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Effect of Growing Media on Dry Matter Accumulation in the Seedlings of Ber (*Ziziphus mauritiana* var. rotundifolia)

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ABSTRACT

The media are composed of soil, organic matter, pond soil and sand for the fruit crop seedlings. The aim was to increase the porosity, the supplementation of the sand be carried out while the organic matter particularly, FYM and vermicompost added to enrich adequate nutrients for the seedling. A study on the effect of growing media on seedling growth of ber (*Ziziphus mauritiana* var. rotundifolia) was conducted during 2018-19 in the nursery at Experimental Orchard of CCS Haryana Agricultural University, Hisar. The media for the study were garden soil and sand with the different proportion of vermicompost, FYM and cocopeat constituting 16 treatments. The experiment was conducted in randomized block design. The results revealed that growing Media T_7 : Garden soil + FYM + VC + CP (3:1:1:1) improved the seedling height, stem girth, leaf area, fresh and dry weight of shoot and root. Media T_7 having Garden soil + FYM + VC + CP (3:1:1:1) found better in improving the dry matter accumulation in ber seedlings.

Key Words: Ber, Growing , Germination media, Growth, Seed, Seedling.

INTRODUCTION

Ber seedlings are raised and propagated in open field nurseries then transferred to orchards but ber has tap root system, which is injured when uprooting/ transporting the nursery plants to transplant in field. Good media management is basic requirement in the production of quality grown ber nursery plants. Optimum water holding capacity, electrical conductivity, pH, better aeration and organic matter of media may help in better seedling stand and growth of plants. Ber is commercially propagated by budding on the seedling rootstock of *Z. rotundifolia*. The seed stones are used to obtain seedling rootstock for budding. There are 2-3 seed kernel inside the endocarp of the drupe in each seed stone. The survival per cent of the plants under nursery depends on the aeration and water drainage, in the absence of which, the development of roots is suppressed and there are chances of occurrence of diseases like damping off (Beattie and White, 1992). Seed germination is also governed by the growing media, which not only acts as growing place but also as a source of nutrient for plant growth (Wilson *et al,* 2001).

Generally, the media are composed of soil, organic matter, pond soil and sand for the fruit crop seedlings. The aim was to increase the porosity, the supplementation of the sand be carried out while the organic matter particularly, FYM and vermicompost, added to enrich adequate nutrients for the seedling. Conventional soil mix sometimes thought to be a source of soil borne pests and diseases but the main purpose of media can be understood by understanding the relationship between the manure and rooting and it means that manure prompt better rooting (Akanbi and Togun, 2002). Soil medium was found best for the growth of mangosteen seedling as compared to the other

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media (Jawal *et al,* 1998). The medium formulated with top soil + poultry manure + river sand in 1:2:3 (v/v/v) ratios were found best for seedling qualities of African breadfruit (Baiyeri, 2003). Ratna *et al* (2006) working on banana cv. Raja Serai concluded that soil and sand medium was the most suitable medium for shoot and leaf growth of this banana.

The farmyard manure (FYM) seems to be directly responsible for increasing crop yield as it contains all the essential elements like nitrogen, phosphorus and potassium. Vermicompost, an eco-friendly natural fertilizer and rich in macro and micronutrients (Kaur, 2017). Cocopeat is conserved as a good growing media component with acceptable pH, electrical conductivity and other chemical attributes (Abad *et al*, 2002). It exhibited good physical properties (Evams *et al,* 1996). The initial level of potassium and sodium is usually high in cocopeat, so, the fertilization program should be adjusted carefully according to plant requirements. To grow ber seeds in the combination of soil and sand, FYM, vermicompost and cocopeat, requires careful examination of the growing media in a proportion or along. Therefore, the present experiment on the effect of growing media on dry matter accumulation of seedlings of ber (*Ziziphus mauritiana* var. rotundifolia) was planned

MATERIALS AND METHODS

The present study was conducted during 2018 in the experimental orchard of Department of Horticulture, CCS HAU Hisar in the nursery section. The geographical location of the field was 29.15˚ North and 75.68˚ East. The source of irrigation was a pond near the fruit nursery, CCS HAU Hisar. Hisar falls in the semi- arid region of Haryana felt rainfall greater than > 250 mm. Its maximum average temperature during 11th April to 17th April, 2018 was 34.94 ˚C, while minimum temperature was 18.31 ˚C. The relative humidity during this week was 64.10 per cent during morning, while 34.56 per cent during evening. This standard week did not receive any rainfall. From this week onwards *i.e.* 18th April to 30 May, 2018 the average maximum temperature increased from 36.77 ˚C to 43.53 ˚C, while the minimum temperature increased from 17.74 ˚C to 28.67 ˚C. Both relative humidity morning and evening steadily reduced from 1st week to 3rd week of crop growth but after this steadily increased up to 6th week, sharply decreased during 7th week and again increased up to 9th week. The relative humidity during morning and evening decreased steadily during 11th week and sharply increased during 12th week where rainfall occurs up to 13.69 mm. After this the relative humidity remains within same values. During the 15th week, the average rainfall was recorded as 10.96 mm. The maximum temperature from 12th standard week remain almost same *i.e.* 33.46 ˚C to 34.07 ˚C during 22nd week. The minimum temperature during 2nd standard week was 17.74 ˚C and remains same and was 25. 44˚C during 22nd week.

Total 16 treatments (Table 1) were prepared in three replications and studied in RBD for present investigation. Garden soil was taken from the Experimental Horticultural orchard. Sand was procured from local source near the orchard. Vermicompost was procured from Department of Agronomy. Cocopeat was purchased from Kanta Enterprises, Hisar. The combinations were prepared according the treatment details as given above. Observations were taken at 60, 90, 120, 150 days after sowing of seed and collaboration with Department of Soil Science on seedlings leaf area (cm^2), dry weight of shoot (g), dry weight of root (g).The randomized block design (RBD) is used to reduce the experimental error among observations of the same treatment by accounting for the differences among blocks (Panse and Sukhatme, 1954).Statistical analysis of the data was worked in OPSTAT available at hau.ac.in (http://14.139.232.166/opstat/default.asp) in randomized block design (Sheoran *et al,* 1998).

Table 1. Effect of different growing media on leaf area of ber per plant.

Treatment	Leaf area (cm^2) per seedling			
	60 DAS	90 DAS	120 DAS	150 DAS
T_1 : Garden soil + FYM (1:1)	99.59	274.59	444.63	587.20
T_2 : Garden soil + VC (1:1)	109.33	289.77	456.33	595.50
T_3 : Garden soil + CP (1:1)	93.24	269.50	412.08	536.11
T_4 : Garden soil + FYM + VC (2:1:1)	131.16	311.41	500.19	648.46
T_5 : Garden soil + FYM + CP (2:1:1)	117.37	304.99	473.13	622.17
T_6 : Garden soil + VC + CP (2:1:1)	141.49	335.46	542.06	707.73
T_7 : Garden soil + FYM + VC + CP (3:1:1:1)	165.73	377.08	558.81	726.92
T_8 : Garden soil	92.91	263.67	404.06	531.27
T_9 : Sand + FYM (1:1)	94.04	270.62	438.33	575.90
T_{10} : Sand + VC (1:1)	106.97	277.45	453.52	594.87
T_{11} : Sand + CP (1:1)	91.26	251.18	405.48	534.43
T_{12} : Sand + FYM + VC (2:1:1)	126.17	307.08	478.67	624.46
T_{13} : Sand + FYM + CP (2:1:1)	112.61	290.02	470.14	611.04
T_{14} : Sand + VC + CP (2:1:1)	136.18	319.82	503.33	654.92
T_{15} : Sand + FYM + VC + CP (3:1:1:1)	154.41	341.35	548.47	716.60
T_{16} : Sand	85.75	226.63	389.64	457.82
CD at 5%	17.62	41.10	35.58	41.78

RESULTS AND DISCUSSION

Effect of growing media on growth parameters

Height of the seedlings

The data (Fig.1) clearly indicated that significantly higher seedling height was observed under T_7 - Garden soil + FYM + VC + CP (3:1:1:1) *i.e.* 22.73, 47.90, 71.57 and 106.43 cm at 60, 90, 120 and 150 DAS, respectively over other treatments except T_{15} (Sand + FYM + VC + CP (3:1:1:1) at 120 DAS (69.17 cm) to which it was found statistically at par. This treatment was closely followed by T_{15} (Sand + FYM + VC + CP (3:1:1:1) and T_6 – Garden soil + VC + CP (2:1:1) with germination of seed sat every time of observation taken. The data clearly revealed that garden soil in combination with FYM, vermicompost and cocopeat contributed more in improved in height at different intervals as compared to other treatments. The lowest seedling height was observed in Media T_{16} – sand (13.43, 22.57, 39.23 and 63.53 cm) at 60, 90, 120 and 150 days after sowing. This might be due to the fact that FYM, vermicompost and cocopeat in the above media brought improvement in the physical and chemical properties of the rooting medium (Dileep *et al*, 1994).

Stem girth

The data (Fig.2) clearly indicated that the significantly higher stem girth was observed under T_7 : Garden soil + FYM + VC + CP (3:1:1:1)*i.e.* 6.53, 7.70, 9.53 and 11.27 mm at 60, 90, 120 and 150 DAS over other treatment except treatment T_{15} (Sand + FYM + VC + CP (3:1:1:1) to which it was statistically at par with stem girth *i.e.* 6.50, 7.57, 9.37 and 11.10 mm at 60, 90, 120 and 150 DAS, respectively. The data clearly revealed that garden soil in combination with FYM, vermicompost and cocopeat contributed more in improved in stem girth at different intervals as compared to other treatments. The lowest seedling girth was observed in Media T_{16} – sand (4.23, 5.03, 6.77 and 7.70 mm) at 60, 90, 120 and 150 days after sowing, respectively. The girth of stem was found increased due to

Table 2. Effect of different growing media on dry weight of shoot in ber seedlings.

Treatment	Dry weight of shoot (g)			
	60 DAS	90 DAS	120 DAS	150 DAS
T_1 : Garden soil + FYM (1:1)	0.97	3.52	10.43	14.92
T_2 : Garden soil + VC (1:1)	1.11	3.83	10.71	15.34
T_3 : Garden soil + CP (1:1)	0.80	3.22	9.88	13.05
T_4 : Garden soil + FYM + VC (2:1:1)	1.33	4.31	11.04	16.04
T_5 : Garden soil + FYM + CP (2:1:1)	1.25	4.12	10.74	15.70
T_6 : Garden soil + VC + CP (2:1:1)	1.50	4.43	11.37	16.42
T_7 : Garden soil + FYM + VC + CP (3:1:1:1)	1.58	5.57	11.47	16.78
T_8 : Garden soil	0.73	2.95	9.08	12.08
T_9 : Sand + FYM (1:1)	0.93	3.35	10.15	13.34
T_{10} : Sand + VC (1:1)	1.04	3.72	10.62	15.19
T_{11} : Sand + CP (1:1)	0.76	3.09	9.26	12.44
T_{12} : Sand + FYM + VC (2:1:1)	1.30	4.19	10.99	15.82
T_{13} : Sand + FYM + CP (2:1:1)	1.17	3.98	10.72	15.46
T_{14} : Sand + VC + CP (2:1:1)	1.41	4.38	11.28	16.28
T_{15} : Sand + FYM + VC + CP (3:1:1:1)	1.51	5.45	11.40	16.50
T_{16} : Sand	0.66	2.42	4.05	7.18
CD at 5%	0.12	0.25	0.27	0.43

action of different kind of enzymes present in the earth worm's body, the bioavailability of different nutrient present in vermicompost increased and lead to increased growth characters like plant height and stem girth. The vermicompost containing humid substances lead to higher levels of auxin activity lead to more cell division and more growth in terms of height and seedling girth (Canellas *et al*, 2002).

Leaf area

The data related to leaf area is presented in Table 1, which clearly indicated that leaf area per seedling of ber was found significantly higher in T_7 – Garden soil + FYM + VC + CP (3: 1: 1:1) *i.e.* 165.73, 377.08, 558.81 and 726.92 cm^2over other treatment except treatment T_{15} (Sand + FYM + VC + CP (3:1:1:1) with leaf area *i.e.* 154.41, 341.35, 548.47 and 716.60 cm^2 at 60, 90, 120 and 150 DAS and T_6 – Garden soil + VC + CP (2:1:1) with stem girth *i.e.* 542.06 and 707.73 at 120 and 150 DAS, respectively to which it was statistically at par. The leaf area in growing media T_7- Garden soil + FYM +VC + CP (3:1:1:1), T_6 - Garden soil + VC + CP (2:1:1) and T_{15} - Sand + FYM + VC + CP (3:1:1:1) *i.e.* 542.06 and 707.73 cm^2were found superior over all other growing media at 120 and 150 days after sowing, respectively. The lowest leaf area was observed in media T_{16} – sand (85.75, 226.63, 389.64 and 457.82 cm^2) at 60, 90, 120 and 150 days after sowing, respectively. This might be due to nutrient availability in vermicompost, FYM and Cocopeat enriched garden soil leading to higher production of photo synthetically functional leaves and higher leaf area due to growing media (Borah *et al,* 2008). The results are in confirmation with Kaur (2017).

Dry weight of shoot

The data (Table 2) which ndicated that significantly higher dry weight of shoot was found in T_7 – Garden soil + FYM + VC + CP (3:1:1:1) *i.e.* 1.58, 5.57, 11.47 and 16.78 g over other treatment except treatment T_{15} (Sand + FYM + VC + CP

Table 3. Dry weight of root under the influence of different growing media in ber.

Treatment	Dry weight of root (g)			
	60 DAS	90 DAS	120 DAS	150 DAS
T_1 : Garden soil + FYM (1:1)	0.14	1.78	4.15	5.79
T_2 : Garden soil + VC (1:1)	0.15	1.97	4.41	6.18
T_3 : Garden soil + CP (1:1)	0.13	1.64	3.75	5.25
T_4 : Garden soil + FYM + VC (2:1:1)	0.19	2.26	4.83	6.83
T_5 : Garden soil + FYM + CP (2:1:1)	0.18	2.11	4.60	6.59
T_6 : Garden soil + VC + CP (2:1:1)	0.20	2.38	5.09	7.09
T_7 : Garden soil + FYM + VC + CP (3:1:1:1)	0.22	2.48	5.21	7.32
T_8 : Garden soil	0.12	1.36	3.19	4.85
T_9 : Sand + FYM (1:1)	0.14	1.73	4.05	5.66
T_{10} : Sand + VC (1:1)	0.14	1.89	4.31	5.93
T_{11} : Sand + CP (1:1)	0.13	1.49	3.44	5.12
T_{12} : Sand + FYM + VC (2:1:1)	0.19	2.14	4.80	6.72
T_{13} : Sand + FYM + CP (2:1:1)	0.16	2.02	4.49	6.51
T_{14} : Sand + VC + CP (2:1:1)	0.20	2.37	4.96	6.91
T_{15} : Sand + FYM + VC + CP (3:1:1:1)	0.21	2.41	5.13	7.16
T_{16} : Sand	0.12	0.91	2.55	3.41
CD at 5%	0.03	0.11	0.19	0.18

(3:1:1:1) with dry weight of shoot *i.e.* 1.51, 5.45, 11.40 and 16.50 gat 60, 90, 120 and 150 DAS, respectively and T_6 – Garden soil + VC + CP (2:1:1) with dry weight of shoot *i.e.* 1.50, 11.37 and 16.42 g at 60, 120 and 150 DAS, respectively to which it was statistically at par. The lowest dry weight of shoot was observed in Media T_{16} – sand (0.66, 2.42, 4.05 and 7.18 g) at 60, 90, 120 and 150 days after sowing, respectively.

Dry weight of root

The data (Table 3) indicated that significantly higher dry weight of root was found in T_7 – Garden soil + FYM + VC + CP (3:1:1:1) *i.e.* 0.22, 2.48, 5.21 and 7.32 g over other treatment except treatment T_{15} (Sand + FYM + VC + CP (3:1:1:1) with dry weight of root *i.e.* 0.21, 2.41, 5.13 and 7.16 gat 60, 90, 120 and 150 DAS, respectively; treatment T_{14} (Sand + VC + CP (2 : 1 : 1) with dry weight of root *i.e.* 0.20 and 2.37 g at 60and 90 DAS, respectively; treatment T_{12} (Sand + FYM + VC (2:1:1) with dry weight of root *i.e.* 0.19 g at 60DAS, respectively and T_6 – Garden soil + VC + CP (2:1:1) with dry weight of root *i.e.* 0.20, 2.38 and 5.09 g at 60, 90 and 120 DAS, respectively to which it was statistically at par. The lowest dry weight of root was observed in media T_{16} – sand (0.12, 0.91, 2.55 and 3.41 g) at 60, 90, 120 and 150 days after sowing, respectively. Dry weight of root and shoot was affected by the growing media and was found higher under treatment T_7 where the Garden soil was mixed with vermicompost, FYM and cocopeat in 3:1:1:1 proportion as compared to T_{16} where only sand was used. The higher nutrient availability resulted into increased biomass production leading to higher fresh and dry weight of root and shoot in ber seedlings. The results are in confirmation with Shamet *et al* (1994) and Kaur (2017). The available nutrients might increase the production of auxin, gibberellins, cytokinins led to overall growth and dry matter accumulation of plants.

CONCLUSION

The results indicated that growing Media T_7: Garden soil + FYM + VC + CP (3:1:1:1) improved the seedling height, stem girth, leaf area, fresh and dry weight of shoot and root. Media T_7 having Garden soil + FYM + VC + CP (3:1:1:1) found better in improving the dry matter accumulation in ber seedlings.

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