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Full Research Article

Effect of Organic Manures and Biofertilizers on the Productivity of Tomato and Bell Pepper under Mid-Hill Conditions of Himachal Pradesh

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Abstract

A field study on the effect of organic manures and biofertilizers was conducted on the farmer field during the years (2009-10) and (2010-11). Heem Sohna, Rakshita, Naveen+2000 and Sun Seed 7711 varieties of tomato and K. Sel, California Wonder, Indra and Dollar varieties of capsicum were taken for the present studies. Farm Yard Manure (FYM) at the rate of 30 tones per hectare and vermicompost (VC) at the rate of 6 tones per hectares treated with *Tichoderma viridi* at the rate of 500 gm/2 tones of manures were made at the time of field preparation and during different stages of growth. In conventional treatment recommended doses of fertilizers and FYM were applied. In chemical treatments only recommended fertilizer dosages were used. The spacing adopted in tomato was 60×30 cm and 45×30 cm in capsicum. The highest yield of 134.4 tones/hectare in case of tomato variety Rakshita and 65.0 tones/hectare in capsicum variety Dollar were recorded in conventional system whereas the corresponding figures were slightly less in organic system of cultivation. However, the yields in both the crops were drastically reduced under chemical cultivation. The fruit quality attributes were marginally higher in organic system of cultivation and the crop longevity was also noted to be prolonged to the considerable extent.

1. Introduction

Tomato (*Solanum lycopersicum* L.) is the most important and remunerative vegetable crop and is grown over an area of 479200 ha with 8585800 MT annual productions in India. In Himachal Pradesh, the vegetable cultivation is done on an area of 63700 ha with a production of 11.5 lakh MT which brings revenue of rupees 7 Crores to the state annually. Out of which tomato alone covers an area of 9555 ha with a production of 3.4 MT annually. Bell pepper (*Capsicum annuum* L.) is looked as luxury vegetable in the world. Both of these are cultivated from March to November in the state and become off season vegetables in the markets of North-Indian plains fetching attractive returns to the farmers. In the quest of high productivity, the farmers are using chemicals indiscriminately which has resulted in deterioration of the soil texture and the soils has become sick. The need of the day is to make vegetable farming sustainable, profitable and reduce the use of harmful chemicals by gradually changing over to non-chemical methods like organic farming. During the recent past years, the use of chemicals for the management of pest and diseases and improve the soil fertility has been increased. This practice has lead to health hazards, water and environmental pollution and the productivity levels have decreased to a considerable extent. Therefore, several countries around the world including India, demand for organically produced vegetables is increasing among the consumers. The ever increasing costs of chemical fertilizers and pesticides have also emphasized the need for exploitation of bio-fertilizers.

Biofertilizers are eco-friendly low cost input and not only improved the crop growth and yield but also improve food quality. Keeping these facts in view the present studies were undertaken to know the effect of manures and bio-fertilizers on tomato and capsicum the major vegetable crops being grown by the farmers of the area.

2. Materials and Methods

A field experiment on the effect of manures and biofertilizers on the productivity of tomato varieties; Heem Sohna, Rakshita, Naveen+2000 and Sun Seed 7711 and capsicum varieties K. Sel., California Wonder, Indra and Dollar was carried out

during kharif season of 2009-10 and 2010-11 in the farmers field. The treatments under organic cultivation received well decomposed farm yard manure (FYM) and vermicompost (VC) as the source of nutrients .The quantity of FYM and VC applied was 300 quintals and 6 quintals per hectare, respectively. FYM was applied at the time of last ploughing of field preparation for which 4 ploughing were used. VC was applied @ of 2 qts each at three different stages of growth i.e. 30 days after transplanting, flowering stage and turning stage of first fruit cluster. FYM was also enriched by mixing *Trichoderma viridi* @ of 500 gm/2 ton of manure. Prior to sowing the seed and seed bed were treated with *Tricoderma virdi* (4 gm kg^{-1} of seed) and nursery bed (1×3 m) respectively.

The twenty days old seedlings were also given neem soap spray (7 gm^{-1} L) to protect them from sucking pest and white fly. The seedlings were also drenched with *Pseudomonas fluorescence* (10 gm^{-1}L) before transplanting to prevent foliar diseases. At the time of transplanting the root portions of seedlings were treated by dipping them in asafetida suspension (100 gm asafetida /500L of water) for 15-20 minutes to prevent the soil borne pathogens causing wilt diseases. The spacing adopted in tomato was 60×30 cm and 45×30 cm in capsicum. Only two shoots were allowed to grow which were trained on support system having bamboo poles (2.5 m height), GI wires and plastic ropes. Before the onset of monsoon, lower leaves up to 20 cm height were also removed. In conventional treatment, recommended fertilizers i.e. CAN 600 kg ,super phosphate 750 kg and murate of potash 90 kg per hectare were applied along with recommended dose of FYM i.e. 25 ton ha^{-1}. In chemical treatments, only recommended fertilizers were used. In both the conventional and chemical treatments, plant protection was taken care by using chemical. For weed management, four hand weeding were adopted. In all the experimental plots the irrigation was provided at an interval of 7 to 10 days. However, during the months of July and August no irrigation was given being the monsoon period. Proper drainage was also maintained through out cropping period. A distance of 10m was also maintained between organic and non-organic fields to prevent drift of chemicals and the space was used for growing tall variety of maize. No chemicals were used since 2004 in the experimental fields.

The experimental fields are located at Basal about 5 Km from Solan at an altitude of 1270 m above mean sea level laying 30-52' north and latitude 77-11' east .It falls under mid-hill zone of Himachal Pradesh. The climate ranges from sub-tropical to sub-temperate. May and June are the hottest months while, January and February are the coldest months. It experiences 1100-1300 mm rainfall, most of which occurs during monsoon (July-august). The meteorological data is presented in Table-2.

3. Results and Discussion

A perusal of the data presented in Table 3 shows that conventional system of cultivation resulted in maximum yield (1255 q ha^{-1}) followed by 1151 q ha^{-1} under organic cultivation and 983 q ha^{-1} under chemical cultivation in Hem Shona variety of Tomato. An increase of 8.28 per cent was worked out when conventional system of cultivation was compared with organic cultivation. However, the increase in yield was 21.67 per cent over chemical method. Similar trend was observed in all the

Table 1: Area (ha) and production (MT) under different vegetable crops in district Solan of Himachal Pradesh

Crop	Year									
	2005-06		2006-07		2007-08		2008-09		2009-10	
	Area	Production	Area	Production	Area	Production	Area	Production	Area	Production
Peas	1142	11420	1146	10887	1160	11650	1160	11050	1190	11880
Tomato	3800	125400	3935	137725	3950	138425	4020	147000	4275	175375
Beans	442	4940	457	5027	456	4650	456	1689	480	7230
Onion	37	740	33	627	30	700	30	570	40	700
garlic	91	1638	97	1745	130	2360	135	2430	150	2400
Cabbage	71	1775	77	1925	70	1945	62	2025	65	2225
Cauliflower	106	1908	116	2320	118	2580	110	2010	130	3400
Radish, Turnip & Carrot	93	1860	101	2020	115	2120	118	2173	130	3250
Okra	124	1488	141	1833	120	1560	110	1430	130	1950
Cucurbits	110	1100	117	2925	120	2140	120	2100	122	2205
Capsicum & Chillies	601	7813	649	8437	651	8472	653	8510	955	14400
Brinjal	94	1128	98	1176	94	1024	94	1048	95	1215
Other vegetables	270	4743	411	7398	415	7420	425	8468	455	11025
Total	6981	165953	7378	184045	7429	185046	7493	190503	8217	237255

Table 2: Meteorological data of experimental site

Month	Rain-fall (mm)	Temperature		Relative humidity (%)
		Max	Min	
April-10	8	26.03	12.93	61.36
May-10	104	26.12	15.61	58.45
June-10	194	23.30	12.8	59.7
July-10	435.1	21.12	11.77	73.16
Aug-10	316.8	22.51	13.93	76.8
Sept-10	357.4	23.10	14.3	79.3
Oct-10	40	20.64	11.54	50.58
Nov-10	-	18.96	9.5	60.1
Dec-10	105	15.16	6.8	31.71
Jan-11	17	9.64	5.96	29.64
Feb-11	67.8	12.03	8.5	67.8
March-11	50.4	18.50	10.3	60.4

four hybrids studied. In terms of profit and B:C ratio, Rakshita hybrid maintained it superiority over all the four hybrids under all the systems of cultivation studied, followed by Naveen $^{+}$ 2000 and Heem Sohna .

In case of bell pepper (Table 4), Dollar hybrid registered maximum yield (650 q ha^{-1}) under conventional system of cultivation followed by 565 q ha^{-1} in Indra 452 q ha^{-1} in K. Sel and 424 q ha^{-1} in California wonder. Like tomato, similar trend was also observed in organic and chemical system of cultivation. Overall maximum yield was recorded in all the varieties under conventional system of cultivation. As regards the net profit and B:C ratio maximum values of Rs. 9.33 lakh was recorded in hybrid Dollar under conventional system of cultivation having maximum B:C ratio of 4.92:1 which was closely followed by Rs. 6.67 lakh in Indra hybrid with B:C ratio 3.80:1. The same trend was noted in organic and chemical system of cultivation and California Wonder was placed at the trail end having minimum profit and B:C ratio under all the cultivation system. From the present findings, it can be concluded that hybrid Rakshita of tomato and Dollar of bell pepper produced best results in terms of profit under all the cultivation systems.

Organic system of cultivation though produced slightly less yield and profit in both the crops but on account of better quality and higher prices the organic system of cultivation is preferred in the long run in the interest of soil health, environmental pollution and no residuals on produce. The data presented in Table 5 and 6 reveals that in organically grown tomato and capsicum, most of the quality parameters were marginally superior to conventionally grown crops. The pericarp thickness that imparts resistance to the fruits against bruises and injuries during transportation of harvested produce, was recorded highest in organically grown tomato variety Heem Sohna (6.60 mm) followed by Naveen+2000 (6.50 mm), while corresponding values in conventional grown tomato were 5.50 mm and 5.15 mm, respectively. Similarly, higher Total Soluble Solids were also recorded in organically grown tomatoes as compared to conventional system. The same trend was also observed in case of ascorbic acid contents. TSS and ascorbic acid content are most important quality parameters in the processing industries and equally important as nutritional constituents. In case of average fruit weight the different system of cultivation had a remarkable effect on the fruit weight.

Table 3: Comparative performance of tomato varieties under different cultivation systems

Variety	Organic cultivation			Conventional cultivation			Chemical cultivation		
	Yield (q ha^{-1})	Net Profit (Rs) in lac	B:C ratio	Yield (q ha^{-1})	Net Profit (Rs) in lac	B:C ratio	Yield (q ha^{-1})	Net Profit (Rs) in lac	B:C ratio
Heem Sohna	1151	7.56	2.20:1	1255	6.06	1.67:1	983	3.42	1.40:1
Rakshita	1222	8.41	2.34:1	1344	7.13	1.79:1	1040	4.12	1.49:1
Naveen $^{+}$ 2000	1202	8.17	2.30:1	1328	6.94	1.77:1	991	3.52	1.41:1
Sun Seed 7711	1188	8.01	2.28:1	1282	6.38	1.70:1	927	2.75	1.32:1

Sale rate Rs. 12 Kg^{-1}

Table 4: Comparative performance of capsicum varieties under different cultivation systems

Variety	Organic cultivation			Conventional cultivation			Chemical cultivation		
	Yield (q ha^{-1})	Net Profit (Rs) in lac	B:C ratio	Yield (q ha^{-1})	Net profit (Rs) in lac	B:C ratio	Yield (q ha^{-1})	Net Profit (Rs) in lac	B:C ratio
K. Sel	450	4.05	2.80:1	452	3.95	2.60:1	418	3.50	2.48:1
California Wonder	400	3.35	2.48:1	424	3.56	2.50:1	374	2.88	2.22:1
Indra	550	6.55	3.91:1	565	6.67	3.80:1	504	5.71	3.42:1
Dollar	625	9.00	5.00:1	650	9.33	4.92:1	580	8.09	4.43:1

Sale rate : K. Sel and California wonder Rs. 14 Kg^{-1}, Indra Rs. 16 Kg^{-1}, Dolar Rs. 18 Kg^{-1}

Table 5: Effect of different cultivation systems on quality attributes and crop longevity of tomato

Variety	Pricarp Thickness (mm)		TSS (° B)		Ascorbic Acid Content (mg 100g^{-1})		Average Fruit Weight (g)		Harvest Duration (Days)	
	Organic	Conventional	Organic	Conventional	Organic	Conventional	Organic	Conventional	Organic	Conventional
Heem Sohna	6.6	5.5	4.6	3.25	30.13	27.57	73.53	82.5	48	40
Rakshita	5.7	5.02	4.1	3.1	31.44	26.23	70.75	81.2	46	34
Naveen+2000	6.5	5.15	4.11	3.32	30.42	28.73	72.1	80.4	46	35
Sun Seed 711	6.15	5.5	4.25	3.62	31.75	28.92	78.55	82.7	50	38

Table 6: Effect of different cultivation systems on quality attributes and crop longevity of capsicum

Variety	Pricarp Thickness (mm)		Ascorbic Acid Content (mg 100g^{-1})		Average Fruit Weight (g)		Harvest Duration (Days)	
	Organic	Conventional	Organic	Conventional	Organic	Conventional	Organic	Conventional
K.Sel	3.27	2.87	132.4	128.3	120.5	90.40	46.63	40.33
California Wonder	3.47	2.78	129.7	124.5	125.66	95.72	40.67	32.66
Indra	4.07	3.73	132.4	130.3	128.6	98.00	50.00	41.33
Dollar	4.1	3.67	132.6	129.8	130.33	98	55.33	42.60

Longer harvest duration is preferred in the present marketing systems under Indian conditions because it not only avoids the glut in the market but off-season nature of the crop is also maintained. In the present study, the harvest duration was considerable increased under organic cultivation system.

The same trends in respect of quality attributes and duration of harvest were observed in capsicum (Table 6). The maximum pericarp thickness was observed in organically grown capsicum variety Dollar (4.10 mm), however the thinnest pericarp was recorded in conventionally grown capsicum variety California Wonder (2.78 mm). The increase in ascorbic acid content and fruit weight to a considerable extent was observed under organically grown capsicum. The harvest duration was also prolonged in organic cultivation system ranging from 6.33 days (K.Sel) to 12.73 days (Dollar).

4. Conclusion

It is summarized that organic cultivation of tomato and capsicum is feasible by using appropriate crop specific organic farming practices. In addition, the non-conventional sources of fertilizers are not only cost effective but simultaneously boost up the productivity of soil and crop.

5. References

Anonymous. 2008. Package of Practices for Vegetable Crops in imachal Pradesh. Directorate of Extension Education, Dr Y S Parmar University of Horticulture and Forestry, Solan (HP)

Patra, S.K., Padhi, A.K., Mishra, S.N., 1989. Effect of biofertilizers at graded levels of nitrogen on the yield of wheat and toria in the north-eastern ghat region of Orrisa. *Environ. Ecol*. 7: 533-36

Shukla, Y.R., Thakur A.K., Joshi, A., 2009. Effect of inorganic and bio-fertilizers on yield and horticultural traits in tomato. *Indian Journal of Horticulture. 66(2): 285-87*

Thakur, K.S., Kumar, D., Vikram, A., Thakur, A.K., Mehta, D.K., 2010. Effect of organic manures and biofertilizers on growth and yield of tomato and French bean under mid hills of Himachal Pradesh. *Journal of Hill Agriculture* .1(2): 176-178