Optimizing Growth Parameters of Bell Pepper (*Capsicum frutescens L.)* through Comprehensive Nutrient Management on Farm of the Department of Horticulture, MGCGV, Chitrakoot,Madhya Pradesh, India

Abstract:

The study was conducted at the Research Farm of the Department of Horticulture, MGCGV, Chitrakoot. Bell pepper, a popular vegetable crop, faces challenges related to growth and productivity. This research aimed to determine the most suitable treatment for enhancing the growth parameters of Bell pepper plants.

The experiment involved a comprehensive approach, combining organic nutrient management, bioenhancers, and chemical fertilizers. Various treatments were applied to evaluate their impact on the growth parameters of Bell pepper. These parameters included plant height, leaf area, flowering, fruit set, and yield. Additionally, soil health and nutrient dynamics were assessed to understand the long-term sustainability of the treatments.

Preliminary findings suggest that a balanced combination of organic nutrients, bioenhancers, and judicious use of chemical fertilizers significantly improved the growth parameters of Bell pepper. This approach not only promoted vigorous vegetative growth but also enhanced reproductive stages, leading to higher fruit set and ultimately increased yield. Moreover, the study provides insights into the potential for sustainable Bell pepper cultivation practices.

The outcomes of this research contribute to the development of effective strategies for optimizing the growth parameters of Bell pepper, thereby enhancing its overall productivity and sustainability in agriculture. Further investigation is recommended to validate and fine-tune these findings for broader adoption in Bell pepper cultivation.

Key words: Growth Parameters, Bell Pepper,Nutrient Management,commercial crops

INTRODUCTION

Bell pepper (*Capsicum frutescens L.*) is an annual and day neutral plant belongs to Solanaceae family. It is a one of the most important vegetable crop grown in India as well as in the world, because of its nutritive value, flavor, colour and is considered as one of the major commercial crops of the world (Tiwari *et al.* 2013) [36]. It is relatively non pungent or less pungent with thick flesh and is the world second most important vegetable crop after tomato. Sweet pepper has little energy value but the nutritive value of sweet pepper is high especially for vitamin A and vitamin C (Roy *et al.* 2011) [27].

Organic manures refer to plant and animal waste that undergo decomposition. Farmyard manure (FYM) is a mixture of decomposed dung and urine from farm animals, along with litter and other materials from their fodder. On average, well-decomposed FYM

contains 0.5% nitrogen (N), 0.3% phosphorus (P_2O_5), and 0.5% potassium (K_2O). It can provide most of the essential soil fertility elements required by crops, although not always in sufficient quantities or the correct proportions. Manure's plant nutrients become available to crops as it decomposes with the help of soil microorganisms.

Vermicompost is another organic fertilizer derived from the excreta of earthworms. It is rich in NPK (nitrogen, phosphorus, and potassium) and micronutrients like calcium, magnesium, zinc, and manganese. Vermicompost also contains enzymes such as amylase, lipase, cellulase, and chitinase, which continue to break down organic matter in the soil and release nutrients to plant roots. It offers various benefits, including plant growth promotion, nutrient-rich content, beneficial bacteria, and mycorrhizae.

Similarly, poultry manure is the waste generated by chickens and serves as a valuable organic fertilizer. It supplies both macro and micro nutrients essential for the growth, yield, and quality of horticultural crops. Poultry manure is particularly notable for its higher nitrogen and phosphorus content compared to other organic manures, with average nutrient levels of 1.5% nitrogen, 1.5% phosphorus (P_2O_5), and 1.8% potassium (K_2O). Proper handling and management are essential, as exposed poultry manure can lose up to 50% of its nitrogen within 30 days. Additionally, poultry manure plays a crucial role in supporting crop nutrition and maintaining soil physical and chemical properties.

Materials and Methods

The present investigation was carried out during the year 2022-23 in Kharif season at Research Farm, Department of horticulture, MGCGV, Chitrakoot, Satna, Madhya Pradesh.

Table 1: Treatment combination.

S. No.	Treatment No.	Treatment Combination
1	T_1	Control (Farmers Practices)
2	T_2	RDF (Refuse derived fuel) (250:150:150 kg ha^{-1}) NPK
3	T_3	FYM 25 t ha^{-1}
4	T_4	Vermicompost 10 t ha^{-1}
5	T_5	SPNF (Subhash palekar natural farming) (Bijamrit + Jivamrit ++ Mulching)
6	T_6	50% FYM (Farm yard manure) + 50% RDF (Refuse derived fuel)
7	T_7	50% Vermicompost + 50% RDF (Refuse derived fuel)
8	T_8	SPNF (Subhash palekar natural farming) + Panchgavya
9	T_9	50% FYM (Farm yard manure) + Panchgavya
10	T_{10}	50% Vermicopost + Panchgavya

11	T_{11}	50% RDF (Refuse derived fuel) + Panchgavya
12	T_{12}	50% FYM (Farm yard manure) + 50% Vermicompost

Techniques of analysis

a. Soil sampling

The soil samples were taken from different places of the experimental field with the help of auger from 12-15 cm depth after clearing the surface vegetation. These samples were properly mixed, air dried in diffused sunlight, finally powered and again mixed thoroughly. A representative sample of 5 g was taken for each analysis and subjected to mechanical and chemical analysis.

b. Mechanical analysis of soil

The mechanical analysis of sample soil was done with the help ofBouyoucos Hydrometer method (1952)and result so obtained are presented table 1.

Table 2: Mechanical composition of soil

Soil Properties	**Percentage**	**Method Employed**
Sand	61%	Bouyoucos Hydrometer method (1952)
Silt	26%	
Clay	15%	
Textural	Sandy loam	

c. Chemical analysis of soil

The chemical analysis of soil was conducted to determine the percentage of major elements viz., nitrogen, phosphorus, potash, organic carbon, organic matter, pH and electrical conductivity. Nitrogen was estimated by alkaline permanganate method(Subbaih and Asija, 1956).The phosphorus was estimated by Olsen's Colorimeteric method(*Olsen et al*., 1954) and potash was estimated by Flame Photometericmethod (Jackson, 1958) respectively. The soil organic matter was estimated

by Hydrocloric oxidation method as suggested by Walkey and Black (1934). The pH of soil was determined by pH meter (Elico pH meter model 2.112).

Statistical analysis

The data were analyzed in randomized block design as per procedure of Cochran and Cox (1959). Interpretation of results was made on the basis of "F" test and critical difference at 0.05 probability calculated to compare the treatments. The data were presented by way of tables, graphs and photographs.

Critical Difference

The significance of differences between the mean values of different treatments for different characters was taken by calculating critical differences (CD) at 5% level of significance as follows CD = SED X T

CD= √ 2 x EMss/r x t value

T = number of error d.f at 5 % level of significance

Where, SED = $\sqrt{(2\,Me/r)}$

t = table value of "t" at error degree of freedom

r = number of replications

Results and Discussion

The results of the present investigation was carried out during the year 2022-23 in Kharif season at the Research Farm, Department of Horticulture, MGCGV, Chitrakoot, Satna, Madhya Pradesh, India.. The results of the investigation regarding the influence organic nutrients and N.P.K. on growth and yield of Bell pepper have been presented in

tables and wherever required. The result of the experiment has been presented given below table.

Table 3: Results of organic nutrients and N.P.K. on growth and yield of bell pepper

Treatment No.	Treatment Combination	Plant height (cm) at harvest	No. of leaves per plant at harvest	No. of fruit per plant	Fruit length (cm)	Fruit width (cm)	Weight of fruit (g)	Fruit yield (g) per plant	Fruit yield quintal per hectare
T1	Control (farmers practices)	48.14	125.11	6.25	6.11	5.82	78.25	745.52	275.52
T2	RDF(30:60:30 kg per ha) NPK	51.45	138.41	9.88	7.15	6.88	84.52	854.15	301.22
T3	FYM 25 ton per ha	60.63	141.66	10.33	9.05	7.12	89.88	975.55	303.78
T4	Vermicompost 10 ton per ha	61.45	145.45	10.28	9.17	7.28	90.15	978.58	308.11
T5	SPNF (bijamrit + jivamrit ++ mulching)	58.44	137.02	9.71	8.63	6.45	81.46	893.25	288.45
T6	50% FYM + 50% RDF	56.28	132.52	9.36	8.45	6.52	88.15	878.25	291.27
T7	50% vermicompost + 50% RDF	57.08	131.25	9.52	8.22	6.28	85.63	863.25	293.25
T8	SPNF + panchgavya	51.45	128.15	9.11	8.63	6.10	86.14	841.25	280.11
T9	50% FYM + panchgavya	52.15	132.55	9.63	7.82	6.22	82.63	838.52	286.44
T10	50% vermicompost + panchgavya	58.11	136.25	9.25	8.66	6.41	84.52	841.45	282.81
T11	50% RDF + panchgavya	52.11	131.41	9.05	8.14	6.33	80.25	852.11	283.12
T12	50% FYM + 50% vermicompost	65.15	148.66	10.45	9.25	7.33	91.45	980.15	310.45
	F- Test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
	C.D. at	**1.758**	**0.542**	**0.031**	**0.103**	**0.191**	**0.976**	**1.282**	**2.710**
	S.Ed. (+)	**0.848**	**0.262**	**0.015**	**0.050**	**0.092**	**0.471**	**0.618**	**3.683**

Growth parameters

Plant height (cm)

The height of the plants was measured from the base to the growing tip of the plants at harvest stage. The mean plant height were worked out and expressed in cm.

Number of branches plant^{-1}

The total number of branches per plant at four growth harvest stage were recorded from five observational plants and mean value recorded.

The observation in term of plant height (cm) at harvest of Bell pepper(*Capsicum Frutescens L.)* was statistically analyzed and has been presented in table. The perusal of the table shows that the application of organic nutrient and N.P.K had significant positive effect on plant height (cm) at harvest of Bell pepper(*Capsicum Frutescens L.).*Among the treatments applied, treatment T_{12} 50% FYM + 50% Vermicompostexhibited significantly maximum plant height (65.15) at harvest, and closely followed by T_4Vermicompost 10 t ha^{-1} and T_3FYM 25 t ha^{-1}. Whereas the minimum plant height (48.14) at harvest found in T_1 Control (Farmers Practices). Similar results were reported by Pariari and Khan (2013), Shiva *et al*., (2015) and Adhikari *et al.*, (2016). (Table 3).

The observation in term of number of leaves per plant at harvest of Bell pepper(*Capsicum Frutescens L.)*was statistically analyzed and has been presented in table. The perusal of the table shows that the application of organic nutrient and N.P.K had significant positive effect on number of leaves per plant at harvest of Bell pepper(*Capsicum Frutescens L.).* Among the treatments applied, treatment T_{12} 50% FYM + 50% Vermicompostexhibited significantly maximum number of leaves per plant (148.66) at harvest, and closely followed by T_4Vermicompost 10 t ha^{-1} and T_3FYM 25 t ha^{-1}. Whereas the minimum number leaves per plant (125.11) was found in T_1 Control (Farmers Practices). Similar results were reported by Pariari and Khan (2013), Shiva *et al*., (2015) and Adhikari *et al*., (2016). (Table 3).

The observation in term of Number of fruit plant-1 of Bell pepper(*Capsicum Frutescens L.*) was statistically analyzed and has been presented in table. The perusal of the table shows that the application of organic nutrient and N.P.K had significant positive effect on Number of fruit plant-1 of Bell pepper(*Capsicum Frutescens L.).*Among the treatments applied, treatment T_{12} 50% FYM + 50% Vermicompostexhibited significantly maximum Number of fruit plant-1 (10.45), and closely followed by T_4Vermicompost 10 t ha^{-1} and T_3FYM 25 t ha^{-1}. Whereas the minimum Number of fruit plant-1 (6.25) found in T_1 Control

(Farmers Practices). Similar results were obtained by Gopinath *et al*., (2011), Pariari and Khan (2013), Shiva *et al*., (2015), Adhikari *et al*., (2016). (Table 3).

The observation in term of fruit length (cm) of Bell pepper(*Capsicum Frutescens L*.) was statistically analyzed and has been presented in table. The perusal of the table shows that the application of organic nutrient and N.P.K had significant positive effect on fruit length (cm) of Bell pepper(*Capsicum Frutescens L*.). Among the treatments applied, treatment T_{12} 50% FYM + 50% Vermicompostexhibited significantly maximum fruit length (cm) (9.25), and closely followed by T_4Vermicompost 10 t ha^{-1} and T_3FYM 25 t ha^{-1}. Whereas the minimum fruit length (cm) (6.11) found in T_1 Control (Farmers Practices). Similar results were obtained by Gopinath *et al*., (2011), Pariari and Khan (2013), Shiva *et al*., (2015), Adhikari *et al*., (2016). (Table 3).

The observation in term of fruit width (cm) of Bell pepper(*Capsicum Frutescens L*.) was statistically analyzed and has been presented in table. The perusal of the table shows that the application of organic nutrient and N.P.K had significant positive effect on fruit width (cm) of Bell pepper(*Capsicum Frutescens L*.). Among the treatments applied, treatment T_{12} 50% FYM + 50% Vermicompostexhibited significantly maximum fruit width (cm) (7.33), and closely followed by T_4Vermicompost 10 t ha^{-1} and T_3FYM 25 t ha^{-1}. Whereas the minimum fruit width (cm) (5.82) found in T_1 Control (Farmers Practices). Similar results were obtained by Gopinath *et al*., (2011), Pariari and Khan (2013), Shiva *et al*., (2015), Adhikari *et al*., (2016). (Table 3).

The observation in term of Weight of fruit (g) of Bell pepper(*Capsicum Frutescens L*.) was statistically analyzed and has been presented in table. The perusal of the table shows that the application of organic nutrient and N.P.K had significant positive effect on Weight of fruit (g) of Bell pepper(*Capsicum Frutescens L*.). Among the treatments applied, treatment T_{12} 50% FYM + 50% Vermicompostexhibited significantly maximum Weight of fruit (g) (78.25), and closely followed by T_4Vermicompost 10 t ha^{-1} and T_3FYM 25 t ha^{-1}. Whereas the minimum Weight of fruit (g) (91.45) found in T_1 Control (Farmers Practices). Similar results were obtained by Gopinath *et al*., (2011), Pariari and Khan (2013), Shiva *et al*., (2015), Adhikari *et al*., (2016). (Table 3).

The observation in term of Fruit yield (g) plant^{-1} of Bell pepper(*Capsicum Frutescens L.*) was statistically analyzed and has been presented in table. The perusal of the table shows that the application of organic nutrient and N.P.K had significant positive effect on Fruit yield (g) plant^{-1} of Bell pepper(*Capsicum Frutescens L.*). Among the treatments applied, treatment T_{12} 50% FYM + 50% Vermicompostexhibited significantly maximum Fruit yield (g) plant^{-1} (745.52), and closely followed by T_4Vermicompost 10 t ha^{-1} and T_3FYM 25 t ha^{-1}. Whereas the minimum Fruit yield (g) plant^{-1} (745.52) found in T_1 Control (Farmers Practices). Similar results were obtained by Gopinath *et al.*, (2011), Pariari and Khan (2013), Shiva *et al*., (2015), Adhikari *et al*., (2016). (Table 3).

The observation in term of fruit yield (quintal/hectare)of Bell pepper(*Capsicum Frutescens L.*) was statistically analyzed and has been presented in table. The perusal of the table shows that the application of organic nutrient and N.P.K had significant positive effect on fruit yield (q ha^{-1}) of Bell pepper(*Capsicum Frutescens L.*). Among the treatments applied, treatment T_{12} 50% FYM + 50% Vermicompostexhibited significantly maximum fruit yield (q ha^{-1}) (275.52), and closely followed by T_4Vermicompost 10 t ha^{-1} and T_3FYM 25 t ha^{-1}. Whereas the minimum fruit yield (quintal/hectare) (310.45) found in T_1 Control (Farmers Practices). Similar results were obtained by Gopinath *et al.*, (2011), Pariari and Khan (2013), Shiva *et al*., (2015), Adhikari *et al*., (2016). (Table 3).

Conclusions

Among the various levels of organic nutrient and NPK used in the experiment, treatment T_{12} 50% FYM + 50% Vermicompost for plant height (65.15) at harvest,number of leaves per plant (148.66) at harvest,Number of fruit plant-1 (10.45),fruit length (cm) (9.25),fruit width (cm) (7.33),Weight of fruit (g) (78.25),Fruit yield (g) plant^{-1} (745.52),fruit yield (quintal/hectare) (275.52), was the best for the maximum growth and yield of chilli under Satna agro-climatic condition when compared with control and the other treatments.

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