International Journal of Applied Research
Journal HP: www.intjar.com, ISSN: 2411-6610

Performance of organic fertilizer on yield and yield attributes on tomato

MK Islam[1], MUS Khatun[1], MA Alam[1], Ummay Kulsum Laily[1] and MM Rahman[2]

[1]*On-Farm Research Division, Bangladesh Agricultural Research Institute, Agricultural Research Station, Alamnagar, Rangpur, Bangladesh*
[2]*Agriculture Training Institute, Faridpur, Bangladesh*

ARTICLE INFO

Article history

Accepted 25 Feb 2018
Online release 27 Mar 2018

Keyword

Organic Fertilizer
Shekor Jaibo Sar
Yield performance
Tomato

Corresponding Author

Md. Khairul Islam
Email: kh_raju235@yahoo.com

ABSTRACT

This study explores the potential use of organic fertilizers on tomato production in Bangladesh. Effect of organic fertilizer on growth and yield of tomato (*Solanum lycopersicum L*) was studied in a field experiment. The experiment was conducted during rabi season 2016-2017 at Agricultural Research Station, On Farm Research Division, Alamnagar, Rangpur to find out the useful effects of organic fertilizer on growth and yield of tomato. The experiment was arranged in a randomized complete block design (RCBD) with seven treatments in three replications. The treatments included T_1: 100% Recommended Chemical Fertilizer (RCF), T_2: 85% RCF, T_3: 70% RCF, T_4: 85% CF + 3 t ha^{-1} organic Fertilizer (OF), T_5: 85% CF + 1 t ha^{-1} OF, T_6: 70% CF + 3 t ha^{-1} OF and T_7: 70% CF + 1 t ha^{-1} OF. The highest yield was obtained from T_4 which was statistically similar with T_1 and the lowest yield was found in T_3 treatment. Maximum gross margin was obtained from the treatment T_1 followed by T_4 and minimum from T_3 treatment.

Introduction

The term **"**Organic fertilizer" comprises material from animal or plant origin. It covers all soil amendments that add to the pool of soil organic matter, namely organic compounds and carbon (C). Soil organic matter improves the physical properties of the soil by improving its structure and water holding capacity and by preventing nutrient leaching. Since high temperatures promote the decomposition of organic matter in soils (FAO, 2006), the addition of organic matter to soils is particularly important for maintaining long-term soil fertility. Organic fertilizers usually also provide some measure of N, P and K, as well as varying amounts of micronutrients. Poor soil fertility resulting from low organic matter content is a major production constraint in Bangladesh. Better soil fertility with higher organic matter content is a prerequisite for sustainable crop production, and organic manure can play a role in increasing soil fertility and crop production. Application of organic manures has been reported to increase crop yield and improve soil quality, especially soil organic matter content (Garg et al., 2005; Islam et al., 2010). Although synthetic fertilizer contains higher quantities of plant nutrients than organic fertilizer, the presence of growth-promoting agents in organic fertilizer makes them important for enhancement of soil fertility and productivity (Sanwal et al., 2007; Yadav and Garg, 2016). Soil productivity is affected by cropping systems and crop management practices including tillage, synthetic fertilizer, and organic manure management (Anwar et al., 2017; Bhushan and Sharma, 2002). It has been reported that continuous and unbalanced use of synthetic fertilizer degrades physicochemical and biological soil environment (Mahajan et al., 2007). Balanced fertilization is a prerequisite for exploiting optimum crop yield potential and beneficial effects of organic manure in crop production have been demonstrated (Mahamood et al., 2016; Moyin-Jesu, 2015). Combined application of organic fertilizer along with synthetic fertilizer could be a promising soil management practice to improve crop productivity, soil fertility, and sustainability (Hernandez et al., 2016; Moyin-Jesu, 2015; Ferdous *et al*. 2017b, 2017c, 2017d).

Tomato (*Solanum lycopersicum L.*) is a very important vegetable crop and consumed in most parts of the world, from home gardens and greenhouses to large commercial farms due to its wider adaptability to various agro-climatic conditions. It is one of the most fashionable salad vegetables and is taken with great relish. It is also one of the organically produced vegetables crops in the world. The main sources of the organic fertilizers are composted livestock manures, plant residues and industrial wastes. The organic fertilizers provide the nutritional requirements of plants and also suppress the plant pest populations. Additionally, they increase the microbial activity in soil, anion and cation exchange capacity, organic matter and carbon-content of soil. Organic fertilizers increase the yield and quality of agricultural crops in ways similar to inorganic fertilizers (Liu et al., 2007; Tonfack et al., 2009). Shekor is a newly introduce organic fertilizer that can improve the yield of crops. Therefore, the study was taken to find out the useful effects of organic fertilizer on growth and yield of tomato

Materials and Methods

Site description and experimental design

The experiment was conducted during 2016-2017 cropping seasons at the Agricultural Research Station, On farm Research Division, Alamanagar, Rangpur, Bangladesh located at $25^0$43.251' N latitude and $089^0$15.735' E longitude with an elevation of 29 m above mean sea level. The area mostly falls under high- and medium-high land of the Tista Meander Floodplain (Anowar et al., 2015; Ferdous et al., 2016). Water holding capacity of the soil is good. The area receives an average annual rainfall of around 2,160 mm with an average temperature of about 25°C (Ferdous et al., 2016).

The experiment was arranged in a randomized complete block design (RCBD) with seven treatments in three (03) compacted replicate blocks. The treatments included T_1: 100% Recommended Chemical Fertilizer (RCF), T_2: 85% RCF, T_3: 70% RCF, T_4: 85% CF + 3 tha^{-1} organic Fertilizer (OF), T_5: 85% CF + 1 tha^{-1} OF, T_6: 70% CF + 3 tha^{-1} OF and T_7: 70% CF + 1 tha^{-1} OF. The crop variety was Mintu. Each plot measured 3m×2m. Thirty days old seedlings were transplanted on 10 October, 2016 maintaining 60 cm x 40cm spacing.

Crop management

The crop was fertilized with recommended doses of fertilizers at the rate of 207-50-130-20-3 kg/ha of NPKSZn along with organic fertilizer as par treatments. All the fertilizers were applied at the time of final land preparation except urea and MoP. N and K were applied in three equal installments 10 days after transplanting (DAT), 22 DAT and 36 DAT. Bavistin, marshal, tafgor, secure and acrobat were applied against late blight disease. The crop was irrigated three times at 20 DAT, 37 DAT and 61 DAT. Other intercultural operations were done as and when necessary. The crop was harvested twelve times and the last harvest was done on 03 March 2017.

Data analysis

Data on yield and yield contributing characters were taken and statistically analyzed using 'R' software package (R Core Team, 2017). Production of tomato included costs of field preparation, seed, planting, irrigation, organic manure and synthetic fertilizer, plant protection chemicals, and harvesting. Gross return under a treatment was calculated by multiplying the gross amount of crop produced by the farm-gate price. The gross margin was calculated by subtracting cost of production from the gross return (Ferdous et al., 2017a).

Results and Discussion

The most important parameter i.e. yield which was affected significantly with different dozes of organic fertilizer on tomato production in Bangladesh. The results presented in Table 1 revealed that there was significant difference among the treatments in respect of plant height, number of fruit $plant^{-1}$, weight of fruit $plant^{-1}$ and yield. The highest plant height was found in T_1 (109.67 cm) which was statistically similar with T_4 (109.47cm) and the lowest in T_3 (101.33 cm) which was statistically similar with T_7 (101.73cm). The highest number of fruit $plant^{-1}$ (61) and weight of fruit $plant^{-1}$ was obtained from T_4 (3.45 kg) and the lowest from T_3. The highest yield was observed in T_4 (97.67 t ha^{-1}) due to more number of fruit $plant^{-1}$ & weight of fruit $plant^{-1}$ and the lowest was in T_3 (76.22 t ha^{-1}).

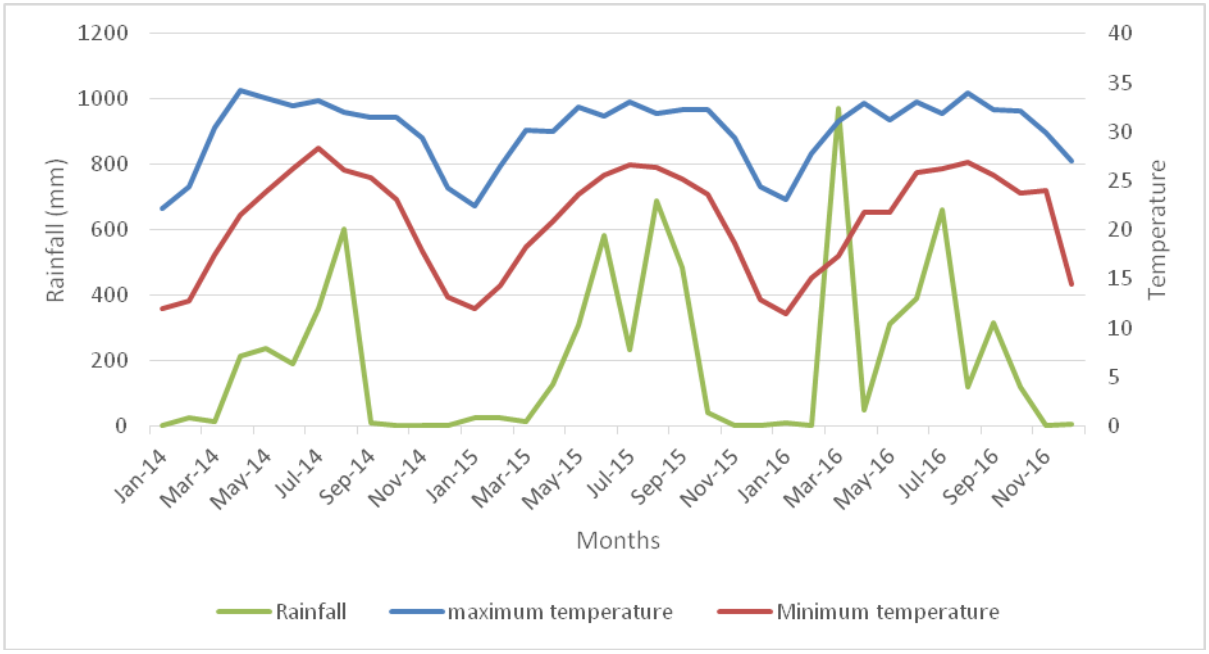

Figure 1. Maximum, minimum temperature and rainfall during the crop growing season

Table 1. Initial status of soils of the experimental plots at OFRD, ARS, Alamanagr, Rangpur during 2015-2016

Soil characteristics	On Farm Research Station, Alamnagar, Rangpur
Land type and soil texture	Medium High Land and Loamy
pH	5.89
Organic Matter (%)	1.03
K (mleq/100 soil)	2.69 (High)
N (%)	0.08(Very low)
P (Micro gram/g soil)	24.61 (Very high)
S (Micro gram/g soil)	32.7 (High)
Zn (Micro gam/g soil)	0.61 (Low)
B (Micro gram/g soil)	0.43 (Optimum)

Table 1. Yield and yield attributes of tomato as influenced by Organic fertilizer (Shekor Jaibo Sar) at Agricultural Research Station, OFRD, BARI, Rangpur during 2016-17

Treatments	Plant height (cm)	Number of Fruit plant^{-1}	Weight of fruit plant^{-1} (kg)	Yield (t ha^{-1})
T_1: 100% Recommended Chemical Fertilizer (RCF)	109.67a	59.87a	3.44a	97.47a
T_2: 85% RCF	107.40ab	54.40ab	2.86abc	81.03 b
T_3: 70% RCF	101.33c	49.67b	2.69c	76.22 b
T_4: 85% RCF + 3 tha^{-1} OF	109.47a	61.13a	3.45a	97.75a
T_5: 85% RCF + 1 tha^{-1} OF	101.73c	59.00ab	3.03abc	85.85b
T_6: 70% RCF + 3 tha^{-1} OF	104.20bc	61.73a	3.33ab	84.35 b
T_7: 70% RCF + 1 tha^{-1} OF	103.67bc	52.40ab	2.72bc	77.07b
CV (%)	2.19	9.15	10.57	6.96

Table 2. Cost and return analysis of tomato as influenced by Organic fertilizer (Shekor Jaibo Sar) at Agricultural Research Station, OFRD, BARI, Rangpur during 2016-17

Treatments	Yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Total variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})
T_1: 100% Recommended Chemical Fertilizer (RCF)	97.47	779760	284900	494860
T_2: 85% RCF	81.03	648240	280420	367820
T_3: 70% RCF	76.22	609760	278180	331580
T_4: 85% RCF + 3 tha^{-1} OF	97.75	780400	299540	480860
T_5: 85% RCF + 1 tha^{-1} OF	85.85	686800	287540	399260
T_6: 70% RCF + 3 tha^{-1} OF	84.35	674800	296180	378620
T_7: 70% RCF + 1 tha^{-1} OF	77.07	616500	284180	332320

Exchange rate in 2017: 1 USD = approx. 82 BDT (Bangladeshi Taka)
Market price of Tomato @ 10 BDT kg^{-1}, urea @ 16, triple super phosphate @ 25, muriate of potash @15, gypsum @10, zinc sulphate @ 150 and boric acid@ 150 BDT kg^{-1}, Organic manure @ 6 BDT kg^{-1}

These results may be due the parameters of growth components increased with increasing amount of organic and inorganic fertilizers applied. This can be due to the role of organic fertilization in plant physiology and improving the quantity and quality growth characterization and can provide plants with essential elements required (Sun *et al*. 2003; Lin *et al*. 2010; Ferdous *et al*. 2014). The highest yield was observed in T_4 (97.67 t ha^{-1}) due to more number of fruit plant^{-1} & weight of fruit plant^{-1} and the lowest was in T_3 (76.22 t ha^{-1}). Combination of organic and inorganic fertilizer treated plots produced higher yield than plots without combination of organic and inorganic fertilizer (Sarker *et al*. 2010; Rahman *et al*. 2011; Anwar *et al*. 2012; Ferdous *et al*. 2018). Similar results are reported by Anil *et al*. (2008) who report increase fruit yield with phosphorus and organic manure application. Anil *et al.* (2008) observed an increase in seed yield with combine application of organic and inorganic fertilizers.

Economic performance

The cost and return analysis of different treatments are presented in Table 3. The highest gross return (BDT. 780400) was found in T_4 treatment and the lowest gross return (BDT. 609760) was recorded from T_3. The highest gross margin (BDT. 480860 ha-1) was obtained from T_4. The lowest gross margin (Tk. 331580 ha-1) was obtained from T_3 (Anwar *et al*. 2012). Similar result was reported by Ferdous *et al*. (2017b, 2017c, 2017d) who report highest gross margin with combination of organic and inorganic fertilizer application.

Conclusion

Fertilizer application, especially for chemical fertilizer and organic manure applied to tomato field, can be highly profitable with sustainable production increases for smallholder farming in northern region of Bangladesh. Integrated nutrient management (combination of organic and inorganic fertilizer) is the best option for higher tomato production in Bangladesh. From the study it can be concluded that if organic fertilizer usage can be increased then chemical fertilizer application will be decreased and soil health ultimately improved.

References

Alam, M.A.U., Ferdous, Z., Islam, K., Khatun, M.U.S., Akter, M.B., Laily, U.K., Anwar, M. & Sarker, K.K. (2017). Sustainable Water Management for Potato Production in Drought Prone Areas in Bangladesh. *Annu. Res. Rev. Biol*., 21(3): 1-9, 2017.

Anowar, M., Parveen, A., Ferdous, Z., Kafi, A.H. & Kabir, M.E. (2015). Baseline survey for farmer livelihood improvement at farming system research and development, Lahirirhat, Rangpur. *Int. J. Bus. Manag. Soc. Res.* 2:92–104.

Anowar, M.M., Ferdous M.Z. & Islam M. (2012). Determination of nutrient management for Potato-Mungbean-T.aman rice cropping pattern. Bangladesh *J. Prog. Sci. & Tech*. 10(2): 173-176.

Anwar, M., Ferdous, Z., Sarker, M.A., Hasan, A.K., Akhter, M.B., Zaman, M.A.U., Haque, Z. & Ullah, H. (2017). Employment Generation, Increasing Productivity and Improving Food Security through Farming Systems Technologies in the Monga Regions of Bangladesh. *Annu. Res. Rev. Biol.*16(6):1–15.

Bhushan, L. & Sharma P.K. (2002). Long-term effects of lantana (Lantana spp. L.) residue additions on soil physical properties under rice-wheat cropping. I. Soil consistency, surface cracking and clod formation. Soil Till. Res 65:157–167.

Hernandez, T., Chocano C., Moreno J.L & Garcia C. (2016). Use of composts as an alternative to conventional inorganic fertilizer in intensive lettuce (*Lactuca sativa L*.) crops - Effects on soil and plant. *Soil Tillage Res.* 160:14–22.

Datta, A., Shrestha, S., Ferdous, Z. & Win, C.C. (2015). Strategies for Enhancing Phosphorus Efficiency in Crop Production Systems. In: A Rakshit, HB Singh, A Sen (Eds.), Nutrient Use Efficiency: from Basics to Advances. pp. 59–71.

Datta, A., Ullah, H. & Ferdous, Z. (2017). Water Management in Rice. In: BS Chauhan, K Jabran, G Mahajan (Eds.), Rice Production Worldwide. pp. 255–277.

FAO (2006). Plant nutrition for food security - A guide for integrated nutrient management, by Roy, R.N., Finck A., Blair G.J. & Tandon, H.L.S., Food and Agriculture Organization of the United Nations, Rome, Italy.

Ferdous, Z., Anwar, M., Haque, Z., Islam, M.K., Khatun M.U.S., Alam, M.A. (2017). Sustainable food security through cropping system analysis using different farming technologies at northern region of Bangladesh. *Progs Agri. 28 (3): 204-215.*

Ferdous, M.Z., Anwar, M.M., Haque, Z., Mahamud, N.U. & Hossain, M.M. (2014). Comparative performance of two magnesium sources on yield and yield attributes of potato. *Bangladesh J. Environ. Sci* .27: 98–10.

Ferdous, Z., Datta, A., Anal, A.K., Anwar, M. & Khan, M.R. (2016). Development of home garden model for year round production and consumption for improving resource-poor household food security in Bangladesh. NJAS - *Wageningen J. L. Sci*. 78, 103–110.

Ferdous, Z., Datta, A. & Anwar, M. (2017a). Effects of plastic mulch and indigenous microorganism on yield and yield attributes of cauliflower and tomato in inland and coastal regions of Bangladesh. *J. Crop Improv*. 31: 261–279.

Ferdous, Z., Hossain, A., Mahmud, N.U., Ali, R. & Ahmed, N.U. (2017b). Effect of poultry manure and lime in combination with chemical fertilizer on groundnut production in char areas under tista mender flood plain agro ecological zone in Bangladesh. *Int. J. Sustain. Crop Prod.* 12(1):10–14.

Ferdous, Z., Datta, A. & Anwar, M. (2017c). Synthetic pheromone lure and apical clipping affects productivity and profitability of eggplant and cucumber, *Int. J. Veg. Sci.* DOI: 10.1080/19315260.2017.1407858.

Ferdous, Z., Anwar, M., Uddin, N., Ullah, H. & Hossain, A. (2017d). Yield performance of okra (*Abelmoschus esculentus*) through integrated nutrient management. *Int. J. Biosci.*10 (1): 294–301.

Ferdous, Z., Ullah, H., Datta, A., Anwar, M. & Ali M. (2018). Yield and Profitability of Tomato as Influenced by Integrated Application of Synthetic Fertilizer and Biogas Slurry. Int. J. Veg. Sci.

FRG (Fertilizer Recommendation Guide) (2012). Fertilizer Recommendation Guide-2012, vol. 1215. Bangladesh Agricultural Research Council, Farmgate, Dhaka, pp.274

Garg, R.N., Pathak, H., Das, D. K. & Tomar, R.K. (2005): Use of fly ash and bioslurry for improving wheat yields and physical properties of soil, Environmental Monitoring and Assessment, vol. 107,pp. 1-9.

Islam, M.R., Rahman, S.M.E., Rahman, M.M, Hwan, D. & Six, R.C. (2010). The effects of biogas slurry on the production and quality of maize fodder. *Turk. J. Agric. For.* 34: 91–99.

Liu, B., Gumpertz, M.L., Hu, S. & Ristaino, J.B. (2007). Long-term effects of organic and synthetic soil fertility amendments on soil microbial communities and the development of southern blight. *Soil Biol. Biochem*., 39: 2302-2316.

Mahamood, N.U., Ferdous Z., Anwar, M., Ali, R., Sultana, M. (2016). Yield maximization of maize through nutrient management. *Progr. Agric.* 27 (4): 428–434.

Rahman, M.M., Yasmine, F., Rahman, M.A., Ferdous, Z. & Kar, P.S. (2011). Performance of poultry bio-slurry as a source of organic manure on potato production. *J. Agrofor. Environ*. 5:81–84

Sarker, M.A.I., Ferdous, Z., Anwar, M., Mahamud, N.U., Ali, M. (2010). Performance of poultry bio-slurry as a source of organic manure on wheat production. *Bangladesh J. Environ. Sci.* 19:36–38.

Mahajan, S.., Kanwar, S.S. & Sharma, S.P. (2007). Long-term effect of mineral fertilizers and amendments on microbial dynamics in an alfisol of Western Himalayas. *Indian J. Microbiol*. 47:86–89.

Moyin-Jesu, E.I. (2015). Use of different organic fertilizers on soil fertility improvement, growth and head yield parameters of cabbage (Brassica oleraceae L). *Int. J. Recycl. Org.Waste Agric*. 4:291–298.

Sanwal, S.K., Lakminarayana, K., Yadav, R.K., Rai, N., Yadav, D.S. & Bhuyan, M. (2007). Effect of organic manures on soil fertility, growth, physiology, yield and quality of turmeric. *Indian J. Hortic*. 64:444–449.

Tonfack, L.B., Bernadac, Youmbi, A.E, Mbouapouognigni V.P., Ngueguim, M. & Akoa, A. (2009). Impact of organic and inorganic fertilizers ontomato vigor, yield and fruit composition under tropical andosol soil conditions. Fruits, 64: 167-177.

Yadav, A., & V.K. Garg. 2016. Vermiconversion of biogas plant slurry and parthenium weed mixture to manure. *Int. J. Recycl. Org. Waste Agric*. 5:301–309.