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Effect of various potting media on growth and development of Chilli (*Capsicum annuum* L.) seedlings for grafting

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Abstract
The field experiment was conducted at Department of Vegetable Science, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli (M.S.) during the *rabi* season 2020-21. In experiment Factor A consisted sterilized (S_0), non-sterilized (S_1) potting media and Factor B consisted four different media i.e. M_1: Cocopeat (100%), M_2: Cocopeat (75%) + vermicompost (25%), M_3: Cocopeat (75%) + Rice husk (25%) and M_4: Cocopeat (75%) + Saw dust (25%). For rootstock seedlings the interaction S_1M_2 found superior with minimum days required for germination (8.00), maximum height (14.88 cm), Diameter at collar region (1.81 mm), Plant spread (10.73 cm), length of tap root (6.68 cm), number of adventitious roots (29.93), fresh weight (216.0 mg), dry weight (28.10 mg), graftable seedling percentage (92.49%) and minimum number of days required for graftable stage (51.74). For scion seedlings the interaction S_1M_2 gives best results with early germination (7.00), highest height (19.96 cm), Diameter at collar region (1.78 mm), Plant spread (10.63 cm), length of tap root (5.33 cm), number of adventitious roots (24.53), fresh weight (591.0 mg), dry weight (37.65 mg), graftable seedling percentage (98.24%) and early graftable stage (44.03 days).

Keywords: Chilli, potting media, sterilization, grafting, rootstock, scion

Introduction
Chilli (*Capsicum annuum* L.) belongs to the family solanaceae having diploid species with 2n=2x=24 chromosomes. Thirty wild species and five cultivated species namely *Capsicum annum*, *C. baccatum*, *C. chinensis*, *C. frutescens* and *C. pubescens* in genus *Capsicum* have been reported (Dewitt and Bosland, 1996). Chilli cultivation has various limiting factors such as abiotic i.e. water stress, heavy rains, lodging due to weak root growth, salt concentration, chilling injury, high temperature and biotic *i.e*. soil borne diseases, viruses, sucking pests and nematodes etc. Also, there are challenges regarding production cost and marketing trends in India. These abiotic and biotic factors are damages growth as well as production of chilli. To increase the area and productivity of chilli production it is essential to mitigate these problems with desirable effects. To tackle most of biotic and abiotic stresses, grafting in chilli can be the effective solution. Grafting can also be used to increase yield, improve fruit quality, and extend harvest times, as well as reduce agrochemical applications (Colla *et al*., 2010) [6] and improve the commercial quality of vegetable crops.
Though growing media provides support and nutrient for seedling growth, many times growing media is the ultimate reservoir of all disease microorganisms which attacks the crops (Baker 1967a.) [3]. The micro-organisms include beneficial as well as harmful i.e., soil- borne plant disease causing organisms e.g. *Pythium* spp. To eliminate soil-borne pathogens and weed to obtain healthy growth of seedling, it is essential to sterilize the soilless media. For seedlings production and creation of physical union by physical manipulation there is requirement of quality scion and rootstocks seedling to make easy and successful grafting.

Material and Method
The experiment was carried out at High-Tech Unit, College of horticulture, Dapoli, District Ratnagiri (M.S.). Days required for germination and for graftable stage were counted from date of sowing in each treatment while other observations *viz.* height of seedling (cm), diameter at collar region (mm), number of functional leaves, plant spread (cm), length of tap root (cm), number of adventitious roots, fresh weight (mg) and dry weight (mg) were recorded by randomly selecting ten seedlings and tagged in each treatment in three replications of scion

as well as rootstock and periodical observations at an interval of 7 days during experimentation. The data obtained for all the parameters were analysed statistically as per the method prescribed by Panse and Sukhatme (1995) [18].

Result and Discussion

Rootstock seedlings

The potting media M_2 - Cocopeat @ 75% + Vermicompost @ 25% with sterilization (S_1) recorded early germination (8.00 days) with maximum height of seedling (14.88 cm), diameter at collar region (1.81 mm), plant spread (10.73 cm), length of tap root (6.68 cm), number of adventitious roots (29.93), fresh weight (216.03 mg), dry weight (28.10 mg), minimum days for graftable stage (51.47 days) and highest graftable seedling percentage (92.49%) at 49 days after germination but maximum (7.70) number of functional leaves was recorded in S_0M_2. Whereas, late germination (9.67 days) with minimum height of seedling (7.66 cm), diameter at collar region (1.10 mm), number of function leaves (5.67), plant spread (7.85 cm), length of tap root (4.48 cm), number of adventitious roots (17.40), fresh weight (105.00 mg), dry weight (10.93 mg), more number of days (75.07 days) for gaftable stage and lowest graftable seedling percentage (75.53%) in non-sterilized (S_0) potting media M_1 – Cocopeat @ 100% at 49 days after germination.

The all desired values of observations under study was recorded superior in treatment S_1 – Sterilized + M_2 – Cocopeat @ 75% + vermicompost @ 25% potting media for rootstock seedlings might be due to the difference in the availability of the aeration, moisture and congenial condition for seed germination. More height of rootstock seedlings might be due to increased aeration, water holding capacity and nutrient content by vermicompost with healthy environment. Diameter at collar region of rootstock seedlings was highest could be due to the vermicompost improves the physical and chemical properties with sterilization of potting media. Maximum number of functional leaves might be due to fast uptake of nutrition from vermicompost. Maximum plant spread could be due to the availability of nutrients in growing substrate greatly affects the size of leaves and water holding capacity favourable for emergence and expansion of leaves. Maximum length of tap root might be due to Vermicompost with cocopeat improve soil porosity, water content, pore of drainage, media permeability and water availability. Maximum number of adventitious roots could be due to the good physical and biological conditions in cocopeat with vermicompost. Maximum fresh weight of rootstock seedlings might be due to more vigour of seedlings in terms of seedlings height, diameter and other growth parameters under study. The maximum dry weight of rootstock seedlings was recorded in S_1M_2 could be due to the vermicompost increased light use efficiency and overall growth of the seedlings which gives increased dry weight of seedlings. The early graftable stage of rootstock seedlings in sterilized potting media might be due to availability of congenial condition which effect on all growth parameters. The minimum days required for graftable stage in M_2 - cocopeat @ 75% + vermicompost @ 25% could be due to high rate of seedlings growth and maximum growth parameters like seedlings height, diameter at collar region likely it was increased graftable seedling percentage.

This results were supported by the findings given by different scientist regarding different observation like Markovic *et al*. (1995) in pepper and tomato, Dagan and Aback (2003), Adediran (2005) [1] in tomato and lettuce, Lee *et al*. (2010) [11] in watermelon, brinjal and tomato, Demir *et al*. (2010) [8] in pepper, Unal *et al*. (2013) [22] in growth of vegetable seedlings, Rahimi *et al*. (2013) [20] in sweet pepper, Vivek and Duraisamy (2017) [23] in tomato, Mathowa *et al*. (2017) [13] in sweet paper, Ziest (2017) [24] in tomato, Radha *et al*. (2018) [19] in chilli, Bhardwaj *et al*. (2019) [5] in brinjal, Palada and Wu (2019) [17] in sweet pepper, Nagma Surve (2019) [15] in brinjal, Nirmal, (2019) [16] in chilli seedlings, Bantie *et al*. (2020) in watermelon scion and squash rootstock and Rayker (2020) [21] in brinjal.

Scion seedlings

The early germination (7.00 days) with highest height of seedling (19.96 cm), diameter at collar region (1.74 mm), plant spread (10.63 cm), length of tap root (5.33 cm), number of adventitious roots (25.53), fresh weight (216.03 mg), dry weight (37.65 mg), minimum days for graftable stage (45.20 days) and highest graftable seedling percentage (98.24%) were observed in treatment S_1 - sterilized + M_2 - Cocopeat @ 75% + Vermicompost @ 25% potting media but maximum number of functional leaves were recorded in S_0M_2 at 42 days after germination. While in S_0 - non sterilized potting media M_4 – Cocopeat @ 75% + Saw dust @ 25% were noticed late germination (8.33 days) and lowest height of seedling (10.54 cm), diameter at collar region (1.13 mm), number of functional leaves (5.67), plant spread (8.95 cm), length of tap root (4.25 cm), number of adventitious roots (16.20), fresh weight (141.67 mg), dry weight (14.37 mg) with maximum number of days required for graftable stage (64.63 days) and minimum graftable seedling percentage (85.29%) at 42 days after germination.

Scion seedlings showed good performance in S_1 – Sterilized potting media with M_2 - cocopeat @ 75% + vermicompost @ 25% could be due to difference in the availability of the aeration, moisture and congenial condition for germination. Height of scion seedlings was maximum could be due to sterilized media with high nutrient content available in vermicompost. Highest diameter at collar region of scion seedling might be due to its richer nutritional status which enhanced photosynthetic activity resulted in stored more plant food material which increasing seedlings girth. In S_0M_2, maximum functional leaves were recorded which might be due to cocopeat mixtures with organic substrates such as vermicompost enhanced the production of leaves. Maximum plant spread recorded could be due to the availability of nutrients in growing substrate greatly which affects the size of leaves and availability of good properties of media namely pH value, EC value and NPK content. Maximum length of tap root might be due to vermicompost with cocopeat improve media aggregation and air flow in the media, this type of condition provide support to fast growth of the seedlings due to availability of better nutrition with water and air in root zone. The maximum number of adventitious roots was might be due to the good physical and biological conditions in cocopeat and vermicompost had positive effect on root development. Maximum fresh weight of scion seedlings could be due to more vigour of seedlings in terms of seedlings height, diameter and other growth parameters under study. The maximum dry weight of scion seedlings could be due to the more absorbed photo synthetically active radiation, micro and macro nutrients, light use efficiency and photosynthetic rate, which had resulted in to significant improvement in dry matter production. The minimum days required for graftable

stage in M_2 - cocopeat @ 75% + vermicompost @ 25% could be due to high rate of seedlings growth and maximum growth parameters like seedlings height, diameter at collar region with highest graf table seedling percentage.

This results also supported by Markovic *et al*. (1995) in tomato and pepper, Atiyeh *et al*. (2000) [2] observed in tomato, Dagan and Aback (2003) in pepper, Adediran (2005) [1] in tomato and lettuce, Nadia *et al*. (2007) [14] in tomato, Demir *et al*. (2010) [8] in pepper, Lee *et al*. (2010) [11] in watermelon, brinjal and tomato, Khah (2011) in brinjal, Rahimi *et al*. (2013) [20] in pepper. Unal *et al*. (2013) [22] in tomato, Vivek and Duraisamy (2017) [23] in tomato, Mathowa *et al*. (2017) [13] in sweet pepper, Bhardwaj *et al*. (2019) [5] in brinjal, Bantie *et al*. (2020) in watermelon scion and squash rootstock seedlings, Nirmal, (2019) [16] in Chiili seedlings, Nagma Surve (2019) [15] in brinjal, Palada and Wu (2019) [17] in sweet pepper and Rayker (2020) [21] in brinjal.

Present study revealed that, in (M_2) cocopeat (75%) + vermicompost (25%) attained graftable stage at 49 DAG and 42 DAG in rootstock and scion seedlings, respectively. Obtaining healthy, vigorous seedlings which is further utilized for grafting purpose is the important aspect in any nursery programme. In present investigation one of the objective was to obtain maximum percentage of graftable seedlings at shorter period of growth, Thus study revealed that, scion and rootstock seedlings for chilli grafting raised in sterilized M_2 – Cocopeat @ 75% + Vermicompost @ 25% potting media was 92.49% and 98.24% graftable respectively. Thus standard media found effective in enhancing growth of seedlings for obtaining maximum graftable seedlings.

Table 1: Effect of sterilization and potting media on rootstock seedlings

Treatment	Days required for germination	Height of seedlings (cm)	Diameter at collar region (mm)	Number of functional leaves	Plant spread (cm)	Length of tap root (cm)
S_0M_1	9.33	7.66	1.10	5.67	7.85	4.48
S_0M_2	8.00	12.49	1.60	7.70	9.46	5.33
S_0M_3	9.33	9.45	1.25	6.00	8.46	4.62
S_0M_4	9.67	8.53	1.21	5.70	8.24	4.54
S_1M_1	8.00	10.97	1.27	6.23	9.60	4.72
S_1M_2	8.00	14.88	1.81	6.97	10.73	6.68
S_1M_3	9.00	10.42	1.34	6.63	9.53	4.81
S_1M_4	9.00	11.07	1.27	6.80	9.58	4.71
Mean	8.79	10.68	1.36	6.46	9.18	4.99
S.Em	0.41	0.36	0.04	0.17	0.27	0.28
CD @ 5%	NS	1.10	NS	0.53	NS	NS
Treatment	Number of adventitious roots	Fresh weight (mg)	Dry weight (mg)	Days required for graftable stage	Graftable seedling percentage (%)	
S_0M_1	17.40	105.0	10.93	75.07	75.53	
S_0M_2	23.33	196.9	19.73	52.60	86.61	
S_0M_3	21.80	121.3	14.03	73.50	79.63	
S_0M_4	20.00	125.6	13.47	73.77	80.46	
S_1M_1	22.07	119.5	13.73	65.27	80.72	
S_1M_2	29.93	216.0	28.10	51.47	92.49	
S_1M_3	23.07	154.2	16.07	64.77	81.42	
S_1M_4	20.87	208.1	17.43	66.33	83.33	
Mean	22.31	155.8	16.69	65.35	82.53	
S.Em	1.04	5.8	1.43	1.36	0.52	
CD @ 5%	3.20	17.8	NS	4.18	1.61	

Table 2: Effect of sterilization and potting media on scion seedlings

Treatment	Days required for germination	Height of seedlings (cm)	Diameter at collar region (mm)	Number of functional leaves	Plant spread (cm)	Length of tap root (cm)
S_0M_1	8.00	11.93	1.02	6.23	9.38	4.80
S_0M_2	7.00	18.71	1.50	7.97	10.62	5.32
S_0M_3	8.33	11.72	1.11	6.20	9.27	4.85
S_0M_4	7.33	10.54	1.03	6.13	8.95	4.25
S_1M_1	7.33	15.31	1.13	6.60	10.74	4.88
S_1M_2	7.00	19.96	1.78	7.73	10.63	5.33
S_1M_3	8.00	13.82	1.18	6.70	9.31	5.23
S_1M_4	7.33	12.91	1.23	6.63	9.21	4.40
Mean	7.54	14.36	1.25	6.77	9.76	4.88
S.Em	0.38	0.29	0.05	0.13	0.41	0.07
CD @ 5%	NS	0.89	NS	NS	NS	NS
Treatment	Number of adventitious roots	Fresh weight (mg)	Dry weight (mg)	Days required for graftable stage	Graftable seedling percentage (%)	
S_0M_1	17.93	156.1	14.73	64.27	90.92	
S_0M_2	23.53	572.0	27.10	45.20	95.43	
S_0M_3	19.33	234.9	18.55	63.50	88.41	
S_0M_4	16.20	141.7	14.37	64.63	85.29	
S_1M_1	18.83	295.0	23.77	53.13	92.77	
S_1M_2	24.53	591.0	37.65	44.03	98.24	

S_1M_3	19.33	258.8	21.20	53.93	90.14
S_1M_4	19.67	261.7	20.87	54.83	88.79
Mean	19.92	313.9	22.28	55.44	91.25
S.Em	0.35	12.8	1.26	0.64	0.30
CD @ 5%	1.09	39.5	3.89	1.97	0.91

Conclusion

The sterilized potting media (S_1) for grafting was found superior with respect to various growth and development parameters under study in both rootstock and scion seedlings while, among different potting media M_2: cocopeat (75%) + vermicompost (25%) was most superior with respect to various parameters under study and took minimum days for attaining graftable stage as well as maximum graftable seedling percentage.

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