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Studies on the effect of different growing media on survivability, root and shoot growth of dragon fruit (*Hylocereus polyrhizus* L.) cuttings

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Abstract
The present investigation "Studies on the effect of different growing media on survivability, root and shoot growth of dragon fruit (*Hylocereus polyrhizus* L.) Cuttings" was conducted during the year 2020-2021 at Centre of Excellence on Protected Cultivation and Precision Farming, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh. Media were used as purely as well as in different ratio compositions of 1:1 and 2:1:1 (v/v). The experiment had 16 treatments and was laid out in Randomized Block Design, which was replicated thrice. Application of Vermicompost + Soil (1:1) yielded the maximum root parameters, such as average number of primary and secondary roots (8.63 and 62.85), root thickness (0.27 mm), root volume (1.98 cc), root fresh and dry weight (2.62 and 0.68g). However, Vermicompost + Sand (1:1) took shortest time (24.21 days) to root initiation. Average length of root was found longest (24.19 cm) in the media combined with Soil + Sand (1:1). Different shoot growth parameters *i.e.* number of sprouts (5.60), shoot length (36.64 cm), fresh and dry weight of shoot (122.48 and 11.57 g), survival percentage (98.33%) and root to shoot ratio (0.059) was significantly recorded best under the treatment combination of Vermicompost + Soil (1:1) as compared to control. However, application of Soil + FYM + Vermicompost (2:1:1) registered the shortest time to sprout initiation.

Keywords: Dragon fruit, media, vermicompost, FYM, Saw dust, sand

Introduction

Dragon fruit [*Hylocereus undatus* (Webber) Britton and Rose], is a tropical climbing vine fruit crop belongs to the Cactaceae family, which has received worldwide recognition, first, as an ornamental plant and then as a fruit crop. It is also known as pitaya or pitahaya or strawberry pear or night blooming cereus. Dragon fruit has red or pink thornless skins, while its juicy flesh can range from white to magenta. The skin is covered with bracts or scales. The origin of *Hylocereus spp.* is in the tropical and subtropical forest regions of Mexico and Central and South America. Dragon fruit is considered a promising crop to be grown commercially in dry regions (Vaillant *et al.* 2005) [23]. Usually, dragon fruit is propagated sexually by seed and asexually by grafting and stem cutting. The easiest, cheapest and convenient method of propagating dragon fruit is by stem cutting. Though seed propagation method is very simple but seeds are not true to type due to cross pollination (Andrade *et al*. 2005) [1].

The growing medium plays an important role in the successful propagation and cultivation of dragon fruit. For obtaining high-quality cuttings the media composition (mixing sand with organic matter) can be an alternative as a growing medium for successful propagation. Healthy media compositions are one of the materials that can be used to increase the supply of nutrients in soil. Some commonly available media are soil, sand, FYM, vermicompost, saw dust, etc (Mubarok *et al*. 2017) [13]. Various inorganic and organic materials used as a growing medium provide nutrients to plants. Moreover, organic materials possess macro and micro-pores that are almost balanced with the air and water.

Materials and Methods

The present investigation entitled "Studies on the effect of different growing media on survivability, root and shoot growth of dragon fruit (*Hylocereus polyrhizus* L.) cuttings" was carried out during the year 2020-21 at Centre of Ecxellence on Protected Cultivation and Precision Farming, IGKV Raipur. The experiment was laid out in Randomly Block Design and replicated thrice. The planting material (Fresh dragon fruit cuttings) from one-year old stem sections of genotype Red into Red with 4-6 nodes each was procured from dragon fruit block, which is already existed at Centre of Excellence on Protected Cultivation and Precision Farming, located at College of Agriculture, IGKV, Raipur (C.G.). A total of 10 cuttings were taken in each treatment, which were treated in different media *viz.* soil, sand, saw dust, vermicompost, farm yard manure and their mixtures at different ratios by volume basis. Total of 16 different treatments were formed *i.e.* T_0-Soil (Control), T_1-Sand, T_2-Saw dust, T_3-Vermicompost, T_4-FYM + Soil (1:1), T_5-Soil + Sand (1:1), T_6-Soil + Saw dust (1:1), T_7-Sawdust + Sand (1:1), T_8-Vermicompost + Soil (1:1), T_9-Vermicompost + Sand (1:1), T_{10}-Vermicompost + Saw dust (1:1), T_{11}-Soil + Sand + Vermicompost (1:1:1), T_{12}-Soil + FYM + Vermicompost (1:1:1), T_{13}-Sand + FYM + Vermicompost (1:1:1), T_{14}-Soil + Saw dust + Vermicompost (1:1:1) and T_{15}-Sand + Saw dust + Vermicompost (1:1:1) to study their impact on root and shoot parameters of dragon fruit cuttings. Cuttings were planted in the media filled with grow bags, which were placed in partial shade. After planting all the cuttings, it was transferred to an open field and arranged accordingly. The planting was done in the first week of December. All the experimental cuttings were uniformly maintained and same cultured practices were provided *i.e.* fertilization, irrigation and plant protection measures during whole period of investigation. During the final harvest (120 DAP), root and shoot growth parameters were recorded

Results and Discussions
The results of experiment pertaining to various aspects of root and shoot growth parameters is summarized as follows:

Days taken to root initiation
A statistically significant differences was found among the growing media and their combined effect in terms of days to first root initiation (Table-1). The dragon fruit stem cuttings treated with various growing media revealed that T_9 - Verrmicompost + Sand (1:1) required minimum number of days (24.21) to root initiation, which was found non-significant difference with T_2-Sand having the mean value (24.55 days) under the present investigation.

Similarly, treatments T_{12} & T_8 and T_4, T_{13} & T_7 and T_{15} & T_{14} and T_{15} & T_5 having the respective days taken to root initiation 25.19 & 25.34 and 25.86, 26.13 & 26.17 and 26.95 & 27.43days were statistically at similar between each other at 5% level of significance. The maximum number of days (28.94 days) taken to root initiation was observed in T_0-Soil (control) compared to other treatments. Application of vermicompost to stem cuttings have stimulated the root initiation, elongation and root biomass (Tomati & Galli 1995) [22]. Media with better aeration is also responsible for conducting metabolic processes and improving root initiation, according to study of rooting performance in Sheanut tree by Yeboah *et al.* (2009) [26]. Similarly, Knight (1926) [9] also confirmed sand as medium was the most favoured for rooting in certain fruit crops.

Average number of roots per cutting
From the Table-1, it can be observed that the combination of T_8-Vermicompost + Soil (1:1) triggered highest average number of primary (8.63) and secondary roots (62.58). These average number of roots were comparable to the cuttings treated with T_{12}-Soil +FYM + Vermicompost (2:1:1) having the respective average no. of primary 8.45 and secondary roots 57.83 under the present investigation. The treatments T_6, T_7 & T_3 and T_9, T_{13}, & T_4 with average number of primary roots of 5.76, 5.93 & 6.12 and 7.58, 7.78 & 7.94 per cutting were statistically similar among each other at 5% LOS. In case of secondary roots, the treatments T_6, T_7 &T_3 and T_5, T_9 & T_{13} responded non-significant with each other at 5% level of significance. However, the minimum average number of primary (4.32) and secondary (22.37) roots were obtained in T_0-Soil (Control). The addition of vermicompost also improves soil physical, chemical and biological properties (Norman *et al.* 2005) [14]. The present findings with respect to average number of roots per cuttings in dragon fruit is in accordance with the findings of Sudarjat *et al.* (2018) [21].

Average length of root (cm)
Statistical analysis (Table-1) showed that the different media combinations significantly affected the average length of root. Among the various treatments, the maximum average length of root (24.19 cm) was recorded in T_5-Soil + Sand (1:1) media combination which was found statistically at par with the mean length registered in T_4, T_{11}, & T_{12} (22.87, 23.28 & 23.84 cm, respectively). Meanwhile, T_2-Saw dust (15.38 cm) registered lower root length which however, was non-significant different with the cuttings planted in T_1-Sand (16.74). The shortest average length of root (9.25 cm) was yielded in T_0-Soil (Control). This might be due to better synergistic effect leading to increased porosity and looseness in soil + sand combination, along with better water holding and retention capacity to prevent dessication of the cutting provision of an aerating agent so that air can circulate within the medium providing increased length of root. The cuttings that had longer root length was found smaller root numbers and vice-versa. This result is equivalent to result found by Sudarjat *et al.* (2018) [21] who also concluded soil + sand in dragon fruit cuttings showed longest average length of root. Bagel and Saraswati (1989) [5] also reported similar findings in pomegranate.

Root thickness (mm)
Root thickness differed significantly among different media and their combined effect (Table-2). The root thickness varied from 0.11 to 0.27 mm. The highest root mean thickness (0.27 mm) was obtained under the treatment T_8- Vermicompost + Soil (1:1) which was followed by $T_{12}$and T_{11} whose respective mean root thickness was 0.25 and 0.23 mm at 120 days after planting. The treatments T_1, T_2, T_6 & T_3 and T_{14}, T_5 & T_9 with the following mean root thickness 0.13, 0.14 & 0.15 and 0.19, 0.20 & 0.21 mm, respectively were confirmed non-significant between each other. Moreover, the treatments like T_2 & T_3 and T_{10} & T_5 and T_4 & T_{11} achieved the same mean root thickness value (0.15, 0.17 and 0.23 mm, respectively). However, the lowest mean root thickness per cutting (0.11 mm) was obtained in T_0-soil (control) at 120 DAP. This may be due to friable nature of rooting media, resulting good penetration enriched with available nutrients and ability of the plants to respond appropriately to nutrient availability in the medium which accelerate the root growth leading to development in root vascular cambium which is responsible for increasing root length, diameter and thickness. Similar findings are in agreement with Kumar *et al.* (2015) [10] on rooting of stem cutting of lemon and Rathwa *et al.* (2017) [19] in pomegranate.

Root volume (cc)

Significant differences among growing media with respect to root volume was observed in the dragon fruit cuttings at 120 DAP, which is presented in Table-2. Among the different medias T_8- Vermicompost +Soil (1:1) showed the maximum root volume (1.98 cc) which was statistically at par with T_{12}-Soil + FYM + Vermicompost (1:1:1) and T_{11}-Soil + Sand + Vermicompost (2:1:1) having the respective root volume 1.94 & 1.92 cc during the period of experiment. The minimum mean root volume (1.36 cc) was observed in T_0-Soil (Control). Media that produces greater number of roots in cuttings/plants than a controlled group of plants at a group optimum performs much better in nutrient uptake which significantly increase root volume (O'Brien, E.E. & Brown, J.S.) (2008) [15]. The present findings of root volume with respect to maximum average number of roots per cuttings with simultaneous increased root volume were also analogous with the findings of Sudarjat *et al.* (2018) [21] in dragon fruit cuttings.

Fresh weight of roots (g)'

The highest root fresh weight (2.62 g) was noted in T_8-Vermicompost + Soil (1:1) followed by T_{12}-Soil+ FYM+ Vermicompost (2:1:1) with mean 2.5 g which showed non-significant difference from each other but both were significantly different from other treatments (Table-2). The mean fresh weight of T_6-Soil + Saw dust (1:1) was slightly less (1.32 g), but that of T_0-Soil (Control) substantially lowest (1.32 g) among all other treatments. Similar findings with respect to highest fresh weight of roots was reported by Yadav *et al.* (2012) [25] in media containing Soil + Sand + Vermicompost + Vermiculite + Coco peat (1:1:1:1). The reason might be due to greater amount of N,P,K present in vermicompost compare to other growth media making it ideal than other media. Vermicompost with vast surface area increase microbial activities, provide strong absorbability and beneficial effect of increasing nutrient uptake leading to formation of more roots, higher accumulation of food material as well as longer root length and changes in amino acid metabolism during the regeneration of roots. Similarly, Mishra *et al.* (2014) [12] reported that maximum root fresh weight of acid lime was registered in rooting media containing soil + FYM + sand (1:1:1).

Dry weight of roots (g)

The dry weight of roots (Table-2) were significantly affected by different growing media. The results obtained for root dry weight ranged significantly from 0.25 to 0.68 g. A significant higher dry weight of root (0.68 g) per cutting was recorded in T_8- Vermicompost + Soil (1:1), which was statistically similar with T_{12}- Soil + FYM + Vermicompost (2:1:1) with mean value 0.64 under the present investigation. However, the lowest dry weight of root per cutting (0.22 g) was observed in T_0-Soil which did not show marked difference with T_1-Sand (0.25 g). It may be due to the application of vermicompost resulted in higher number of roots and root fresh weight, which might be the reason for corresponding increase in root dry weight. Khot *et al.* (2017) [8] reported highest root dry weight with media Soil + Vermicompost (1:1) in Bullock's Heart (*Annona reticulate* L.).

Table 1: Effect of different growing media on days to root initiation, average number of roots and average length (cm) of roots in dragon fruit cuttings

Treatments	Days taken to root initiation	Primary roots per cutting	Secondary roots per cutting	Average length of root (cm) at 120 DAP
T_0-Soil	28.94^{k}	4.32^{a}	22.37^{a}	11.07^{a}
T_1-Sand	24.55^{b}	4.59^{a}	27.38^{b}	16.74^{bc}
T_2-Saw dust	28.62^{jk}	5.38^{b}	30.85^{c}	15.38^{b}
T_3-Vermicompost	28.39^{j}	6.12^{cd}	36.59^{d}	17.73^{cd}
T_4-FYM + Soil (1:1)	25.86^{de}	7.94^{hi}	54.61^{i}	22.87^{gh}
T_5-Soil + Sand (1:1)	27.23^{gh}	7.12^{g}	51.38^{h}	24.19^{h}
T_6-Soil + Saw dust	26.51^{f}	5.76^{bc}	34.67^{d}	16.95^{c}
T_7- Saw dust + Sand (1:1)	26.17^{e}	5.93^{c}	36.34^{d}	18.23^{d}
T_8-Vermicompost + Soil (1:1)	25.34^{c}	8.63^{k}	62.85^{l}	22.55^{g}
T_9-Vermicompost + Sand (1:1)	24.21^{a}	7.58^{h}	51.73^{h}	19.08^{de}
T_{10}- Vermicompost + Saw dust (1:1)	27.64^{i}	6.63^{ef}	44.82^{f}	18.41^{de}
T_{11}-Soil + Sand + Vermicompost (2:1:1)	24.77^{b}	8.13^{ij}	57.83^{j}	23.28^{gh}
T_{12}-Soil + FYM + Vermicompost (2:1:1)	25.19^{c}	8.45^{jk}	60.77^{k}	23.84^{gh}
T_{13}-Sand + FYM + Vermicompost (2:1:1)	26.13^{e}	7.78^{hi}	52.57^{hi}	20.49^{f}
T_{14}-Soil + Saw dust + Vermicompost (2:1:1)	27.43^{hi}	6.86^{fg}	47.64^{g}	19.67^{ef}
T_{15}-Sand + Saw dust + Vermicompost (2:1:1)	26.95^{g}	6.34^{de}	41.43^{e}	18.86^{de}
S. Em±	0.11	0.13	0.94	0.47
CD @ 5%	0.32	0.38	2.73	1.37

1. DAP- Days After Planting
2. FYM-Farmyard manure
3. The superscript letters signifies that the treatment means with similar letters are not significantly different at 5% level of significance, while the means with different letters are significantly different at 5% level of significance. These letters have been affixed based on CD-value comparison of treatment means.

Table 2: Effect of different growing media on days to root thickness (mm), root volume (cc) root fresh weight (g) and root dry weight (g) of dragon fruit cuttings

Treatments	Root thickness (mm) at 120 DAP	Root volume (cc) at 120 DAP	Root fresh weight (g) at 120 DAP	Root dry weight (g) at 120 DAP
T_0-Soil	0.11^{a}	1.36^{a}	1.21^{a}	0.22^{a}
T_1-Sand	0.13^{ab}	1.42^{a}	1.60^{cd}	0.25^{ab}

T_2-Saw dust	0.14^{bc}	1.44^{a}	1.51^{c}	0.28^{b}
T_3-Vermicompost	0.15^{bcd}	1.66^{d}	1.64^{d}	0.36^{cd}
T_4-FYM + Soil (1:1)	0.23^{hi}	1.91^{hij}	2.35^{jk}	0.58^{hi}
T_5-Soil + Sand (1:1)	0.2^{efg}	1.84^{fgh}	1.83^{g}	0.47^{f}
T_6-Soil + Saw dust	0.15^{bcd}	1.54^{b}	1.32^{b}	0.33^{c}
T_7- Saw dust + Sand (1:1)	0.16^{cd}	1.56^{b}	1.62^{d}	0.34^{c}
T_8-Vermicompost + Soil (1:1)	0.27^{j}	1.98^{j}	2.62^{l}	0.68^{k}
T_9-Vermicompost + Sand (1:1)	0.21^{fgh}	1.86^{ghi}	1.97^{h}	0.52^{g}
T_{10}- Vermicompost + Saw dust (1:1)	0.17^{de}	1.76^{ef}	1.72^{ef}	0.42^{e}
T_{11}-Soil + Sand + Vermicompost (2:1:1)	0.23^{hi}	1.94^{hij}	2.11^{k}	0.62^{ij}
T_{12}-Soil + FYM + Vermicompost (2:1:1)	0.25^{ij}	1.92^{ij}	2.59^{l}	0.64^{jk}
T_{13}-Sand + FYM + Vermicompost (2:1:1)	0.22^{gh}	1.88^{ghi}	2.11^{i}	0.55^{gh}
T_{14}-Soil + Saw dust + Vermicompost (2:1:1)	0.19^{ef}	1.80^{efg}	1.81^{fg}	0.43^{ef}
T_{15}-Sand + Saw dust + Vermicompost (2:1:1)	0.17^{de}	1.74^{de}	1.68^{de}	0.39^{de}
S. Em±	0.007	0.03	0.03	0.01
CD @ 5%	0.02	0.08	0.09	0.04

1. DAP- Days After Planting
2. FYM-Farmyard manure
3. The superscript letters signifies that the treatment means with similar letters are not significantly different at 5% level of significance, while the means with different letters are significantly different at 5% level of significance. These letters have been affixed based on CD-value comparison of treatment means.

Table 3: Effect of different growing media on days to sprout initiation, average number of sprouts, shoot length (cm) and survival percentage (%) of dragon fruit cutiings

Treatments	Days to sprout initiation	Shoot Fresh weight	Shoot dry weight	Per cent survivability (%) at 120 DAP	Root to shoot ratio
T_0-Soil	56.83^{j}	70.38^{a}	6.64^{a}	75.83^{a}	0.033^{a}
T_1-Sand	54.42^{i}	74.56^{b}	6.83^{a}	80.83^{bc}	0.037^{b}
T_2-Saw dust	56.43^{j}	76.94^{c}	7.27^{b}	78.33^{ab}	0.039^{bc}
T_3-Vermicompost	52.62^{h}	87.14^{e}	8.06^{cd}	84.58^{de}	0.045^{def}
T_4-FYM + Soil (1:1)	40.17^{b}	116.64^{i}	10.67^{h}	93.75^{ij}	0.054^{ijk}
T_5-Soil + Sand (1:1)	45.35^{e}	105.58^{h}	9.05^{fg}	89.58^{gh}	0.052^{hi}
T_6-Soil + Saw dust	53.43^{i}	80.72^{d}	7.85^{c}	76.67^{a}	0.042^{cd}
T_7- Saw dust + Sand (1:1)	50.38^{g}	86.63^{e}	7.94^{c}	82.50^{cd}	0.043^{de}
T_8-Vermicompost + Soil (1:1)	37.83^{a}	122.48^{k}	11.57^{j}	98.33^{k}	0.059^{l}
T_9-Vermicompost + Sand (1:1)	43.67^{d}	106.74^{h}	9.38^{g}	91.67^{hi}	0.049^{gh}
T_{10}- Vermicompost + Saw dust (1:1)	49.67^{g}	97.55^{g}	8.84^{ef}	87.08^{efg}	0.047^{fg}
T_{11}-Soil + Sand + Vermicompost (2:1:1)	39.49^{b}	119.42^{j}	11.04^{i}	95.83^{jk}	0.056^{jkl}
T_{12}-Soil + FYM + Vermicompost (2:1:1)	37.31^{a}	124.53^{l}	11.23^{ij}	96.67^{k}	0.057^{kl}
T_{13}-Sand + FYM + Vermicompost (2:1:1)	41.26^{c}	115.93^{i}	10.45^{h}	92.92^{i}	0.053^{ij}
T_{14}-Soil + Saw dust + Vermicompost (2:1:1)	47.48^{f}	99.71^{g}	8.92^{f}	87.91^{fg}	0.048^{fg}
T_{15}-Sand + Saw dust + Vermicompost (2:1:1)	49.83^{g}	93.93^{f}	8.46^{de}	85.83^{ef}	0.046^{efg}
S. Em±	0.27	0.70	0.15	0.97	0.001
CD @ 5%	0.80	2.04	0.43	2.80	0.003

1. DAP- Days After Planting
2. FYM-Farmyard manure
3. The superscript letters signifies that the treatment means with similar letters are not significantly different at 5% level of significance, while the means with different letters are significantly different at 5% level of significance. These letters have been affixed based on CD-value comparison of treatment means

Days taken to sprout initiation

The minimum number of days (37.31) taken to sprout initiation (Table-3) was observed in T_{12}-Soil + FYM + Vermicompost (2:1:1) followed by T_8-Vermicompost + Soil (1:1) with average days to sprout initiation 37.83 days. Both these treatments were at par and significantly superior than other treatments. Meanwhile, the cuttings planted in T_{11}-Soil + Sand + Vermicompost (2:1:1) took 39.49 days for sprouting, which was also statistically similar with T_4- FYM + Soil (1:1) with mean 40.17 days. Whereas, in T_0-Soil (Control), the maximum number of days (56.83) was required for sprouting which showed non-significant difference with T_2- Sawdust having corresponding mean 56.43 days. Rooting media like soil + sand + vermicompost may also be provided good congenial condition for early sprouting in cuttings. Similar results were also concluded by Awasthi *et al.* (2008) [4] in guava and Minz (2021) [11] in dragon fruit cuttings.

Number of sprouts per cutting'

At 60 DAP, number of sprouts per cutting was significantly influenced by different growing media and its composition (Table-4). According to the statistically analyzed data, the treatment T_8-Vermicompost + Soil (1:1) delivered the highest number of sprouts (2.85) per cutting and was significantly superior among all the other treatments.. Furthermore, the lowest number of sprout per cutting (1.07) was obtained in T_0-Soil (Control), although it was not significantly different withT_6-Soil + Saw dust (1:1), whose mean value was 1.13 with respect to number of sprouts per cutting.

At 90 DAP, it was observed that the maximum mean number of sprouts per cutting (3.87) was yielded in the treatment T_8-Vermicompost + Soil (1:1) which was followed by T_{12}-Soil + FYM + Vermicompost (2:1:1) (3.76) and T_{11}- Soil + Sand + Vermicompost (2:1:1) (3.58) respectively. The treatments T_2 & T_1 and T_6 & T_7 and T_9, T_{13} & T_4 having the respective number of sprouts 2.06 & 2.12 and 2.33 & 2.41 and 3.26, 3.32 & 3.44 were statistically similar 'with each other at 5% level of significance.' The lowest number of sprouts (1.53) was recorded in T_0- soil (Control).

At 120 DAP, the same trend was observed for the highest average number of sprouts per cutting planted in the media T_8-Vermicompost + Soil (1:1) which gave significantly superior number of sprouts (5.67) compare to all other treatments except T_{12}- Soil + FYM + Vermicompost (2:1:1) and 'T_{11}- Soil + Sand + Vermicompost (2:1:1)' which was statistically at par with each other having the respective average number of sprouts 5.54, and 5.47 under the present investigation. While, the minimum number of sprouts (3.06) was registered in T_0-Soil (Control). This might be due to higher organic matter content in vermicompost, which is related to the buildup of high concentration of nutrients especially nitrogen and phosphorus in the cells and also good moisture capacity of the medium. This result was in close agreement with the evaluation of Panchal *et al.* (2014) [16] in Sapota. Similarly, Rashmita *et al*. (2016) [18] also recorded maximum number of sprouts in treatment consisting of soil + vermicompost (1:1) in pear (*Prunus persica* L.) cuttings.

Shoot length (cm)

At 60 DAP, significant variations were observed under the different growing media. The data showed that the treatment T_{12}- Vermicompost + Soil (2:1) improved the shoot length and delivered the longest shoot length (25.35 cm) significantly than all the other treatments (Table-4).' The minimum length of the shoot (3.66 cm) was observed in T_0-Soil (Control), although it was not significantly different (3.78 cm) from T_6- Soil + Saw dust (1:1).

At 90 DAP, the longest shoot length (30.94 cm) was recorded in the treatment T_8-Vermicompost + Soil (1:1), which was followed by T_{12}-Soil +FYM + Vermicompost (2:1:1) (29.46 cm) and T_{11}- Soil + Sand + Vermicompost (2:1:1) (28.82 cm) under the present trial. The treatments T_{14} & T_5 and T_{13} & T_4 with mean 26.63 & 26.6 and 27.98 & 28..35 cm respectively, were found non-significant between each other with respect to shoot length. Whereas, T_0- Soil (100%) recorded the lowest shoot length (7.5 cm).

At 120 DAP, again statistically significant differences was found in various treatments with respect to the shoot length of cuttings. The same response with the treatment T_8-Vermicompost + Soil (1:1) was noted, which exhibited longest shoot length (36.64 cm). It also showed non-significant difference with T_{12}-Soil + FYM + Vermicompost (2:1:1) whose corresponding mean value was 35.76 cm. Both T_8 and T_{12} were similarly effective for shoot growth of cuttings. The treatments T_6, T_3, T_{15} & T_{10} and T_5, T_9, T_{13} & T_4 (30.09, 30.40, 30.78 &,31.46 and 32.29, 32.39, 33.34 & 33.47 cm respectively), were statisitically similar with each other at 5% level of significance. However, the shoot length in T_1-Sand (1:1) and T_0-Soil (Control) progressively delivered cuttings with shorter shoot length (12.45 and 10.64 cm, respectively). This may be attributed to better media combinations, higher nutrient and water retention capacities, good aeration, porosity and drainage than other growing media mixtures, which helped in forming better root system and hence, better shoot development. Similar study was conducted by Sudarjat *et al.* (2018) [21] in dragon fruit cuttings and concluded that the mixture of soil + vermicompost and soil + sand + vermicompost recorded the longest shoot length compared to other media. Minz (2021) [11] reported that Soil + Sand + Cocopeat + Vermicompost obtained higher shoot length than other media in dragon fruit cuttings.

Shoot fresh weight (g)

Among the various treatments, more positive response can be observed in vermicompost containing media. The maximum fresh weight of shoot (116.64) was recorded under the treatment T_8- Vermicompost + Soil (1:1) which was significantly superior among all the treatments. Mean comparison between the treatments showed that T_{10}-Vermicompost + Saw dust (1:1) & T_{14}- Soil + Saw dust + Vermicompost (2:1:1) and T_5- Soil + Sand (1:1) & T_9-Vermicompost + Sand (1:1) and T_{13}- Sand + FYM + Vermicompost (2:1:1) & T_4- FYM + Soil (1:1) with their mean values 97.55 & 99.71and 105.58 & 106.74 and 115.93 & 116.64 g respectively, were statistically non-significant towards each other at 5% level of significance. Whereas, the minimum fresh weight of shoot (70.38 g) was obtained under the media T_0-soil followed by T_6-Soil + Saw dust (1:1) and T_1-Sand, with obtained mean 74.56 and 76.94 g during the current investigation. This may be due to improved physical and chemical properties of growing media. Vermicompost contains humic acids and growth regulating substances (Atiyeh *et al.* 2002) [3] plant growth hormone (Arancon and Edwards, 2006) [2], which might have increased the plant growth. Similar results were in accordance with Dhakar *et al*. (2016) [7] in papaya and Yadav *et al.* (2012) [25] in acid lime.

Shoot dry weight (g)"

In the present investigation, the effect of different growing media was statistically significant with respect to shoot dry weight per cutting of dragon fruit. Among the various treatments, T_8-Vermicompost + Soil (1:1) resulted the highest dry weight of shoot (11.57 g) at the end of the investigation (120 DAP). It was succeeded by T_{12}-Soil + FYM + Vermicompost (1:1), T_{11}-Soil + Sand + Vermicompost (2:1:1) and T_4-FYM + Soil (1:1) whose mean shoot dry weight values were 11.23, 11.04 and 10.67 respectively. According to mean differences, T_1-Sand showed significant difference with T_2-Saw dust but non-significant with T_0-Soil (Control), each having their mean values 6.83, 6.64 and 7.27 g respectively, under the present study. The lowest shoot dry weight (6.64 g) was obtained under the treatment T_0-Soil (Control). This may be due to positive interactions between the media composition, which enriches nutrients and improves physical, biological and chemical properties of the growing media attributing increased fresh and dry weight of shoot Similar findings were also observed by Dhakar *et al.* (2016) [7] in papaya seedling where media combined with soil + FYM+ Sand + Vermicompost (1:1:1:1) recorded significantly maximum dry weight. Similarly, Prajapati *et al.* (2017) [17] reported that media with Soil + Vermicompost (1:1) registered maximum dry weight of shoot in acid lime.

Survival per cent of cuttings (%)

Significant differences were observed between treatments for survival percentage of dragon fruit cuttings recorded after 120 days of planting. The highest survival percentage (98.33%) was registered in the treatment 'T_8-Vermicompost + Soil (1:1) and the other treatments like T_{12}-Soil + FYM+ Vermicompost (2:1:1') and T_{11}- Soil + Sand + Vermicompost (2:1:1) with their observed mean 96.67 and 95.83% were statistically at par with T_8-Vermicompost + Soil (1:1) during the current investigation. The survival percentage for T_2- Saw dust was slightly less (76.67%), but that of T_0-Soil (Control) was substantially lower (75.83%). The probable reasons for higher survivability in these media combinations could be due to the fact that vermicompost provided favourable physical conditions and triggering biochemical activities (Wazir *et al.* 2003) [24]. This results are in close relation with Rashmita *et al.* (2016) [18] in Pear (*Pyrus pyrifolia* L.) and similar results have been reported previously by Sharma (1993) [20] in semi hardwood cuttings of mulberry where maximum success and survival per cent was achieved in FYM + soil. Similarly, Baiyeri (2003) [6] and also found comparable findings in African breadfruit.

Root to shoot ratio

In the present experiment root shoot ratio increased significantly at the end of investigation. The root and shoot growth was influenced by different growing media to which the maximum root to shoot ratio (0.059) was recorded in the treatment T_{12}- Vermicompost + Soil (1:1) and it was at par with T_{12}-Soil + FYM + Vermicompost (2:1:1) and T_{11}-Soil + Sand + Vermicompost (2:1:1) with mean values 0.057 and 0.056, respectively. Non-signidicant differences were also observed in the treatments T_3, T_{15}, T_{10} & T_{14} and T_5, T_{13} & T_4 having the respective mean root to shoot ratio 0.045, 0.046, 0.047 & 0.048 and 0.052, 0.053 & 0.054 at 5% level of significance. However, the minimum root to shoot ratio (0.033) was registered in T_0-Soil. It might be due to higher organic matter content in the media combinations attributing to better aeration and water holding capacity of the media, which invigorates improved physiological activities of the plant and thus, helps in obtaining maximum root and shoot dry mass, which further results in higher root to shoot ratio. This findings are in close relation with earlier findings of Dhakar *et al.* (2016) [7] in papaya.

Table 4: Effect of different growing media on number of sprouts and shoot length of dragon fruit cuttings at 60, 0 and 120 days after planting (DAP)

Treatments	No. of sprouts per cutting			Shoot length (cm)		
	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
T_0-Soil	1.07^{a}	1.53^{a}	3.06^{a}	18.66^{a}	22.53^{a}	25.64^{a}
T_1-Sand	1.35^{b}	2.06^{b}	3.93^{b}	18.78^{a}	22.98^{ab}	27.32^{b}
T_2-Saw dust	1.13^{a}	2.12^{b}	4.07^{bc}	19.72^{b}	23.27^{bc}	27.45^{bc}
T_3-Vermicompost	1.53^{de}	2.67^{d}	4.42^{de}	20.24^{c}	24.88^{e}	30.40^{ef}
T_4-FYM + Soil (1:1)	2.46^{i}	3.44^{hi}	5.35^{i}	21.86^{g}	28.35^{kl}	33.47^{hi}
T_5-Soil + Sand (1:1)	2.14^{g}	3.06^{f}	4.93^{gh}	20.93^{e}	26.96^{hi}	32.29^{gh}
T_6-Soil + Saw dust	1.40^{bc}	2.33^{c}	4.13^{bc}	19.76^{b}	23.94^{cd}	28.88^{cd}
T_7- Saw dust + Sand (1:1)	1.48^{cd}	2.41^{c}	4.29^{cd}	19.84^{b}	24.12^{d}	30.09^{de}
T_8-Vermicompost + Soil (1:1)	2.85^{k}	3.87^{k}	5.60^{k}	25.35^{h}	30.94^{n}	36.64^{k}
T_9-Vermicompost + Sand (1:1)	2.27^{h}	3.26^{gh}	5.11^{hi}	21.23^{f}	27.37^{ij}	32.39^{gh}
T_{10}- Vermicompost + Saw dust (1:1)	1.86^{f}	2.84^{de}	4.73^{fg}	20.93^{de}	25.85^{fg}	31.46^{efg}
T_{11}-Soil + Sand + Vermicompost (2:1:1)	2.67^{j}	3.58^{ij}	5.47^{j}	24.34^{h}	28.82^{lm}	34.83^{ij}
T_{12}-Soil + FYM + Vermicompost (2:1:1)	2.53^{i}	3.76^{jk}	5.54^{j}	23.16^{h}	29.46^{m}	35.76^{jk}
T_{13}-Sand + FYM + Vermicompost (2:1:1)	2.33^{h}	3.32^{h}	5.26^{i}	21.18^{g}	27.98^{jk}	33.34^{h}
T_{14}-Soil + Saw dust + Vermicompost (2:1:1)	1.93^{f}	2.93^{ef}	4.86^{g}	22.84^{e}	26.63^{gh}	31.62^{fg}
T_{15}-Sand + Saw dust + Vermicompost (2:1:1)	1.60^{e}	2.75^{de}	4.55^{ef}	20.72^{d}	25.52^{ef}	30.78^{ef}
S. Em±	0.04	0.06	0.08	0.11	0.25	0.50
CD @ 5%	0.11	0.18	0.24	0.31	0.72	1.46

1. DAP- Days After Planting
2. FYM-Farmyard manure
3. The superscript letters signifies that the treatment means with similar letters are not significantly different at 5% level of significance, while the means with different letters are significantly different at 5% level of significance. These letters have been affixed based on CD-value comparison of treatment means.

Conclusion

From the results of the present investigation on the effect of different growing media on survivability, root and shoot growth parameters in dragon fruit cuttings, it can be concluded that the growing media affects the success and growth of ctuiings. Vermicompost and soil combinations proved to be the best among all the treatments for most of the growth parameters. The application of vermicompost into the soil improves the root and shoot growth of the cuttings.

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