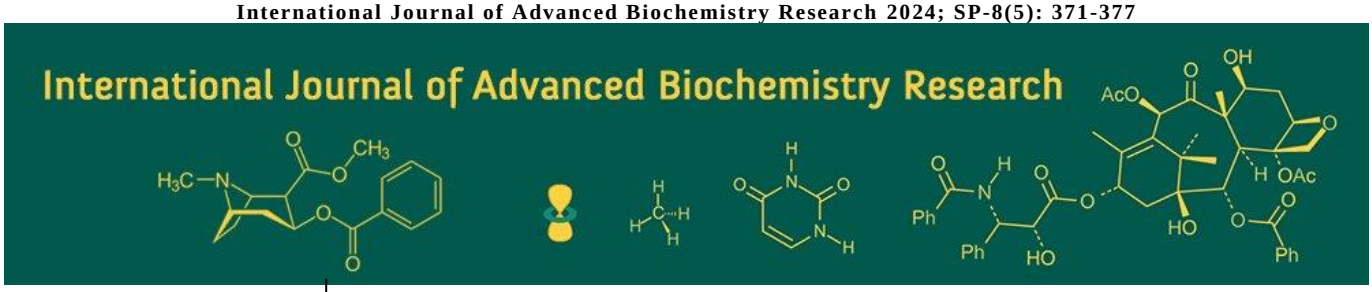

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; SP-8(5): 371-377
www.biochemjournal.com
Received: 09-02-2024
Accepted: 29-04-2024

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Differential responses of liquid and solid organic manures on the performance of capsicum (*Capsicum annuum* L.) under North Western Himalayan region

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DOI: https://doi.org/10.33545/26174693.2024.v8.i5Se.1237

Abstract
The present investigation was carried out at the Expeimental Research Farm, School of Agriculture, Abhilashi University, Mandi, (H.P.) during the summer season of 2023.The experiment was laid out in Randomized Block Design(RBD) with 7 treatment combinations. Among different organic manures, vermicompost and FYM performed best for most of the growth and yield contributing traits of capsicum. The results revealed that maximum plant height (74.84 cm), days to first flowering (32.54 days), number of branches (4.42) and number of leaves (55.02) were recorded under treatment T_2(Vermicompost (50%) + Farm Yard Manure (50%). Similarly treatment T_2 showed higher results on yield parameters like fruit length (8.07 cm), fruit diameter (6.72 cm), average fruit weight (97.24 g), number of fruits per plants (13.68), yield per plant (1.33 kg), yield per plot (11.98 kg), yield per hectare (269.48 q) and numbers of picking (4.42). This treatment was followed by treatment T_3(Poultry Manure 50% + Farm Yard Manure 50%) while minimum observations were recorded under treatment T_7 (Absolute control). Treatment T_2 recorded maximum soil pH (6.08), available potassium (230.20 kg/ha) and organic carbon (1.42%). While maximum available nitrogen (259.20 kg/ha) and phosphorous (26.51 were observed under treatment T_3 (Poultry Manure 50% + Farm Yard Manure 50%).The maximum B:C ratio of (3.78) was also found to be maximum under treatment T_2.

Keywords: Capsicum, manures, yield, economics and vermicompost

Introduction
Capsicum(*Capsicum annuum* L.) also known as sweet pepper or bell pepper is an important commercial vegetable crop belongs to family Solanaceaehaving chromosomeno.2n = 2x = 24 and is believed to be originated in South America (Shoemaker and Teskey, 1995) [30]. Capsicum is also famous with the name of Shimla mirch as itwas introduced to India by the British colonists in 19th centuryand the first successful large-scale good-quality cultivation was done in the Shimla hills area of Himachal Pradesh (Bijalwan *et al.* 2022) [5]. Capsicum belongs to a very narrow horticulture group (bell group) within *Capsicum annuum* L. It is characterized by large, blocky and blunt fruits having three or four lobes and thick wall. Fruit color is usually green or occasionally yellow or orange when immature and red when mature. It grows well in summer season in hilly area and in cooler season in plains. It's a self-pollinated crop with out-crossing to an extent of 62%. Insects like honey bees, ants, thrips are responsible for natural crossing. Therefore treated as an often cross pollinated crop (Soli *et al.* 2020) [32]. In India it is grown over an area of 37 thousand ha with a production of 0.563 M MT (Anonymous, 2021). It is an important cash vegetable crop of Himachal Pradesh which fetches good returns to the growers due to its off-season cultivation. The environmental conditions in the mid hills of Himachal Pradesh are very conducive for producing excellent quality fruits of capsicum.

With the increase in population, demand of food supply is also increasing rapidaly. Therefore, to fulfil the demands growers are making heavy use of chemical fertilizers and pesticides with out any consideration to soil and human health. Heavy use of chemical fertilizers, pesticides and fungicides causes health hazards and environmental pollution. Thus, sustainable agriculture is the answer to tackle various issues arising from excessive dependence on synthetic chemicals (Chauhan *et al.* 2023) [8].

Organic farming is not merely nonchemical agriculture, but is a system for integrating interactions between soil plant, water and soil micro-flora and fauna. Compared with conventional agriculture, organic farming uses fewer pesticides, reduces soil erosion, decreases nitrate leaching into groundwater and surface water, and recycles animal wastes back into the farm. Organic farming keeps soil healthy by improving biological life therein and helps sustain yields (Lampkin, 1990) [19]. It is based mainly on principles of restoration of soil organic matter in the form of humus and increasing microbial population (Pathak and Ram, 2020) [23]. Farmyard manure is a term used to describe a degraded mixture of animal excrement, urine, litter and byproducts from roughages or fodder fed to cattle. Average amounts of well-decomposed farmyard manure contain 0.5% N, 0.2% P_2O_5 and 0.5% K_2O. It enhances soil structure and is utilised in farming as a natural fertilizer. It boosts the soil's ability to store more nutrients and water. It improves the soil's mineral supply and plant nutrients, also boosts its microbial activity.

Vermicompost is the product of the decomposition process using various species of worms, usually red wigglers, white worms and other earthworms, to create a mixture of decomposing vegetable or food waste, bedding materials, and vermicast. (Sahni *et al.* 2008) [27]. Vermicompost helps in improving soil texture, aeration and increases water retention capacity. While poultry manure is the feces of chickens used as an organic fertilizer, especially for soil low in nitrogen. Poultry manure itself is a valuable source of organic fertilizer for plant nutrients as it contains high content of essential macro and micro-nutrients (Warman, 1986 [34], Dikinya and Mufwanzala, 2010) [21] but improper management and over application are responsible for ammonia volatilization, higher nitrogen mineralization.

Jeevamruth, panchgavya and cow urine can be used as ogranic fertilizers as they are great replacement of chemical fertilizers. These are the good source of biomass, natural carbon, nutrients like nitrogen, phosphorous potassium, calcium and other nutrients which are essential for plant growthand development. Jeevamruth and panchgavya enhances the microbial activity in the soil and also helps in improvement of soil fertility (Chauhan *et al.* 2023) [8]. Where as cow urine has got anti-fungal properties and being used in crop production since ages (Devakumar *et al.* 2008) [10]. Capsicum being a high-value crop, is subjected to indiscriminate use of fertilizers and pesticides for getting higher yields. But information on organic cultivation of capsicum as of now is rather scanty. Therefore, the present study was carried out to asses the response of capsicum to organic sources of nutrients in relation to growth, yield and biological status of the soil.

Materials and Methods

The current investigation was carried out at the Experimental Research Farm, School of Agriculture, Abhilashi University, Mandi, (H.P.) during the summer season of 2023. The experimental site is located at 31º N latitude and 77ºE longitude with the elevation of 1,416 m above mean sea level.

Table 1: Experimental details

Notation	Treatments
T_1	Farm Yard Manure (100%)
T_2	Vermicompost (50%) + Farm Yard Manure (50%)
T_3	Poultry Manure (50%) + Farm Yard Manure (50%)
T_4	Jeevamrutha (50%) + Cow Urine spray (50%)
T_5	Panchgavya (50%) + Jeevamrutha (50%)
T_6	Cow Urine Spray (100%)
T_7	Absolute control

Note: Application of FYM, vermicompost and poultry manure were done before transplanting while jeevamrutha, panchgavya and cow urine spray were applied at 20, 35 and 45-days intervals.

Experimental details and layout:

Design	: Randomized Complete Block Design (RCBD)
Replication (s)	: 3
No of treatments	: 7
Number of experimental plots	: 21
Variety	: Ganga (F_1 hybrid)
Plot size	: 2 m × 2 m
Spacing	: 45 cm × 45 cm
Date of Nursery sowing	: 23rd March, 2023
Date of transplaning	: 28th April, 2023

Growth parameters

Plant height (cm)

Plant height of five randomly selected plants were measured at harvest from base to the highest tip of the plant and the average mean height was calculated in centimeters.

Days to first flowering

The plants were observed daily after transplanting to record the appearance of first flower. Total number of days from transplanting to the date when first flower emerged were counted and subjected to statistical analysis.

Number of branches per plants

The lateral branches arising from the main stems of five randomly selected plants were counted and average was calculated as mean.

Number of leaves per plant

Five random plants were selected from the plots and the number of leaves were counted. Further average was calculated as mean.

Yield parameters

Fruit length (cm)

Mature fruits were selected and used for measuring the length of individual fruit. Fruit length was measured using scale. The mean was calculated and expressed in centimeters.

Fruit diameter (cm)
After recording the length, same fruits were used for measuring the diameter. Fruit diameter was measured using vernier calipers. The mean was calculated and expressed in centimeters.

Average weight of fruits (g)
After harvesting of fruits from selected five plants, individual weight of fruit using the digital balance was recorded and the average weight was calculated.

Number of fruits per plant
The total number of fruits harvested in every pickings were summed up and average value per plant was worked out.

Fruit yield per plant (kg)
Fruit produced from each plant was picked separately and the yield from various treatments were reported. The average yield of fruits per plant was calculated.

Fruit yield per plot (kg)
The total weight of harvested fruits of all the pickings were considered and the average yield per plant was calculated. From this value the total fruit yield per plot was worked out and values were expressed in kilogram.

Fruit yield per hectare (q)
On the basis of yield obtained from each plot in kilogram, yield per hectare was calculated in quintals. The yield per plot (kg) was transformed into yield per hectare (q) by multiplying the suitable factor.

Soil analysis
Soil samples from 0-15 cm depth were collected from all the plots separately and were air dried, crushed, passed through 2 mm sieve and then soil testing was done for chemical parameters like soil pH, available NPK and organic carbon concentration.

Table 2: Initial chemical parameters of the experimental soil

S No.	Parameters	Values obtained	Methods used
1.	Soil pH (1:2.5 soil: water)	5.8	Glass electrode method (Jackson,1973) [15]
2.	Available Nitrogen(kg/ha)	205	Alkaline potassium permanganate (Subbiahand Asija, 1956) [31].
3.	Available Phosphorous (kg/ha)	20	Olsen's method of extraction with 0.5 1NaHCO3 at pH8.5 (Olsen etal.1954) [22]
4.	Available Potassium (kg/ha)	185	Neutral ammonium acetate extraction method (Merwin and Peech 1950) [20].
5.	Organic carbon (%)	0.52	Rapid titration method (Walkley and Black 1934) [33].

Economics
The cost of cultivation of each treatment was calculated per hectare on the basis of prevailing rates of labour, organic manures, irrigation and other expenditure. The total income per hectare was calculated as per the average wholesale price of capsicum in the market. The net profit per hectare was obtained by deducting the cost from treatments.

Cost of cultivation (₹/ha)
By presuming the item-wise input cost based on the local market rate, the cost of cultivation per hectare of land was worked out and were computed treatment-wise also.

Gross returns (₹/ha): From the total yield of each treatment plot, the gross monetary return was worked out based on the average selling price of the product and it was recorded accordingly in ₹/ha.

Gross returns (₹/ha) = Market price × yield/ ha

Net returns (₹/ha)
The most crucial factor to consider before recommending any remedies to farmers for wide spread use is their economic viability. The average treatment yield and current market rates for inputs and output were utilized to determine the therapy's economics. The cost of cultivation for each treatment was deducted from the gross return from the economic yield to determine the net return. Net returns (₹/ha) are calculated as follows:

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

Benefit cost ratio (B:C ratio)
Benefit cost ratiowere worked out for each nutrient treatment by adopting the following formula:

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

Results and Discussion
Growth parameters
Among all the treatments, maximum plant height (74.84 cm) was recorded in treatment T_2 (Vermicompost 50% + Farm Yard Manure 50%) which was statistically at par with the treatment T_3 (Poultry Manure (50%) + Farm Yard Manure (50%). While the minimum plant height (60.52 cm) was observed in T_7 (Absolute control) (Table 3).Increase in plant height might be due to the fact that vermicompost, poultry manure and farm yard manure supplying additional amount of nutrients and also improve the physical, chemical and biological properties of soil and this leads to improvement in the root growth and development, thereby uptake of nutrients and water resulting in to better plant growth. The results of present investigation in terms of vegetative growth are also in concordance with the findings reported by Reddy *et al*. (2017) [26] and Raghunauth *et al.* (2023) [24].
The days to first flower apperance varied from 32 days to 44 days. The minimum days (32.54) for appearance of first flowering was recorded in treatment T_2 which was followed by treatment T_3i.e. (35.67) where as the maximum days for flower apperance was recorded in T_7 (Absolute control) (Table 3). The possible reason for earliness in flowering reported with the application of Vermicompost (50%) + Farm Yard Manure (50%) might be due to the use of these organic manures which are rich in beneficial microorganisms that enhance nutrient cycling and there availability. These microorganisms have the ability to produce growth-promoting substances, such as phytohormones (e.g. auxins, gibberellins) which can encourage early flowering. The results of present investigation in terms of days to first flowering are also in

concordance with the findings reported by Bagale *et al.* (2014) [4] and Raturi *et al.* (2019) [25].

Significantly maximum number of branches per plant (4.42) was recorded with the application of treatment T_2 (Vermicompost 50% + Farm Yard Manure 50%) which was statistically at par with the treatment T_3 (Poultry Manure (50%) + Farm Yard Manure (50%). While the minimum number of branches per plant (2.45) was observed in T_7 (Absolute control). (Table 3). The enhancement of vegetative growth like number of branches is might be due to the fact that all these organic manures improves the soil fertility, structure and microbial activity, as well as providing essential nutrients and growth promoting substances. These improvements create a favouravle environment for plant growth, leading to more vigorous vegetative growth and development of new branches. Similar results were observed by Raghunauth *et al.* (2023) [24].

Maximum number of leaves per plant (55.02) were recorded with tha application of treatment T_2 (Vermicompost 50% + Farm Yard Manure 50%) which was followed by the treatment T_3 (Poultry Manure (50%) + Farm Yard Manure (50%) i.e (52.11) and treatment T_1 (Farm Yard Manure (100%) i.e. (50.46). While treatment T_7 (Absolute control) recorded minimum number of leaves (41.03). (Table 3).This might be due to application of FYM and vermicompost which had supplied an acceptable amount of nitrogen which is associated with the high rate of photosynthesis and vigorous vegetative development. While minimum number of leaves in absolute control might be due to the absence of required nutrients for vegetative growth. Similar results were observed by Kishor Singh *et al.* (2014) [18], Bagale *et al.* (2014) [4] and Jamir *et al.* (2017) [16].

Yield parameters

The data revealed that treatment T_2 (Vermicompost 50% + Farm Yard Manure 50%) shows significant increase in fruit length (8.07 cm) fruit diameter (6.72 cm) average fruit weight (97.24 g) and number of fruits per plant (13.68) which is statistically at par with treatment T_3 (Poultry Manure (50%) + Farm Yard Manure (50%) i.e. (7.65 cm), (5.94 cm), (93.36 g) and (12.18) respectively. Whereas the minimum values were obtained under T_7 (Absolute control). (Table 4). This result was might be due to the use of organic amendments which are rich in essential nutrients such as nitrogen, phosphorus and specially potassium. Potassium enhances the physiological and metabolic processes that contribute to the development of longer and wider fruits with maximum fruit weight and more numbers of capsicum fruit production. By supporting cell division and enlargement, ensuring efficient photosynthesis and nutrient transport, potassium plays an important role in optimizing the growth conditions necessary for producing healthier fruits. Similar results were reported by Jamir *et al.* (2017) [16], Altaf *et al.* (2019) [2], Reddy *et al.* (2017) [26], and Salma *et al.* (2020) [28].

Similarly**,** Treatment T_2 (Vermicompost 50% + Farm Yard Manure 50%) resulted inhigher yield per plant (1.33 kg), yield per plot(11.98 kg) and yield per hectare (269.48 q/ha) which was followed by treatment T_3 (Poultry Manure 50% + Farm Yard Manure 50%) i.e. (1.13 kg), (10.21 kg) and (229.70 q/ha) respectively. However, the lowest yield was obtained in those plants which were grown without any nutrient supply i.e. T_7 (Absolute control). (Table 5). Increase in yield by the application of T_2, was might be due to adequate supply of nutrients from vermicompost and FYM which probably favoured the production of maximum fruits with optimum size and led to higher yield per plant, per plot and per hectare. Similar are the findings observed by Adhikari *et al.* (2016) [1], Jamir *et al.* (2017) [16], Khurshid *et al.* (2019) [17], Hameedi *et al.* (2022) [13] and Raghunauth *et al.*(2023) [24].

Soil parameters

Higher soil pH (6.08) was recorded under treatment T_2 (Vermicompost 50% + Farm Yard Manure 50%) and treatment T_3 (Poultry Manure 50% + Farm Yard Manure 50%) whereas the lower soil pH (5.80) was recorded under treatment T_7 (Absolute control). (Table 6). The treatment remains non-significant.

The higher content of available nitrogen (259.20 kg/ha) was observed under the treatment T_3 (Poultry Manure 50% + Farm Yard Manure 50%) which was followed by treatment T_2 (Vermicompost 50% + Farm Yard Manure 50%). Whereas the lower content of available nitrogen (203.50 kg/ha) was found under treatment T_7 (absolute control). (Table 6). This increase in the rate of nitrogen in soil with the application of poultry manure and fym might be due to high amount of uric acid and urea substances present in poultry manure, which readily release NH_4 ±N. Similar are the findings of Das *et al.* (2012) [9] and Sharma *et al.*(2020) [29].

The higher avaialability of phosphorous content (26.51 kg/ha) was observed under treatment T_3 (Poultry manure 50% + Farm Yard Manure 50%). While the lower avaialability (20.10 kg/ha) was found in treatment T_7 (Absolute control). (Table 6). The increase in availability of phosphorus in soil might be due to the combine effect of poultry manure and farm yard manure. As poultry manure contain higher nitrogen and phosphorous compared to other bulky manures, which means that poultry manure is sufficient to increase the avalability of phosphorous. These results are in accordance with Sharma *et al.* (2020) [29] and Salma *et al.* (2022) [28].

Treatment T_2 (Vermicompost 50% + Farm Yard Manure 50%) shows better avalabitily (233.20 kg/ha) of potassium in the soil after harvest, followed by treatment T_3 (Poultry manure 50% + Farm Yard Manure 50%). While the minimum available K (185.20 kg/ha) was recorded from T_1(Absolute Control) treatment. (Table 6). One possible explanation for the elevated potassium level could be the use of organic manure, like vermicompost. During vermicompost preparation earthworm's digestive tracts have the ability to enhance the release of K in vermicompost, making it an abundant source of potassium. This influence could have resulted in overall increase of potassium in soil also. Similar results were observed earlier by Jamir *et al.* (2017) [16] and Sharma *et al.* (2020) [29].

Treatment T_2recorded significantly higher content of organic carbon (1.09%) in soil. Whereas the lower content of organic carbon (0.52%) was found under treatment T_7 (Absolute control). The overall statsu shows that soil were mediaum to high in organic carbon concentration. (Table 6). A rise in the amount of organic carbon might be due to the addition of vermicompost and FYM as these are rich in organic matter, which directly contributes to the soil organic pool. They contain partially decomposed plant and animal residues that are high in carbon content. Similar results were

observerd by Chatterjee *et al.* (2016) [6] and Jamir *et al.* (2017) [16].

Economics

An introspection of data shows that highest cost of cultivation, maximum gross return per hectare, highest net return and maximum B:C ratioi.e.₹1,12,554, ₹ 5,38,955, ₹ 4,26,401 and 3.78 respectively was incurred in treatment T_2 (Vermicompost 50% + Farm Yard Manure 50%) followed by treatment T_1 (Farm Yard Manure 100%). i.e.₹1,11,304 and T_3 (Poultry Manure (50%) + Farm Yard Manure (50%) i.e. ₹98,554 whereas lowest was observed in treatment T_7(Absolute control) i.e. ₹ 71,354, ₹ 2,42,942, ₹ 1,71,588 and (2.48:1) respectively. (Table 6). Similar are the findings of Altaf *et al.* (2019) [2], Raturi *et al.* (2019) [25] and Hameedi *et al.* (2022) [13].

Table 3: Effect of liquid and solid organic manures on plant height (cm), days to first flowering, number of branches per plant and number of leaves per plant

Treatments	Plant height (cm)	Days to first flowering	Number of branches per plant	Number of leaves per plant
Farm Yard Manure (100%)	68.39	36.25	3.81	50.46
Vermicompost (50%) + Farm Yard Manure (50%)	74.84	32.54	4.42	55.02
Poultry Manure (50%) + Farm Yard Manure (50%)	71.48	35.67	4.12	53.02
Jeevamrutha (50%) + Cow Urine spray (50%)	65.42	40.44	3.72	44.21
Panchgavya (50%) + Jeevamrutha (50%)	66.28	38.32	3.77	48.51
Cow Urine Spray (100%)	62.94	41.21	3.52	42.63
Absolute control	60.52	43.64	2.45	41.03
S.Em (±)	1.36	0.71	0.16	0.67
$CD_{(0.05)}$	4.25	2.22	0.51	2.10

Table 4: Effect of liquid and solid organic manures on fruit length (cm), fruit diameter (cm), Average fruit weight (g) and number of fruits per plant

Treatments	Fruit length (cm)	Fruit diameter (cm)	Average fruit weight (g)	Number of fruits per plant
Farm Yard Manure (100%)	7.39	5.57	83.77	12.06
Vermicompost (50%) + Farm Yard Manure (50%)	8.07	6.72	97.24	13.68
Poultry Manure (50%) + Farm Yard Manure (50%)	7.65	5.94	93.36	12.18
Jeevamrutha (50%) + Cow Urine spray (50%)	6.88	4.92	76.59	9.54
Panchgavya (50%) + Jeevamrutha (50%)	7.20	5.42	78.41	10.58
Cow Urine Spray (100%)	6.37	4.77	68.59	9.03
Absolute control	5.57	3.74	66.72	8.98
S.Em (±)	0.14	0.33	1.27	0.43
$CD_{(0.05)}$	0.45	1.01	3.91	1.35

Table 5: Effect of liquid and solid organic manures on yield per plant (kg), yield per plot (kg) and yield per hectare (q)

Treatments	Yield per plant (kg)	Yield per plot (kg)	Yield per hectare (q)
Farm Yard Manure (100%)	1.01	9.12	205.11
Vermicompost (50%) + Farm Yard Manure (50%)	1.33	11.98	269.48
Poultry Manure (50%) + Farm Yard Manure (50%)	1.13	10.21	229.70
Jeevamrutha (50%) + Cow Urine spray (50%)	0.73	6.57	147.76
Panchgavya (50%) + Jeevamrutha (50%)	0.83	7.49	168.57
Cow Urine Spray (100%)	0.62	5.58	125.64
Absolute control	0.60	5.40	121.47
S.Em (±)	0.04	0.37	8.53
$CD_{(0.05)}$	0.13	1.16	26.29

Table 6: Effect of liquid and solid organic manures on soil pH, available nitrogen (kg/ha) available phosphorous (kg/ha), available potassium (kg/ha) and organic carbon (%)

Treatments	Soil pH	Available nitrogen (kg/ha)	Available phosphorous (kg/ha)	Available potassium (kg/ha)	Organic carbon (%)
Farm Yard Manure (100%)	6.0	250.25	24.02	220.42	0.80
Vermicompost (50%) + Farm Yard Manure (50%)	6.1	252.68	24.22	233.20	1.09
Poultry Manure (50%) + Farm Yard Manure (50%)	6.1	259.20	26.51	227.14	0.92
Jeevamrutha (50%) + Cow Urine spray (50%)	5.9	236.40	22.16	199.48	0.71
Panchgavya (50%) + Jeevamrutha (50%)	6.0	240.41	23.20	210.14	0.75
Cow Urine Spray (100%)	5.9	200.30	20.52	192.22	0.69
Absolute control	5.8	203.50	20.10	185.20	0.52
S.Em (±)	0.09	1.51	0.34	1.93	0.01
CD (0.05)	NS	4.67	1.06	5.96	0.04

Table 7: Effect of liquid and solid organic manures on cost of cultivation (₹/ha), gross return (₹/ha), net return (₹/ha) and benefit: cost ratio

Treatments	Cost of cultivation (₹/ha)	Gross returns (₹/ha)	Net returns (₹/ha)	Benefit: Cost ratio
Farm Yard Manure (100%)	1,11,304	4,10,225	2,98,921	2.68:1
Vermicompost (50%) + Farm Yard Manure (50%)	1,12,554	5,38,955	4,26,401	3.78:1
Poultry Manure (50%) + Farm Yard Manure (50%)	98,554	4,59,406	3,60,852	3.66:1
Jeevamrutha (50%) + Cow Urine spray (50%)	76,567	2,95,515	2,18,948	2.85:1
Panchgavya (50%) + Jeevamrutha (50%)	79,627	3,37,149	2,57,522	3.23:1
Cow Urine Spray (100%)	75,569	2,51,277	1,75,708	2.32:1
Absolute control	71,354	2,42,942	1,71,588	2.40:1

Conclusion

From the present studies it can be concluded that among all the treatments, vermicompost and FYM performed best for most of the growth, yield and yield contributing traits. It also resulted in maximum gross return and net return with highest benefit cost ratio. Additionally, if the farmer produces FYM and vermicompost on the same land, it will undoubtedly lower cultivation costs necessary to achieve higher yields, sustainable crop production, and a positive financial return. So, it may be recommended for the commercialization after verification of results by way of conducting the farm trial across the capsicum growing areas of Himachal Pradesh, India.

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