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Propagation Studies in Costa Rican Pitahaya *(Selenicereus costaricensis)* under Humid Tropical Conditions

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Abstract

Dragon fruit is an exotic cactus bearing edible fruits that are prized for their nutraceutical properties. Of late, the cultivation of dragon fruit has increased and farmers are showing interest in its cultivation due to remunerative prices fetched by the produce. However, most of the produce coming in the market is white fleshed, which is considered to have subtle sweet taste. However, the Costa Rican Pitahaya- *Selenicereus costaricensis* is a much sweeter and attractive red to purple fleshed species. Increasing demand for quality planting material and exchange of germplasm across the diverse agro-climatic zones has necessitated the need for research on its site-specific propagation aspects. In order to study if auxin is required for vegetative propagation in this species, the present study was undertaken with two treatments and five replications of 50 cuttings each. Further, performance of propagules was also studied after one year. The obtained data was analyzed using t-test. Results suggested that, cuttings treated with auxin (IBA, 500 ppm) had highly significant improvement in terms of sprouting (60%) over the untreated ones (32.8%) in the initial period. Further, number of roots were improved with auxin, but thicker roots were observed in the control. However, observations recorded after one year suggested non-significant differences among the treated and untreated cuttings; thereby suggesting non requirement of auxin for propagation of Costa Rican Pitahaya under warm and humid conditions of the Bay Islands.

Key words: *Red fleshed dragon fruit, sprouting, stem cutting, survival*

Introduction

Dragon fruit is a common terminology used for several edible fruit bearing species of the genus *Selenicereus* (erstwhile *Hylocereus*). Of the dragon fruit species, *S. undatus*, *S. costaricensis*, *S. megalanthus, S. monacanthus* (*H. polyrhizus*), *S. triangularis* (*H. trigonus*) etc. are among the commonly cultivated ones. Cultivation of dragon fruit is increasingly getting popular across the world as fruits are sources of nutritionally beneficial vitamins, minerals, dietary fibers, energy, polyphenols, flavonoids, antioxidants etc. In India also, the acreage under the crop has been on rise with an estimated area of 3,085 ha and production of 12,000 tons in 2020 (Wakchaure et al., 2021).

Though white fleshed dragon fruit is mostly grown, purple fleshed Costa Rican Pitahaya (*S. costaricensis*, Fig. 1) is more preferred in the Indian markets due to its sweetness and richness in anthocyanins. Apart from providing the benefits of fresh fruits, the bioactives present in the pulp are known to contribute towards the functional properties of this fruit. Widyaningsih et al. (2017) in their trial found that fruit juice of *S. costaricensis* could be consumed for preventing anemia among the pregnant women due to its richness in iron. In a study with three dragon fruit species, *H. costaricensis* showed the highest antioxidant activity and selective cytotoxic activity against gastrointestinal tract cancer cell lines through advanced chemometric analysis (Pawel et al., 2021). A study on obese wistar rats suggested antiobesity and hypolipidemic activity of *H. costaricensis* (Ni et al., 2018).

Propagation of dragon fruit is mainly done through vegetative means. A study by Fumuro (2011) has suggested role of several factors such as origin (basal, middle, upper), age, maturity, weight and length of cuttings along with auxins in the rooting success of *S. undatus*. Considering the fact that different species may have different propagation requirements, standardization

for each species is required. Further, its cultivation is being extended in non-traditional regions including the warm and humid tropical Andaman Islands. Hence, protocol for each agro-climatic condition is warranted.

Figure 1. View of fruits (above) and cut slices (below) of *S. costaricensis*

Figure 2. Untreated (left) and treated (right) cuttings of *S. costaricensis*

In the remotely located islands, availability of quality planting material as well as auxins to the farmers is a major concern. Further, the Horticulture Plants Propagation Unit of the authors' institute, though produces the plants, their transportation to different parts of the islands gets difficult due to geographical challenges. Studies have indicated that cuttings of *S. undatus* could root even in the absence of auxins (Elobeidy 2006). Use of IBA (5000 ppm) with cutting exposing interior wood portion was recommended in *S. costaricensis* under Arunachal Pradesh conditions (Prabha et al., 2023). In order to know if *S. costaricensis* could be propagated without auxins and performance of propagules during post-hardening period under Andaman Islands conditions, the present study was undertaken.

Materials and methods

The present study was conducted during the year 2024. Stem cuttings of 30 cm (Devi et al., 2025) of *Selenicereus costaricensis* were collected from the experimental farm of Division of Horticulture and Crop Improvement, ICAR-Central Island Agricultural Research Institute, Sri Vijaya Puram, Andaman and Nicobar Islands and used for the study. The cuttings were kept for curing in a shaded and ventilated place for 3 days. Lower ends of these cured

cuttings were dipped in 500 ppm of IBA solution for 15 minutes and then, planted in polybags of 6" × 8" size, containing soil: FYM (1:1) as substrate. This treatment was compared with untreated cuttings as control. Each set was replicated five times with 50 cuttings per replication. Cuttings were kept in naturally ventilated polyhouse with overhead sprinklers for rooting.

Observations on sprouting and survival were recorded after 12 weeks of treatment and comparative analysis of treated and untreated cuttings was done. Number of sprouts observed per cutting were recorded manually, while length of longest sprout was measured using a scale and expressed into cm. Thickness of the sprout was determined using a digital vernier caliper. After careful excavation of plants from the polybags, basal parts were washed and numbers of roots per cutting were counted. Length of longest root and thickness of root were measured using scale and vernier caliper, respectively. After one year of treatment, observations on sprouting, survival and growth of sprouted cuttings were recorded again. The obtained data was subjected to two sample t-test and significance was tested at 5% level of significance.

Results and discussion

Indole-3-butyric acid has been used as a rooting hormone in various plant species. However, response of various species and their varieties to its application varies. In the present study, cuttings treated with IBA (500 ppm) exhibited highly significant improvement (60%) in sprouting, when compared with the untreated ones (32.8%). Though survival of cuttings was non-significantly improved to 84.8% with use of IBA from 80.4% in untreated cuttings, number of sprouts produced per cutting was not influenced by the treatments (Table 1). Elobeidy (2006) and Fumuro (2011) observed that rooting in white fleshed dragon fruit is possible even in the absence of the auxins, however, use of it could improve the success. In order to know the response of this factor in red-fleshed species, the present study was taken up.

Table 1: Sprouting, survival and growth parameters in cuttings of Costa Rican Pitahaya as influenced by presence or absence of IBA after 12 weeks

Treatment	Sprouting (%)	Survival (%)	No. of sprouts	Length of longest sprout (cm)	Thickness of longest sprout (mm)	No. of roots	Length of longest root (cm)	Thickness of longest root (mm)
Untreated control	32.8	80.4	1.13	18.97	20.01	3.20	18.06	1.95
IBA (500 ppm)	60.0	84.8	1.13	27.05	20.80	5.67	18.32	1.47
Significance	**	ns	ns	**	ns	**	ns	*

ns: non significant; *: significant and **: highly significant

Interestingly, different studies conducted under diverse agro-climatic conditions have suggested optimum dose for rooting hormone, mainly IBA, in *S. undatus* as 4000 ppm under Punjab conditions (Singh and Kaur, 2024), 6000 ppm under Tamil Nadu conditions (Dharani et al., 2023), 6000 to 7000 ppm under Karnataka conditions (Ayesha et al., 2018) etc. Under Arunachal Pradesh conditions, 65.4% rooting was observed in *S. costaricensis* without use of auxins (Prabha et al., 2023), which is much lower than that observed in the present study. These findings emphasize upon the importance of optimization of factors under the study region in question.

In the present study, significantly longer sprouts were produced in the cuttings treated with IBA (500 ppm), while thickness of the sprout was not influenced by the treatments. Number of roots (Fig. 2) had highly significant improvement (5.67 per cutting) in IBA treatment than the untreated ones (3.20). A recent study suggested 60% higher internal concentration of IAA and 40.63% GA_3 in the cuttings treated with 1000 ppm IBA over the untreated control in white fleshed dragon fruit (Ajaypartap et al., 2025). These hormones could have resulted in higher number of roots and longer sprouts in the present study. The roots formed were significantly thicker (1.95 mm) in the untreated ones over treated cuttings (1.47 mm).

Fumuro (2011) had reported 78.3% rooting without use of auxins in *S. undatus*; however, improvement of rooting percentage (91.7% in IBA and 98.3% in NAA) and higher root mass was obtained by treating them with auxins; which is in line with the present study. Similarly, improvement of rooting (%), length of sprout, and number of roots per cuttings due to use of auxin observed in the present study is supported by findings of Singh and Kaur (2024).

Since, there were stark differences in percentage sprouting and survival during 12 weeks observations, after one year, the cuttings were tested for these parameters again (Table 2). It was found that plants in both the batches grew normally and had no statistically significant differences for any of the studied parameters. Sprouting was found to be between 76-81% among the treatments. These findings clearly indicate that auxins, though improve the sprouting and rooting of cuttings in the initial stage; the effect doesn't provide superiority to the plants' growth thereafter. Number of sprouts ranged between 1.27 and 1.47 per cutting, while length varied between 61.57 and 61.92 cm after one year. Long term studies under nursery conditions are limited in the crop; however, 1.33 to 5.66 shoots per cutting and shoot growth of 19.23 to 40.87 cm were reported in *S. polyrhizus* after eight months of experiment on substrate standardization (Baby et al., 2025). During one year period, roots in the present study grew to 21.43 cm (500 ppm IBA) to 24.73 cm (untreated), while growth of 18.11 to 28.79 cm was reported after eight months under Mizoram conditions in *S. polyrhizus* (Baby et al., 2025).

Table 2: Sprouting, survival and growth parameters in cuttings of Costa Rican Pitahaya as influenced by presence or absence of IBA after one year

Treatment	Sprouting (%)	Survival (%)	No. of sprouts	Length of longest sprout (cm)	Thickness of longest sprout (mm)	No. of roots	Length of longest root (cm)	Thickness of longest root (mm)
Untreated control	76.0	79.6	1.47	61.57	23.72	10.33	24.73	2.48
IBA (500 ppm)	81.0	84.0	1.27	61.92	23.01	9.67	21.43	1.92
Significance	ns	ns	ns	ns	ns	ns	ns	ns

ns: non significant

Sixty sprouted plants were randomly uprooted from both the batches and it was observed that all the sprouted plants had produced roots. However, surprisingly, there were a few plants in both the batches, which did not sprout even after such a long period. All these cuttings were uprooted and checked. In untreated batch, there were nine unsprouted cuttings, out of which eight had produced roots while one was unrooted. In IBA treated batch, there were seven unsprouted cuttings of which two had produced roots. Probably, the high relative humidity conditions prevailing in the protected environment where cuttings were kept and inherently high moisture retention capability of cactus species might have prevented drying of the cuttings even without rooting. Similar results of long-term survival of IBA treated cuttings without initiation of rooting have been reported in *Cycas edentata*, *C. nitida* and *C. micronesica* (Marler et al., 2020). The non-rooting of such cuttings needs further investigation.

Conclusion

The study clearly demonstrated that the Costa Rican Pitahaya could root and survive without use of auxin. Though, the use of auxin was beneficial in the initial period, its long-term superiority in providing plants with added advantage were not noticed. Hence, farmers from the remote islands could collect the cuttings from reputed sources and produce the planting material of Costa Rican Pitahaya at their own farms without the need of any rooting hormones.

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Disclosure statement

Authors declare that they have no conflict of interest to declare.

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