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Effect of different growing media on growth, yield and quality in bell paper (*Capsicum annuum* L.) Under polyhouse condition

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Abstract

The present experiment was carried out during October, 2023 to January, 2024 in polyhouse, Research field, Department of Horticulture, SHUATS, Prayagraj. The experiment was conducted in randomized block design (RBD), with twelve treatments replicated thrice with growing media (Cocopeat + vermicompost + perlite + sawdust + RDF) on variety (Green, Red indo. American and Yellow pahuja). On capsicum the treatments were used to find out the most suitable growing media for quality, yield and growth of the capsicum. The results of the experiment have revealed that application of treatment of T₁ (cocopeat + vermicompost 25% + 75% RDF) has significantly increased the growth and yield parameters like plant height, number of branches, and yield parameters like days to first harvest, number of fruits per plant and maximum fruit yield. This study used to evaluate the effect of selected treatments on yield of capsicum. And the capsicum plants responded significantly to the growing media supply.

Keywords: Different growing media, bell pepper

1. Introduction

(*Capsicum annuum* L.) belongs to the family Solanaceae with chromosome number $2n = 24$. It is originated from South America. The edible part is matured fruit. It is emerging as one of the commercial vegetable at global level.

Plants are semi perennials that are grown as annuals in commercial cultivation. It is rich source of vitamin A, C and E and minerals like Calcium, Magnesium and Phosphorus. Capsicum has medicinal properties and it is used as traditional medicine. In ayurveda, it is classified as Guna (properties), Rasa (taste) and Virya (potency). It has antioxidant and antimicrobial properties. It plays a vital role in improving immune system, enhances metabolism. The leading states in India in capsicum production are Karnataka, Tamil Nadu, Andhra Pradesh, Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, Maharashtra, West Bengal, Gujarat and Goa.

Capsicum (*Capsicum* spp.), also called as pepper, is a main vegetable and spice crop originated in the American tropics and today cultivated all over the world for fresh, dried, and processing products. Pepper belongs to the genus *Capsicum* which is a member of the Solanaceae family. Around the genus *Capsicum* there is an increasing interest and fascination due to the considerable variation for several traits, which makes this crop extremely versatile and suitable for innumerable uses as food and non-food products. The genus *Capsicum* includes over 30 species, five of which (*C. annuum*, *C. frutescens*, *C. chinense*, *C. baccatum*, and *C. pubescens*) are domesticated and mainly grown for consumption. A large number of accessions of domesticated and wild species are stored in the world seed banks, representing a valuable resource for breeding in order to transfer traits related to resistances to various abiotic and biotic stresses as well for quality improvement. The recent advances in terms of genetic and genomic knowledge will help to unlock the potentiality of these resources.

A green pepper is a highly nutritious vegetable. This bell-shaped vegetable with a green, glossy exterior adds a dash of color to any dish. It is also referred to as a bell pepper. It has a tangy taste that enhances food flavor. The inside has a small, white foam-like core with tiny seeds attached to it.

This pepper isn't hot due to the absence of capsaicin which gives pepper the characteristic "hot" taste. Orange, yellow and red variants also exist. The pepper is packed with nutrients. It is a good source of vitamins, minerals and phytochemicals. The fruits may be thin and long, large and thick, short and bell-shaped, small and round. The unripe fruits may be green, creamy white, yellow, purple, red and orange. While, the ripe fruits may be of different shades of red. The pungency of fruit is mainly due to presence of a compound called capsaicin (0.1-1.5%)

Growing media plays an important role in successful cultivation of any crop. It should have a property of good water holding capacity and also able to drain excess water to come to field capacity which creates congenial root environment. For proper plant growth, organic fertilizers such as farmyard manure and vermicompost etc. provide consistently all essential nutrients, be it macro or micro, in an adequate quantity resulting in healthy growth of the plants. The more incorporation of organic matters in the media are expected to improve the physical structure of the soil, enhance the population of micro-organisms and increase the potential availability of growth influencing substances.

2. Materials and Methods

2.1 Experimental site: The experiment was conducted in polyhouse conditions, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj (U.P.). All the facilities necessary for cultivation, including labour were made available in the department.

2.2 Climate: Prayagraj is situated at an elevation of 104meters above sea level at 25.870 North latitude and 81.150 E longitudes. This region has a sub-tropical climate prevailing in the South- East part of U.P. with both the extremes in temperature, i.e., the winter and the summer. In cold winters, the temperature sometimes is as low as 0 °c in December – January and very hot summer with temperature reaching up to 45 °C in the months of May and June. During winter, frosts and during summer, hot scorching winds are also not uncommon. The average rainfall is around 1013.4 (cm) with maximum concentration during July to September months with occasional showers in winters.

Table 1: Treatment Details

Treatment symbol	Treatment combination
T ₀ (Green)	Control + RDF
T ₁	Cocopeat+vermicompost25%+75%RDF
T ₂	Perlite+vermicompost25%+75%RDF
T ₃	Sawdust+vermicompost25%+75%RDF
T ₄ (Red indo American)	Control + RDF
T ₅	Cocopeat+vermicompost25%+75%RDF
T ₆	Perlite+vermicompost25%+75%RDF
T ₇	Sawdust+vermicompost25%+75%RDF
T ₈ (Yellow Pahuja)	Control + RDF
T ₉	Cocopeat+vermicompost25%+75%RDF
T ₁₀	Perlite+vermicompost25%+75%RDF
T ₁₁	Sawdust+vermicompost25%+75%RDF

3. Results and Discussion

3.1 Plant height (cm), Number of branches per plant, Number of leaves per plant

In the different growing media, the maximum plant height was observed in (Green) T₁ (Cocopeat + vermicompost 25% + 75% RDF), 30.75 cm at 30 DAT, 47.74 cm at 60 DAT, 72.65 cm at 90 DAT. Followed by T₃ (sawdust + vermicompost 25% + 75% RDF), 30.00 cm at 30 DAT, 46.74 cm at 60 DAT, 70.64 cm at 90 DAT in and minimum plant height was observed in T₀(Control + RDF), 25.10cm at 30 DAT, 41.30 cm at 60 DAT, 58.40 cm at 90 DAT respectively are shown in Table(1). The highest plant height in the mixture of cocopeat and vermicompost might be due to better physicochemical properties of the mixture compared to vermicompost and cocopeat individually. The number of branches per plant of Bell Pepper (Capsicum) with different growing media found significant at 30 DAT, other two intervals i.e.,60, 90DAT. In the different growing media, the maximum number of branches per plant was observed in T₁(Cocopeat vermicompost 25%+75%RDF), 3.38 at 30 DAT, 8.40 at 60 DAT,18.27 at 90 DAT. Followed by T₃ (sawdust + vermicompost 25% + 75% RDF), 3.27 at 30

DAT,8.33 at 60 DAT, 17.29 at 90 DAT and minimum number of branches per plant was observed in T₀ (Control + RDF), 2.45 at 30 DAT, 6.10 at 60 DAT, 10.14 at 90 DAT respectively are shown in Table(2). Several investigators mentioned similar results on different plants such as capsicum.

The Number of leaves per branch of Bell Pepper with different growing media their found significant at all three intervals *i, e,* 30, 60, 90 DAT. In the 12 treatment of different growing media the maximum Number of leaves per branch was recorded in T₁(Cocopeat + vermicompost 25% + 75% RDF), 47.77 at 30 DAT, 82.52 at 60 DAT, 94.03 at 90 DAT. Followed by T₃ (sawdust+vermicompost25%+75%RDF), 47.00 at 30 DAT, 82.52 at 60 DAT, 94.00 at 90 DAT and minimum number of branches per plant was observed in T₀ (Control + RDF), 40.20 at 30 DAT, 52.63 at 60 DAT, 65.43 at 90 DAT respectively are shown in Table(3).The best result of the mixture Cocopeat + vermicompost in both the cases of plant height and total number of leaves per branch may be due synergistic effects of the mixture of growing medium for growth and development of the plants. that mixtures of cocopeat with other organic substrates produced higher growth and yield in vegetable crops

Table 2: Effect of different growing media on Plant height (cm) of Bell Papper (Capsicum)

Rotation	Treatments	30 DAYS	60 DAYS	90 DAYS
T ₀	Control + RDF	25.10	41.30	58.40
T ₁	Cocopeat + vermicompost 25% + 75% RDF	30.75	47.64	72.65
T ₂	Perlite + vermicompost 25% + 75% RDF	27.99	44.88	63.78
T ₃	Sawdust + vermicompost 25% + 75% RDF	30.00	46.74	70.64
T ₄	Control + RDF	27.30	44.19	68.54
T ₅	Cocopeat + vermicompost 25% + 75% RDF	29.79	46.68	65.10
T ₆	Perlite + vermicompost 25% + 75% RDF	25.10	41.99	59.75
T ₇	Sawdust + vermicompost 25% + 75% RDF	28.94	45.83	69.51
T ₈	Control + RDF	28.30	45.94	66.74
T ₉	Cocopeat + vermicompost 25% + 75% RDF	29.50	45.00	68.82
T ₁₀	Perlite + vermicompost 25% + 75% RDF	27.46	43.75	67.54
T ₁₁	Sawdust + vermicompost 25% + 75% RDF	25.80	43.80	65.70
	S(Ed.) ±	0.57	0.56	1.29
	CD	5.22	3.28	5.09
	F-test	S	S	S

Table 3: Effect of different growing media on No. of branches per plant of Bell Pepper

Number of branches per plant				
Rotation	Treatments	30 days	60 days	90 days
T ₀	Control + RDF	2.45	6.10	10.14
T ₁	Cocopeat + vermicompost 25% + 75% RDF	3.38	8.40	18.27
T ₂	Perlite + vermicompost 25% + 75% RDF	2.85	7.27	13.33
T ₃	Sawdust + vermicompost 25% + 75% RDF	3.27	8.33	17.29
T ₄	Control + RDF	2.63	8.27	16.27
T ₅	Cocopeat + vermicompost 25% + 75% RDF	2.86	7.43	14.27
T ₆	Perlite + vermicompost 25% + 75% RDF	3.00	6.27	10.27
T ₇	Sawdust + vermicompost 25% + 75% RDF	2.93	7.54	14.28
T ₈	Control + RDF	3.10	7.93	15.74
T ₉	Cocopeat + vermicompost 25% + 75% RDF	2.78	7.20	16.39
T ₁₀	Perlite + vermicompost 25% + 75% RDF	2.63	8.32	12.27
T ₁₁	Sawdust + vermicompost 25% + 75% RDF	2.82	8.27	16.32
	S(Ed.) ±	0.26	0.37	0.67
	CD	9.62	11.89	12.56
	F-test	S	S	S

Table 4: Effect of different growing media on Number of leaves per branch of Bell Pepper.

Number of leaves per branch				
Rotation	Treatments	30 DAYS	60 DAYS	90 DAYS
T ₀	Control + RDF	40.20	52.63	65.43
T ₁	Cocopeat + vermicompost 25% + 75% RDF	47.77	82.52	94.03
T ₂	Perlite + vermicompost 25% + 75% RDF	45.83	72.83	84.03
T ₃	Sawdust + vermicompost 25% + 75% RDF	47.00	82.52	94.00
T ₄	Control + RDF	40.90	53.02	69.30
T ₅	Cocopeat + vermicompost 25% + 75% RDF	42.64	78.93	83.03
T ₆	Perlite + vermicompost 25% + 75% RDF	42.85	82.22	91.30
T ₇	Sawdust + vermicompost 25% + 75% RDF	41.42	59.90	82.03
T ₈	Control + RDF	43.93	63.62	76.93
T ₉	Cocopeat + vermicompost 25% + 75% RDF	42.84	59.63	72.84
T ₁₀	Perlite + vermicompost 25% + 75% RDF	45.92	63.49	74.54
T ₁₁	Sawdust + vermicompost 25% + 75% RDF	46.64	70.63	81.83
	S(Ed.) ±	1.97	2.03	3.58
	CD	9.46	10.48	11.63
	F-test	S	S	S

3.2 Flowering parameters (Days to first flowering, Days to 50% flowering, Days to first fruit setting)

In the all treatments of different growing media of bell pepper the maximum days of first flowering was recorded in T₅ (Cocopeat+ vermicompost 25% + 75% RDF), 36.33 DAT. Followed by T₁(Cocopeat + vermicompost 25% + 75% RDF) with 32.33 DAT, and minimum Days of first flowering was recorded in T₀(Control + RDF) with 26.67 DAT are shown in Table(5). The result may be due to better nutritional status and

uptake in soilless media integrated with organic amendments like compost.

The Days of 50% flowering in Bell Pepper under different treatments with different growing media their found significant. In the 12 treatment of different growing media the maximum days required for 50% flowering was observed in T₅ (Cocopeat +vermicompost 25%+75%RDF), 53.00 DAT. Followed by T₁ (Cocopeat +vermicompost 25%+75% RDF) with 49.67 DAT, and minimum Days of 50% flowering was recorded in

T₀(Control + RDF) with 44.33 DAT are shown in Table (5). In the 12 treatment of different growing media the maximum days required for Days to first fruit setting from planting was observed in T₅ (Cocopeat +vermicompost 25%+75%RDF), 59.00 DAT. Followed by T₉ (Cocopeat+vermicompost 25%+75%RDF) with 58.33 DAT, and minimum Days of first flowering was recorded in T₀ (Control + RDF) with 49.67 DAT

are shown in Table (5). Transplanting at (Cocopeat +vermicompost 25%+75%RDF), with spacing showed maximum length of branch which might be attributed to a more vertical growth of the plant under dense spacing which in turn might be the effect of competition for space and light. Böhme M, *et al.* (2001) ^[11], observed the similar result in Bell pepper.

Table 5: Effect of different growing media in terms of flowering parameters

Rotation	Treatments	Days to 1 st flowering	Days to 50% flowering	Days to 1 st fruit setting
T ₀	Control + RDF	26.67	44.33	49.67
T ₁	Cocopeat+vermicompost25%+75%RDF	32.33	49.67	56.00
T ₂	Perlite+vermicompost25%+75%RDF	30.33	50.67	55.67
T ₃	Sawdust+vermicompost25%+75%RDF	29.00	51.00	56.00
T ₄	Control + RDF	27.67	49.67	52.67
T ₅	Cocopeat+vermicompost25%+75%RDF	36.33	53.00	59.00
T ₆	Perlite+vermicompost25%+75%RDF	30.67	51.00	54.33
T ₇	Sawdust+vermicompost25%+75%RDF	28.33	51.00	55.67
T ₈	Control + RDF	31.00	48.33	52.33
T ₉	Cocopeat+vermicompost25%+75%RDF	30.33	45.33	58.33
T ₁₀	Perlite+vermicompost25%+75%RDF	30.00	47.33	57.67
T ₁₁	Sawdust+vermicompost25%+75%RDF	32.33	48.33	58.33
	S(Ed.) ±	2.24	2.04	4.63
	CD	4.67	4.26	9.66
	F-test	S	S	S

3.3 Quality parameters

In the 12 treatment of different growing media the maximum days required for Days to first fruit picking from planting was observed in T₅ (Cocopeat+ vermicompost 25%+75% RDF), 72.16 DAT. Followed by T₁₀ (perlite +vermicompost 25%+75% RDF) with 69.81 DAT, and minimum Days to first fruit picking from planting was recorded in T₀ (Control + RDF) with 62.56 DAT are shown in Table (6). In 12 treatments of different growing media the maximum number of fruits per plant was observed in T₁(Cocopeat + vermicompost 25%+75%RDF), 18.40. Followed by T₅ (Cocopeat+ vermicompost 25%+75% RDF) with 15.87, and minimum number of fruits per plant was recorded in T₀ (Control + RDF) with 11.65. The result may be due to ideal conditions for good growth of plants in the mixture medium giving way to higher yield. Gungor and Yildirim (2013) ^[18] also found the same result that mixture of different growing media has a significant effect on total number of fruits per plant in pepper.

In 12 treatments of different growing media the maximum Fresh weight of fruit per plant was observed in T₁ (Cocopeat+vermicompost 25%+75% RDF), 121.42g. Followed by T₅ (Cocopeat +vermicompost 25%+75% RDF) with 121.35g, and minimum Fresh weight of fruit per plant was recorded in T₀ (Control + RDF) with 112.20g. This was may be due to high uptake of nutrients and build-up of sufficient photosynthesis enabled the increase in size of fruits (length and breadth). Similar findings were recorded. In twelve treatments of different

growing media the maximum TSS (Total soluble solid B⁰) was observed in T₆ (perlite + vermicompost 25% + 75% RDF), 10.87B⁰. Followed by T₅ (cocopeat + vermicompost 25% + 75% RDF) with 9.87 B⁰, and minimum TSS (Total soluble solid B⁰) was recorded in T₀ (Control + RDF) with 4.90 B⁰. This increase in TSS level of fruits may be due to increased availability of major as well as minor nutrients especially N and K in the treatment as they play a vital role in enhancing the fruit quality. Similar are the findings of Singh *et al.* (2010) ^[13]. In twelve treatments of different growing media the maximum Vitamin C content was observed in T₆ (perlite + vermicompost 25% + 75% RDF), 150.01 mg/100g. Followed by T₁₀ (perlite +vermicompost 25%+75%RDF) with 147.77 mg/100g, and minimum Vitamin C content was recorded in T₀ (Control + RDF) with 143.70 mg/100g. This result showed that growing medium in addition to plant spacing also could affect vitamin C content. The treatments might have helped in the nitrogen fixation besides providing higher root biomass and release of nutrients slowly so that they are taken by the crop for synthesis of useful biochemical component. Improvement in ascorbic acid content in sweet pepper fruits by the application of this treatment combination may be because of slow but continuous supply of the entire macro and micro nutrients which might have helped the assimilation of carbohydrates resulting into synthesis of ascorbic acid (Bahadur *et al.*, 2005) ^[16]. Similar are the findings of Jaipaul *et al.* (2011) ^[21].

Table 6: Effect of different growing media in terms of quality parameters

Rotation	Treatments	Days of 1 st fruit picking	Number of fruits/plant	Avg. fruit weight(g)	(TSS B ⁰)	Vit-C(mg/100g)
T ₀	Control + RDF	62.56	11.65	112.20	4.90	143.70
T ₁	Cocopeat+vermicompost25%+75%RDF	68.14	18.40	121.42	7.80	145.43
T ₂	Perlite+vermicompost25%+75%RDF	63.81	14.87	117.51	6.87	143.63
T ₃	Sawdust+vermicompost25%+75%RDF	68.81	15.67	120.28	6.47	144.70
T ₄	Control + RDF	59.81	14.07	116.67	7.87	146.27
T ₅	Cocopeat+vermicompost25%+75%RDF	72.16	15.87	121.35	9.87	147.60
T ₆	Perlite+vermicompost25%+75%RDF	62.81	11.80	120.46	10.87	150.01
T ₇	Sawdust+vermicompost25%+75%RDF	65.81	13.67	112.67	8.70	147.50
T ₈	Control + RDF	66.61	14.86	120.54	7.20	145.20
T ₉	Cocopeat+vermicompost25%+75%RDF	67.56	13.43	119.86	7.90	145.80
T ₁₀	Perlite+vermicompost25%+75%RDF	69.81	13.87	119.10	8.40	147.77
T ₁₁	Sawdust+vermicompost25%+75%RDF	65.68	14.20	120.67	8.10	146.33
	S(Ed.) ±	0.13	0.25	0.40	0.03	0.04
	CD	0.36	2.92	0.58	0.64	0.04
	F-test	S	S	S	S	S

3.4 Fruit yield and Economics

In twelve treatments of different growing media the maximum Fruit yield per plot was observed in T₁ (Cocopeat + vermicompost 25% + 75% RDF), 20.56 kg. Followed by T₅ (Cocopeat+ vermicompost 25% + 75% RDF) with 17.27 kg, and minimum Fresh weight of fruit per plant was recorded in T₀ (Control + RDF) with 11.50kg are shown in Table (7). The result may be due to ideal conditions for good growth of plants

in the mixture medium giving way to higher yield. also concluded that soilless media has a good effect on yield of different vegetables. In twelve treatments of different growing media the maximum Fruit yield per hectare was observed in T₁ (Cocopeat+ vermicompost 25%+75% RDF), 45.51 t/ha. Followed by T₅ (Cocopeat + vermicompost 25% + 75% RDF) with 38.23t/ha. and minimum Fruit yield per hectare was recorded in T₀ (Control + RDF) with 26.12t/ha.

Table 7: Effect of different growing media in terms of total yield

Rotation	Treatments	Fruit yield/plot(Kg)	Yield (t/ha)
T ₀	Control + RDF	11.50	26.12
T ₁	Cocopeat+vermicompost25%+75%RDF	20.56	45.51
T ₂	Perlite+vermicompost25%+75%RDF	15.66	34.66
T ₃	Sawdust+vermicompost25%+75%RDF	16.90	37.41
T ₄	Control + RDF	14.72	32.56
T ₅	Cocopeat+vermicompost25%+75%RDF	17.27	38.23
T ₆	Perlite+vermicompost25%+75%RDF	11.91	26.35
T ₇	Sawdust+vermicompost25%+75%RDF	14.76	32.68
T ₈	Control + RDF	15.86	30.54
T ₉	Cocopeat+vermicompost25%+75%RDF	15.15	29.73
T ₁₀	Perlite+vermicompost25%+75%RDF	14.36	28.80
T ₁₁	Sawdust+vermicompost25%+75%RDF	14.86	32.65
	S(Ed.) ±	0.32	0.71
	CD	3.51	3.50
	F-test	S	S

Table 8: Economics of Bell pepper (Capsicum)

Treatment	Cost of cultivation	Yield (q/200 ² m)	Gross return(INR)	Net return(INR)	Benefit: Cost ratio
T ₀	14983	9.57	23925	8942	1.59
T ₁	14983	11.00	27500	12517	1.83
T ₂	14983	12.07	30175	15192	2.01
T ₃	14983	10.98	27450	12467	1.83
T ₄	19916	9.60	48000	33017	2.41
T ₅	19916	10.05	50250	35267	2.52
T ₆	19916	10.45	52250	37267	2.62
T ₇	19916	9.45	47250	32267	2.37
T ₈	18683	10.26	41040	26057	2.19
T ₉	18683	11.58	46320	27637	2.47
T ₁₀	18683	10.26	41040	22357	2.19
T ₁₁	18683	11.84	47360	28677	2.53

4. Conclusion

It is concluded from the present study of Effect of different growing media on growth, yield and quality in Bell pepper (*Capsicum annum*) under polyhouse conditions that the treatment T₁- Cocopeat + vermicompost 25% + 75% RDF was

identified as a suitable treatment with better plant height at 30, 60 and 90 days (cm), a greater number of branches per plant, maximum number of fruits per plant, Maximum yield per plot and fruit yield per Ha. T₀ (control) with lowest was recorded. The application of Cocopeat + vermicompost 25% + 75% RDF

together can increase the yield, improve the input-use efficiency by the crop and can certainly lower down the expenditure on costly fertilizers to the farmers. The B:C ratio was maximum at T₆ with 2.62

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