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Enhancing Dragon Fruit (*Hylocereus undatus*) Propagation Efficiency through Growing Media

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Abstract

The experiment was carried for one and half year during November, 2019 to January, 2020 under the shade house of Fruit nursery at Main Horticultural Research and Extension Centre (MHREC), College of Horticulture, University of Horticultural Sciences, Bagalkot, Karnataka, India to assess the influence of different media on root induction, growth and shoot parameters in dragon fruit. The experiment involving different media viz., sand, sand+soil, sand+fym, sand+vermicompost, sand+soil+fym, sand+soil+vermicompost, soil, soil+fym, soil+vermicompost, fym and vermicompost was carried out using completely randomized design (CRD). It revealed that vermicompost was found the best media for the propagation of cutting which recorded early sprouting (13.2 days), highest sprout length, number of sprouts per cutting, length of the longest root, number of primary roots, fresh weight, dry weight (15.19 cm, 3.20, 15.08 cm, 9.60, 82.00 g, 34.60 g respectively at 90 days after planting), and survival percentage (84%), whereas, the sand and soil media combination resulted in the lowest performance of dragon fruit cuttings, with minimal sprout length (4.10 cm), low percentage of cuttings sprouted (24%), and poor root development (9.64 cm longest root, 3.60 primary roots) with lowest fresh weight (27.80 g), dry weight (11.80 g) and survival percentage (20%) at 90 DAP. Hence, it appears, a rooting media with more fertility would be highly useful in obtaining high root and shoot parameters in dragon fruit. The results of this study are helpful in choosing propagation media for large scale planting material.

Keywords: Dragon fruit cutting, media, stem cuttings, propagation

1. Introduction

Dragon fruit, scientifically known as *Hylocereus undatus*, is a captivating tropical fruit celebrated for its vibrant appearance and unique flavour. Dragon fruit is one of the few edible crops within the Cactaceae family. It is native to Central America but now cultivated in various tropical and subtropical regions worldwide. In India, dragon fruit cultivation covers approximately 400 ha, which can thrive even in dry, frost-free regions of Northeastern, Southeastern, and Western India. The fruit is also commonly referred to as pitaya or pitahaya (Nangare et al., 2019; Ahmad et al., 2016; Patwary et al., 2013; Zee et al., 2004). The external features of dragon fruit are visually striking, characterized by its bright pink or yellowish skin adorned with green scales. Once cut open, the fruit reveals a white or red flesh speckled with tiny black seeds, creating an aesthetically pleasing contrast (Tripathi et al., 2014). Dragon fruit is not only visually appealing but also boasts a subtly sweet taste with a texture reminiscent of kiwi. Beyond its delightful taste, dragon fruit is recognized for its rich nutritional profile, containing essential vitamins, minerals, and antioxidants (Luu et al., 2021; Hossain et al., 2021). Its versatility in culinary applications, coupled with its potential health benefits, has propelled dragon fruit into the spotlight, making it a popular choice among consumers and a fascinating subject of agricultural cultivation and research (Jeronimo et al., 2015). The global popularity of dragon fruit is not only from its delicious, medicinally enriched fruits but also its water use efficiency and quick yield, typically within two years of planting (Pedda et al., 2019; Kakade et al., 2019). It also reduces transpiration loss through Crassulacean Acid Metabolism (CAM), a process in which cacti and succulents close their stomata during hot days to fix CO_2 during daytime and open their stomata at cool nights to assimilate CO_2 (Cabahug et al., 2018).

In recent years, the cultivation of pitaya has gained significant agricultural prominence due to its nutritional value and economic potential (Ramli and Rahmat, 2014; Jeronimo et al., 2015). As global demand for this exotic fruit continues to rise, optimizing propagation methods becomes crucial for enhancing overall efficiency in cultivation practices. Dragon fruit propagation can be achieved through two primary methods: seeds and cuttings (Borchetia et al., 2022). The use of cuttings is often preferred when aiming to maintain specific traits from the parent plant. It offers several advantages compared to other methods like growing from seeds which include genetic uniformity, faster maturity, established root system and also elimination of seed germination challenges (Crane and Belerdi, 2005; TelZur et al., 2004). The success of stem cutting technique relies on factors including cutting size, maturity, timing, stem portion used, rooting medium, PGR application, cutting weight, and environmental conditions (Borchetia et al., 2022).

Selecting the right growing media or substrate is crucial for dragon fruit cutting cultivation because it directly impacts the success of root development, overall plant health, and subsequent growth. The choice of media plays a pivotal role in providing essential nutrients, aeration, drainage, and support for the developing root system (Vijaya and Syariful, 2018). The ideal medium for stem cuttings should possess adequate water retention and drainage capabilities to ensure proper hydration without water stagnation (Tripathi et al., 2014). This research paper explores the improvement of propagation efficiency in pitaya, focusing on the utilization of various growing media. By investigating the impact of different substrates on the growth and development of pitaya plants, this study aims to contribute valuable insights that can enhance the sustainability and productivity of pitaya cultivation.

2. Materials and Methods

The present study on dragon fruit propagation using stem cuttings was carried out under the shade house of Fruit Science nursery, at Main Horticultural Research and Extension Centre (MHREC), College of Horticulture, University of Horticultural Sciences, Bagalkote, Karnataka, India during November, 2019 to January, 2020. The average maximum and minimum temperature during this period was 33.4°C and 21.5°C respectively with an average relative humidity of 56.8%.

Good quality, pest and disease free, matured dragon fruit cuttings of white fleshed cultivar was brought from farmer fields. Different sized cuttings were prepared as required, dipped in a Bavistin (0.1%) for 30 minutes and used for planting

2.1. Influence of media

The experiment was carried out using CRD with 10 treatments and five replications. The different treatments are M_0-Sand, M_1-Sand+Soil (1:1), M_2-Sand+FYM (1:1), M_3-Sand+Vermicompost (1:1), M_4-Sand+Soil+FYM (1:1:1), M_5-Sand+Soil+Vermicompost (1:1:1), M_6-Soil, M_7-Soil+FYM (1:1), M_8-Soil+Vermicompost (1:1), M_9-FYM, M_{10}-Vermicompost. Observations on shoot and root parameters were taken at 30, 60 and 90 days after planting.

2.2. Observations

The different observations recorded were days taken for sprouting (The number of days taken from the day of planting to the day of sprouting of new shoots), sprout shoot length^{-1} (The length of new shoot sprout from the point of the sprouted node to the tip of the new sprout in centimeter), Number of cutting sprouted, number of sprouts cutting^{-1}, length of the longest root (cm), number of primary roots, fresh weight (Weight of the cutting immediately after uprooting the rooted cutting was recorded and expressed as fresh weight of shoot), dry weight (Weight of the cutting after removal of water content by drying) and survival percentage.

2.2.1. Percentage of sprouted cuttings (%)

It is calculated by number of cuttings shown sprouts Total number of cuttings planted^{-1}X100.

2.2.2. Survival percentage (%)

It is calculated by number of cuttings survived number of cuttings planted^{-1}×100)

2.3. Processing and statistical analysis of data

The data obtained from all the above experiments were tabulated, calculated percentages wherever necessary and subjected to statistical analysis (AVOVA) and the significance of treatments were worked out by comparing the difference between two treatments mean and C.D at 5% level of significance.

3. Results and Discussion

Studies on propagation in dragon fruit are very few and most of them have concentrated on effect of growth regulators. In this view, the present study becomes very important to record impact of media, which is need of the hour for multiplication of large scale planting material.

3.1. Influence of rooting media on root induction in stem cuttings and further responses

3.1.1. Shoot parameters

In this experiment, shoot parameters are significantly affected by rooting medium. The minimum days (13 days) taken for sprouting was recorded in M_{10}-vermicompost and the maximum days (28.6) for it was in M_1-Sand+Soil (Table 1). The early germination in vermicompost media might be owing to the texture of media which is finely divided peat-like materials with high porosity, aeration, drainage, high water-holding capacity. Furthermore, apart from acting as a substrate for root induction, vermicompost provides nutrition as an addition. Early sprouting is highly necessary event that keeps

Table 1: Effect of media on different shoot and root parameters of dragon fruit cuttings

Treatment	No. of days taken for sprouting	Shoot length (cm)	No. of sprouts cuttings^{-1}	Length of the longest root (cm)	Fresh weight (g)	Dry weight (g)	Survival percentage (%)
M_0	28.40^{a}	4.30^{g}	1.80^{f}	10.70^{c}	35.20^{i}	14.00^{e}	36.00^{f}
M_1	28.60^{a}	4.10^{g}	1.40^{h}	9.64^{d}	27.80^{k}	11.80^{f}	20.00^{g}
M_2	25.20^{b}	12.16^{bc}	2.00^{e}	10.46^{c}	41.80^{h}	20.40^{d}	44.00^{e}
M_3	21.40^{cd}	12.63^{b}	2.40^{d}	7.96^{e}	66.60^{d}	26.80^{b}	68.00^{c}
M_4	19.80^{ef}	8.06^{e}	2.00^{e}	8.14^{e}	50.60^{f}	20.60^{d}	58.00^{d}
M_5	20.80^{de}	9.61^{d}	1.80^{f}	9.72^{d}	46.00^{g}	19.20^{d}	46.00^{e}
M_6	27.80^{a}	6.12^{f}	1.60^{g}	6.62^{f}	31.40^{j}	12.28^{d}	44.00^{e}
M_7	22.00^{c}	9.53^{d}	2.40^{d}	10.50^{c}	54.00^{e}	21.70^{d}	68.00^{c}
M_8	19.20^{f}	11.70^{c}	2.80^{b}	12.10^{b}	76.20^{b}	27.40^{b}	76.00^{b}
M_9	20.00^{ef}	11.75^{c}	2.60^{c}	11.72^{b}	71.80^{c}	24.70^{c}	76.00^{b}
M_{10}	13.20^{g}	15.19^{a}	3.20^{a}	15.08^{a}	82.00^{a}	34.60^{a}	84.00^{a}
SEm±	0.74	0.40	0.21	0.47	3.28	1.11	4.51
CD (p=0.05)	2.14	1.16	0.61	1.36	9.38	3.19	12.90

M_0: Sand; M_1: Sand+Soil; M_2: Sand+FYM; M_3: Sand+Vermicompost; M_4: Sand+Soil+FYM; M_5: Sand+Soil+Vermicompost; M_6: Soil; M_7: Soil+FYM; M_8: Soil+Vermicompost; M_9: FYM; M_{10}: Vermicompost; *Means with same superscript within a plant matrix do not vary significantly at (p≤0.05) amongst each other

cutting physiologically active and hence, there will be more demand for resources for growth and development. This in turn promotes root induction. In support of this, Arancon and Edwards (2005) reported that vermicompost greatly increased surface areas, providing more microsites for microbial decomposing organisms, and strong adsorption and retention of nutrients which enhance the rate of sprouting. In this study, the secondbest media, that is M_8-Soil+Vermicompost (1:1) also contains vermicompost. The media taken for maximum days (28.4) for root induction contains sand. Hence, vermicompost has a role in early root induction whereas sand delays it (Figure 1).

In this study, the maximum shoot length (15.19 cm) was recorded in the vermicompost at 90 DAP (Table 1). Also, more number of sprouts (3.2) was recorded in the vermicompost media. The better response of cuttings with the vermicompost was might be attributed to the fact that it is a type of organic fertilizer which contain an average of 3% N, 1% P, and 1.5% K and other micronutrients in abundant that can augment chemical nutrients in the soil. Similarly, Sudarjat et al. (2018) stated that vermicompost is made from worm manure that has been decomposed and the application of vermicompost as a growing medium is responding well because it can improve the soil texture and have good aeration and water retention capacity to hasten the growth rate. The minimum length of sprouting (4.1 cm) was measured in the treatment combination of (Sand+soil) at 90 DAP. It might be owing to the lack of nutrients and good aeration in the media and hard compact nature of the soil which fails to sprout the cutting. Our result

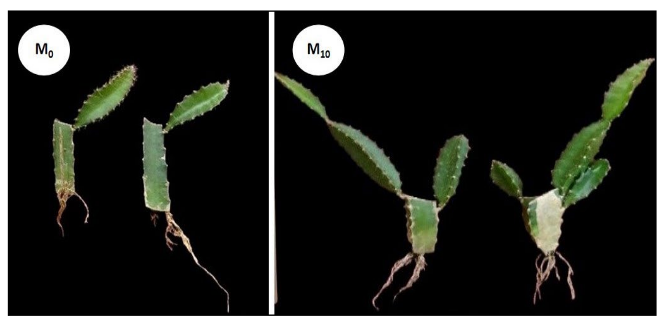

Figure 1: Influence of shoot growth of lowest and highest treatment among different media of dragon fruit cutting

was in concurrent with the outcome revealed by Sajana et al. (2018), who revealed that the maximum seedling height (18.72 cm) in marking nut (*Semecarpus anacardium*) was revealed with the cuttings planted in the vermicompost+sand+pond soil (1:1:1) compared to other media.

3.1.2. *Root parameters*

Early root induction and highest fresh weight as well as dry weight are very important and indicative root parameters for maximum survival of cuttings. In this experiment, root parameters are significantly affected by rooting medium. The maximum root length (15.08 cm) was recorded in the vermicompost and the least root length (6.62 cm) was observed in the Soil media at 90 DAP (Table 1). The active growth of roots of dragon fruit cutting in the vermicompost media might be due to the texture of the media which was supported by Mahewarappa et al. (1999), who reported that, the increased organic carbon amounts, pH improvements, decreased bulk density, improved soil porosity, and water-holding capacity, increased microbial populations, and soil dehydrogenase activity was the reason behind the better response of vermicompost treatments in arrow root. Also, the less response of roots in soil media was might be owing to the compact nature of the soil which does not have good aeration, leads to the restricted root growth.

In this study, the highest fresh weight was recorded in the Vermicompost (82 g) which was on par (76.2 g) with soil+vermicompost media and the lowest fresh weight (27.8 g) was recorded in Sand+Soil media. Further, the maximum dry weight (34.6 g) was recorded in vermicompost and the minimum (11.8 g) of it was recorded in the Sand+soil media at 90 DAP (Table 1). In addition to the texture and nutrient releasing ability of the vermicompost, several scientists have documented the physical, chemical and biological properties of this media and unlike other media, it has the ability to convert the nutrients already present in the soil to plant-available form due to the availability of large amount of microbial population and also it is a source of plant growth regulators created by interactions between microorganisms and earthworms, which could significantly contribute to plant growth and accumulation of more biomass (Sudarjat et al., 2018). This could have helped to produce more fresh weight of the dragon fruit cutting. In this experiment, the increase in dry weight was proportional to the fresh weight and as the fresh weight increased dry weight will also have increased, which might be the reason for the increased dry weight of the cuttings in vermicompost and less in Sand+Soil media. Our finding was in accordance with the study conducted by Meena et al. (2017), who revealed that the highest dry weight (0.7 g) was recorded in soil+vermicompost+vermiculite (1:1:1) media.

In this study, the maximum survival percentage (84%) was reported in the vermicompost which was on a level with FYM and vermicompost media (76%). The minimum survival percentage was noted in sand+Soil (20%) (Table 1). The maximum survivability of cuttings in the vermicompost media is owing to the enhanced soil aeration and porosity of the media which exchange more carbon dioxide (CO_2) with atmosphere and hence, it would be the reason for better survivability of the cuttings in vermicompost whereas, soil and sand media is compact and may not have much porosity and aeration which will reduce the root growth.

In the study by Elobeidy (2006), the number and length of the developed roots were affected by the type of substrate. The maximum number of roots cutting^{-1} was recorded in peat moss substrate (43.00), while the minimum root number was noticed in the sand substrate (14.00). So, it appears, addition of sand in the present study and also by Elobeidy (2006) reduced rooting efficiency.

Similarly, media with more porosity and nutrient content shown best root induction in arrow root (Mahewarappa et al., 1999), who reported that, the increased organic carbon amounts, pH improvements, decreased bulk density, improved soil porosity, and water-holding capacity, increased microbial populations, and soil dehydrogenase activity was the reason behind the better response of vermicompost treatments. Also, the less response of roots in soil media (minimum number of roots cutting^{-1} 24.67, minimum root length-17.0 cm) was reported by Rajkumar et al. (2017) in the study conducted in pomegranate cv, Phule Arakta. They inferred that the reduced root length and number might be owing to the compact nature of the soil which does not have good aeration leads to the restricted root growth.

4. Conclusion

Vermicompost proved to be the most effective medium amongthe eleven media evaluated for propagating dragon fruit cuttings which exhibited rapid sprouting, increased sprout length, high percentage of successful sprouting, longest roots, higher number of primary roots, greater fresh and dry weights, and an impressive survival rate (84%) at 30, 60, and 90 days after planting. Conversely, the combination of sand and soil yielded sub-optimal results with shorter roots, fewer sprouts, and lower survival rates.

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