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Effect of Potting Media on Seedling Growth and Quality Parameters of *Prunus cerasoides* D. Don seedlings under Nursery Conditions

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Abstract: *Prunus cerasoides* D. Don. is an important multipurpose tree with a significant socio-religious and medicinal value. Keeping in the importance of this plant, a study was conducted to assess the impact of various potting media combinations on the seedling growth and quality parameters of *Prunus cerasoides* seedlings under nursery conditions. The seeds of *Prunus cerasoides* were sown in polybags filled with different potting media with seven treatments comprising various combinations of soil, sand and farmyard manure, and five replications in a completely randomized design to study their effect on seedling growth and quality parameters. Significant differences were observed in seedling growth parameters, shoot, root & total biomass, and quality parameters of *Prunus cerasoides* seedlings raised in different potting media in the nursery. The maximum growth of various seedling parameters viz., shoot length (101.50 cm), collar diameter (3.38 mm), root length (38.30 cm), number of roots (31.50), shoot fresh biomass (26.00 g seedlings^{-1}), root fresh biomass (16.20 g seedlings^{-1}), total fresh biomass (42.20 g seedlings^{-1}), shoot dry biomass (14.00 g seedlings^{-1}), root dry biomass (9.00 g seedlings^{-1}) and total dry biomass (23.00 g seedlings^{-1}) was recorded in seedlings raised in potting media composed of soil, sand, and farmyard manure (1:1:2) whereas minimum growth of various seedling growth parameters viz., shoot length (47.05 cm), collar diameter (1.29 mm), root length (22.30 cm), number of roots (21.20), shoot fresh biomass (2.33 g seedlings^{-1}), root fresh biomass (1.33 g seedlings^{-1}), total fresh biomass (3.66 g seedlings^{-1}), shoot dry biomass (1.37 g seedlings^{-1}), root dry biomass (0.67 g seedlings^{-1}) and total dry biomass (2.04 g seedlings^{-1}) was recorded in seedlings raised in potting media composed of nursery soil only. Similarly, the maximum value of volume index (343.07 cm^2) and least value of sturdiness quotient (30.03) was also observed in seedlings raised in potting media composed of soil, sand, and farmyard manure (1:1:2). However, the maximum value of root shoot ratio (0.82) was recorded in seedlings raised in potting media composed of soil, sand, and farmyard manure (3:1:1) and maximum value of quality index was recorded in seedlings raised in potting media composed of soil, sand, and farmyard

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manure (1:1:3). The study recommended raising of seedlings of *Prunus cerasoides* in soil, sand and farm yard manure (1:1:2) for production of quality nursery stock.

Key words: Quality parameters, quality index, volume index, sturdiness quotient, root shoot ratio.

Prunus cerasoides D. Don. is a deciduous plant with a significant ethno-botanical and therapeutic importance found in sub tropical to temperate regions of the Himalayas at an altitude of 1200-2400 m above mean sea level. In the local language, it is also known by the names "Pajja", "Padam", "Padmaka" etc. The geographical distribution of this tree ranges from Sikkim, Nepal, Bhutan, Myanmar, West China, Jammu and Kashmir, Himachal Pradesh and Uttarakhand. In India, this tree is found mainly in Shimla, Solan, Sirmaur, Mandi, Chamba and Kullu districts of Himachal Pradesh. It is a medium sized, deciduous tree which grows up to 30 m height. The color of the bark of this tree is brownish-grey which peels off in thin shinning horizontal strips. It flowers in autumn and winter, specifically in the month of October and November. It grows in association with the species *Pinus roxburghii, Aesculus indica, Rhododendron arboretum, Cedrus deodara, Rubus ellipticus, Berberis lycium, Urtica dioica, Indigofera heterantha* etc. It has a rich socio-religious importance in the temperate areas of Himachal Pradesh. The well-seasoned timber is valued for its durability and is used to make ornamental furniture, walking sticks and other handcrafted wooden items. Its fruit is edible and pulp is used to make cherry brandy (Tewari and Tewari, 2016). The leaves, twigs and fruits have many medicinal values viz., antioxidant, antimicrobial and anti-inflammatory activities. It is very common tree in middle forest and is representative of Himalayan cherry tree (Joseph *et al.*, 2018).

The seedlings of *P. cerasoides* are raised in polybags in the nursery by the forest department for the production of nursery stock for carrying out plantations. The quality of these seedlings is pivotal for their successful establishment in the field. The nursery managers often use various potting mixtures and soil amendments to optimize seedling growth. Selecting an appropriate potting medium is crucial, as it not only enhances seedling survival rates but also ensures the development of high-quality nursery stock. A well-formulated potting mix provides essential support, nutrients, water, and air to the root system, fostering healthy and vigorous seedlings. Utilizing quality nursery stock in plantation programs subsequently leads to improved seedling survival and promotes vigorous growth in the plantation area after out planting. Therefore, careful consideration of potting media composition is essential for the successful cultivation of Prunus cerasoides seedlings.

Selecting the optimal potting medium is essential for enhancing seedling survival rates and producing uniform, high-quality *Prunus cerasoides* nursery stock. The nursery growers are raising the seedlings for plantation without any proper standardized potting media due to which quality of nursery stock gets compromised. Therefore, the study was undertaken to standardize the proper potting media for the raising of quality planting stock that ensures better survival and growth of seedlings after out planting in field. While numerous studies (Badreshiya *et al.*, 2024) have examined the effects of various potting media on the growth performance of different forestry species, there is a lack of documented information specifically addressing *Prunus cerasoides*. To bridge this knowledge gap, the present study was undertaken to evaluate the impact of different potting media combinations on the growth and quality parameters of *P. cerasoides* seedlings. The objective was to identify the most suitable potting mixture that promotes optimal seedling development, thereby facilitating the production of superior planting stock in the nursery.

Material and Methods

The experiment on effect of different potting media on growth performance of *Prunus cerasoides* was carried out at Model Nursery, Baragaon of Himalayan Forest Research Institute, Shimla during 2020-2021. The experimental site is situated at N 31°04′ 14.3″ and E 77°10′ 15.7″ at 1800 m above msl. The texture of the nursery soil is clay loam, known for its moisture retention. The area experiences light snowfall and freezing temperature during winter months. The maximum temperature during summer months goes up to 32°C and minimum temperature during winter months goes down to -2°C.

The seeds of *P. cerasoides* collected from Ghanahatti area of Shimla district of Himachal

Pradesh were sown in the polybags of size 9"x 5". The polybags were filled with different combinations of potting mixtures having soil, sand and farm yard manure in different ratio so that the best potting media could be identified for the production of planting stock. The experiment consisted of seven treatments: (T1-Nursery Soil), (T2-Soil + sand + FYM in 1:1:1 ratio), (T3-Soil + sand + FYM in 1:1:2 ratio), (T4-Soil + sand + FYM in 1:1:3 ratio), (T5-Soil + sand + FYM in 1:2:1 ratio), (T6-Soil + sand + FYM in 2:1:1 ratio), and (T7-Soil + sand + FYM in 3:1:1 ratio). A total of 50 seeds treatment-1 (10 seeds x 5 replications) were sown in polybags at Model Nursery, Baragaon. The experimental trial was conducted in the nursery with seven treatments and five replications in a completely randomized block design (CRBD).

The watering of polybags containing seedlings was done as and when required during entire course of nursery trial. The seedlings were maintained in the nursery for two years. After that three seedlings from all replications of each treatment were randomly extracted during July, 2022 to study growth and biomass. The root system containing potting mixtures was thoroughly cleaned with water till all the particles of potting mixture washed away from the root system. The various seedling growth parameters such as shoot length, root length, collar diameter and number of lateral roots were recorded. The shoot length (cm) and root length (cm) were taken by measuring scale and collar diameter (mm) was taken by digital vernier caliper. After that, shoot and root were separated with a secateur and placed in the oven at 80°C till constant weight was recorded. The fresh as well as dry weight of shoot and root, and total biomass were recorded and root shoot ratio (on biomass basis) was calculated. The seedling quality parameters viz., sturdiness quotient, volume index, quality index and root shoot ratio were calculated as:

1. Sturdiness Quotient (Ritchie, 1984)

S.Q.=Height (cm)/Diameter (mm)

2. Volume Index (Hatchell, 1985)

V.I. = Diameter $(mm)^2$ x Height (cm)

3. Quality Index (Dickson *et al.,* 1961)

Q.I.= [Seedling dry weight]/[{Height (cm)/Diameter (mm)} + {Shoot dry weight(g)/Root dry weight(b)}]

4. Root Shoot Ratio = Root dry weight (g)/ Shoot dry weight(g)

The data of various growth parameters, shoot, root and total biomass of the seedlings were subjected to analysis of variance (ANOVA) to establish the significance of differences between the treatments. The critical difference (CD) was calculated for the variables studied using computer program "SPSS-16"- a statistical package for social sciences.

Results and Discussion

The effect of different potting media on various growth parameters, shoot and root biomass and seedling quality parameters of *Prunus cerasoides* and their trends have been presented in Table 1, 2 and 3, respectively. Perusal of data from the Tables reveals that potting media significantly influenced the different growth and quality parameters of *P. cerasoides* seedlings in the nursery.

The maximum shoot length (101.50 cm) was recorded in seedlings raised in potting media (T_3) composed of soil + sand + FYM (1:1:2) followed by T_4 (85.00 cm), T_2 (72.60 cm), T_5 (67.10 cm), T_6 (64.80 cm) and T_7 (63.00 cm) in decreasing order which are statistically at par with each other but significantly better than control (T_1). The minimum value of shoot length growth (47.05 cm) was recorded in seedlings raised in potting media composed of nursery soil (T_1). The maximum collar diameter (3.38 mm) was recorded in treatment T_3 followed by T_4 (2.70 mm), T_2 (1.80 mm), T_5 (1.54 mm), T_6 (1.45cm) and T_7 (1.42 mm). The minimum value of collar diameter was recorded in T_1 (1.29 mm).

The maximum root length (38.30 cm) was also recorded in seedlings raised in potting media (T_3) composed of soil + sand + FYM (1:1:2) which is at par with T_4, (31.20 cm), T_2 (29.10 cm), T_5 (27.00 cm) but significantly better than T_6 (26.03 cm), T_7 (25.30 cm) and T_1 (22.30 cm). The minimum value of root length (22.30 cm) was recorded in seedlings raised in potting media composed of nursery soil (T_1). The maximum average number of roots (31.5) was recorded in treatment T_3 followed by treatment T_4 (28.7), T_2 (26), T_5 (25), and are statistically at par with each other but significantly better than treatments T_6 (24.2), T_7 (22.2), and T_1 (21.2). The minimum number of roots (21.2) was recorded in seedlings raised in potting media composed

Table 1. Growth parameters of Prunus cerasoides seedlings as affected by different Potting Media under nursery condition (average of five replications)

Treatments	Shoot length (cm)	Collar diameter (mm)	Root length (cm)	Number of roots
T_1: Nursery soil	47.05^{c}	1.29^{c}	22.30^{c}	21.20^{c}
T_2: Soil + sand + FYM (1:1:1)	72.60^{cb}	1.80^{c}	29.10^{bc}	26.00^{ab}
T_3: Soil + sand + FYM (1:1:2)	101.50^{a}	3.38^{a}	38.30^{a}	31.50^{a}
T_4: Soil + sand + FYM (1:1:3)	85.00^{ab}	2.70^{ab}	31.20^{bc}	28.70^{ab}
T_5: Soil + sand + FYM (1:2:1)	67.10^{bc}	1.54^{c}	27.00^{c}	25.00^{bc}
T_6: Soil + sand + FYM (2:1:1)	64.80^{bc}	1.45^{c}	26.03^{c}	24.20^{abc}
T_7: Soil + sand + FYM (3:1:1)	63.00^{bc}	1.42^{c}	25.30^{c}	22.20^{bc}
p≤0.05	<0.001	0.01	<0.001	<0.001
SEm±	3.66	0.18	1.20	0.68
CD	19.08	1.16	6.89	3.43

Mean wile same letters are not significantly different @5% level of significance.

of nursery soil (T_1). Similarly, significant differences were observed in shoot, root, and total biomass production of *Prunus cerasoides* seedlings raised under different potting media in the nursery (Table 2).

The maximum fresh shoot biomass (26 g seedlings^{-1}) was recorded in seedlings raised in potting media (T_3) composed of soil + sand + FYM (1:1:2) which is at par with T_4 (15.68 g seedlings^{-1}), T_2 (8.34 g seedlings^{-1}), T_5 (8.13 g seedlings^{-1}) and T_6 (7.58g seedlings^{-1}) in decreasing order and are statistically at par with each other but significantly better than treatments T_7 (4.01 g seedlings^{-1}) and T_1 (2.33 g seedlings^{-1}). The minimum fresh shoot biomass (2.33 g seedlings^{-1}) was recorded in seedlings raised in potting media composed of nursery soil (T_1). However, maximum fresh root biomass (16.20 g seedlings^{-1}) was also recorded in seedlings raised in potting media (T_3) composed of soil + sand + FYM (1:1:2) which is at par with T_4 (9.51 g seedlings^{-1}), T_2 (5.44 g seedlings^{-1}), in decreasing order but significantly better than treatments T_5 (5.17 g seedlings^{-1}), T_6 (4.47 g seedlings^{-1}), T_7 (3.39 g seedlings^{-1}) and T_1 (1.33 g seedlings^{-1}). The minimum fresh root biomass (1.33 g seedlings^{-1}) was recorded in seedlings raised in potting media composed of nursery soil (T_1). The maximum value of total fresh biomass (42.20 g seedlings^{-1}) was recorded in seedlings raised in potting media (T_3) composed of soil + sand + FYM (1:1:2) which is at par with T_4 (25.19 g seedlings^{-1}), T_2 (13.78 g seedlings^{-1}), T_5 (13.30 g seedlings^{-1}), T_6 (12.05 g seedlings^{-1}) in decreasing order and are statistically at par with each other but significantly better than treatments T_7 (7.40

Table 2. Biomass of prunus cerasoides seedlings as affected by different potting media under nursery condition (average of five replications)

Treatment	Shoot fresh biomass (g plant^{-1})	Root fresh biomass (g plant^{-1})	Total fresh biomass (g plant^{-1})	Shoot dry biomass (g plant^{-1})	Root dry biomass (g plant^{-1})	Total dry biomass (g plant^{-1})
T_1: Nursery Soil	2.33^{c}	1.33^{b}	3.66^{c}	1.37^{b}	0.67^{b}	2.04^{b}
T_2: Soil + sand + FYM (1:1:1)	8.34^{bc}	5.44^{b}	13.78^{bc}	4.29^{b}	2.70^{b}	6.99^{b}
T_3: Soil + sand + FYM (1:1:2)	26.00^{a}	16.20^{a}	42.20^{a}	14.00^{a}	9.00^{a}	23.00^{a}
T_4: Soil + sand + FYM (1:1:3)	15.68^{ab}	9.51^{ab}	25.19^{ab}	8.47^{ab}	5.19^{ab}	13.66^{ab}
T_5: Soil + sand + FYM (1:2:1)	8.13^{bc}	5.17^{b}	13.30^{bc}	4.00^{ab}	2.64^{b}	6.64^{b}
T_6: Soil + sand + FYM (2:1:1)	7.58^{c}	4.47^{b}	12.05^{c}	3.95^{b}	2.37^{b}	6.32^{b}
T_7: Soil + sand + FYM (3:1:1)	4.01^{c}	3.39^{b}	7.40^{c}	2.26^{b}	1.85^{b}	4.11^{b}
P≤0.05	<0.001	<0.001	<0.001	0.01	0.01	0.01
SEm±	1.17	0.85	1.92	1.00	0.64	1.63
CD	5.95	4.38	8.99	6.21	4.09	10.18

Mean wile same letters are not significantly different @5% level of significance.

Table 3. Quality parameters of Prunus cerasoides seedlings as affected by different potting media under nursery condition

Treatment	Root: Shoot ratio	Sturdiness quotient	Volume index (cm^2)	Quality index
T_1: Nursery soil	0.49^b	36.47^a	60.69^b	0.05^a
T_2: Soil + sand + FYM (1:1:1)	0.63^b	40.33^a	130.68^b	0.17^a
T_3: Soil + sand + FYM (1:1:2)	0.64^{ab}	30.03^a	343.07^a	0.73^a
T_4: Soil + sand + FYM (1:1:3)	0.61^b	31.48^a	229.50^{ab}	1.41^a
T_5: Soil + sand + FYM (1:2:1)	0.66^b	43.57^a	103.33^b	1.15^a
T_6: Soil + sand + FYM (2:1:1)	0.60^{ab}	44.69^a	93.96^b	1.14^a
T_7: Soil + sand + FYM (3:1:1)	0.82^a	44.37^a	89.46^b	0.09^a
P≤0.05	0.02	0.47	<0.001	0.04
SEm±	0.03	4.38	23.95	0.07
CD	0.20	33.68	141.12	0.47

g seedlings^{-1}) and T_1 (3.66 g seedlings^{-1}). The minimum value of total fresh biomass (3.66 g seedlings^{-1}) was recorded in seedlings raised in potting media composed of nursery soil (T_1).

The maximum dry shoot biomass (14 g seedlings^{-1}) was recorded in seedlings raised in potting media (T_3) composed of soil + sand + FYM (1:1:2) which is at par with T_4 (8.47 g seedlings^{-1}), T_2 (4.29 g seedlings^{-1}), T_5 (4 g seedlings^{-1}) and T_6 (3.95 g seedlings^{-1}) and are statistically at par with each other but significantly better than treatments T_7 (2.26 g seedlings^{-1}) and T_1 (1.37g seedlings^{-1}). The minimum dry shoot biomass (1.37g seedlings^{-1}) was recorded in seedlings raised in potting media composed of nursery soil (T_1). However, maximum dry root biomass (9 g seedlings^{-1}) was also recorded in seedlings raised in potting media (T_3) composed of soil + sand + FYM (1:1:2) which is at par with T_4 (5.19 g seedlings^{-1}), T_2 (2.70 g seedlings^{-1}) and T_5 (2.64 g seedlings^{-1}) and are statistically at par with each other but significantly better than treatments T_6 (2.37 g seedlings^{-1}), T_7 (1.85 g seedlings^{-1}) and T_1 (0.67 g seedlings^{-1}). The maximum value of total dry biomass (23g seedlings^{-1}) was recorded in treatment T_3 followed by T_4 (13.66 g seedlings^{-1}), T_2 (6.99 g seedlings^{-1}), T_5 (6.64 g seedlings^{-1}), T_2 (6.32 g seedlings^{-1}) and are statistically at par with each other but significantly better than treatments T_7 (4.11 g seedlings^{-1} and T_1 (2.04 g seedlings^{-1}). The minimum value of total dry biomass (2.04 g seedlings^{-1}) was recorded in seedlings raised in potting media composed of nursery soil (T_1).

On the basis of values of various seedling growth parameters and biomass of the seedlings raised in different potting media, it clearly appears that addition of soil amendments in potting mixtures influences the growth of various seedling parameters and seedling biomass production in the nursery as compared to pure nursery soil. The seedlings treated only with nursery soil without any soil amendments exhibited poor performance in the nursery as compared to the seedlings treated with different soil amendments. This may be probably due to lesser availability of essential macro and micro nutrients in the nursery soil that is required for the proper growth of seedlings in the nursery. Therefore, potting media having soil: sand: farm yard manure in ratio of 1:1:2 is the best potting media for the production of quality nursery stock. The results are in conformity with the findings in *Picea smithiana* seedlings (Mugloo *et al.,* 2014) in which maximum height, collar diameter and biomass accumulation growth of seedlings were obtained in soil, sand and FYM at a 1:1:2 ratio as compared to nursery soil alone. Similarly, Minj *et al.* (2024) also observed increased growth parameters of *Cordia macleodii* seedlings raised in potting mixture consisting of soil, sand and FYM (1:1:2) as compared to control. Handa *et al.* (2005) also observed increased height, collar diameter, fresh and dry weight of seedling of *Albizia amara* raised in potting medium consisting of soil, sand and FYM in different combination (1:1:2 and 1:2:1). Further, this study is also in conformity with results obtained in *Albizia gummifera* and *Cordia africana* (Mulugeta, 2014) where shoot and root growth, number of roots, shoot and root dry weight and survival rate of seedlings were significantly influenced by potting mixture.

The seedling quality parameters which were calculated on the basis of various growth and biomass parameters are presented in Table 3 to evaluate the superiority of different potting

media in the nursery. Perusal of data reveals that maximum value of root shoot ratio (0.82) was observed in seedlings raised in potting media (T_7) composed of soil + sand + FYM (3:1:1) followed by T_5 (0.66), T_3 (0.64), T_2 (0.63) and minimum value (0.49) was recorded in seedlings raised in potting media composed of nursery soil (T_1). It is observed that plant species having a high root-to-shoot ratio have a greater ability to penetrate hard soil layers and thereby, result in more absorption of minerals and water from the soil. Thus, a higher root-shoot ratio contributes significantly to the better establishment and survival and subsequently promotes better shoot growth after planting in the field (Gedrock *et al.,* 1996; Chauhan and Sharma, 1997; Davis and Jacobs, 2005).

The least value of sturdiness quotient (30.03) was observed in treatment T_3 composed of soil + sand + FYM (1:1:2) followed by T_4 (31.48), T_1 (36.47), T_2 (40.33), T_5 (43.57), T_7 (44.37) and T_6 (44.69) in ascending order. The low sturdiness value helps in promoting vigorous growth of seedlings in plantations (Chauhan and Sharma, 1997).

The maximum value of volume index (343.07) was observed in treatment T_3 composed of soil + sand + FYM (1:1:2) followed by T_4 (229.50), T_2 (130.68), T_5 (103.33), T_6 (93.96) and T_3 (89.46) in decreasing order. The minimum value of volume index (60.69) was recorded in seedlings raised in potting media composed of nursery soil (T_1). The higher value of volume index contributes significantly towards better establishment, survival, and subsequently promotes better growth of seedlings after out planting in the field (Chauhan and Sharma, 1997). The highest value (1.41) of Dickson quality index was recorded in treatment T_4 composed of soil + sand + FYM (1:1:3) followed by T_5 (1.15), T_6 (1.14), T_3 (0.73), T_2 (0.17) in decreasing order and lowest value (0.05) was recorded in seedlings raised in potting media composed of nursery soil (T_1) and are statistically at par with each other.

The Dickson quality index usually indicates the overall quality of the seedlings; therefore, it is evident from the above values of quality index that seedlings raised in potting media consisting of soil, sand and farm yard manure (1:1:2) is the best potting media for raising of *P. cerasoides* seedlings in the nursery. The results have further indicated that among different potting media, best growth and maximum biomass of nursery stock was produced in above mentioned potting media. *P. cerasoides* seedlings raised in that potting media also produced good values of various growth parameters viz., shoot length, root length, collar diameter, number of roots and total fresh and dry biomass of seedlings raised in potting media consisting of soil, sand and farm yard manure in ratio of 1:1:2 excelled over other potting media grown seedlings. This study is also in accordance with views of Grossnickle (2012) and Grossnickle and MacDonald (2018) in which they mentioned that the desirable level of seedling quality attributes ensures high survival capability, increases the speed with which plants overcome stress, and ensures successful seedling establishment in the field.

Conclusions

The findings of the present investigation reveal that *Prunus cerasoides* seedlings raised in potting media consisting of soil, sand and farm yard manure (1:1:2) produced maximum shoot length, root length, collar diameter, number of roots and biomass along with good values of root shoot ratio, sturdiness, volume index and quality index. Hence, it is concluded that seedlings of *Prunus cerasoides* should be raised in potting media consisting of soil, sand, and farm yard manure (1:1:2) for the production of quality nursery stock.

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