7	1.53±0.01	0.58±0.00	2.23±0.01

± SE value, Significant at 0.05 level, Significant at 0.01 level. Figures in parenthesis denote percent increase (+) or decrease (-) over the control.

Table 3. Effect of integrated nutrient management on the bio-chemical constituents of tomato (*Lycopersicon esculentum* Mill).

Treatments	Plant height (cm)	Fresh weight (g $plant^{-1}$)	Dry weight (g $plant^{-1}$)
T_0	63.09±0.02	29.43±0.07	13.76±0.43
T_1	70.72±0.23	43.08±0.98	19.04±0.02
T_2	69.45±0.16	42.98±0.56	18.94±1.23
T_3	65.09±0.08	37.02±2.34*	16.89±0.02
T_4	64.78±0.12	33.45±0.02	15.34±0.34
T_5	72.32±0.8.02**	54.87±0.34	25.56±0.21
T_6	74.89±0.09	49.08±0.09	21.02±0.02
T_7	72.03±0.18	47.12±0.23	20.98±0.45

± SE value, Significant at 0.05 level, Significant at 0.01 level. Figures in parenthesis denote percent increase (+) or decrease (-) over the control.

DISCUSSION

The significant reduction in the growth and yield of tomato as observed in the control (T_0), is a good indication that the soil used for growing the crops was low in nutrientcontents for optimum yield.

The chlorophyll a, chlorophyll b and total chlorophyll increased when poultry manure and vermi compost applied along with 75% NPK fertilizers, respectively. These results are in line with findings of Bokhtiar and Katsutoshi (2005), who also observed that the application of organic manure along with chemical fertilizers increased chlorophyll contents in leaf tissues as compared with inorganic fertilizers used alone.

Table 4. **Effect of integrated nutrient management on the yield parametersof tomato (*Lycopersicon esculentum* Mill).**

Treatments	Number of clusters (plant^{-1})	Individual fruit weight (g)	Number of leaves (plant^{-1})	Number of fruits (plant^{-1})	Fruit yield (g plant^{-1})
T_0	5.61±0.90	32.62±0.32	78.08±0.89	13.65±2.21*	200.67±0.34
T_1	6.34±0.02	37.09±0.06	92.09±0.08	17.02±0.34	421.02±0.21
T_2	6.01±0.03	39.45±0.21	89.34±0.02	16.90±0.21	423.02±0.56
T_3	5.96±0.04	37.02±0.02	89.08±0.04	15.89±0.09	380.23±0.09
T_4	5.78±0.45	35.62±0.08	82.43±0.34	15.00±0.34	357.02±0.67
T_5	7.23±0.02	45.98±0.56	103.09±0.90	22.76±0.01	580.05±0.06
T_6	7.00±0.08	41.56±0.31	108.56±0.01	26.23±0.04	558.92±0.42
T_7	6.56±0.01	41.02±0.09	100.21±0.21	18.05±0.56	492.02±0.12

± SE value, Significant at 0.05 level, Significant at 0.01 level. Figures in parenthesis denote percent increase (+) or decrease (-) over the control.

The better efficiency of organic manures in combination with inorganic fertilizers might be due to the presence of phytohormones inorganic fertilizers that stimulate plant growth (Gajalakshmi *et al.,* 2001; Nogales *et al.,* 2005) such as plant height and dry weight, by enhancing cell multiplication, elongation and expansion and deep green color of leaves due to chlorophyll synthesis. Similar findings were reported by Alam *et al*., 2007, reported that growth of red amaranth were significantly increased with the application of vermi compost and NPKS and that was significantly and positively correlated with total dry matter, plant height, leaf length and stem length. This might be due to the fact that the application of NPK, FYM and vermi compost provided adequate N which is associated with high photosynthetic activity and vigorous vegetative growth. Combination of organic and inorganic fertilizers significantly increased the number of leaves in cabbage (Azad, 2000). This could be attributed to the addition of NPK fertilizers with poultry manure aided mineralization of nutrients in poultry manure due to enhanced supply of nutrients, leading to better yield component. Adekiya and Agbede (2009) also reported better performance in terms of growth and yield of tomato under poultry manure with NPK fertilizers. The maximum individual fruit weight was observed at treatment T_6 (Table 4) where 75% NPK with vermicompost was applied in soil the findings were reported earlier by Prativa and Bhattarai (2011).

CONCLUSION

Integrated nutrient management of soil with NPK and organic manures (farmyard manure, vermi compost and poultry manure) improved soil nutrient status which resuted in better growth and yield of tomato.

The maximum improvement in growth, pigment content and yield of tomato was found with 25% reduction in NPK mixed with poultry manure in soil. The integrated nutrient management may be helpful in improving soil health, growth and yield of other crops and environ friendly for crop production.

ACKNOWLEDGEMENTS

Authors are grateful to Professor Y.K. Sharma, Department of Botany, Lucknow University, Lucknow for their invaluable suggestions during the course of study.

REFRENCES

Adekiya, A.O. and T.M. Agbede, 2009. Growth and yield of tomato (*Lycopersicon esculentum* Mill) as influenced by poultry manure and NPK fertilizer. *Emir. J. Food Agric*. 21 (1): 10-20.

Alam, M.N., Jahan, M.S., Ali, M.K., Islam, M.S. and Khandaker, S.M.A.T. 2007. Effect of Vermicompost and NPKS on Growth, Yield and Yield Components of Red Amaranth. *Aust J Basic and Appl Sci*. 1(4): 706-716.

Anitha Kumari, K., Kumar, K.N. Raja and Rao, C.H. Narasimha, 2014. Adverse effects of chemical fertilizers and pesticides on human health and environment. *Journal of Chemical and Pharmaceutical S*ciences. 3: 150-151.

Azad, A.K. 2000. Effects of plant spacing, source of nutrients and mulching or growth and yield of Cabbage. MS Thesis. Department of Horticulture, Bangladesh Agricultural University Mymensingh, pp. 15-40.

Bokhtiar, S.M and Katsutoshi, S. 2005. Effect of application of inorganic and organic fertilizers on growth, yield and quality of sugarcane. *Sugar Tech*. 7(1): 33-37.

Chesti, M.H. Anshuman, K. And Sharma, A.K. 2013. Effect of integrated nutrient management on yield of and nutrient uptake by wheat (*Triticum aestivum*) and soil properties under intermediate zone of Jammu and Kashmir. *Journal of the Indian Society of Soil Science*. 61(1): 1-6.

Gabhane Vijay, Mahendra Nagdeve and Mahipal Ganvir 2013. Effect of long term integrated nutrient management on sustaining crop productivity and soil fertility under cotton and green gram intercropping in vertisols under semi arid agro ecosystem of Maharashtra, India. *Acta Biologica Indica*. 2(1): 284-291.

Gajalakshmi, S., E.V. Ramasamy, and S.A. Abbasi 2001. Potential of two epigenic and two anecic earthworm species in vermi composting of water hyacinth. *Bioresource Technology*. 76: 177-181.

Govinda Bhandari 2014. An Overview of Agrochemicals and Their Effects on Environment in Nepal. *Applied Ecology and Environmental Sciences*. 2(2): 66-73.

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

Jayathilake, P.K.S., I.P. Reddy., D. Srihari and K.R. Reddy 2006. Productivity and soil fertility status as influenced by integrated use of n-fixing biofertilizers, organic manures and inorganic fertilizers in onion. *Journal of Agricultural Sciences*. 2(1): 46-58.

Kharche, V.K., S.R. Patil., A.A Kulkarni., V.S. Patil and R.N. Katkar 2013. Long-term integrated nutrient management for enhancing soil quality and crop productivity under intensive cropping system on vertisols. *Journal of the Indian Society of Soil Science*. 61 (4): 323-332.

Lichtenthaler, H.K. and Welburn, A.R. 1983. Determination of chlorophyll a and b of leaf extracts in different solvents. *Biochemistry Society Transition*. 11: 591-598.

Muhammad Ibrahim, I., Anwar-UL-Hassan, Muhammad Iqbal and Ehsan Elahi Valeem 2008. Response of wheat growth and yield to various levels of compost and organic manure. *Pak. J. Bot*. 40(5): 2135-2141.

Nogales, R., C. Cifuentes, and E. Benítez. 2005. Vermi composting of winery wastes: A laboratory study. *Journal of Environmental Science and Health*, Part B. 1234:659-573.

Prativa, K.C. and B.P. Bhattarai 2011. Effect of integrated nutrient management on the growth, yield and soil nutrient s tatus in tomato. *Nepal Journal of Science and Technology*. 12: 23–28.

Rana Inayat Ali, Nadeem Iqbal, Muhammad Usman Saleem and Muhammad Akhtar 2012. Efficacy of various organic manures and chemical fertilizers to improve paddy yield economic returns of rice under rice-wheat cropping sequence. *Int. J. Agric. Appl. Sci*. 4(2): 35-40.

Reddy Uma, R. Reddy Suryanarayan, M. 2011. Availability of major nutrients in soil as influenced by integrated nutrient management in tomato-onion cropping system. *Indian Journal of Horticulture*. 68(2): 224-228.

Shahin Mokhtariniya and Seyed Ata Siadat 2011. The study of using zeolite integrated with sheep manure before composting in reducing the consumption of chemical fertilizer in corn cultivation in light textured soils in Khuzestan, Iran. *American Journal of Scientific Research*. 32: 90-97.

Thakur R., Sawarkar S.D., Vaishya U.K. and Singh M. 2011. Impact of continuous use of inorganic fertilizers and organic manure on soil properties and productivity under soyabean-wheat intensive cropping of a Vertisols. *Journal of the Indian Society of soil science*. 59: 74-81.

Corresponding author: Dr. S.N. Pandey, Department of Botany, Lucknow University, Lucknow, 226007, U.P. India
Email: snpandey511@gmail.com