Performance of Capsicum Cv. Yellow Wonder Grown Through Organic Farming under Low Cost Protective Structure and Open Field Conditions

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ABSTRACT

Capsicum is one of the most important nutritious and highly remunerative vegetable crops grown mainly for its green fruits. It is mostly grown in greenhouses or in low cost protective structures. Capsicum is an important cash crop for smallholder farmers in developing countries like India. The present investigation on capsicum was conducted at Ramakrishna Mission Vivekananda Educational and Research Institute, F/C: IRTDM, Morabadi, Ranchi campus. Seven organically designed treatments (including control) *viz.*: T_1: *Enriched Sanjeevani* (1%); T_2: *Enriched Sanjeevani* (3%); T_3: BD-501 (1%); T_4: BD-501 (3%); T_5: *Sasyagavya* (10%); T_6: *Sanjeevani* (10%) and T_7: Absolute Control were assigned for the study by employing Randomized Complete Block Design with three replications for each treatment under both open field and protective condition. Different growth, yield and quality attributes were taken into account for evaluation of capsicum cv. Yellow Wonder both under open field and low cost protective conditions. The findings revealed that coloured capsicum cv. Yellow Wonder is not suitable for growing under open field condition of the south Chhotanagpur plateau of Jharkhand, whereas, it performed well under low cost protective structure. From the study, it was revealed that the T_6 treatment [*Sanjeevani* (10%)]is the best treatment regarding yield potential (13216.46 ± 297.46kgha^{-1} ≈13.0 tha^{-1}) under protection as contrast to the open field condition (424.69 ± 39.33kgha^{-1} ≈0.4 tha^{-1}). As a consequence, growing capsicum variety Yellow Wonder through T_6 treatment under low cost protective structure emerged as the best concerning net return per unit area with the highest benefit:cost ratio (3.46).Findings also accentuated that capsicum may well be suited for cultivation even in commercial scale through non-chemical farming approaches in this region. However, different studied quality contributing parameters perform independently under the influences of organically designed treatments under both of the growing conditions.

Keywords: Capsicum; Growth; Yield; Quality; *Enriched Sanjeevani*; BD-501; *Sasyagavya*; *Sanjeevani, B:C Ratio*

INTRODUCTION

Capsicum (*Capsicum annuum* L. var. *grossum*)also known as bell pepper or sweet pepper or Simla Mirch,is one of the most popular and highly remunerative annual herbaceous vegetable crop. It belongs to the family *Solanaceae*(Rahim and Mat, 2012) with chromosome number 2n=24 (Cheema and Pant, 2013).It is a high economic value vegetable and spices crop used both for domestic purpose and inter states marketing networks due to its more consumer's preferences for using in various culinary products. It is eaten raw or used in dehydrated and processed meat, stuffing, baking, pizza, burger and preparation of salad and soup. Capsicum is a rich source of vitamin "A" and "C" (ascorbic acid) and considered better than tomato (Boraiah, 2013). It is also important for some essential minerals like Na (3.40 - 2.10 ppm); K (98.80 - 43.70 ppm); Ca (32.00 - 6.00 ppm); Mg (13.20 - 6.00 ppm); Zn (0.04 - 0.01 ppm); Fe (7.10 -2.65 ppm); Cu (1.05 - 0.16 ppm); Mn (0.44 - 0.12 ppm) [Raimi *et al.,* 2014]. Besides, capsicum is a good source of total phenolic contents, total flavonoid contents and antioxidants (Rahim and Mat, 2012).It contents higher percentage of citric acid, malic acid and tartaric acid as well (Lopez-Valdez *et al.,* 2016).Hence, there is good demand from urban consumers and export necessitating the production throughout the year. It is one of the leading vegetables grown in open field conditions as well as under protected conditions.Now-a-days, the capsicum is highly suitable for protective condition under poly/net houses. In case of open field production many production problems like emergence of new pests, soil borne diseases, micro nutrient deficiencies *etc*. are the common.

Organic agriculture is an element of the system for sustainable agriculture and an alternative to conventional approaches in agriculture where, organic manure gave better yield than chemical fertilizers (Bokhtiar *et al.*,2008). Organic agriculture ensures the health of soils as well. It is the alternative use of those people who are want quality fruits Moreno-Resendez *et al.* (2016). Organic fertilizers safeguard level of acidity and organic pepper safer for human consumption (Funsho *et al.,* 2015). Keeping in view of these aspects, the present study was a modest attempt to analyze the economics of capsicum production under protected as well as open filed conditions. The specific objectives of the present investigation were: to study about the performance of growth, yield andquality attributes of capsicum grown under both open and protective environmentsand to estimate the B: C ratio of such organically grown capsicum.

MATERIAL AND METHODOLOGY

The present experiment was conducted at the organic experimental farm of the Ramakrishna Mission Vivekananda Educational and Research Institute, Ranchi Campus, Jharkhand. The experimental sites located at 23.23^0N latitude and 85.23^0E longitude in the eastern edge of the Deccan plateau under the typical humid subtropical climatic region of southern part of the Chhota Nagpur plateau. The experiment was carried out by employing the 'Yellow Wonder' variety of capsicum which colour is dark yellow. The seedlings were produced in a raised nursery bed, during September month. The seedlings were transplanted to the experimental plots after 35days of sowing. The experiment was designed after Randomized Complete Block Design in 42 experintal plots (21 plots each for open field and protective conditions). Seedlings were

transplanted with an interplantspacing of 45 cm (R-R) and intra plant spacing of 30 cm (P-P) inall experimental plots each measuring 2.70 m x 2.10 msizes. Thereby, 42 plants were accommodated in each plot.The experiment was conducted both under open field and under low-cost protective structure by applying seven organic liquid manures as treatments (including a control with no liquid manure) with their three replications. Treatments used were:T_1- Enriched Sanjeevani (1%), T_2- Enriched Sanjeevani (3%), T_3- BD-501 (1%), T_4- BD-501 (3%), T_5- Sasyagavya(10%), T_6- Sanjeevani (10%), and T_7- Absolute Control.Applied of neem leaf extract and tobacco stalk decoction as against insect pests but for diseases management cheese water mixed with turmeric powder and ginger, garlic and chilli paste mixture were applied 10 days interval as prophylactic measures. Different growth, yield and quality attributes were taken into account from the selected five plants from each plots. Standard methodologies were followed for proximate quality parameters analysis. Data thus obtained were subjected to statistical analysis for their interpretation.

RESULTS AND DISCUSSION

Different growth and yield attributes of capsicum showed statistical significant differences bothe under protection and open field conditions. As a consequence, amongst different treatments, T_6 (Sanjeevani 10%) the recorded higher plant height (45.33 cm under protective condition), more branches plant^{-1} (7.50 under protective condition)but earliness of flowering (21.50 days) documented in T_3**(**1% BD-501)[Table-1]. More number of fruitsplant^{-1} (4.67 under protective condition) was recorded in T_6[Table-2] and other yield associated attributes were greatly influenced by this treatment especially under protective condition.Thereby, the highest yield (13.22t ha^{-1}) with statistical significant differences with other treatments was estimated in the case of Sanjeevani 10% (T_6) [Table-2]. However, under open field condition the performance of the crop was meager resulting poor yield in almost all of the treatment conditions [Table-2]. Quality contributing traits, on the other hand, performed independently under different treatment conditions but almost all of the cases, better results were found again under the growing condition of low cost protective structure [Table-3]. As the crop variety was not performing well under open field condition, thereby, during its economics study only protective growing condition was taken into account. In this particular context, T_6 emerged as the best treatment with the highest B:C ratio (3.46) as the yield and its associated traits were highly influenced by this treatment condition [Table-4].

CONCLUSION

The conventional chemical farming practices and the over uses of agro-chemicals is main to degradation of soil health and reduce the quality yield of the crop. In that situation alternative approach of farming is the one and only way for sustaining soil health and quality of crop produces. From the present experiment and findings, it may beconcluded that the *Sanjeevani* has significantly good effect over the growth and yield of capsicum. In this context, T_6 [*Sanjeevani* (10%)] emerged as the best treatment in terms of yield expression in capsicum cv. Yellow Wonder. The benefit: cost study also showed better results in this treatment (T_6) with B:C ratio of 3.46 under growing condition of the low cost protective structure.

REFERENCES

Bokhtiar, S. M.; Paul, G. C. and Alam, K. M. (2008). Effects of Organic and Inorganic Fertilizer on Growth,Yield, and Juice Quality and Residual Effects on Ratoon Crops of Sugarcane. *Journal of Plant Nutrition*, **31** (10):1832-1843.

Boraiah, B. (2013). Effect of organic Liquid Formulations and Manures on Growth and Yield of Capsicum (*Capsicum annuum* L. var. *grossum*). Unpublished paper retrieved from http://apeda.in/agriexchange/India%20Production/India_Productions.aspx?hscode=1072.

Cheema, S. K. and Pant, M. R. (2013). Karyotype analysis of seven cultivated varieties of *Capsicum annuum* L.. *Caryologia*, **66**(1): 70-75.

Funsho , F. E.; Oluwafemi, A. B.; and Joseph, A. (2015). Comparative Evaluation of Organic and Inorganic Manure on Sweet Pepper Performance in Two Ecological Zones of Nigeria. *American Journal of Experimental Agriculture*, **6**(5): 305-309.

Lopez-Valdez, L.G.; Barrales-Cureno, H.J.; Reyes, C. R.; Salinas, S.C. and Valdes, R. V. (2016). Research Paper Phytochemical Analysis in *Capsicum* spp Medical Science. *Indian Journal of Research*, **5** (3): 47-49.

Moreno-Resendez, A.; Parcero-Solano, R.; Reyes-Carrillo, J. L.; Salas-Pérez, L.; Moncayo-Luján, M. R.; Ramírez-Aragón, M. G. and Rodríguez- Dimas, N. (2016). Organic Manures Improved the Phenolic Content, Antioxidant Capacity and Soluble Solids in Pepper. *Food and Nutrition Sciences*, **7**:1401-1413.

Rahim R. A. and Mat I.(2012). Phytochemical Contents of *Capsicum frutescens* (Chili Padi), *Capsicum annum* (Chili Pepper) and *Capsicum annum* (Bell Peper). *International Conference on Biological and Life Sciences*, **40**: 164-167.

Raimi, M. M.; Shittu, S. A. and Oyetade, O. A. (2014). Physicochemical Properties and Mineral Composition of *Capsicum annum* and *Capsicum frutescens* Oils. *IOSR Journal of Applied Chemistry*, **7**(1): 112-116.

Table-1: *Per se* performance of different growth attributes of capsicum grown under protection (P) and open field (O) condition

Treatment	Plant height (cm)		No. of branches plant^{-1}		Days to first flowering after transplanting	
	P	O	P	O	P	O
T_1	28.67	22.00	5.83	6.50	33.11	21.00
T_2	24.50	17.50	5.17	5.25	32.57	29.83
T_3	41.50	16.25	6.17	7.75	21.50	15.40
T_4	37.33	15.00	4.83	4.75	23.00	18.50
T_5	41.33	20.58	5.67	6.00	29.33	16.00
T_6	45.33	23.33	7.50	4.75	22.67	20.00
T_7	43.17	18.42	6.33	5.25	33.17	21.33
SEm(±)	1.39	0.85	0.50	0.59	2.93	2.92
$CD_{(P\leq0.05)}$	3.50	2.14	1.26	1.48	7.37	NS

Note: **T_1:** *Enriched Sanjeevani* (1%); **T_2:** *Enriched Sanjeevani* (3%); **T_3:** BD- 501 (1%); **T_4:** BD-501 (3%); **T_5:** *Sasyagavya* (10%); **T_6:** *Sanjeevani* (10%) and **T_7**Absolute Control; P: Under low cost protective structure and O: Open field condition; NS: Non-significant.

Table-2: *Per se* performance of different yield attributes of capsicum grown under protection (P) and open field (O) condition

Treatment	No. of fruit plant^{-1}		Average fruit weight (g)		Equatorial diameter of fruit (cm)		Polar diameter of fruit (cm)		Yield (t ha^{-1})	
	P	O	P	O	P	O	P	O	P	O
T_1	3.00	1.33	13.45	11.23	17.07	16.80	8.48	7.00	1.99	0.41
T_2	2.67	1.67	13.21	9.41	17.80	15.23	8.25	6.43	1.74	0.42
T_3	2.00	2.00	56.63	6.51	19.20	19.10	10.14	7.75	5.59	0.35
T_4	2.33	ϕ	55.55	ϕ	21.56	ϕ	11.57	ϕ	6.40	ϕ
T_5	3.33	ϕ	35.27	ϕ	22.31	ϕ	9.50	ϕ	5.81	ϕ
T_6	4.67	1.67	57.35	8.70	19.77	17.75	11.15	6.50	13.22	0.39
T_7	1.67	1.00	84.44	11.60	20.55	13.88	11.96	10.33	6.95	0.31
SEm(±)	0.44	0.38	3.46	1.00	1.10	0.80	1.12	0.45	1.99	0.41
$CD_{(P\leq0.05)}$	1.11	0.97	8.71	3.80	2.76	2.02	NS	1.13	1.74	0.42

Note: **T_1:** *Enriched Sanjeevani* (1%); **T_2:** *Enriched Sanjeevani* (3%); **T_3:** BD- 501 (1%); **T_4:** BD-501 (3%); **T_5:** *Sasyagavya* (10%); **T_6:** *Sanjeevani* (10%) and **T_7**Absolute Control; P: Under low cost protective structure and O: Open field condition; NS: Non-significant; ϕ: Data not available

Table-3: *Per se* performance of different quality attributes of capsicum grown under protection (P) and open field (O) condition

Treatment	TSS (°Brix)		Ascorbic Acid (mg $100g^{-1}$)		Total Sugar (%)		Reducing Sugar (%)	
	P	O	P	O	P	O	P	O
T_1	7.50	7.30	246.15	179.49	11.98	4.90	10.30	4.88
T_2	7.10	7.30	189.74	134.84	11.12	9.77	11.51	10.06
T_3	7.70	6.00	194.87	192.31	13.38	7.04	12.02	8.03
T_4	5.60	ϕ	220.51	ϕ	8.25	ϕ	9.33	ϕ
T_5	6.60	ϕ	164.10	ϕ	8.73	ϕ	7.15	ϕ
T_6	6.00	6.03	189.23	182.49	3.43	7.88	9.76	8.29
T_7	6.60	6.20	208.21	186.15	6.89	10.59	16.02	7.72
SEm(±)	0.37	0.12	16.95	9.34	0.94	0.80	1.11	0.66
$CD_{(P\leq0.05)}$	0.95	0.31	NS	23.53	2.36	2.01	2.80	1.66

Note: **T_1:** *Enriched Sanjeevani* (1%); **T_2:** *Enriched Sanjeevani* (3%); **T_3:** BD- 501 (1%); **T_4:** BD-501 (3%); **T_5:** *Sasyagavya* (10%); **T_6:** *Sanjeevani* (10%) and **T_7**Absolute Control; P: Under low cost protective structure and O: Open field condition; NS: Non-significant; ϕ: Data not available

Table-4: Economics of capsicum organically growing under different treatment conditions in one hectare of land under protective condition

Cost components	T_1	T_2	T_3	T_4	T_5	T_6	T_7
Land preparation (Rs.)	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00
polly house (Rs.)	250000.00	250000.00	250000.00	250000.00	250000.00	250000.00	250000.00
Nursery and transplanting(Rs.)	8000.00	8000.00	8000.00	8000.00	8000.00	8000.00	8000.00
Manures (Rs.)	3000.00	3000.00	3000.00	3000.00	3000.00	3000.00	3000.00
Plant protection (Rs.)	3000.00	3000.00	3000.00	3000.00	3000.00	3000.00	3000.00
Inter-cultural operations (Rs.)	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00
Irrigation (Rs.)	2000.00	2000.00	2000.00	2000.00	2000.00	2000.00	2000.00
Harvesting and post-harvest operations cost (Rs.)	1500.0	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00
Wages of labours (Rs.)	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00
Miscellaneous costs (Rs.)	3000.00	3000.00	1800.00	1800.00	2500.00	2000.00	1000.00
Total cost of cultivation (A)	**284000.00**	**284000.00**	**282800.00**	**282800.00**	**283500.00**	**283000.00**	**282000.00**
Benefit: cost ratio							
Production (kgha-1)	6511.11	6500.69	7684.22	9654.32	7116.60	12228.81	5059.81
Selling price (Rs kg-1)	80.00	80.00	80.00	80.00	80.00	80.00	80.00
Total income (Rs ha-1) (B)	520888.89	520054.87	614738.00	772345.68	569327.85	978304.53	404784.64
Net profit (Rsha-1) (B-A)	236888.89	236054.87	331938.00	489545.68	285827.85	695304.53	122784.64
B:C Ratio (B/A)	**1.83**	**1.83**	**2.17**	**2.73**	**2.01**	**3.46**	**1.44**

Note: Prevailing and average market price of capsicum during harvesting was taken into consideration and the premium price of organically grown produce was not considered here due to absenteeism of organic certification of the crop.