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Studies on effect of different concentrations of IBA and length of cuttings on rooting and shoot growth performance in dragon fruit *Hylocereus* spp.-red flesh with pink skin under Telangana conditions

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Abstract
The present investigation entitled "Studies on effect of different concentrations of IBA and length of cuttings on rooting and shoot growth performance in dragon fruit *Hylocereus* spp. - red flesh with pink skin under Telangana conditions" was carried out under open field conditions at College Farm, College of Horticulture, Rajendranagar, Hyderabad, from December 2020 to March 2021. The experiment was laid out in Factorial Completely Randomized Design with fifteen treatments replicated thrice. Treatment consisted of five levels of IBA, Control, 4000 ppm, 5000 ppm, 6000 ppm and 7000 ppm and three levels of length of cuttings 10 cm, 15 cm, 20 cm. The significant effect of the IBA and length of cuttings were observed for rooting and shooting behaviour. Indole butyric acid had significant effect on rooting and shooting performance over control. Among various concentrations of IBA @ 7000 ppm showed better results and among various cutting lengths 20 cm showed superior results and *viz*., earliest shoot initiation, maximum shoot growth, individual shoot length, number of new shoots per cutting, average number of roots per cuttings, individual root length, fresh weight of roots, dry weight of roots, survival percentage of rooted cuttings. Comparatively, minimum values of rooting and shooting parameters was found in control and cutting length of 10 cm.

Keywords: Dragon fruit, *Hylocereus* spp., Indole butryric acid, Rooting, Shooting, Cuttings

Introduction
Dragon fruit (*Hylocereus* sp.) is diploid (2n=22) and belongs to the genus *Hylocereus*, family Cactaceae and subfamily Cactoideae. It is one of the newly introduced exotic fruit crops in India. It is commonly called as Pitaya, Strawberry pear, Night blooming cereus, Queen of night, Honorable queen (Martin *et al*., 1987) [10]. It is a promising tropical epiphytic cactus, originated from the rain forests of Latin America (Le Bellec *et al*., 2006) [8] and Central America (Barbeau 1993; Britton, and Rose, 1963 and Mizrahi *et al*., 1997) [2, 3, 11].
The plants can tolerate cool or warm climate. The average annual rainfall requirement for healthy plant growth is about 500 to 1500 mm. Dragon fruit crop is cultivated with easy agronomic practices, low maintenance cost and require minimal after care due to less attack of pests and diseases.
It has received worldwide recognition as an ornamental as well as fruit crop. Major dragon fruit growing countries are Vietnam, Columbia, Mexico, Costa Rica and Nicaragua and to a lesser degree, cultivation occurs in Australia and Israel. It is one of the newly introduced exotic fruit crops in India and is being cultivated in Maharashtra, Gujarat, Andhra Pradesh, Telangana, Karnataka and Tamil Nadu.
Dragon fruit can be propagated by seed or cuttings, but the propagation by cuttings is most common and easy practice for which entire segment of cladode or cuttings varying from 10-60 cm length are used (Zee *et al*., 2004) [20]. Length of cuttings plays an important role in rooting and it is key variable determining the rooting success (Leakey, 2004) [9]. Further, length of cutting optimization is very essential as longer cuttings could result in wastage of propagation material whereas shorter might lead to poor rooting and establishment. Further, rooting varies with length of cutting used for propagation from species to species. Currently, seed propagation could not meet the current market demand (Gunasena *et al*., 2007) [9].
On the other hand, rooting on small cuttings of dragon fruit was stimulated by IBA treatments (Elobeidy, 2006) [6]. Indole-3-butyric acid is a synthetic auxin, commonly applied to stimulate root initiation in cuttings of plants.

Since 1930s, the indole-3-butyric acid (IBA) is being used in cuttings for rooting and in other growth processes. Concentrations ranging from 10 to 20,000 ppm of IBA is used for rooting in several plants and it is determined by many variables including plant type, time of year, propagation conditions, etc. Therefore, large number of plantlets with healthy shoot and root system can be produced to meet the demand of increasing commercial cultivation through vegetative propagation. Research on stem cuttings of dragon fruit is very less regarding rooting hormone, cutting length and their specific dosage, etc.

Keeping in view of the above information, the research programme entitled "Studies on effect of different concentrations of IBA and length of cuttings on rooting and shoot growth performance in dragon fruit *Hylocereus* spp.- red flesh with pink skin under Telangana conditions is planned".

Materials and Methods

The experiment was carried out at College of Horticulture, Rajendranagar, Hyderabad, Telangana during rabi season of 2020-21. The experimental site is situated at the altitude of the 542.3 m above the mean sea level on 17º 191 North latitude and 79º 231 East longitude. The experiment was laid out in factorial completely randomized Design (FCRD) with three replications and fifteen treatments. The meteorological data were collected from ARI, Rajendranagar. The minimum and maximum temperatures recorded were 12.5°C and 36.3 °C respectively. The average relative humidity ranges from 41 to 95%.

Treatment of cuttings

The cuttings were treated with IBA by quick dip method for five seconds, later they were allowed to dry for five minutes under shade and planted in poly bags containing the rooting media.

Data collection on shoot parameters

Sprouted cuttings were randomly selected for recording shoot related observations from each replication of every treatment throughout the study. The observations included were, days taken for shoot initiation, shoot growth (the observations were recorded at 45, 60, 90 DAP) individual shoot length (length of longest shoot was measured at 90thday), number of new shoots per cutting (the observations were recorded at 60, 90 DAP).

Data collection on root parameters

Sprouted cuttings were randomly selected for recording the observations from each replication of every treatment throughout the study on destructive basis. The observations included were average number of roots formed, individual root length (measured with the help of measuring scale from the base to the tip of root and the mean length was calculated and expressed in centimeters), fresh weight of roots (measured with the help of an electronic balance and the mean values were calculated and expressed in grams), dry weight of roots (After recording the fresh weight, the roots were kept in brown covers oven dried at 65oC temperature for 24 hours and dry weight of roots were recorded with the help of electronic balance. The mean root dry weight was calculated and expressed in grams), survival percentage of rooted cuttings (calculated using the formula, number of cuttings rooted/total number of cuttings planted x 100).

Result and Discussion

Shoot growth

The data on shoot growth was recorded at 45, 60, 90 days after planting has been tabulated in the table 1.

It was observed that IBA significantly promoted the shoot growth. The IBA treatment was also found to be significant on shoot growth and the maximum shoot growth (3.81 cm, 9.03cm, 20.17 cm) was noticed in the treatment of 7000 ppm IBA followed by 6000 ppm IBA- 3.51cm, 7.44 cm, 20.17 cm) and the minimum was recorded in the treatment control with 1.08 cm, 1.86 cm and 11.30 cm at 45, 60 and 90 DAP, respectively. The effect of length of the cutting on shoot growth was found significant and the maximum cutting length (3.68 cm, 7.73 cm, 20.17 cm) was recorded in the treatment of cutting length- 20 cm followed by cutting length-15 cm- 3.01 cm, 5.67 cm and 17.31 cm at 45, 60 and 90 DAP, respectively). The cutting length cutting length of 10 cm recorded the minimum shoot growth.

The interaction effect of IBA and length of the cutting was found to be significant and the maximum shoot growth (4.97 cm, 13 cm, 24.53 cm respectively) was observed in the treatment of (20 cm cutting+ 7000 ppm IBA) at 45, 60 and 90 DAP, and whereas the control recorded minimum shoot growth than all the other treatment combinations.

The shoot growth found maximum when treated with rooting hormone concentration, IBA @ 7000 ppm could be attributed to the rapid hydrolysis of polysaccharides stored in the cuttings into physiologically active sugars by activation of hydrolytic enzymes. These sugars provide energy for the meristematic tissue trough respiratory activity leads to early formation of shoots. The present findings are accordance to the results of Seran and Thiresh (2015) [16] and Dhruve *et al.* (2018) [5] in dragon fruit.

Table 1: Effect of different concentration of IBA and length of cuttings on shoot growth in dragon fruit *Hylocereus* spp.–with red flesh and pink skin

Shoot growth(cm)														
45 DAP					60 DAP					90 DAP				
RH/CL	CL_1	CL_2	CL_3	Mean	RH/CL	CL_1	CL_2	CL_3	Mean	RH/CL	CL_1	CL_2	CL_3	Mean
RH_0	0.00	1.47	1.77	1.08e	RH_0	1.31	1.97	2.30	1.86e	RH_0	9.47	11.10	13.33	11.30e
RH_1	1.90	2.67	3.57	2.71d	RH_1	3.33	4.79	5.13	4.42d	RH_1	13.07	16.81	19.40	16.42d
RH_2	2.13	3.37	3.73	3.08c	RH_2	3.68	5.37	7.17	5.41c	RH_2	12.60	17.97	20.60	17.06c
RH_3	2.57	3.60	4.37	3.51b	RH_3	4.32	6.93	11.07	7.44b	RH_3	13.80	19.00	23.73	18.84b
RH_4	2.53	3.93	4.97	3.81a	RH_4	4.80	9.29	13.00	9.03a	RH_4	14.30	21.67	24.53	20.17a
Mean	1.83c	3.01b	3.68a		Mean	3.49c	5.67b	7.73a		Mean	12.65c	17.31b	20.32a	
	S.Em±		C.D at 5%		S.Em±			C.D at 5%		S.Em±			C.D at 5%	
RH	0.074		0.214		0.154			0.447		0.285			0.826	
CL	0.057		0.165		0.119			0.346		0.22			0.64	
RHXCL	0.127		0.370		0.267			0.774		0.493			1.431	

Factor-1: RH_0-0 ppm IBA RH_1-4000 ppm IBA RH_2-5000 ppm RH_3-6000 ppm IBA RH_4- 7000 ppm IBA

Factor-2: Cutting length (CL) CL_1-10 cm CL_2-15 cm CL_3-20 cm

Shoot initiation

The data recorded on number of days taken to shoot initiation as influenced by IBA concentrations and their cutting length where control shows significant difference with treatments is presented in table 2.

Among various concentrations of IBA, cuttings treated with IBA at 7000ppm significantly emerged new shoots earliest at (30.34 days) and was on par IBA at 6000ppm (31.70 days) and IBA at 5000ppm (33.42 days). However, the treatment control recorded maximum number of (42.22 days) than all treatments.

The mean days required for shoot initiation differed significantly among the various length of cuttings. The 20 cm cutting length significantly reduced the days to shoot initiation (31.12 days) as compare to 15 cm cutting length (33.70 days) and 10 cm cutting length (38.79 days).

The interaction between concentrations of IBA and different length of cuttings also varied significantly. The earliest (26 days) shoot initiation was observed in the cutting treated with IBA at 7000 ppm with 20 cm cutting length which was on par IBA at 7000 ppm with 15 cm cutting length (29.60 days) and IBA at 6000 ppm with 20 cm cutting length (28.37 days). The delayed shoot initiation was found in the 0 ppm with 10 cm cutting length compared to all the treatment combinations (47 days). IBA @ 7000 ppm induces earlier sprouting of cuttings than control treatment, this could be attributed to better utilization of reserve carbohydrates, nitrogen and other factors stored in stem cuttings by activation of hydrolytic enzymes (Chandramouli, 2001) [4]. Similar findings were reported in Muhammad *et al.* (2009) [12] in jojoba.

Individual shoot length

The data on individual shoot length per cutting at 90 DAP as influenced by IBA concentrations, cutting length and their interaction are presented in table 2.

Among the various concentrations of IBA differed significantly the longest shoot length was observed IBA at 7000 ppm is (20.89 cm) followed by IBA at 6000 ppm (19.33 cm) and minimum shoot length recorded in 0 ppm IBA compared to all the treatments.

The length of cuttings differed significantly the length of longest shoot was observed at cutting length-20 cm is (20.13 cm) followed by cutting length-15 cm is (17.39 cm) and minimum shoot length was observed in 10 cm cutting length (12.95 cm).

The interaction between concentrations of IBA and different length of cuttings also varied significantly. The length of longest shoot was observed IBA at 7000 ppm with 20 cm cutting length (25 cm) followed by IBA at 6000ppm with 20 cm cutting length (23 cm) and minimum shoot length was observed in control with 10 cm cutting length (7.20 cm) than other treatment combinations.

The length of shoot found maximum when treated with plant growth regulator concentration, IBA @ 7000 ppm could be attributed to the rapid hydrolysis of polysaccharides stored in the cuttings into physiologically active sugars by activation of hydrolytic enzymes. These sugars provide energy for the meristematic tissue trough respiratory activity leads to increase in the length of shoot. The present findings are accordance to the results of Seran and Thiresh (2015) [16] and Dhruve *et al.* (2018) [5] in dragon fruit.

Table 2: Effect of different concentration of IBA and length of cuttings on shoot initiation and individual shoot length in dragon fruit *Hylocereus* spp.–with red flesh and pink skin

	Shoot initiation (days after planting)				Individual shoot length (cm)			
RH/CL	**CL_1**	**CL_2**	**CL_3**	**Mean**	**CL_1**	**CL_2**	**CL_3**	**Mean**
RH_0	47.00	41.33	38.33	42.22	7.20	11.10	13.33	10.54e
RH_1	39.50	33.67	31.80	34.99	13.93	16.00	18.67	16.20d
RH_2	37.00	32.17	31.10	33.42	13.27	17.53	20.67	17.16c
RH_3	35.00	31.73	28.37	31.70	15.00	20.00	23.00	19.33b
RH_4	35.43	29.60	26.00	30.34	15.33	22.33	25.00	20.89a
Mean	38.79	33.70	31.12		12.95c	17.39b	20.13a	
	S.Em±		C.D at 5%		S.Em±		C.D at 5%	
RH	0.317		0.919		0.306		0.887	
CL	0.245		0.712		0.237		0.687	
RHXCL	0.549		1.592		0.53		1.537	

Factor-1: Five different level of concentration of IBA RH_0- 0 ppm IBA RH_1-4000 ppm IBA RH_2-5000 ppm RH_3-6000 ppm IBA RH_4-7000 ppm IBA

Factor-2: Cutting length (CL) CL_1-10 cm CL_2-15 cm CL_3-20 cm

Number of new shoots per cutting

The number of new shoots per cutting was recorded at 60, 90 days after planting is influenced by IBA concentrations, cutting length and their interaction are presented in table 3.

The different concentrations of IBA was also found significant at 60 and 90 DAP and the highest number of shoots per cutting (2.52, 3.06 respectively) was recorded in the treatment (7000 ppm IBA) was on par with (6000 ppm IBA) with, (2.29, 2.67) number of shoots, respectively. The lowest number of shoots per cutting (0.90, 1.27) was recorded with treatment control 60 and 90 DAP, respectively.

The highest number of shoots (2.37, 3.04) was observed at cutting length- 20 cm, 60 and 90 DAP respectively followed by cutting length 15 cm (2.05, 2.39) and the lowest number of shoots was recorded in cutting length 10 cm treatment.

The interaction between concentrations of IBA and different length of cuttings is found to be significantly differed the maximum number of shoots per cuttings were observed in (3.24, 4.0) at 60, 90 days respectively.

Among various concentration of IBA @ 7000 ppm produce more number of new shoots per cutting than control treatment might be due to activation of dormant buds on cuttings. The supply of respiratory substrates to glycolytic enzymes leads to release of energy and helps in early sprouting of dormant buds on cuttings. The present findings are conformity with Upadhyay and Badyal (2007) [2] in pomegranate and Rahad *et al.* (2016) [14] in dragon fruit.

Table 3: Effect of different concentration of IBA and length of cuttings on Number of new shoots per cutting in dragon fruit Hylocereus spp.–with red flesh and pink skin

Number of new shoots per cutting								
	60 DAP				90 DAP			
RH/CL	CL_1	CL_2	CL_3	Mean	CL_1	CL_2	CL_3	Mean
RH_0	0.83	0.89	1.00	0.90d	1.05	1.27	1.49	1.27d
RH_1	1.16	2.05	2.24	1.82c	1.89	2.38	2.89	2.38c
RH_2	1.55	2.28	2.65	2.16b	1.94	2.72	3.17	2.61b
RH_3	1.89	2.30	2.70	2.29b	1.94	2.39	3.67	2.67b
RH_4	1.61	2.72	3.24	2.52a	2.00	3.17	4.00	3.06a
Mean	1.41c	2.05b	2.37a		1.77c	2.39b	3.04a	
	S.Em±		C.D at 5%		S.Em±		C.D at 5%	
RH	0.067		0.194		0.091		0.265	
CL	0.052		0.15		0.071		0.205	
RHXCL	0.116		0.336		0.158		0.459	

Factor 1: RH_0-0 ppm IBA RH_1-4000 ppm IBA RH_2-5000 ppm RH_3-6000 ppm IBA RH_4- 7000 ppm IBA
Factor 2: Cutting length (CL) CL_1-10 cm CL_2-15 cm CL_3-20 cm

Effect of different concentrations of IBA and length of cuttings on rooting parameters

Average number of roots per cutting

The data pertaining to average number of roots on per cutting at 90 DAP as influenced by IBA concentrations, cutting length and their interaction are presented in table 4.

At 90 DAP, the cuttings treated with IBA at 7000 ppm gave maximum number of roots per cuttings (18.83) and was superior to all the concentrations of IBA followed by (17.17) with IBA at 6000 ppm.

Among the various lengths of cutting was also found significant at 90 DAP,20 cm cutting length showed maximum number of roots per plant (18.89) and minimum number of roots was observed in 10 cm cutting length (10.47).

The interaction between the various concentrations of IBA and different length of cuttings was significantly varied. At 90 DAP, the maximum number of roots per plant (24.57) was observed in the cuttings treated with IBA at 7000 ppm with 20 cm cutting length followed by IBA at 6000 ppm with 20 cm cutting length (22.80) and least was observed in RH_0CL_1 treatment (5.87).

The higher concentrations of IBA gave maximum number of roots which might be due to its effect on cell wall plasticity which accelerates cell division, stimulates callus development and root growth. The induction of maximum number of roots in treated cuttings may be due to the fact that cambial activity and metabolic activity involved in root initiation is stimulated by growth regulators as reported by Rahad *et al.* (2016) [14] and Dhruve *et al.* (2018) [5] in dragon fruit.

Individual root length

The data pertaining to maximum length of roots per cutting as affected by rooting IBA, length of cuttings and their interaction at 90 DAP are tabulated in table 4.

The data indicate that there were significant differences among the various concentration of IBA on maximum root length per cutting. At 90 DAP, cuttings treated with IBA at 7000 ppm showed maximum root length (14.79 cm) followed by (13.42) at 6000 ppm and minimum root length was observed in control (7.88 cm).

Among the different length of cuttings, at 90 DAP, the cuttings of 20 cm length showed maximum root length (13.13 cm) followed by 15 cm cutting length (11.55cm) and minimum root length was observed in10 cm cutting length.

There existed a significant interaction between concentrations of IBA and length of cuttings in the study. At 90 DAP, cuttings treated with IBA at 7000 ppm with 20 cm cutting length showed maximum root length (16.63 cm) which was significantly superior to all the treatment combinations.

The treatment of cuttings with IBA @ 7000 ppm initiates the formation of maximum root length, could be due to the hydrolysis of polysaccharides stored in the cuttings into physiologically active sugars, which provides energy through respiratory activity to the root primordia and helps in rapid elongation of meristematic cells and initiate to obtain maximum root length (Singh *et al*. 2014) [18]. Similar results were reported in Rahad *et al.* (2016) [14] in dragon fruit.

Table 4: Effect of different concentration of IBA and length of cuttings on average number of roots per cutting and individual root length (cm) in dragon fruit *Hylocereus* spp.– with red flesh and pink skin

Average number of roots per cutting					Individual root length (cm)			
RH/CL	CL_1	CL_2	CL_3	Mean	CL_1	CL_2	CL_3	Mean
RH_0	5.87	7.40	11.07	8.11e	6.47	8.13	9.03	7.88e
RH_1	9.37	14.27	16.60	13.41d	9.97	10.07	11.43	10.49d
RH_2	11.33	16.10	19.43	15.62c	10.48	11.07	13.47	11.67c
RH_3	11.97	16.73	22.80	17.17b	12.10	13.07	15.10	13.42b
RH_4	13.80	18.13	24.57	18.83a	12.33	15.40	16.63	14.79a
Mean	10.47c	14.53b	18.89a		10.27c	11.55b	13.13a	
	S.Em±		C.D at 5%		S.Em±		C.D at 5%	
RH	0.26		0.754		0.15		0.435	
CL	0.201		0.584		0.116		0.337	
RHXCL	0.45		1.307		0.26		0.754	

Factor 1: Five different level of concentration of IBA RH_0- control, RH_1-4000 ppm IBA, RH2-5000 ppm, RH_3-6000 ppm IBA, RH4-7000 ppm IBA
Factor 2: Cutting length (CL) CL_1-10 cm, CL2-15 cm, CL_3-20 cm

Fresh weight of roots (g)

The data pertaining to fresh weight of roots as affected by rooting IBA, length of cuttings and their interaction at 90 DAP are presented in table 5.

The data indicate that there were significant differences among the various concentration of IBA on maximum fresh weight of roots (g). At 90 DAP, cuttings treated with IBA at 7000 ppm showed maximum fresh weight (1.96 g) was followed by (1.69 g, 1.47 g) at 6000 ppm and 5000 ppm respectively, and minimum fresh weight was observed in control (0.63 g).

Among the different length of cuttings, at 90 DAP, the cuttings of 20 cm length showed maximum fresh weight (1.89 g) followed by 15 cm cutting length (1.34 g) and minimum fresh weight was observed in 10 cm cutting length.

There existed a significant interaction between concentrations of IBA and length of cuttings in the study. At 90 DAP, cuttings treated with IBA at 7000 ppm with 20 cm cutting length showed maximum fresh weight of roots (2.57 g) which was followed by IBA at 6000 ppm which was significantly superior to all the treatment combinations.

The fresh weight of roots was high when the cuttings were treated with IBA @ 7000 ppm could be attributed to the rapid hydrolysis of polysaccharides stored in the cuttings into physiologically active sugars by activation of hydrolytic enzymes. These sugars provide energy for the meristematic tissue through respiratory activity leads to initiate more number of adventitious roots which helps in early establishment of cuttings and subsequently increased the

uptake of more nutrients and water from the growing media resulted in an increase in root fresh weight. The present findings are in conformity with the results of Singh *et al.* (2013) [17] in lemon and Seran and Thiresh (2015) [16] in dragon fruit.

Dry weight of roots (g)

The data pertaining to dry weight of roots as affected by rooting IBA, length of cuttings and their interaction at 90 DAP are presented in table 5.

The different concentrations of IBA was also found significant at 90 DAP and the maximum was recorded (0.98 g) in the treatment (7000 ppm IBA) followed by (6000 ppm IBA) with (0.88 g). The minimum dry weight was observed in control (0.17 g) than all the treatments.

Among the various cutting length the dry weight was found significant the maximum dry weight was observed in cutting length-20 cm is (1.07 g) followed by cutting length -15cm is (0.52 g).

The interaction effect of IBA and cutting length was found significant RH_4CL_3 recorded maximum dry weight (1.50 g) was followed by (1.47 g) RH_3CL_3 and least was recorded in RH_0CL_1.

Among various concentrations of IBA @ 7000 ppm showed more dry weight when compared to control treatment. It could be due to enhancement of hydrolysis of polysaccharides stored in stem cuttings by the hydrolytic enzymes activated by plant growth regulators into physiologically active sugars. Its helps in formation of more number of roots per cutting which leads to an increase in dry weight of roots. Similar findings were also reported by Porghorban *et al.* (2014) [13] in olive and Rahad *et al.* (2016) [14] in dragon fruit.

Table 5: Effect of different concentration of IBA and length of cuttings on Fresh weight of roots (g) and Dry weight of roots (g) in dragon fruit *Hylocereus* spp.– with red flesh and pink skin

	Fresh weight of roots (g)				Dry weight of roots (g)			
RH/CL	**CL_1**	**CL_2**	**CL_3**	**Mean**	**CL_1**	**CL_2**	**CL_3**	**Mean**
RH_0	0.40	0.63	0.86	0.63e	0.09	0.16	0.26	0.17e
RH_1	1.09	1.13	1.59	1.27d	0.26	0.54	0.97	0.59d
RH_2	1.07	1.25	2.10	1.47c	0.46	0.51	1.13	0.70c
RH_3	1.13	1.63	2.30	1.69b	0.52	0.65	1.47	0.88b
RH_4	1.23	2.07	2.57	1.96a	0.70	0.75	1.50	0.98a
Mean	0.99c	1.34b	1.89a		0.41c	0.52b	1.07a	
	S.Em±		C.D at 5%		S.Em±		C.D at 5%	
RH	0.054		0.157		0.025		0.073	
CL	0.042		0.122		0.019		0.056	
RHXCL	0.094		0.273		0.043		0.126	

Factor-1: Five different level of concentration of IBA RH_0- control, RH_1-4000 ppm IBA, RH_2-5000 ppm, RH_3-6000 ppm IBA, RH_4-7000 ppm IBA

Factor-2: Cutting length (CL) CL_1-10 cm, CL2-15 cm, CL_3-20 cm

Survival percentage of rooted cuttings

The data on survival percentage of rooted cuttings as influenced by IBA, cutting length and their interaction are presented in table 6.

The different concentrations of IBA treatment were found significant and the treatment with IBA concentration 7000 ppm resulted in the maximum survival percentage (94.43%) was on par with 6000 ppm IBA (90.72%).

The length of the cutting was varied significantly and the maximum survival percentage (96.66%) was observed in 20cm cutting length followed by (87.75%).The large-sized cutting length survived better due to the more number of roots and the longest length of the roots per cutting and it has more food reserve materials and nutrients which make the plant stronger and it can survive more easily than other smaller sized cutting length and similar results were reported by (Ahsan-Ullah, 2015) [1] in dragon fruit.

The interaction of different concentrations of IBA and length of cuttings are not significantly differed 100% survival was observed in, RH4CL3, RH3CL3, RH_1CL_3.

The dragon fruit cuttings which were treated with IBA @ 7000 ppm showed highest survival percentage, it might be due to that fact increased number of roots and root length per cutting influenced the better uptake of water and nutrients (Reddy *et al*., 2008) [15]. The supply of photo assimilates synthesized in new shoots towards the root system also helps in rapid survival of rooted cuttings in dragon fruit. The results are similar with the findings of Rahad*et al*. (2016) [14] and Dhruve *et al*. (2018) [5] in dragon fruit.

Table 6: Effect of different concentration of IBA and length of cuttings on survival percentage of rooted cuttings in dragon fruit *Hylocereus* spp.– with red flesh and pink skin

Survival percentage of rooted cuttings				
RH/CL	**CL_1**	**CL_2**	**CL_3**	**Mean**
RH_0	66.60	77.73	88.87	77.73c
RH_1	77.73	83.30	100.00	87.01b
RH_2	83.30	83.30	94.43	87.01b
RH_3	77.73	94.43	100.00	90.72a
RH_4	83.30	100.00	100.00	94.43a
Mean	77.73c	87.75b	96.66a	
	S.Em±		C.D at 5%	
RH	2.033		5.899	
CL	1.574		4.569	
RHXCL	3.521		NS	

Factor-1: Five different level of concentration of IBA RH_0- control, RH_1-4000 ppm IBA, RH_2-5000 ppm, RH_3-6000 ppm IBA, RH_4-7000 ppm IBA

Factor-2: Cutting length (CL) CL_1-10 cm, CL2-15 cm, CL_3-20 cm

Conclusion

In the present investigation IBA treatment was found successful in rooting and shooting parameters of dragon fruit cutting and as the concentration of IBA increased the performance of the cutting was also increased and the maximum was recorded at 7000 ppm IBA treatment. Among the different length of the cuttings, 20 cm cutting length responded well than other length of cuttings with respect to various rooting and shooting parameters.However, it could be concluded from the present studies that, the effect of IBA at 7000 ppm and length of cuttings of 20 cm significantly influenced the rooting and shooting parameters in dragon fruit cuttings.

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