Biological Forum – An International Journal **15(11): 355-360(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Effect of Different Sources of Organic Manures on Growth and Yield of Chilli

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(Received: 07 September 2023; Revised: 07 October 2023; Accepted: 18 October 2023; Published: 15 November 2023)
(Published by Research Trend)

ABSTRACT: A randomized design was used to test different organic manures treatments affected the growth and yield of Kashi Anmol variety in the field seven treatments were applied, T1- 100% Recommended dose of fertilizer (RDF), T2- 100% FYM T3- 100% GM, T4-100% VC, T5- 50% VC+ 50% FYM, T6-50% GM+ 50% FYM, T7-33.3% GM+33.3% FYM+ 33.3% VC. The results demonstrated that treatment T5 exhibited the highest growth and yield, and T2 showed significantly higher economic profits compared to the other treatments, with T5 achieving a gross monetary return of 5,50,050 ha^{-1} and T5 achieving a higher net income of 3,87,200 ha^{-1}. The benefit-cost ratio was highest at 3.77 with T2. The findings suggested that organic manures, involving the combined application of vermicompost, and FYM, can effectively enhance the productivity of chilli. Considering the cost-benefit ratio, it is recommended to use FYM 100% at a rate of 25 tons per hectare to maximize farmer profits. This combination can provide a balance between yield improvement and cost-effectiveness, ensuring sustainable and profitable cultivation of chilli. Balancing and optimizing various organic manure sources to enhance chili growth and yield poses a complex challenge in this research.

Keywords: Kashi Anmol, organic manure, chilli, economic, eastern Uttar Pradesh.

INTRODUCTION

Chilli (*Capsicum annuum* L.) belongs to the family Solanaceae having chromosome number 2n= 24. It is an annual herb, profusely branching bushy plant. The nutritive value of chilli is outstanding. It is a rich source of vitamin C and E. It is not only used as food additive but also have medicinal benefits such as saliva stimulation, proper digestion and better blood circulation (Knapp *et al.*, 2004; Hunziker, 2001). A byproduct named capsaicin extracted from ripe dried fruits is used in pharmaceutical preparations and medicines related to cardiac diseases (Baenas *et al.* 2019). The primary centre of origin of chilli is said to be Mexico with secondary centre in Guatemala and Bulgaria (Salvador *et al.*, 2002). India is one of the largest producer, consumer and exporter of chilli in the world, because of favourable soil and climatic conditions prevailing for Chilli production (Anonymous 2022). India accounting for 13.76 million tonnes of production annually followed by China with a production of around 3 million tonnes. Out of the total (37.62 million tonnes) world chilli production, 36.57 percent is contributed by India. The major chilli growing states are Maharashtra, Andhra Pradesh, Karnataka, Orissa, Tamil Nadu, Madhya Pradesh, West Bengal and Rajasthan (Rao and Rao 2014). Now a day the farming totally depends on use of chemical fertilizers, pesticides and growth regulators for enhancing their crop productivity. This ultimately led to high cost of production, low net returns, heavy debts and finally into a crisis situation and pesticide residues being left in the environment polluting air, water and soil. Hence it is necessary to overcome this problem. The organic (biological/ecological) approach is one of the alternatives to conventional production system currently being advocated (Subbarao and Ravishankar 2001). The sustainable production at higher levels is possible only by the proper use of inputs which will help to increase the organic matter content of soils, thus reducing the bulk density and decreasing compaction. Various organic manures like farm yard manure, vermicompost, green manure etc., are added to the soil from time to time further added to the store of organic matter (Palaniappan and Annadurai 2018). Keeping the points in view the research was carried out to study the effect of various organic manures on growth and yield of chilli and economic analysis was also done.

MATERIALS AND METHODS

The experiment was carried at the Horticulture Research Farm, Department of Horticulture, Faculty of Agriculture and Natural Sciences, Deen Dayal Upadhyay Gorakhpur University, Gorakhpur and situated within latitude 26*46`N and longitude 83*2` E.

with an altitude of 75 meters above the mean sea level during *Rabi*, 2022-23. Soil of the experimental site was sandy loam with ph. of 6.6, EC (0.11dsm/m), Organic carbon (0.24 %), N (54 kg/ha), P (13.5 kg), K (148.5 kg/ha). The experiment was laid out on Randomize block design with seven treatment including control which is replicated thrice. The variety kashi Anmol was used for the observation. The size of each plot was 3 × 3.15 m with the spacing of 60 × 45 cm counting 24 plants per plot. The gap between the plots was 50 cm and between the replications was 1 m. Total of seven treatments were their including the untreated control which were T1: RDF 150:60:60 (N: P: K), T2: 100 % FYM (25ton/ha), T3: 100% Goat manure (5 ton/ha), T4: 100% Vermi compost (6 ton/ha), T6: 50% Vermi compost + 50% FYM, 50% Goat manure + 50% FYM, 33.3% Goat manure + 33.3% FYM + 33.3% vermicompost selected for the investigation. RDF applied in all the plots and the T1 plot with only RDF is considered as the untreated control plot. The data were taken from randomly selected five plants from each plot on various characters *viz*., plant height(cm), number of primary branches, days of 50% flowering, fruit length (cm), fruit width (cm), number of seeds per fruit, seed yield (q/ha), total fruit yield per hectare (q/ha), leaf area, plant biomass, B:C ratio. All the data analysis was carried out as per described by Gomez and Gomez (1984).

RESULT AND DISCUSSION

A. Growth parameters

Plant height (cm). As observe in Table 1, the effect of different treatment was found significant for plant height at 60, 90 and at harvest. At 30 days after transplanting the data was found non-significant. At 60 days the maximum plant height was observed with the application of 50% VC + 50%FYM (50.93 cm) which was significantly at par with 100% GM (49.57 cm) followed by 33.3% GM + 33.3% FYM +33.3%VC (48.80). The lowest plant height was observed in 100% FYM. At 90 days the maximum plant height was observed with the application of 50% VC + 50% FYM (68.45 cm) which was significantly at par with control (66.83 cm), 33.3% GM +33.3% FYM +33.3%VC (66.53 cm), followed by GM (65.63 cm). The lowest plant height was observed in 100% FYM. At harvest the maximum plant height was observed with the application of 50% VC +50% FYM (88.76 cm) which was significantly followed by GM and control, the lowest plant height was observed in 100% FYM. The results are in line with Atiyeh *et al.* (2002); Ankaram (2013) who reported that application of pig manure vermicompost enhanced the overall growth of tomato plant as compared to other manure. Thus, vermicompost provides better environment in the rhizosphere for the growth and extension of root. The higher nutrient absorption more will be the plant height (Nehra *et al*., 2001).

Primary branches. The effect of different treatment was found significant for number of branches per plant. The maximum number of primary branches per plant was observed with the application of 50% VC + 50% FYM (5.42) which was followed by 33.3% GM + 33.3% FYM + 33.3% VC (5.21), 100% GM (5.12) and the lowest primary branches was observed in 100% FYM (Table 2). Comparatively similar results were obtained by Singh *et al.* (2014); Dhanalakshmi *et al.* (2014) who described that application of vermicompost on okra and chilli crop responded maximum number of branches plant^{-1}.

Leaf area. The effect of different treatment was found significant for leaf area per plant. The maximum leaf area was observed with the application of 50% VC +50% FYM (5.42 cm^2) which was significantly at par with 33.3% GM +33.3% FYM +33.3% VC, followed by control (4.46 cm^2) and the lowest leaf area was observed in 100% FYM (Table 2). The application of vermicompost this might be due to vermicompost contains significant quantities of water-soluble nutrients which are readily available to the crop during active growth periods. A large beneficial microbial population like, bacteria, Protozoa, nematodes, fungi, actinomycetes are present in Vermicompost. In terms of plant growth and soil health, vermicompost plays an important role in improving soil texture, aeration, soil compaction and thus enhances more water and nutrients uptake by plants from their surrounding areas of root zone. As regard to the direct effect on plant growth, vermicompost constitutes a source of plant macro- and micronutrients. Although some of these nutrients are present in inorganic form and are available to plants, most of them are released gradually through mineralization of organic matter, thus constituting slow-release fertilizer that supplies the plant with a gradual and constant source of nutrients (Chaoui *et al.*, 2003).

Plant Biomass. Highest weight of shoot in 50% VC +50% FYM (628.91 g) which was significantly followed by 33.3% GM+33.3% FYM+33.3% VC (583.33 g), 100% GM (577.21 g), Control (553.86 g). The minimum shoot weight present in 100% VC (505.3 g). Highest root weight present in 50% VC + 50% FYM (83.25 g), which was significantly followed by Control (77.33 g), 100% GM (69.72 g), 33.3% GM+33.3% FYM+33.3% VC (68.18 g) minimum value present in 100% FYM (54.32 g) Table 2. Vermicompost significantly increased shoot biomass by 78% and root biomass by 57%. These values are higher than the increases in plant biomass following the addition of earthworms (respectively 23% and 20% for shoot and root biomass values) found in another meta-analysis (Van Groenigen *et al.*, 2014).

B. Yield Parameters

Days of 50% flowering. The maximum number of 50% flowering per plant was observed with the application of 50% VC + 50% FYM (102.39) which was significantly at par with 100% GM (104.13), Control 150:60:60 NPK (105.65), followed by 50% GM+50% FYM (112.73), 33.3% GM+33.3% FYM +33.3%VC (107.98) (Table 3). The lowest 50% flowering was observed in 100% VC (116.00). The results are in line with (Adhikari *et al*., 2016). Days to first flowering may also be reduced because of vermicompost followed by poultry manures application,

which might be due to further decomposition of vermicompost that resulted in an increase temperature and potassium concentration in the root zone. While inorganic fertilizers delayed flowering. Our results are in agreement with Turemis (2002); Abu-Zahra (2012) who reported that days to first flowering reduced with application of organic manures due to increase in temperature in the rhizosphere.

Fruit length (cm) and Fruit width (cm). Highest fruit length was observed with the application of 50% VC +50% FYM (6.51 cm) which was significantly followed by 33.3% GM + 33.3 FYM + 33.3% VC (6.25 cm), control (5.84 cm). The lowest fruit length in 100% FYM (4.57 cm). Highest fruit width was observed with the application of 50%VC +50%FYM (1.21 cm) which was significantly at par with 33.3% GM + 33.3% FYM + 33.3% VC (1.18 cm), followed by Control (1.13 cm) 100% GM (1.14 cm). The lowest fruit width in 100% FYM (0.86 cm) (Table 3).

The increase in fruit length is possibly due to application of vermicompost that releases essential macro major nutrients such as nitrogen, phosphorous and potassium that was readily available to the plant. Ample and efficient supply of readily available nutrients from the rhizosphere relatively lesser holding in the roots and more transformation to the above ground parts for protoplasmic protein and synthesis of plant growth related compounds. Vermicompost could also encourage beneficial microbial population that helped in the production of growth promoting substances and provided favourable micro climate for maximum growth and yield. Our findings are in line with Theunissen *et al.* (2010); Jaipaul *et al.* (2011).

Number of seeds per fruit and Seed yield (kg/ha)

The maximum number of seeds per fruit was observed with the application of 50% VC+50% FYM (70.65) which was significantly at par with 100% VC (67.52), 50% GM + 50% FYM (66.98) followed by control (65.093), 33.3% GM + 33.3%FYM + 33.3% VC (64.73). The lowest number of seeds per fruit observed in 100% FYM (55.12). The maximum seed yield was observed with the application of 50%VC+50% FYM (719.39) which was significantly followed by Control (703.24) 100% FYM (689.15), 100% VC (682.77). The lowest seed yield observed in 100% FYM (55.12), Table 3. The increased seed yield was obtained in biofertilizers application (Azo spirillum and P-solubilizing bacteria) could be attributed to the growth hormones like AA and cytokinin produced by Azo spirillum which stimulated root morphology. This in return, would have improved assimilation of nutrients and thus seed yield. increase in seed yield and its components may be attributed due to increase in seed weight per fruit as a result of improvement in seed number due to adequate plant nutrition. On the other hand, treatment next to control, FYM without biofertilizers recorded lower yield and yield attributing characters as compare to other treatments. This might due to low nutrient supply than that was needed by crop through treatment results were also reported by Suthar *et al*. (2005) in brinjal, Raj *et al*. (2001) in brinjal, Thamizh and Nanjan (1998) in potato.

Total fruit yield (q/ha). The highest fruit yield was observed with the application of 50% VC + 50% FYM (204.227) which was significantly at par with control (202.073) followed by 100% GM (194.75), 33.3% GM +33.3% FYM + 33.3%VC (192.25), 50% GM + 50% FYM (190.65). The lowest fruit yield observed in 100% FYM (185.65) (Table 3). It might be due to the fact that vermicompost provided essential nutrients to the plant in their available form, retained fertility for long time, enhanced the population of microbes and humates content in the soil. It has the capability to increase micro-organism population that produces more powerful growth regulators which results an increase in growth and yield. Our findings are in agreement with Canellas *et al*. (2000); Atiyeh *et al*. (2001); Prabha *et al*. (2007) findings, Comparable findings were also demonstrated by Dhanalakshmi *et al*. (2014); Veena *et al.* (2017), they reported that plant growth and yield increases with application of vermicompost and neem cake.

C. Economic parameter

Cost of cultivation (Rs/ha). The maximum cost of cultivation (2,10,600 Rs/ha) was observed in treatment T4 (100% VC) followed by T5 (50% VC + 50% FYM) 1,62,850Rs/ha, T7 (33.3% GM + 33.3% FYM + 33.3% V) 1,62,767 Rs/ha, T3 100% GM (1,62,600Rs/ha), T2 100% FYM (1,15,100Rs/ha), T6 50% GM + 50% FYM (1,38,850Rs/ha). As compared other treatment, significantly lowest cost of cultivation (1,10,035 Rs/ha) was observed in treatment T1 control (Table 4).

Gross return (Rs/ha). The maximum gross monetary returns (5,50,050 Rs/ha) were observed in T5 treatment (50% VC + 50%FYM) followed by T7(33.3% GM+33.3% FYM + 33.3%VC) (4,73,025 Rs/ha), T3 100% GM (4,70,475 Rs/ha), T6 50% GM + 50% FYM (4,64,400Rs/ha), T4 100% VC (4,48,800 Rs/ha), T2 100% FYM (4,34,775 Rs/ha). As compared other treatment the lowest gross return (3,44,100) was observed in treatment T1 control (Table 4).

Net income (Rs/ha). The maximum net returns (3,87,200 Rs/ha) were recorded in T5 (50% VC + 50% FYM) followed by T6(50% GM + 50% FYM) (3,25,550), T2 (100% FYM) (3,19,675), T7 (33.3% GM + 33.3% FYM + 33.3%VC) (3,10,258), T3(100%GM) (3,07,875), T4(100%VC) (2,38,200 Rs/ha). As compared other treatment lowest net income (2,34,065 Rs/ha) was observed in treatment T1 as control (Table 4).

B:C Ratio. It clear that the maximum benefit cost ratio (3.77) was recorded in the T2 100% FYM, followed by T5 (50% VC+50% FYM), (3.37), T6 (50% GM+50% FYM) (3.34), T1(control) (3.12), T7 (33.3% GM+33.3% FYM+33.3% VC) (2.90), T3(100% GM) (2.89) as compared other treatment lowest B.C ratio (2.13) was observed in (100%VC) (Table 4).

Similar results were observed in soybean - wheat cropping system by Shwetha *et al.* (2009). Though the cost cultivation is high in organic production of chillies, because of the premium price for the organic chillies, the benefit out of organic chillies production is higher when compared to inorganic fertilizer treatments.

Table 1: Influence of treatment on Plant height (cm) of chilli.

Sr. No.	Treatment	30 days	60 days	90 days	At Harvest
1.	Control	26.97	48.68	66.83	84.99
2.	100%FYM	25.41	42.40	57.32	75.59
3.	100% GOAT MANURE	26.17	49.57	65.63	84.72
4.	100% VERMICOMPOST	25.11	46.28	60.14	80.73
5.	50% VC+50% FYM	26.85	50.93	68.45	88.76
6.	50%GM+50%FYM	25.92	43.08	59.06	79.71
7.	33.3%GM+33.3% FYM+33.3%VC	26.65	48.80	66.53	82.86
	C.D.	**NS***	**1.95**	**2.49**	**2.54**
	SE(m)	0.93	0.62	0.79	0.81
	C.V.	6.21	2.30	2.18	1.7

*Non-significant

Table 2: Effect of different organic manures treatment on Growth parameter.

Sr. No.	Treatment	Primary branches	Leaf area	Root biomass	Shoot biomass
1.	RDF 150:60:60 (NPK)	4.84	4.46	77.33	553.86
2.	100%FYM	4.23	4.18	54.32	525.49
3.	100% GOAT MANURE	5.12	4.38	69.72	577.21
4.	100% VERMICOMPOST	4.30	4.22	65.66	505.30
5.	50%VC +50% FYM	5.42	4.55	83.25	628.91
6.	50%GM+50% FYM	4.76	4.25	57.35	470.81
7.	33.3%GM+33.3% FYM+33.3%VC	5.21	4.52	68.18	583.33
	C.D.	**0.06**	**0.06**	**3.61**	**2.65**
	SE(m)	0.02	0.02	1.16	0.85
	C.V.	0.72	0.79	0.95	0.26

Table 3: Effect of different organic manures treatment on Yield Parameter.

Sr. No.	Treatment	Days of 50% flowering	Fruit length	Fruit width	No of seeds per fruit	Seeds yield kg/ha	Total fruit yield (q/ha)
1.	RDF 150:60:60 (NPK)	105.65	5.84	1.13	65.09	493.25	68.82
2.	100%FYM	111.20	4.57	0.86	55.12	425.15	57.97
3.	100%GM	104.13	5.72	1.14	62.30	461.33	62.73
4.	100%VC	116.00	5.37	1.06	67.52	482.33	59.84
5.	50%VC+50%FYM	102.39	6.51	1.21	70.65	505.39	73.34
6.	50%GM+50%FYM	112.73	5.33	0.97	66.98	477.59	61.92
7.	33.3%GM+33.3%FYM+33.3% VC	107.98	6.25	1.18	64.73	469.07	63.07
	C.D.	**3.41**	**0.04**	**0.06**	**3.76**	**12.68**	**2.17**
	SE(m)	1.09	0.01	0.02	1.20	4.07	0.69
	C.V.	1.74	0.46	3.13	1.70	1.49	1.88

Table 4: Effect of different organic manures treatment on Economic Parameter.

Sr. No.	Treatment	Cost of cultivation	Gross return	Net income	B:C ratio
1.	RDF 150:60:60 (NPK)	1,10,035	3,44,100	2,34,065	3.12
2.	100% FYM	1,15,100	4,34,775	3,19,675	3.77
3.	100% GM	1,62,600	4,70,475	3,07,875	2.89
4.	100%VC	2,10,600	4,48,800	2,38,200	2.13
5.	50%VC+50%FYM	1,62,850	5,50,050	3,87,200	3.37
6.	50%GM+50%FYM	1,38,850	4,64,400	3,25,550	3.34
7.	33.3%GM+33.3%FYM+33.3%VC	1,62,767	4,73,025	3,10,258	2.90

CONCLUSIONS

From the above result it was concluded that the application of 50% VC +50% FYM (Treatment T5) positively influenced various aspects of plant growth, leading to superior performance in terms of height (cm), flowering time, branch development, and leaf area (cm^2). It significantly enhanced various yield parameters. These included the number of fruits per plant, length of fruit (cm), diameter of fruit (cm^2), fruit yield per hectare (q), and fruit yield per plant (kg). The incorporation of VC and FYM at this concentration proved to be effective in promoting the growth, development, and overall productivity of the fruit plants.

The economic parameters evaluated in the study clearly indicate that the treatment T2, involving the application of 50% VC+50% FYM outperformed other treatments in terms of gross monetary returns, net monetary returns, and the benefit-to-cost ratio higher in T2 (FYM). These findings suggest that the incorporation of 50% VC+50%FYM at this particular concentration in chilli plant cultivation can be a financially rewarding strategy, as it leads to increased revenue, higher profits, and a favourable return on investment.

FUTURE SCOPE

The "Effect of Different Sources of Organic Manures on Growth and Yield of Chilli" study may provide numerous directions for further research and development like- Examine the synergistic effects of mixing various organic manures to find the best mixes for boosting the growth and productivity of chilies. This can entail researching how different organic sources interact and how that affects the availability of nutrients, the composition of the soil, and the activity of microbes. And examine how applying various organic manures would affect the environment, specifically how it will affect greenhouse gas emissions, water quality, and general ecological sustainability. This can direct farmers and decision-makers toward more ecologically friendly farming methods.

Acknowledgement. I extend my sincere thanks to Dr. Mohd. Talha Ansari (Major advisor) for giving me proper guidance throughout the course of study. I also sincerely thank to Dr. G.P. Rao (Director of IANS) for providing the facilities needed for the research work.
Conflict of Interest. None.

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How to cite this article: Ajay Tripathi, Jatin Kumar Singh, Pradumn Kumar Mourya, Pravesh Chaudhary, Amrendra Kumar Chaudhary and Abhay Kumar Kannaujiya (2023). Effect of Different Sources of Organic Manures on Growth and Yield of Chilli. *Biological Forum – An International Journal*, *15*(11): 355-360.