International Journal of Plant & Soil Science

Volume 35, Issue 21, Page 776-782, 2023; Article no.IJPSS.107914
ISSN: 2320-7035

Evaluation of Different Soilless Substrate on Growth and Yield of Capsicum *(Capsicum annuum var. grossum)*

Mohit Gaikwad [a], Pinkey Dukpa [a++*], Maruthi Naidu [a] and Kunal Adhikary [a]

[a] *Department of Horticulture, School of Agriculture, ITM University, Sithouli-474 001 Gwalior, (Madhya Pradesh), India.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2023/v35i214042

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/107914

Original Research Article

Received: 22/08/2023
Accepted: 27/10/2023
Published: 31/10/2023

ABSTRACT

The greenhouse experiment was carried out at the Department of Horticulture, ITM University, Gwalior (M.P) to assess the impact of different growing media, and varieties of capsicum in the soilless culture. The experiment was performed in a factorial completely randomized design consisting of three growing media viz. cocopeat (M_1), vermicompost (M_2), 1:1 mixture of cocopeat and vermicompost (M_3) and three varieties Indrani, Mahabharath, and california wonder and replicated thrice. The results revealed that the all growth parameters expect numbers of branches were significantly ($p<0.05$) higher in M_3. Among different varieties Indrani recorded the tallest plant height and numbers of leaves while, California wonder had greater number of branches on main stem, and leaf area than the remaining variety. However, the yield parameters viz. numbers of

---

[++] *Assistant Professor;*
**Corresponding author: E-mail: pinkiladukpa6@gmail.com;*

flowers/ plant, number of fruits/plant, locule number was higher in California wonder grown in substrate M_3. In contrast the fruit length, fruit diameter, pericarp thickness, fruit weight, fruit weight/ plant were higher in mahabharath grown in substrate M_3. Therefore, our Finding suggested that M3 and M1 should be used for soilless culture of capsicum in order to achieve greater growth and production characteristics respectively.

Keywords: Capsicum; growing media; growth and yield.

1. INTRODUCTION

Globally, *Capsicum annuum var. grossum* is an important vegetable for domestic and commercial use after tomato, and is a member of the solanaceae family [1]. It is also known as bell pepper, which was first grown in the American tropics and now grown across globe for processing and dried goods. The high nutritional content, color, flavor, and domestic market demand, makes it most significant vegetables crops grown in Indian condition. However, the limited availability of land per person and weather has threatened the cultivation of capsicum in an open field. Further, intense soil based crop cultivation in the green revolution led to reduced soil fertility, increased soil salinity and insect-pest infestation [2]. Thus, it resulted in consistently low yields and poor crop quality and become a major challenge to feed the ever increasing population. Therefore, the soil-less culture can be introduced successfully to obtain higher yield, efficient use of available resources and to mitigate the impact of climate change [3]. The soilless culture is an artificial means of providing plants with support and reservoir for nutrients and water [4]. Soilless growing media are easier to handle and may provide a better growing environment compared to soil [4,5]. Further, replacing soils by soilless growing media could be a viable alternative to overcome the infestation of soil borne pathogens, reduce pesticide use, nitrate pollution and improves yield and quality. In India soilless culture techniques are not in limelight as a result there hasn't been much research or material produced in this area in our country. Thus, the major objectives of this experiment is to find out the best growing media with respect to growth and yield of capsicum under soilless culture and to popularize soilless culture for producing capsicum in the semi-urban and urban areas.

2. MATERIALS AND METHODS

The present experiment was conducted in naturally ventilated greenhouse during *Rabi* season (2022) in the experimental farm of ITM University, Gwalior (M.P). The experiment was set up in factorial completely randomized design (FCRD) with three replications. The treatments comprised of three growing media viz. cocopeat, vermicompost, 1:1 mixture of cocopeat and vermicompost, and three capsicum varieties viz. Indrani, Mahabharath, California wonder. The nine treatments combinations viz. M_1V_1, M_2V_1, M_3V_1, M_1V_2, M_2V_2, M_3V_2, M_1V_3, M_2V_3, and M_3V_3 is arranged randomly in 60 x 60 cm distance of the poly packets. The treatment details were given in Table 1. Firstly, the seed tray was filled with growing media i.e. cocopeat, and seeds of selected varieties was sown in 12th October 2022 on a seed tray that contains forty seedling per tray. After sowing the seed tray was covered with mulch for 15 days and watering was done using fine water cane. When the seedlings are ready to transplant in 35 days, and they are arranged in 20 cm (L), 20 cm (W), and 35 cm (H) polypackets. All the standard recommended cultural practices were followed to raise a successful crop during the course of investigation. The observations were recorded from randomly selected plants. The growth parameters were recorded throughout the growing period at different crop growth stages. While the yield, and quality parameters were recorded after the harvest of the crop.

3. RESULTS AND DISCUSSION

3.1 Plants Growth Characters

The different growing media had a significant ($P<0.05$) effect on the growth parameters of capsicum Table. 2. The maximum plant height (66.08 cm) was obtained in the mixture of cocopeat + vermicompost. While the least plant height (41.97cm) was obtained in cocopeat singly as growing media. The higher plant height, in the cocopeat, and vermicompost mixture could be attributed to the greater physic-chemical qualities of the mixture as compared to vermicompost, and cocopeat alone. This was also reported by Brunda and singh [6]. With

regards to varieties the tallest plant height (61.00 cm) was observed in Indrani, whereas Mahabharath had the lowest (51.47 cm) values. This is mostly attributable to increased availability of several macro and micronutrients, which supports enhanced metabolism. Further, the highest number of leaves per plant (89.31) was obtained under cocopeat + vermicompost mixture and least (37.16) under cocopeat alone. This might be attributed to synergistic effects of different growing media on the plants' growth, and development. Similar findings were made in the study conducted by Thapa et al. [2]. Among different varieties the Indrani had highest leaves per plant (74.55). While the California wonder produced the lowest number of leaves per plant (55.95). The results may be due to varying genotypic potential of the varieties and their differential response to soilless culture. Similarly, the combination of cocopeat+vermicompost and cocopeat alone produced the highest (55.06 cm) and lowest (48.66) leaf area, respectively. More leaf area might be due more leaf number in the plant. Similar result was given by Roy et al. [7] and Kumar and Kohli (2005) in Capsicum. Among the varieties the highest leaf area was observed in California wonder (53.22 cm) which was closely followed by Indrani. In contrast the lowest leaf area (51.20 cm) was obtained with Mahabharath. This is mainly due to increased macro and micronutrient absorption which stimulates the metabolic processes and the accumulation of additional metabolites in plant tissues. The total number of branches did not differ significantly with both varieties, and growing media. However, the cocopeat + vermicompost had maximum number of branches per plant (4.62) while the least number of branches (3.70) on the main stem was observed in cocopeat alone. Similar observation was observed by Dash et al. [8]. The result could be due to the presence of vermicompost which includes auxin a plant growth regulator essential for branching may be the cause of the outcome. Among the varieties California Wonder (4.38) had the highest total number of branches which was closely. In contrast the lowest number of branches on main stem (4.27) was obtained with Indrani.

Table 1. Treatments details of the experiment

Treatments	Combinations	Treatment Notations
T1	Cocopeat + Indrani	M_1V_1
T2	Vermicompost + Indrani	M_2V_1
T3	Mixture Cocopeat + Vermicompost (1:1) + Indrani	M_3V_1
T4	Cocopeat + Mahabharath	M_1V_2
T5	Vermicompost + Mahabharath	M_2V_2
T6	Mixture Cocopeat + Vermicompost (1:1) + Mahabharath	M_3V_2
T7	Cocopeat + California wonder	M_1V_3
T8	Vermicompost + California wonder	M_2V_3
T9	Mixture Cocopeat + Vermicompost (1:1) + California wonder	M_3V_3

Table 2. Influence of growing media and variety on different plant growth characters

Treatments	Plant height (cm)	No. of leaves per plants	Leaf area (cm^2)	No. of branches on main stem
Cocopeat	41.97	37.16	48.66	3.70
Vermicompost	57.02	64.69	52.54	4.61
Cocopeat + Vermicompost (1:1)	66.08	89.31	55.06	4.62
SE (m) $\pm$	1.29	0.98	0.25	0.08
C.D. (P=0.05)	3.87	2.94	0.76	0.24
Indrani	61.00	74.55	51.83	4.27
Mahabharath	51.47	60.66	51.20	4.29
California Wonder	52.61	55.95	53.22	4.38
SE (m) $\pm$	1.29	0.98	0.25	0.08
C.D (P=0.05)	3.87	2.94	0.76	NS

3.2 Yield Attributes and Yield

The different growing media and varieties had a significant impact on the yield attributes and capsicum yield (Table 3). Plants grown in the mixture of cocopeat + vermicompost took the minimum days to flower (72.55) days, while those grown in cocopeat took the maximum days to flower of (83.82) days. This might be due to increased nutrient status, and uptake in soilless media combined with organic fertilizers like vermicompost.This was earlier reported by Singh et al. [9]; Thapa et al. [2] in Capsicum. Among different cultivars, the Indrani gave the earliest flowers at approximately (73.78) days after transplanting, and california wonder takes longer time (79.98) days. After a thorough analysis of the data, it was determined that the mixture of cocopeat and vermicompost had the lowest days to 50% flowering (83.95) days and that cocopeat had the highest days (95.03) days. the early flowering was mostly due to the ideal nutritional status in the medium, along with suitable growth conditions including temperature, light, and relative humidity in the greenhouse [10]. Furthermore,the Indrani gave the earliest 50 percent flowering at 85.6 days after transplanting and California wonder takes the longer time (91.00) days. Plants planted in a cocopeat + vermicompost mixture the highest flowers per plant (34.15) flowers, whereas plants grown in cocopeat produce the fewest flowers per plant (20.85). The result might be due to both the physical and the chemical properties of mixed media which can increase flowering numbers. Similar observation was also reported by Sharma and Godara [11]. With regards to varieties California Wonder gave the maximum number of flowers per plant (29.29) and Mahabharath gave the lowest number of flowers per plants (24.97). It was revealed from the present experiment that, the 50 percent fruit set shows the significant differences among the various growing media. The combination of cocopeat and vermicompost took the lowest number of days (98.91) to 50% fruit set, whereas cocopeat took the highest number of days (114.47). The result may be due to their inherited characters, and the early adaptation to the growing media to enhance their growth and development. This agrees with the report of [10]. Among different varieties Indrani gave earliest 50 percent fruit set (102.06) days after transplanting, and California Wonder takes longer time (107.64) days. Among the number of fruits per plants a highly significant difference was found between growing media and varieties. The maximum number of fruits per plant of (14.86) was obtained when the mixture of cocopeat + vermicompost was used as the growing medium. Number of fruits per plant was lowest (7.49) with cocopeat as growing medium. 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 [12] also found the same result that mixture of different growing media has a significant effect on total number of fruits per plant in pepper. Amongst the varieties California wonder produced the highest number of fruits per plant (12.90), while Mahabharath produced the lowest (10.99). In the Table 3 shows that there was statistically significant ($P<0.05$) effect of different growing media as well as different varieties on days to first marketable harvest. The plants grown in a cocopeat+vermicompost combination took the fewest days (122.13 days) to yield marketable fruits. The present investigation gets support from Indirabai and Sujapratha [13] who also finds that vermicompost contains a high amount of nutrients, and can help plants to promote growth, advance flowering, and fruiting in lady's finger. Amongst the varieties Indrani took the least number of days to produce first marketable fruits (126.58 days) and California Wonder took longest to produce first marketable fruits (131.57) days. The current experiment revealed that the different parameters such as fruit length, fruit diameter pericarp thickness and locule numbers of fruits varied is significantly across the treatments. The fruit length (9.11cm) fruit diameter of (7.44 cm) pericarp thickness of (0.72 cm) and locule number (4.47) were recorded in cocopeat+ vermicom post. Vamsi et al. [14] also reported a significant effect of the mixture cocopeat + vermicompost + FYM + Neem Cake on different fruit characters. Among all the varieties Mahabharath showed the highest fruit length of (7.93) cm, highest fruit diameter of (6.62) cm, maximum pericarp thickness of (0.70) cm and variety California wonder shows maximum locule number of (3.85). For locule number, the effect of variety was significant. The Mahabharath variety had the lowest locule number (3.53). The locule number from each growing medium was statistically significant. Vermicompost (3.49) and cocopeat (3.47) were the next most common growth media, with the combination of cocopeat + vermicompost having the highest locule number (4.00). The result may be due to genotypic potential of the varieties and their differential response to soilless culture. Similiar report was also reported by Shrestha and Kang [15]. The best-performing medium, a mixture of cocopeat and vermicompost,

produced fruit with an average weight of (134.98) g. The least fruit weight (108.15 g) was produced when cocopeat is used as growing medium. This may have been due to a high nutritional intake rate, and the development of adequate photosynthesis which allowed fruits to grow in size (length and breadth). Similar results were noted by Subramani et al. [16]. Among the different varieties, Mahabharath had highest fruit weight (132.31) g, while California Wonder produced lowest fruit weight of (113.00) g. Growing media showed significant effect on the crucial aspect of fruit weight per plant. Maximum fruit weight per plant of (2.03) kg was obtained from the mixture of cocopeat+vermicompost. While plants grown in Cocopeat produced the lowest fruit weight per plant of (0.83) kg. The result may be due to a high nutritional intake rate, and the development of adequate photosynthesis, which allowed fruits to grow in size (length and breadth). Similar results were noted by Kurubetta et al. [17]. Among all the varieties Mahabharath produced the highest fruit weight per plants (1.55) kg .While, Indrani gave the lowest fruit weight of (1.45) kg. Fruit weight per plant was significant varied among the variety as well as growing media. The highest fruit weight per plant of (2.03) kg was obtained in mixture of cocopeat + vermicompost which was closely followed by vermicompost alone has 1.63 kg. Whereas the lowest fruit weight per plant was produce from

Table 3. Influence of Growing media and variety on different yield and yield attributing characters

Treatments	Days to first flowering (Days	50% flowering (Days)	No. of flower/ plant	50% fruit set (Days)	No. of fruits/ plant	Days to first marketable harvest (Days)
Cocopeat	83.82	95.03	20.85	114.47	7.49	138.41
Vermicompost	73.42	85.50	26.73	100.48	13.43	126.19
Cocopeat + Vermicompost (1:1)	72.55	83.95	34.15	98.91	14.86	122.13
SE (m) ±	0.53	0.49	0.44	0.49	0.16	0.41
C.D (P=0.05)	1.58	1.47	1.34	1.47	0.49	1.22
Indrani	73.78	85.64	27.47	102.06	11.89	126.58
Mahabharath	76.02	87.83	24.97	104.16	10.99	128.58
California Wonder	79.98	91.00	29.29	107.64	12.90	131.57
SE (m) ±	0.53	0.49	0.44	0.49	0.16	0.41
C.D (P=0.05)	1.58	1.47	1.34	1.47	0.49	1.22

Table 4. Influence of Growing media and variety on different yield and yield attributing characters

Treatments	Fruit length (cm)	Fruit diameter (cm)	Pericarp thickness (mm)	Locule number	Fruit weight (g)	Fruit weight/plant (kg)
Cocopeat	5.54	4.50	0.64	3.47	108.15	0.83
Vermicompost	6.86	5.95	0.64	3.49	120.86	1.63
Cocopeat + Vermicompost (1:1)	9.11	7.44	0.72	4.00	134.98	2.03
SE (m) ±	0.08	0.08	0.01	0.06	0.64	0.02
C.D (P=0.05)	0.25	0.25	0.03	0.19	1.94	0.06
Indrani	6.97	5.97	0.65	3.57	118.69	1.45
Mahabharath	7.93	6.62	0.70	3.53	132.31	1.55
California Wonder	6.61	5.29	0.65	3.85	113.00	1.50
SE (m) ±	0.08	0.08	0.01	0.06	0.64	0.02
C.D. (P=0.05)	0.25	0.25	0.03	0.19	1.94	0.06

cocopeat (0.83) kg. The outcome may be due to varying genotypic potential of the varieties along with their varying responses to soilless culture. According to Vogel and Schodel [18] crops cultivated in soilless culture yielded 75% more than crops grown traditionally [19].

4. CONCLUSION

Based on the results obtained in present studies, all the growth parameters expect numbers of branches on main stem were significantly higher in M3 (1:1 mixture of cocopeat + vermicompost). Accordingly the variety the highest plant height and numbers of leaves was recorded higher from variety Indrani apart from this number of branches on main stem and leaf area were higher in California Wonder variety. For the yield parameters the study revealed that the earliest variety to attain days to first flowering, days to 50% flowering, days to 50% fruit set, days to first marketable harvest were recorded from Indrani variety in growing media M3. California Wonder variety produced the highest number of flowers/plant, fruits/plant, and locule number in growth media M3. In the same way, the Mahabharath variety using the growth medium M3 had higher fruit length, fruit diameter, pericarp thickness, fruit weight, and fruit weight/plant. Based on the result it may be concluded that for the growth and yield parameters growing substract M3 can be successfully used to obtain better growth and yield of Capsicum in soilless cultivation.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Khan AL, Shinwar ZK, Kim Y, Waqas M, Hamayun M, Kamran M, Lee I. Role of endophyte Chaetomium globosum lk4 in growth of Capsicum annuum by production of gibberellins and indole acetic acid. Pakistan J. Botany. 2012;44(5):1601-1607.
2. Thapa Umesh, Mondal Reva, Mallick Debolina, Das Asim. Standardization of growing media for growth , yield and quality of sweet pepper (*Capsicum Annuum*) under soilless culture. An International Quarterly journal of enviromental sciences. 2016;(9):395-400.
3. Butler JD, Oebker NF. Hydroponics as a Hobby- Growing Plants without Soil. Circular 844. Information Office, College of Agriculture, University of Illinois, Urbana, IL 61801; 2006.
4. Bilderback TE, Warren SL, Owen Jr JS, Albano JP. Healthy substrates need physicals too. Hort. Tech. 2005;15:747-751.
5. Mastouri F, Hassandokht MR, Padasht Dehkaei MN. The effect of application of agricultural waste compost on growing media and greenhouse lettuce yield. Acta Horticulturae. 2005;697:153-158.
6. Brunda SN, Devi Singh. Effect of different growing media on capsicum growth, yield and quality under polyhouse condition. The Pharma Innovation Journal. 2005;12(5): 1421-1424.
7. Roy S, Kumar N, Singh DK, Srivastava AK. Effect of organic growing media and crop geometry on growth and yield of capsicum var. California wonder under protected condition in North West Himalayas. Vegetable Science. 2011;38(1):53-57.
8. Dash madhab Rudra, Patra Sailendri Kumari, Jena Subhendu, mund Swagat Ranjan. Effect of FYM, Vermicompost and Cocopeat and yield of African marigold (*Tagetes Erecta L*.) cv. Sirakole Int. J. Curr. Microbiol. App. Sci. 2021; 10(03):1402-1408.
9. Singh Vishal, VM Prasad, Kasera Saurabh, Singh Bhanu Prakash, Mishra Sudhir. Influence of different organic and inorganic fertilizer combinations on growth, yield and quality of cucumber (*Cucumis sativus* L.) under protected cultivation Journal of Pharmacognosy and Phytochemistry. 2017;6(4):1079-1082.
10. Hazarika Mainu, Saikia Jumi, Gogoi Sailen, Kalita Prakash, Luchon Saikia, Phookan B Deepa, Kumar Praveen. Different growing media effect on seedling quality and field performance of Tomato (*Solanum lycopersicum* L.). The Pharma Innovation Journal. 2022;11(11):308-314.
11. Sharma Kumar Vikas, Godara Kumar Anil. Effect of substrate mixtures on precocity and flower development in strawberry potted plants. Journal of Pharmacognosy and Phytochemistry. 2017;6(5):2406-2412.
12. Gungor F, Yildirim E. Effect of different growing media on quality, growth and yield of pepper (*Capsicum annuum* L.) Under greenhouse conditions. Pakistan J. Botany. 2013;45(5):1605-1608.
13. Indirabai WPS, Sujapratha PSR. Vermicompost of waste by the earthworm,

Lampito mauritii for kitchen garden The Ecoscan. 2009;3(3&4):231-234.

14. Vamsi B, Ravindra Babu M, Aparna D, Peda Babu B. Studies on effect of different growing media combinations on growth, yield and quality of parthenocarpic cucumber (*Cucumis sativus* L.) in soilless cultivation under naturally ventilated polyhouse. The Pharma Innovation Journal. 2021;10(8):1767-1770.
15. Shrestha Surendra lal, kang wonhee. Growth, yield and quality of Tomato (Lycopersicon esculentum) cultivars through stem cutting on coco substrate under greenhouse condition. International Journal of Horticulture, Agriculture and food science (IJHAF). 2018;2(5):182-189.
16. Subramani T, Gangaiah B, Baskaran V, Swain S. Effect of soilless growing media on yield and quality of tomato (*Solanum lycopersicum* L.) under Tropical Island Condition International Journal of Current Microbiology and Applied Sciences. 2020:2084-2090.
17. Kurubetta Y, Patil AA. Performance of coloured capsicum hybrids under different protected structures. Karnataka J. Agri. Sci. 2008;22(5):1058-1061.
18. Vogel G, Schodel S. Beneficial consequences in the soilless cultivation of vegetables in the field.Gartenbau Magazine. 1992;1(10):43-45.
19. Gruda N. Do soilless culture systems have an influence on product quality of vegetables? J. Applied Botany and Food Quality. 2009;82:141-147.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/107914