Original Research Article

Economic Analysis of Bell Pepper (*Capsicum annuum* L.) Production as Influenced by Different Organic Nutrient Sources under Mid Hill Condition of Himachal Pradesh

ABSTRACT

A field investigation was conducted during the Kharif of 2016 at the Department of Vegetable Science, UHF, Nauni, Solan to explore the economic analysis of bell pepper (*Capsicum annuum* L.) production as influenced by organic nutrient sources. The experiment was designed in Randomized Complete Block Design (RCBD) Factorial with three replications comprising 10 different treatments. The study indicated that vermicompost @ 7 t/ha + Jeevamrut (Drenching @ 5% + Foliar spray @ 3%) highly affected yield and yield attributing traits of bell pepper and documented higher fruit weight (59.33 g), no. of fruits/plant (29.13), fruit yield/plot (24.73 kg), and fruit yield/ha (366.42 q) along with the highest gross income (916,050.00/ha) and net return (713,795.00/ha) whereas the greatest B: C ratio (5.43) was attained with no organic manure + Jeevamrut (Drenching @ 5% + Foliar spray @ 3%). As a result, from an economic standpoint, Jeevamrut (Drenching @ 5% + Foliar spray @ 3%) application and Vermicompost @ 7 t/ha in combination with Jeevamrut (Drenching @ 5% + Foliar spray @ 3%) application for high yield may be suggested for commercial production.

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

1. INTRODUCTION

Bell pepper (*Capsicum annuum* L. var. grossum Sendt.) is an important member of Solanaceae family, having chromosome number 2n = 24, and recognized as sweet pepper, capsicum, and Shimla mirch. It is a Mexican native, with a secondary origin in Guatemala (Bukasov, 1930). It is the world's third most popular vegetable crop after tomatoes, having thick flesh and low-calorie content despite being rich in nutrients, especially vitamin A and vitamin C. (Raturi *et al*., 2019). Organic farming has the ability to ameliorate soil productivity, biodiversity, and economic return (Hameedi *et al*., 2018). Organic agriculture is gaining popularity, and organic food markets are fast developing in numerous nations, comprising India (Gopinath *et al*., 2011). Organic amendments might be used as a substitute for 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 chemical fertilizers can only provide one or two essential elements. Organic manure plays an important function in plant growth by providing all needed macro elements and microelements in conveniently accessible forms in the course of mineralization (Nweke *et al*., 2013), and soil physical and chemical qualities improve (Chaterjee e*t al*., 2005). Manures can therefore produce a high yield, a high gross revenue, and a high net return.

MATERIALS AND METHODS

The current investigation was carried out at the Vegetable Research Farm of the Department of Vegetable Science, UHF, Nauni, Solan, HP from April to September 2016. The experiment was conducted in a Randomized Complete Block Design (RCBD) Factorial with three replications including 10 treatment combinations of manure and liquid manure, namely; T_1 (M_0L_0): No organic manure + No liquid manure (Control), T_2 (M_1L_0): FYM @ 20 t/ha + No liquid manure, T_3 (M_2L_0) : Vermicompost @ 7 t/ha + No liquid manure, T_4 (M_3L_0): FYM @ 10 t/ha + VC 3.5 t/ha + No liquid manure, T_5 (M_4L_0): FYM @ 15 t/ha + VC 1.75 t/ha + No liquid manure, T_6 (M_0L_1) : No organic manure + Jeevamrut (Drenching + Foliar Spray), T_7 (M_1L_1): FYM @ 20 t/ha. + Jeevamrut (Drenching+ Foliar Spray), T_8 (M_2L_1): Vermicompost @ 7 t/ha. + Jeevamrut (Drenching + Foliar Spray), T_9 (M_3L_1): FYM @ 10 t/ha + VC 3.5 t/ha + Jeevamrut (Drenching + Foliar Spray), T_{10} (M_4L_1): FYM @ 15 t/ha + VC 1.75 t/ha + Jeevamrut (Drenching + Foliar Spray). On March 5, 2016, seeds of bell pepper cv. Solan Bharpur has been sown in nursery beds, and seedlings have been transplanted on April 26, 2016. The plot was 240 cm × 225 cm in size, with a spacing of 0.6 m X 0.45 m, and benefit: cost (BC) ratios were recorded. As indicated by, the data collected on different factors were examined for RBD design (Gomez and Gomez, 1984). The data were interpreted using the 'F' test value, and the crucial difference (CD) was determined at a 5% level of significance. Before planting, the soil was analyzed and found to be rich in organic matter having OC 1.38 per cent, neutral in reaction (pH 7.2), normal in EC (0.431dSm^{-1}) medium in available nitrogen (395.14 kg/ha) and potassium (263.2 kg/ha) and high in phosphorus (58.24 kg/ha).

2.1 Application of organics

Before transplanting of bell pepper seedlings, all FYM and Vermicompost were applied properly by blending them with soil as per treatment combination per plot, and liquid manure has been applied as 3 drenching with Jeevamrut @ 5% at 15 day intervals started at the time of transplanting + 2 Foliar Spray of Jeevamrut @ 3% at 15 day intervals started after 45 days of transplanting.

2.2 Disease and pest management

To inhibit the growth of soil pathogenic fungi, 5 kg of Trichoderma viride (powder formulation) was mixed with 100 kg of FYM and covered with polythene for 7 days. Before putting it in the field, the mixture was mixed every 3-4 days. On bell pepper plants, 2-3 cc of Verticillium lecanii (liquid formulation) was sprayed to suppress aphids.

2.3 Climate

The area's climate is mainly sub-temperate and semi-humid, with chilly winters. In general, the warmest months are May and June, while the coldest are December and January. The yearly rainfall fluctuates between 1000 and 1300 mm, the majority of which is falling at the time of monsoon season (June-September). The average temperature ranged from 21.5 to 24.4 degree Celsius, with relative humidity ranging from 41% to 83% during the crop season

2.4 Economics of treatments

.The economics of treatment are pivotal factors to examine before recommending it to a farmer. The cost of bell pepper production under different treatments was investigated in order to determine the economics of various organic nutrient sources while taking into account the current price of inputs and produce. The gross return was calculated using the market price of the produce. The following equations were used to calculate net returns and benefit-cost ratios for each nutritional treatment:

Net return (₹/ha) = Gross returns (₹/ha) - Cost of cultivation (₹/ha)

Benefit Cost ratio: = Net return (₹/ha) /Cost of cultivation (₹/ha)

3 Result and discussion

The attentive study of the data in Table 1 displayed that the organic and liquid manure fertilization had a significant impact on bell pepper yield and yield contributing traits individually as well as their combined effect. Among different levels of manure, vermicompost treated plots achieved significantly more fruits per plant (27.00), average fruit weight (56.43 g) ,fruit breadth (5.69 cm), fruit length (6.54 cm), fruit yield (21.77 kg/ plot), and fruit yield (322.47 q/ha), while no manure (M0) produced the least.

In comparison to no Jeevamrut (L0), Jeevamrut (L1) produced the highest number of fruits per plant (25.75), average fruit weight (54.43 g), fruit width (5.62 cm), fruit yield (20.20 kg/plot), and fruit yield (299.26 q/ha). The effect of Jeevamrut on fruit length (cm), as well as their combined effect with different organic manure levels, observed to be non-significant. The combined effect of both the factors revealed that M2L1 had the highest number of fruits (29.13/plant), average fruit weight (59.33 g), fruit width (5.89 cm) fruit yield (24.73 kg/ plot), and fruit yield (366.42 q/ha), whereas M0L0 had the lowest of all these characteristics.

Jeevamrut may have contributed to increased vegetative growth, the quantity of fruits per plant, increased nutrient distribution during the critical growth phase, and increased carbohydrate assimilation and translocation. It might be because of the use of vermicompost, which has a direct influence on plant development by providing a stable provenance of plant macro and microelements. However, some of these essential elements exist in readily available forms to the plants, the maximum of which are liberated gently and depositing minerals, resulting a proper supply of nutrients all the time to the plant by dynamic and consistent source of

essential elements.

It might also be attributable to improved soil physical, chemical, and biological qualities, as well as supplementation of macro and micro nutrients, as a result of the combined impact of vermicompost and Jeevamrut, which improved growth, yield, and yield contributing attributes. These findings are also corroborated by (Arancon et al., 2003 (Natesh et al., 2005), (Arancon et al., 2005), (Joshi and Pal Vig, 2010), (Kumar, 2016), (Ramesh et al., 2015), and (Ahmed et al., 2017). (2016). Huerta et al. (2010) found that Vermicompost had a favorable impact on pepper.

Economics of the treatment

The economics of the various treatment combinations depicted in Table 2. A keen study of data divulged that highest cost of production Rs. 202,255.00 was incurred in M_2L_1, whereas lowest (₹ 94,030.00) was observed in M_0L_0. Similarly maximum gross income per hectare amounting to ₹ 916,050.00 was obtained in M_2L_1 followed by M_1L_1 (₹ 787,650.00), while minimum gross income (₹ 502,225.00) was recorded in M_0L_0. This is due to the high cost of production and maximum marketable yield in M_2L_1 as compared to other treatmentsused in the study. However, highest net return (₹ 713,795.00) was recorded in M_2L_1 followed by M_1L_1 (₹ 652,695.00) and lowest net return (₹ 408,195.00) was observed in M_0L_0. In overall, maximum B: C ratio (5.43) was recorded in M_0L_1 followed by B: C ratio (4.84) in M_1L_1, whereas minimum B: C ratio (2.48) was calculated in M_2L_0, which may be due to the lower cost of production and comparable gross income in M_2L_1. Hence the application of M_0L_1 (No manure + Jeevamrut) rated as the most economic treatment for bell pepper production under mid hill conditions of Himachal Pradesh.

Table 1. Yield and yield contributing traits as influenced by different organic nutrient sources [9]

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_0	20.63	5.90	5.25	45.27	15.13	224.15
M_1	25.23	6.33	5.62	55.00	19.98	296.05
M_2	27.00	6.54	5.69	56.43	21.77	322.47
M_3	24.87	6.51	5.50	52.37	19.22	284.69
M_4	24.37	6.29	5.39	50.13	18.17	269.14
$CD_{0.05}$ (M)	**0.64**	**0.24**	**0.03**	**1.30**	**0.41**	**6.04**
Liquid Manure						
L_0	23.09	6.25	5.36	49.25	17.51	259.34
L_1	25.75	6.38	5.62	54.43	20.20	299.26
$CD_{0.05}$ (L)	**0.41**	**NS**	**0.02**	**0.82**	**0.26**	**3.82**

Interaction (M×L)						
M_0L_0	18.67	5.72	5.22	42.47	13.56	200.89
M_0L_1	22.60	6.08	5.29	48.07	16.70	247.41
M_1L_0	24.40	6.38	5.42	53.47	18.70	277.04
M_1L_1	26.07	6.28	5.83	56.53	21.27	315.06
M_2L_0	24.87	6.50	5.48	53.53	18.80	278.52
M_2L_1	29.13	6.57	5.89	59.33	24.73	366.42
M_3L_0	24.13	6.50	5.38	48.80	18.57	275.06
M_3L_1	25.60	6.53	5.62	55.93	19.87	294.32
M_4L_0	23.40	6.14	5.32	48.00	17.90	265.19
M_4L_1	25.33	6.43	5.45	52.27	18.43	273.09
$CD_{0.05}$ (M×L)	**0.91**	**NS**	**0.04**	**1.84**	**0.58**	**8.54**

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

Treatments	Fruit yield q/ha	Gross income (₹/ha)	Total cost of production (₹/ha)	Net return (₹/ha)	Benefit Cost Ratio
M_0L_0	200.89	502,225.00	94,030.00	408,195.00	4.34
M_1L_0	277.04	692,600.00	132,830.00	559,770.00	4.21
M_2L_0	278.52	696,300.00	200,130.00	496,170.00	2.48
M_3L_0	275.06	687,650.00	166,480.00	521,170.00	3.13
M_4L_0	265.19	662,975.00	149,655.00	513,320.00	3.43
M_0L_1	247.41	618,525.00	96,155.00	522,370.00	5.43
M_1L_1	315.06	787,650.00	134,955.00	652,695.00	4.84
M_2L_1	366.42	916,050.00	202,255.00	713,795.00	3.53
M_3L_1	294.32	735,800.00	168,605.00	567,195.00	3.36
M_4L_1	273.09	682,725.00	151,780.00	530,945.00	3.50

4 CONCLUSION

Based on the current research, it can be stated that the combination application of Vermicompost + Jeevamrut produced the greatest results for the majority of yield and yield contributing attributes. It also produced the greatest gross revenue (916,050.00/ha) and net return (713,795.00/ha), whereas M0L1 (No organic manure + Jeevamrut) produced the highest benefit cost ratio (5.43). As a consequence, based on the findings of the current research, the use of Jeevamrut (Drenching at 5% + Foliar spray at 3%), from an economic standpoint, may be suggested for organic bell pepper growing, as it resulted in the highest B: C ratio (5.43). In contrast, application of vermicompost at a rate of 7 t/ha in conjunction with Jeevamrut (Drenching at 5% + Foliar spray at 3%) is advised for increased yield and long-term crop production.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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