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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(9): 974-977

www.thepharmajournal.com
Received: 13-06-2023
Accepted: 20-07-2023

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Influence of PGRs, type of cut and months on rooting responses in dragon fruit (*Hylocereus costaricensis*)

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Abstract
An experiment was conducted at Fruit Science Nursery, College of Horticulture and Forestry, Pasighat, during 2022 to know the influence of IBA (Indole 3-butyric acid) concentrations, types of stem cutting and months on rooting responses of Dragon fruit (*Hylocereus costaricensis*) under the foothills of Arunachal Pradesh. The result of one year long experiment revealed that after 90 days of planting, percentage of rooting (98.9 %) was observed highest in 7000 ppm IBA with cutting exposing interior wood portion during June, longest root length (29.60 cm) with 7000 ppm IBA applied to slanting cut during May, maximum number of primary roots per cuttings (11.30), maximum fresh weight (1.78 g) and maximum dry weight of roots (0.47 g) were observed with 5000 ppm IBA with cutting exposing interior wood portion during June. Therefore, considering the performance of all the factors in all the parameters recorded, 5000 ppm IBA with cutting exposing interior wood portion during June showed the best performance and is recommended for the propagation of dragon fruit.

Keywords: Dragon fruit, propagation, IBA, rooting, cuttings, month

Introduction
Dragon fruit (*Hylocereus costaricensis)*, diploid (2n=22), perennial edible, climbing cactus belonging to the family of Cactaceae. This fruit crop has been introduced in India during late 90's. It is one of the recently introduced non-native fruit crops to be grown in India; other names for it include pitaya and night blooming cereus, Queen of the night, Strawberry Pear, Honourable as well as queen (Morton, 1987; Maji, 2021) [10, 7]. It is known to be originated from the tropical and subtropical forest regions of Mexico and Central South America (Mizrahi and Nerd, 1997) [9]. Dragon fruit which was once widely grown as an ornamental plant is now considered a fruit crop (Kasim *et al.* 2019) [6]. It is widely and commercially grown in countries like Vietnam, Columbia, Mexico, Costa Rica and Nicaragua and to a lesser extent, cultivation also occurs in Australia and Israel. In India, it is been grown in Maharashtra, Gujarat, Andhra Pradesh, Telangana, Karnataka, Tamil Nadu, and some parts of Northeast *viz*., Mizoram, Nagaland, etc.,

Dragon fruit is known to have high health benefits due to its nutritional status. According to reports, dragon fruit contains phytoalbumins, which may have anti-oxidant properties that help to stop the growth of cancer cells. It is also said to prevent memory loss, control blood sugar levels in diabetic patients, prevent oxidation, aid in wound healing, and is known to promote the growth of probiotics in the intestinal tract (Zainoldin and Baba, 2019) [18]. *Hylocereus costaricensis*, the red fleshed dragon fruit are rich in *betalains* which thereby increasing its antioxidant property.

Dragon fruit is a potential economic crop for international market. It thrives well in warm and dry weather. It is fast return perennial crop which gives economic production after 1-2 years of planting. It is been propagated by stem cuttings as well as by seeds. Since, stem cuttings are known to be fasters and easier means of propagation, hence it is preferred by the growers. It is also preferred because of its earliness in bearing and true to type. The cuttings are usually taken after harvesting of fruits. Stem cuttings are recommended to be taken 1-2 days prior to planting to prevent from rotting due to any kind of fungal infection from the oozing latex. Rooting of cuttings is the most important factor for successful propagation. Rooting is affected by several factors like environment, time of cutting taken, types of cutting performed,

hormonal regulations, etc. Plant growth regulators are known to have the stimulatory effect on the rooting of cuttings (Audus, 1965) [2]. Auxins are known as rooting hormones which are either naturally occurring (endogenous) like IAA or synthetically prepared (exogenous) like IBA and 2, 4-D. The most preferred and commonly used Auxin is IBA (Indole 3 butyric acid) with varied concentration. It also depends on the balance between endogenous auxin and the amount we apply exogenously. Season of planting is another factor responsible for successful rooting of cuttings, depending upon the temperature, moisture availability, humidity in that particular season affects the rooting of cuttings.

There has been number of work done on effect of PGR on rooting of cuttings in dragon fruit. However, a study on effect of time, PGR and types of cuttings on this crop is scanty. Keeping in view, this investigation was carried out to see the role of IBA concentrations on rooting and shooting of different types of cuttings in different months in Dragon fruit.

Materials and Methods

The present research experiment titled "Standardization of PGRs, Type of cut and Months on Rooting responses in Dragon fruit (*Hylocereus costaricensis*)" was conducted under poly house of Department of Fruit Science, College of Horticulture and Forestry, Pasighat, CAU, Arunachal Pradesh during the year 2022. The experiment was laid out in ''Factorial CRD (Completely Randomized Design)'' and replicated thrice with 30 treatments. Combination of three factors and their effects were studied.

A. Factor 1

Plant growth regulators (to be denoted by 'P')

P_0 - Control
P_1 – 5000 ppm
P_2 – 6000 ppm
P_3 - 7000 ppm
P_4 - 8000 ppm

B. Factor 2

Type of cut (to be denoted by 'C')

C_1 – Slanting cut
C_2 – Cutting exposing interior wood portion

C. Factor 3

Months (to be denoted by 'M')

M_1 - May
M_2 - June
M_3 – July

The 3 factors experiment consisting of 5 IBA concentrations (including control), 2 types of cut and 3 months with 30 treatment combinations along with 3 replication was laid out in Completely Randomized Design.

Treatment combination

$P_0C_1M_1$	$P_0C_1M_2$	$P_0C_1M_3$
$P_0C_2M_1$	$P_0C_2M_2$	$P_0C_2M_3$
$P_1C_1M_1$	$P_1C_1M_2$	$P_1C_1M_3$
$P_1C_2M_1$	$P_1C_2M_2$	$P_1C_2M_3$
$P_2C_1M_1$	$P_2C_1M_2$	$P_2C_1M_3$
$P_2C_2M_1$	$P_2C_2M_2$	$P_2C_2M_3$
$P_3C_1M_1$	$P_3C_1M_2$	$P_3C_1M_3$
$P_3C_2M_1$	$P_3C_2M_2$	$P_3C_2M_3$
$P_4C_1M_1$	$P_4C_1M_2$	$P_4C_1M_3$
$P_4C_2M_1$	$P_4C_2M_2$	$P_4C_2M_3$

Where, P_0 – Control, P_1 – 5000 ppm, P_2 – 6000 ppm, P_3 -7000 ppm, P_4 -8000 ppm, C_1 – Slanting cut, C_2 – Cutting exposing interior wood portion, M_1 – May, M_2 – June, M_3 – July

- Cuttings were taken from the mother block (*Hylocereus costaricensis)* from Fruit Science Nursery, College of Horticulture and Forestry, Pasighat, Arunachal Pradesh, during the first week of May, June and July. Mature stems were preferred while taking the cuttings.
- Stem cuttings of 10 -12 cm long were prepared during the months of May, June and July.
- Two types of cut (Slanting cut and cutting exposing interior wood portion) were given in those prepared cuttings and kept in separate container under shade for drying of oozing latex prior to planting to avoid any kind of rotting due to fungal infection.
- Homogenized potting mixture was prepared with Soil: FYM @ 2:1 and filled in black polybags.
- Different IBA concentrations (5000 ppm, 6000 ppm, 7000 ppm & 8000 ppm) were prepared in separate containers and quick dip method was followed right before planting and for control cuttings were dipped in water.
- Same method were followed every months
- Irrigation was given once a week.
- All the parameters were evaluated after 90 days of planting of cuttings.

Data collection on rooting parameters: (90 DAP)

Three cuttings were randomly selected for recording the observations from each replication of every treatment throughout the study on destructive basis. The observations included were percentage of rooting, length of longest root (cm), numbers of primary roots per cuttings, fresh weight of roots (g), and dry weight of roots (g).

Data analysis

All the observations recorded during the experiment were subjected to that statistical analysis of variance by Completely Randomized Design (CRD). Significance and non-significance of the variance due to different treatments were determined by calculating the respective 'F' values as described by Gomez and Gomez (2010) [19].

Results and Discussions

Root parameters

All the data in relation to root growth parameters are presented in Table 1. In the present investigation, influence of PGRs, types of cut and months and their interaction have greatly influenced the percentage of rooting of cuttings. Among the different treatments, cuttings treated with $P_3C_2M_2$ i.e., 7000 ppm IBA with cutting exposing interior wood portion during June (98.9%) gave the maximum percentage of rooting which was at par with $P_3C_1M_2$ i.e., 7000 ppm IBA with slanting cut during June (98.7%). No rooting was observed in treatment $P_0C_1M_3$ i.e., control with slanting cut during July (0.0%), however, rooting percentage of 65.4 % was observed in treatment $P_0C_2M_3$ (Control with cutting exposing interior wood portion during July). These results are in conformity with the findings of Ali *et al.* (2019) [6], Siddiqua *et al.* (2019) [14] and Wadhekar *et al.* (2022) [16]. Bhusal *et al.*, (2003) [3] reported that June had the highest rooting (100%) in common trifoliate oranges. The interplay of endogenous and exogenous plant hormones that influences

rooting response (Guo *et al.*, 2009) [5]. It may be due to the effect of IBA concentration which might have increased cell wall plasticity leading to cell division, stimulation of callus and hence root growth (Weaver, 1972) [17].

In the present investigation the longest root length was recorded in $P_3C_1M_1$ (7000 ppm IBA applied to slanting cut during May) (29.60 cm), whereas the minimum root length was observed in $P_1C_2M_3$ (5000 ppm IBA applied to cutting exposing interior wood portion during July) (13.60 cm). Similar findings were showed by Rahad *et al.* (2016) [12] and Siddiqua *et al.* (2019) [14] in Dragon fruit. It might be due to rapid hydrolysis of starch stored in cuttings into physiologically active sugars, which gives the energy for cell elongation leading to longer root length.

$P_1C_2M_2$ (5000 ppm IBA applied to cutting exposing interior wood portion during June) (11.30) was recorded with maximum number of primary roots per cuttings. Whereas, $P_0C_2M_2$ (control with cutting exposing interior wood portion during June) (1.70) recorded the least number of primary roots per cuttings. Similar findings were reported by Siddiqua *et al.* (2019) [14] in Dragon fruit where number of roots increased from 5000 ppm IBA to 7000 ppm IBA concentration. The maximum number of roots may have been induced in the treated cuttings as a result of growth regulators' stimulation of cambial activity involved in root initiation (Ullah et al., 2005) [15].

Maximum fresh weight was recorded with $P_1C_2M_2$ (5000 ppm IBA, cutting exposing interior wood portion during June) (1.78 g) and the minimum fresh weight of roots was recorded in $P_0C_1M_2$ (control with slanting cut during June) (0.15 g). It may be due to more number of roots leading to more weight. Plant growth regulators treated cuttings aid in greater mobilization of primary metabolites downward for enhanced root development and uptake**.** According to the findings of present investigation the maximum dry weight of roots were observed in $P_1C_2M_2$ (5000 ppm IBA applied to cutting exposing interior wood portion during June) (0.47 g). Siddiqua *et al.* (2019) [14] reported maximum dry weight of roots (0.59 g) when treated with 5000 ppm IBA on dragon fruit stem cuttings. It might be caused by the hydrolytic enzymes that plant growth regulators activate being more effective at converting the polysaccharides in stem cuttings into physiologically active sugars. It facilitates the production of more roots per cutting, increasing the dry weight of the resulting roots. Similar findings were also reported by Porghorban *et al.* (2014) [11] in olive and Rahad *et al.* (2016) [12] in dragon fruit.

Table 1: Influence of IBA, types of cut and months on rooting parameters of dragon fruit cuttings

Treatment	Percentage of rooting	Length of the longest root (cm)	No. of primary roots per cutting	Fresh weight of roots (g)	Dry weight of roots (g)
$P_0C_1M_1$	84.90	14.70	2.33	0.22	0.10
$P_0C_2M_1$	86.20	16.30	2.33	0.31	0.11
$P_1C_1M_1$	94.30	25.00	10.00	0.86	0.25
$P_1C_2M_1$	93.50	24.30	6.00	0.64	0.19
$P_2C_1M_1$	95.70	20.80	4.03	0.25	0.11
$P_2C_2M_1$	95.70	18.70	4.00	1.10	0.34
$P_3C_1M_1$	96.40	29.60	4.67	0.97	0.26
$P_3C_2M_1$	97.90	22.40	3.00	0.69	0.18
$P_4C_1M_1$	94.60	22.90	5.33	0.93	0.17
$P_4C_2M_1$	94.00	25.80	3.67	0.77	0.17
$P_0C_1M_2$	90.00	15.20	4.97	0.15	0.09
$P_0C_2M_2$	90.10	16.90	1.70	0.16	0.10
$P_1C_1M_2$	93.10	15.50	6.33	0.22	0.10
$P_1C_2M_2$	93.40	21.50	11.30	1.78	0.47
$P_2C_1M_2$	92.60	23.50	8.00	0.51	0.14
$P_2C_2M_2$	94.70	25.70	6.03	0.83	0.37
$P_3C_1M_2$	98.70	25.90	6.00	1.67	0.12
$P_3C_2M_2$	98.90	23.00	10.70	1.37	0.44
$P_4C_1M_2$	97.60	19.50	11.00	0.82	0.14
$P_4C_2M_2$	94.70	18.80	10.67	0.49	0.17
$P_0C_1M_3$	0.00	0.00	0.00	0.00	0.00
$P_0C_2M_3$	65.40	14.20	4.67	0.58	0.20
$P_1C_1M_3$	73.80	20.20	7.33	1.17	0.19
$P_1C_2M_3$	79.80	13.60	10.67	0.43	0.18
$P_2C_1M_3$	79.90	20.30	8.37	0.22	0.23
$P_2C_2M_3$	76.50	19.70	8.00	0.21	0.15
$P_3C_1M_3$	87.90	16.60	7.00	0.22	0.09
$P_3C_2M_3$	84.50	17.40	10.67	0.61	0.11
$P_4C_1M_3$	80.80	20.40	4.00	0.18	0.08
$P_4C_2M_3$	83.50	22.50	8.00	0.51	0.16
CD (5%)	4.59	0.75	0.30	0.03	0.01
CV	3.27	2.32	2.86	2.51	3.56
SEm±	1.62	0.26	0.11	0.01	0.00

Conclusion

In this present investigation effect of IBA treatment, types of cut and months was found to be successful on rooting behavior of dragon fruit cuttings. Increase in concentration of IBA led to increase in performance of cuttings as observed in this investigation from 5000 ppm to 7000 ppm IBA. Whereas,

8000 ppm IBA didn't perform well and it might be due to high concentration leading to toxicity in cuttings. More number of rooting was observed in cutting exposing interior wood portion, which may be due to more space of growth for new roots as the interior wood was exposed and came well in contact with the IBA. As per months, June was observed to be the best month for rooting of dragon fruit cuttings due to adequate moisture availability and relative humidity. Dragon fruit is a crop of dry weather due to which it didn't perform well in July and led to rotting because of humidity caused by heavy rainfall. Therefore, IBA concentration of 5000 ppm with cutting exposing interior wood portion during June is recommended for the propagation of dragon fruit through stem cuttings. In conclusion, choosing the right concentration of plant growth regulator with proper technique of cutting in suitable time period is essential to ensure greater and successful rooting of dragon fruit cuttings.

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