

Original Research Article

**Economic Analysis of Organic Bell Pepper (*Capsicum annuum* L.) Production under Mid Hill Condition of Himachal Pradesh**

**ABSTRACT**

The field experiment was conducted during *Kharif* season of 2016 at Experimental farm of the Department of Vegetable Science, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan in order to study economic analysis of organic bell pepper (*Capsicum annuum* L.) production. The experiment was laid out in Randomized Complete Block Design (RCBD) Factorial with three replications comprising of ten treatment combinations. The study divulged that vermicompost @ 7 t/ha + Jeevamrut (Drenching @ 5 % + Foliar spray @ 3 %) significantly influenced yield and yield contributing traits of bell pepper and recorded maximum fruit weight (59.33 g), number of fruits per plant (29.13), fruit yield/plot (24.73 kg) and fruit yield/ha (366.42 q) along with highest gross income (₹ 916,050.00/ha) and net return (₹ 713,795.00/ha) whereas B: C ratio (5.43) was obtained highest with No organic manure + Jeevamrut (Drenching @ 5 % + Foliar spray @ 3 %). Hence, Jeevamrut (Drenching @ 5 % + Foliar spray @ 3 %) application from economic point of view and Vermicompost @ 7 t/ha along with Jeevamrut (Drenching @ 5 % + Foliar spray @ 3 %) for getting high yield can be recommended for commercial cultivation.

**Key words:** Organic manure, Liquid manure, Economics, Yield, Bell Pepper

## 1. INTRODUCTION

Bell pepper (*Capsicum annuum* L. var. *grossum* Sendt.) belongs to family Solanaceae, chromosome number  $2n = 24$ , commonly known as sweet pepper, capsicum and Shimla mirch. It is native of Mexico with secondary centre of origin in Guatemala (Bukasov, 1930). It is the world's second most important vegetable crop after tomato and is relatively non-pungent or slightly pungent with thick flesh. Bell pepper has a low energy content, although it is high in nutrients, particularly vitamin A and vitamin C (Raturi *et al.*, 2019). Organic agriculture has the potential to enhance soil fertility, biodiversity and economic performance (Hameedi *et al.*, 2018). Organic agriculture is gaining popularity, and organic food markets are fast developing in many nations, including India (Gopinath *et al.*, 2011). Organic manure can be applied as counterfeit practice to inorganic fertilizers (Naeem *et al.*, 2006). The excessive use of inorganic fertilizers caused series of problems among which soil degradation, poor quality production, environmental pollution and some serious hazards to human health are the most common. Application of inorganic fertilizers can only supply one or two nutrient elements. Organic manure act out a key role in plant growth as an origin of all essential macro and micronutrients in easily available forms during mineralization (Nweke *et al.*, 2013) and soil physical and chemical properties are improved (Chaterjee *et al.*, 2005). So, high yield, high gross income and net return can be obtained by the application of manures.

## 2. MATERIALS AND METHODS

The present study was carried out at Vegetable Research Farm of the Department of Vegetable Science, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan HP from April to September 2016. The experiment was laid out in Randomized Complete Block Design (RCBD) Factorial with three replications comprising of ten treatment combination of manure and liquid manure viz. T<sub>1</sub> (M<sub>0</sub>L<sub>0</sub>): No organic manure + No liquid manure (Control), T<sub>2</sub> (M<sub>1</sub>L<sub>0</sub>): FYM @ 20 t/ha + No liquid manure, T<sub>3</sub> (M<sub>2</sub>L<sub>0</sub>): Vermicompost @ 7 t/ha + No liquid manure, T<sub>4</sub> (M<sub>3</sub>L<sub>0</sub>): FYM @ 10 t/ha + VC 3.5 t/ha + No liquid manure, T<sub>5</sub> (M<sub>4</sub>L<sub>0</sub>): FYM @ 15 t/ha + VC 1.75 t/ha + No liquid manure, T<sub>6</sub> (M<sub>0</sub>L<sub>1</sub>): No organic manure + Jeevamrut (Drenching + Foliar Spray), T<sub>7</sub> (M<sub>1</sub>L<sub>1</sub>): FYM @ 20 t/ha. + Jeevamrut (Drenching + Foliar Spray), T<sub>8</sub> (M<sub>2</sub>L<sub>1</sub>): Vermicompost @ 7 t/ha. + Jeevamrut (Drenching + Foliar Spray), T<sub>9</sub> (M<sub>3</sub>L<sub>1</sub>): FYM @ 10 t/ha + VC 3.5 t/ha + Jeevamrut (Drenching + Foliar Spray), T<sub>10</sub> (M<sub>4</sub>L<sub>1</sub>): FYM @ 15 t/ha + VC 1.75 t/ha + Jeevamrut (Drenching + Foliar Spray). The seeds of bell pepper cv. Solan Bharpur were sown in the nursery beds on 5<sup>th</sup> March, 2016 and the seedlings were transplanted on 26<sup>th</sup> April, 2016. The plot size was 2.40 m x 2.25 m and a spacing of 60 cm X 45 cm was followed and Benefit: Cost (BC) ratios were recorded. The data recorded on various parameters were analyzed for RBD design as suggested by (Gomez and Gomez, 1983). The results have been interpreted on the basis of 'F' test value and critical difference (CD) was calculated at 5 per cent level of significance. The analysis of the soil was done before planting and it was found that soil was rich in organic matter and having pH, EC and OC values of 7.2, 0.431dSm<sup>-1</sup> and 1.38 per cent, respectively. The available N, P and K content was recorded to be 395.14, 58.24 and 263.2 kg/ha, respectively.

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### 2.1 Application of organics

The entire FYM and Vermicompost as per treatment combination per plot were applied evenly by mixing with soil before transplanting of bell pepper seedlings and liquid manure was applied as 3 drenching with Jeevamrut @ 5 per cent at 15 days interval started at the time of transplanting + 2 Foliar Spray of Jeevamrut @ 3 per cent at 15 days interval started after 45 days of transplanting.

### 2.2 Economics of treatments

The economics of treatment is the most important consideration for making any recommendation to the farmer for its adoption. The cost of bell pepper production under different treatments was studied to work out economics of various sources of organic nutrients considering the present price of inputs and produce, gross return was worked out on the basis of market price of the produce at the time when the produce was ready for sale. Net returns and benefit cost ratios were worked out for each nutrient treatment by adopting the following formulae:

$$\text{Net return (₹/ha)} = \text{Gross returns (₹/ha)} - \text{Cost of cultivation (₹/ha)}$$

$$\text{Benefit: Cost ratio} = \text{Net return (₹/ha)} / \text{Cost of cultivation (₹/ha)}$$

## 3. Result and discussion

A perusal of data presented in Table. 1 revealed that yield in bell pepper was significantly affected by the application of both the manures and their interactions. The data on different levels of manure revealed that vermicompost treated plots produced significantly more number of fruits per plant (27.00), fruit length (6.54 cm), fruit breadth (5.69 cm), average fruit weight (56.43 g), fruit yield per plot (21.77 kg) and fruit yield/ha (322.47 q) and minimum was observed in plots where no manure ( $M_0$ ) was applied.

Levels of liquid manure revealed that Jeevamrut ( $L_1$ ) produced maximum number of fruits per plant (25.75), fruit breadth (5.62 cm), average fruit weight (54.43 g), fruit yield per plot (20.20 kg), fruit yield/ha (299.26 q) as compared with  $L_0$  (No liquid manure). The effect of Jeevamrut as well as its interaction with other levels of organic manure was found to be non-significant on fruit length (cm).

The interactions of both the factors revealed that maximum number of fruits per plant (29.13), fruit breadth (5.89 cm), average fruit weight (59.33 g), fruit yield per plot (24.73 kg), fruit yield/ha (366.42 q), was observed in  $M_2L_1$  and minimum of all these characters were recorded in  $M_0L_0$ .

It could be due to vermicompost application, which has a direct effect on plant growth, providing a source of plant macro and micronutrients. Although some of these nutrients exist in inorganic forms and are quickly available to plants, the majority are released gradually through mineralization of organic materials, resulting in a gradual-release fertilizer that provides a dynamic and steady source of nutrients to the plant. These results are also supported by findings of (Arancon *et al.*, 2003), (Arancon *et al.*, 2005), (Natesh *et al.*, 2005), (Joshi and Pal Vig, 2010), (Ramesh *et al.*, 2015), (Kumar, 2016) and (Ahmed *et al.*, 2017).

### Economics of the treatment

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The economics of the various treatment combinations have been presented in Table 2. A perusal of data revealed that highest cost of production Rs. 202,255.00 was incurred in M<sub>2</sub>L<sub>1</sub>, whereas lowest (₹ 94,030.00) was observed in M<sub>0</sub>L<sub>0</sub>. Similarly maximum gross income per hectare amounting to ₹ 916,050.00 was obtained in M<sub>2</sub>L<sub>1</sub> followed by M<sub>1</sub>L<sub>1</sub> (₹ 787,650.00), while minimum gross income (₹ 502,225.00) was recorded in M<sub>0</sub>L<sub>0</sub>. This is due to the high cost of production and maximum marketable yield in M<sub>2</sub>L<sub>1</sub> as compared to other treatments used in the study. However, highest net return (₹ 713,795.00) was recorded in M<sub>2</sub>L<sub>1</sub> followed by M<sub>1</sub>L<sub>1</sub> (₹ 652,695.00) and lowest net return (₹ 408,195.00) was observed in M<sub>0</sub>L<sub>0</sub>. In overall, maximum B: C ratio (5.43) was recorded in M<sub>0</sub>L<sub>1</sub> followed by B: C ratio (4.84) in M<sub>1</sub>L<sub>1</sub>, whereas minimum B: C ratio (2.48) was calculated in M<sub>2</sub>L<sub>0</sub>, which may be due to the lower cost of production and comparable gross income in M<sub>2</sub>L<sub>1</sub>. Hence the application of M<sub>0</sub>L<sub>1</sub> (No manure + Jeevamrut) rated as the most economic treatment for bell pepper production under mid hill conditions of Himachal Pradesh.

**Table 1. Effect of organic nutrient sources on yield and yield contributing traits**

Particular	Number of fruits per plant	Fruit length (cm)	Fruit breadth (cm)	Fruit weight (g)	Fruit yield kg/plot	Fruit yield q/ha
Organic manure						
M <sub>0</sub>	20.63	5.90	5.25	45.27	15.13	224.15
M <sub>1</sub>	25.23	6.33	5.62	55.00	19.98	296.05
M <sub>2</sub>	27.00	6.54	5.69	56.43	21.77	322.47
M <sub>3</sub>	24.87	6.51	5.50	52.37	19.22	284.69
M <sub>4</sub>	24.37	6.29	5.39	50.13	18.17	269.14
<b>CD<sub>0.05</sub> (M)</b>	<b>0.64</b>	<b>0.24</b>	<b>0.03</b>	<b>1.30</b>	<b>0.41</b>	<b>6.04</b>
Liquid Manure						
L <sub>0</sub>	23.09	6.25	5.36	49.25	17.51	259.34
L <sub>1</sub>	25.75	6.38	5.62	54.43	20.20	299.26
<b>CD<sub>0.05</sub> (L)</b>	<b>0.41</b>	<b>NS</b>	<b>0.02</b>	<b>0.82</b>	<b>0.26</b>	<b>3.82</b>

Interaction (M×L)						
M <sub>0</sub> L <sub>0</sub>	18.67	5.72	5.22	42.47	13.56	200.89
M <sub>0</sub> L <sub>1</sub>	22.60	6.08	5.29	48.07	16.70	247.41
M <sub>1</sub> L <sub>0</sub>	24.40	6.38	5.42	53.47	18.70	277.04
M <sub>1</sub> L <sub>1</sub>	26.07	6.28	5.83	56.53	21.27	315.06
M <sub>2</sub> L <sub>0</sub>	24.87	6.50	5.48	53.53	18.80	278.52
M <sub>2</sub> L <sub>1</sub>	29.13	6.57	5.89	59.33	24.73	366.42
M <sub>3</sub> L <sub>0</sub>	24.13	6.50	5.38	48.80	18.57	275.06
M <sub>3</sub> L <sub>1</sub>	25.60	6.53	5.62	55.93	19.87	294.32
M <sub>4</sub> L <sub>0</sub>	23.40	6.14	5.32	48.00	17.90	265.19
M <sub>4</sub> L <sub>1</sub>	25.33	6.43	5.45	52.27	18.43	273.09
<b>CD<sub>0.05</sub> (M×L)</b>	<b>0.91</b>	<b>NS</b>	<b>0.04</b>	<b>1.84</b>	<b>0.58</b>	<b>8.54</b>

**Table 2. Economics of the bell pepper production as affected by different treatments.**

Treatments	Fruit yield q/ha	Gross income (₹/ha)	Total cost of production (₹/ha)	Net return (₹/ha)	Benefit Cost Ratio
M <sub>0</sub> L <sub>0</sub>	200.89	502,225.00	94,030.00	408,195.00	4.34
M <sub>1</sub> L <sub>0</sub>	277.04	692,600.00	132,830.00	559,770.00	4.21
M <sub>2</sub> L <sub>0</sub>	278.52	696,300.00	200,130.00	496,170.00	2.48
M <sub>3</sub> L <sub>0</sub>	275.06	687,650.00	166,480.00	521,170.00	3.13
M <sub>4</sub> L <sub>0</sub>	265.19	662,975.00	149,655.00	513,320.00	3.43
M <sub>0</sub> L <sub>1</sub>	247.41	618,525.00	96,155.00	522,370.00	5.43
M <sub>1</sub> L <sub>1</sub>	315.06	787,650.00	134,955.00	652,695.00	4.84
M <sub>2</sub> L <sub>1</sub>	366.42	916,050.00	202,255.00	713,795.00	3.53
M <sub>3</sub> L <sub>1</sub>	294.32	735,800.00	168,605.00	567,195.00	3.36
M <sub>4</sub> L <sub>1</sub>	273.09	682,725.00	151,780.00	530,945.00	3.50

#### 4. CONCLUSION

From the present studies, it can be concluded that combined application of Vermicompost + Jeevamrut shown best result for most of the yield and yield contributing traits. It also resulted in highest gross income (₹ 916,050.00/ha) and net return (₹ 713,795.00/ha), whereas highest benefit cost ratio (5.43) was obtained from M<sub>0</sub>L<sub>1</sub> (No organic manure + Jeevamrut). Therefore, on the basis of results obtained in present studies, application of Jeevamrut (Drenching @ 5 % + Foliar spray @ 3 %) from economic point of view can be recommended for organic cultivation of bell pepper, as it resulted in getting maximum B: C ratio (5.43). On the other hand, application of vermicompost @ 7 t/ha along with Jeevamrut (Drenching @ 5 % + Foliar spray @ 3 %) should be recommended for getting higher yield & sustainable crop production point of view. Further, if the farmer produces vermicompost on farm, definitely it will reduce the cost of cultivation incurred for getting better yield and sustainable crop production & good economic return as well.

## 5. References

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