Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(2): 546-579
Received: 03-01-2020
Accepted: 07-02-2020

Priyanshu Singh
M. Sc. from Department of Horticulture, Faculty of Agriculture, Udai Pratap Autonomous College, Varanasi, Uttar Pradesh, India

Diwaker Singh
Associate Professor in Department of Horticulture, Faculty of Agriculture, Udai Pratap Autonomous College, Varanasi, Uttar Pradesh, India

Anand Kumar Singh
Professor in Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

BK Singh
Professor in Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Tejbal Singh
Research scholar in Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Corresponding Author:
Tejbal Singh
Research scholar in Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Economics of tomato production in Varanasi region under different sources of plant nutrients

Priyanshu Singh, Diwaker Singh, Anand Kumar Singh, BK Singh and Tejbal Singh

Abstract
An experiment was laid at the experimental farm of Udai Pratap Autonomous College, Bhojubeer-Varanasi, during winter season of 2016-2017. The economic analysis of tomato production, grown in Varanasi region showed net capital investment varied with different treatments. Results revealed that among the different organic nutrient sources, T_6 (PM: 10 t poultry manure ha^{-1}) registered highest net return followed by T_5 (7.5 t PM ha^{-1}). Lowest net return was observed with treatment T_7 (VC: 2.5 t vermicompost ha^{-1}). Crop alimentation of tomato by supplying 10 t PM ha^{-1} recorded highest benefit - cost ratio (3.39) among the organic sources. While, within organic and inorganic sources; application of RDF of NPK through chemical fertilizer recorded quite lesser benefit- cost ratio (3.36) than organically nurtured tomato *i. e.* T_6 (3.39).

Keywords: Tomato, organic sources, poultry manure, inorganic sources, chemical fertilizer

Introduction
Tomato (*Solanum lycopersicum* L.) belongs to family Solanaceae, is an annual vegetable crop grown throughout the world and ranks second in importance after potato. The tomato is believed to have been originated in Central Africa and South America (Vavilov, 1951) [9]. In India it is an introduced crop and is being grown on an area of 0.458 million hectares with an annual production of 7.277 million tonnes (Anonymous, 2017) [2].
In Uttar Pradesh, average area under tomato for last 5 years is 10.6 thousand hectares with average annual production of 540.67 thousand metric tonnes (Anonymous, 2017) [2]. Along with high nutritional value, tomato has medicinal value that is why it is referred as protective food. For enhancing the yield and quality rational application of adequate quantities of plant nutrients is a pre-requisite which can be met both from organic as well as inorganic sources. Inadequate or imbalanced nutrient supply is one of the major factors responsible for low production. As well as indiscriminate and irrational use of chemical fertilizers to get higher yield by cutting down of production line has long run effect on soil physicochemical property as well as on soil biology. A complete or semi-substitution of high analysis fertilizers like urea and diammonium phosphate for increasing crop productivity is the prime need in era of climate change to maintain the nutritional quality of produce as well as soil fertility (Acharya and Mandal, 2002) [1]. Crop nutrition through organic nutrient sources not only maintain the nutritional quality of fruit but also it has significant role in alleviation of global warming by reduction of carbon addition through agricultural production system.
With rapid increase in population, the demand for the crop has significantly increased, leading to extensive use of chemical fertilizers for supply of plant nutrients without any consideration for soil health, which is a critical factor for realizing sustainable yield of any vegetable crop. Besides, this the residual effects of chemical fertilizers on environment, underground water, soil microflora, vegetable and vegetable products are a matter of concern, as some of the residues like nitrates enter the human body and heavy metals are carcinogenic in nature. Thus, there is an urgent need to utilize other sources of plant nutrients for sustainable and safe tomato production. The answer lies in the use of organic manures which have a potential to provide primary, secondary and micronutrients besides building a strong organic matter base resulting in improvement of soil structure and sustainable vegetable production devoid of most of the harmful residues and the vegetables produced are preferred for their flavor, taste, lusture, nutritive value and being sold at premium prices. But organic sources of plant nutrients are slow release in nature therefore, it is essential to careful application of organic sources in soil as they may play efficacious role in tomato production.

Tomato (*Solanum lycopersicum* L.) belongs to family Solanaceae, is an annual vegetable crop grown throughout the world and ranks second in importance after potato. The tomato is believed to have been originated in Central Africa and South America (Vavilov, 1951) [9]. In India it is an introduced crop and is being grown on an area of 0.458 million hectares with an annual production of 7.277 million tonnes (Anonymous, 2017) [2].

In Uttar Pradesh, average area under tomato for last 5 years is 10.6 thousand hectares with average annual production of 540.67 thousand metric tonnes (Anonymous, 2017) [2]. Along with high nutritional value, tomato has medicinal value that is why it is referred as protective food. For enhancing the yield and quality rational application of adequate quantities of plant nutrients is a pre-requisite which can be met both from organic as well as inorganic sources. Inadequate or imbalanced nutrient supply is one of the major factors responsible for low production. As well as indiscriminate and irrational use of chemical fertilizers to get higher yield by cutting down of production line has long run effect on soil physicochemical property as well as on soil biology. A complete or semi-substitution of high analysis fertilizers like urea and diammonium phosphate for increasing crop productivity is the prime need in era of climate change to maintain the nutritional quality of produce as well as soil fertility (Acharya and Mandal, 2002) [1]. Crop nutrition through organic nutrient sources not only maintain the nutritional quality of fruit but also it has significant role in alleviation of global warming by reduction of carbon addition through agricultural production system.

With rapid increase in population, the demand for the crop has significantly increased, leading to extensive use of chemical fertilizers for supply of plant nutrients without any consideration for soil health, which is a critical factor for realizing sustainable yield of any vegetable crop. Besides, this the residual effects of chemical fertilizers on environment, underground water, soil microflora, vegetable and vegetable products are a matter of concern, as some of the residues like nitrates enter the human body and heavy metals are carcinogenic in nature. Thus, there is an urgent need to utilize other sources of plant nutrients for sustainable and safe tomato production. The answer lies in the use of organic manures which have a potential to provide primary, secondary and micronutrients besides building a strong organic matter base resulting in improvement of soil structure and sustainable vegetable production devoid of most of the harmful residues and the vegetables produced are preferred for their flavor, taste, lusture, nutritive value and being sold at premium prices. But organic sources of plant nutrients are slow release in nature therefore, it is essential to careful application of organic sources in soil as they may play efficacious role in tomato production.

Research methodology

The experiment was carried out at experimental farm of Udai Pratap Autonomous College, Bhojubeer-Varanasi (U.P.) situated at 82^0 58' 20" E longitude and 25^0 21' 13" N latitude of 80.71m above mean sea level during winter season of 2016- 2017. Experiment was laid out in Randomized Block Design (RBD) with taking a tomato variety Kashi-Vishesh (F_1 hybrid: H-86) as a test crop. The three times replicated treatments in experimentation comprising of three levels of three organic nutrient sources *viz.* FYM (10, 20, and 30t ha^{-1}), poultry manure (PM: 5.0, 7.5 and 10 t ha^{-1}), Vermicompost (VC: 2.5, 5.0, and 7.5t ha^{-1}) and another one inorganic source as recommended dose of N, P_2O_5 and K_2O (180, 60, 60) for hybrid tomato was applied through chemical fertilizers (Urea, DAP and MOP). Organic sources of nutrient were applied before transplanting of seedlings (15 days) for proper decomposition and mineralization of nutrients. Transplanting of nursery seedling was done at 8th November, 2016 followed by one light irrigation was applied and second one at 4 Day after transplanting (DAT) by water cane to withstand the crop. Further, five full irrigation were sufficient to bring tomato crop at final picking stage. Two manual hand weeding, first at 35 DAT and second weeding along with earthing up done at 60 DAT to manage weeds in crop, followed by staking operation carried out. As per need, plant protection measures were carried out and harvesting was done by 8 manual picking as first picking starts at 80 DAT and subsequently done at 5 days intervals. Labour charge was fixed on the basis of existing charges in locality. The cost of cultivation of tomato was calculated which includes both total variable and fixed cost. Total variable cost includes both common variable and added variable cost (Table 1&2).

Results and Discussion

As per Table 1 and 2 it was observed that under all the treatments, overall operations except the use of various nutrient sources and their spreading were common. The additional cost incurred on this account was added to the expenditure on all treatments. The cultivation of tomato turned labour intensive and created an employment of 231 labour days ha^{-1} from nursery raising to soil preparation as well as up to the harvesting and marketing of fruits to dispose the produce in main market for getting higher price. Common variable cost and fixed cost for tomato cultivation has been mentioned in Table 1 and compared with added variable cost through nutrient sources in Table 3 to figure out which nutrient source is cheaper for tomato nutrition. Results revealed that crop nourished chemically acquired lesser currency. Tables 2 to 4 revealed that net capital investment showed variation with different treatments in tomato cultivation. Maximum cost of cultivation (Rs. 224404.80) was estimated in T_3 (30 t FYM ha^{-1}) and lowest in T_{10} (180,60,60 kg NPK ha^{-1} through chemical fertilizer) and T_7 (2.5 t VC ha^{-1}) which, respectively accounted for just Rs. 137589.24 ha^{-1} and Rs. 147804.80 ha^{-1}.

It was demonstrated that maximum gross return of Rs. 877035 was registered with T_6 (10 t PM ha^{-1}) followed by T_5 (7.5 t PM ha^{-1}) and T_3 (30 t FYM ha^{-1}). Similarly, maximum net return of Rs. 677430.20 was recorded to crop nurtured with 10 t PM ha^{-1} (T_6) followed by (T_5) and T_3 with net returns per rupee invested (B:C) of 3.39, 3.36 and 2.19, respectively. While, considering organic and inorganic nutrient sources maximum benefit-cost ratio *i. e*., 3.39 was observed to organically nurtured crop is quite higher to crop nurtured inorganically. Application of poultry manure @ 10 t ha^{-1} fetches higher net income than all other sources and their levels including inorganically nourished tomato crop. Therefore, it was concluded that among different sources of plant nutrients T_6 (10 t PM ha^{-1}) proved more profitable in terms of economic benefits. Similar reports were mentioned by researchers like Jhon (1997), Thronsbug *et al*. (2000) [8], Magray *et al*. (2013) [5].

The highest net return is with T_6 (PM @ 10 t ha^{-1}) is possibly due to comparatively lesser total cost of cultivation and utmost yield with this treatment. Superiority of poultry manure in enhancing yield of tomato is richness in nutrition, besides having narrow C:N ratio and thus more decomposition, helping in increasing the availability of nutrients (Magray *et al.* 2013) [5].

Table 1: Cost of cultivation of economics of production of tomato (Cost involved on variable and fixed factors)

Sr. No.	Particulars	Amount
A	Variable cost.	
1	Seed (500 g seed @ 5000 kg^{-1})	2500.00
2	Labour for nursery raising (10 labour @ 300 $man\text{-}days^{-1}$)	3000.00
3	Seed treatment with carbendazim @ 2 g kg^{-1}	1.00
4	Pre planting irrigation @ 800 ha^{-1}	800.00
5	Labour for pre planting irrigation (2 labour @ 300 $man\text{-}days^{-1}$)	600.00
6	Preparatory tillage (three ploughings @ Rs.2000 ha^{-1})	6000.00
7	Planking (2 planking @ 900 ha^{-1})	1800.00
8	Preparation of beds/ channels (25 labour @ 300 $man\text{-}days^{-1}$)	7500.00
9	Seedling conditioning (4 labour @ 300 $man\text{-}days^{-1}$)	1200.00
10	Planting of seedlings (40 labour @ 300 $man\text{-}days^{-1}$)	12000.00
11	Irrigation (five irrigation @ 800 ha^{-1} of each + 3 labour cost per irrigation)	8500.00
12	Inter-cultural operations (2 hand weedings:15 labour per operation @ 300 $man\text{-}days^{-1}$)	9000.00
13	After care operations	
a	Spray of Dithane M-45	1440.00
b	Spraying of Dimethoate (Rogor-30 EC)	975.00
c	Labour for pesticide spraying (10 labour @ 300 $man\text{-}days^{-1}$)	3000.00
d	Staking (10 labour @ 300 $man\text{-}days^{-1}$)	3000.00
e	Staking sticks (37037 sticks ha^{-1} @ 8 sticks per rupee)	4629.63
f	Steel wires (37037 wire pieces ha^{-1} @10 pieces per rupee)	3703.70
g	Gunny thread (37037 threads ha^{-1} @100 rupee per 120m thread)	3000.00
h	Protection from birds and rodents (15 labour @ 300 $man\text{-}days^{-1}$)	4500.00
i	Crop residue removal (10 labour @ 300 $man\text{-}days^{-1}$)	3000.00
14	Harvesting (8 pickings by 5 labors in each picking @ 300 $man\text{-}days^{-1}$)	12000.00
15	Transport and marketing charges (20 labors@ 300 $man\text{-}days^{-1}$)	6000.00
16	Total working capital	98149.33
17	Miscellaneous charges (@2% of working capital)	1962.99
19	Interest on working capital (@ 5% of working capital)	4907.47
	Common variable cost (working capital +miscellaneous charges + interest on working capital)	105019.78
B	Fixed cost	
1	Rental value of land (for six months @ 40000 $year^{-1}$)	20000.00
2	Land revenue	31.00
3	Depreciation of implements	800.00
4	Interest on fixed capital @ 6.5%	1354.02
	Total fixed cost	22185.02
C	Total common cost	127204.80

Table 2: Treatment wise added variable cost in cultivation of tomato

Treatments	Cost $unit^{-1}$ (Rs. kg^{-1})	Input Cost (Rs. ha^{-1})	Labour cost (@ 300 $man\text{-}day^{-1}$)	Total added variable cost (Rs. ha^{-1})
T1: FYM @ 10.0 t ha^{-1}	3	30000	2400	32400
T2: FYM @ 20.0 t ha^{-1}	3	60000	4800	64800
T3: FYM @ 30.0 t ha^{-1}	3	90000	7200	97200
T4: PM @ 5 t ha^{-1}	7	35000	1200	36200
T5: PM @ 7.5 t ha^{-1}	7	52500	1800	54300
T6: PM @ 10.0 t ha^{-1}	7	70000	2400	72400
T7: VC @ 2.5 t ha^{-1}	8	20000	600	20600
T8: VC @ 5.0 tha^{-1}	8	40000	900	40900
T9: VC t @ 7.5 t ha^{-1}	8	60000	1200	61200
T10: 100% RD of NPK-	Through chemical fertilizer (180,60,60: kg NPK ha^{-1})			
Urea: 341.3 kg ha^{-1}	6.4	2184.32	3300	10384.44
DAP: 130.44 kg ha^{-1}	23	3000.12		
MOP: 100 kg ha^{-1}	19	1900		

Table 3: Treatment wise comparative economics of cost of cultivation of tomato

Treatments	Fixed cost (Rs. ha^{-1})	Common variable cost (Rs. ha^{-1})	Added variable cost (Rs. ha^{-1})	Total variable cost (Rs. ha^{-1})	Total cost of cultivation (Rs.)
T_1: FYM @ 10.0 t ha^{-1}	22185.02	105019.78	32400.00	137419.78	159604.7981
T_2: FYM @ 20.0 t ha^{-1}	22185.02	105019.78	64800.00	169819.78	192004.7981
T_3: FYM @ 30.0 t ha^{-1}	22185.02	105019.78	97200.00	202219.78	224404.7981
T_4: PM @ 5 t ha^{-1}	22185.02	105019.78	36200.00	141219.78	163404.7981
T_5: PM @ 7.5 t ha^{-1}	22185.02	105019.78	54300.00	159319.78	181504.7981
T_6: PM @ 10.0 t ha^{-1}	22185.02	105019.78	72400.00	177419.78	199604.7981
T_7: VC @ 2.5 t ha^{-1}	22185.02	105019.78	20600.00	125619.78	147804.7981
T_8: VC @ 5.0 tha^{-1}	22185.02	105019.78	40900.00	145919.78	168104.7981
T_9: VC t @ 7.5 t ha^{-1}	22185.02	105019.78	61200.00	166219.78	188404.7981
T_{10}: 100% RD of NPK	22185.02	105019.78	10384.44	115404.22	137589.2381

Table 4: Economics of tomato production under different treatments involved in cultivation

Treatments	Yield (q ha^{-1})	Cost of cultivation (Rs. ha^{-1})	Gross income (Rs. ha^{-1})	Net income (Rs. ha^{-1})	Benefit-Cost Ratio
T_1: FYM @ 10.0 t ha^{-1}	295.59	159604.80	443385	283780.20	1.78
T_2: FYM @ 20.0 t ha^{-1}	384.69	192004.80	577035	385030.20	2.01
T_3: FYM @ 30.0 t ha^{-1}	476.89	224404.80	715335	490930.20	2.19
T_4: PM @ 5 t ha^{-1}	372.34	163404.80	558510	395105.20	2.42
T_5: PM @ 7.5 t ha^{-1}	490.29	181504.80	735435	553930.20	3.05
T_6: PM @ 10.0 t ha^{-1}	584.69	199604.80	877035	677430.20	3.39
T_7: VC @ 2.5 t ha^{-1}	246.69	147804.80	370035	222230.20	1.50
T_8: VC @ 5.0 tha^{-1}	310.49	168104.80	465735	297630.20	1.77
T_9: VC t @ 7.5 t ha^{-1}	394.39	188404.80	591585	403180.20	2.14
T_{10}: 100% RD of NPK through IF	399.99	137589.24	599985	462395.76	3.36

Conclusion

This study illustrates that application of organic manures for nutrient management in tomato variety Kashi-Vishesh, showed best profitable output over inorganic nutrient management. Use of poultry manure @ 10 t ha^{-1} is more productive and remunerative for nourishment of vegetable crop tomato. For the determination of an appropriate rate of organic sources, the experiment may be repeated at different locations for different varieties of tomato.

References

1. Acharaya CL, Mandal KG. Integrated plant nutrient supply in Vegetable crops. 79-10. In: Compendium: Recent Advances in Vegetable Production Technology: Proceedings of Winter School, 3-23 December,2002, Varanasi, Indian Institute of Vegetable Research, Varanasi, U.P. (INDIA), 2002.
2. Anonymous. National Horticulture Board, Area and Production of Vegetables for the year 2016-2017, 2017.
3. Bhardwaj MI, Harendra R, Koul BL. Yield response and economics of organic sources of nutrients as substitute to inorganic sources in tomato (*Lycopersicon esculentum*), okra (*Hibiscus esculentus)*, cabbage (*Brassica oleracea* Var. capitata) and cauliflower (*Brassica oleracea* Var. botrytis). Indian J Agric. Sci. 2000; 70:653-656.
4. Chattoo MA, Ahmad N, Narayan S, Narayan R, Mir SA. Response of garlic (*Allium Sativum* L.) to biofertilizers application, In Souvenir: National Seminar on organic products and their future prospectus, October 21-22,2003 SKUAST-K Shalimar Srinagar (J&K), India, 2003, 93.
5. Magray MM, Chattoo MA, Wani KP, Parray FA, Shabir A. Economics of production of tomato grown in Kashmir region under different sources of plant nutrients, Asian J Hort. 2013; 8(1):218-221.
6. Malewar GU, Ismail S, Rudraksha GB. Integrated nitrogen management in Chilli (*Capsicum annum* L). Bull. Indian Institute Soil Sci. 1998; 2:156-163.
7. Singh B, Singh N, Singh DV. Prospectus of vegetable production in Ladakh,.85-98. In; Dynamics of Cold Arid Agriculture (Eds J.P Sharma and A.A. *Kalyani Publisher*, New Delhi, India, 2000.
8. Thornsbug SD, Stoffela PJ, Minton TM. Economics of organic waste compost utilization in commercial tomato production system. Acta Horticulture. 2000; 536:93-99.
9. Vavilov NI. The origin, variation immunity and breeding of cultivated plants. Chemical Bot. 1951; 1(6):364.