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Effect of plant growth regulator on propagation of dragon fruit through stem cutting under shade net condition

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Abstract
The present experiment was done to entitled "Effect of plant growth regulators on propagation of Dragon fruit through stem cutting under shade net condition" was carried out during 2020-2021 at College Farm, Pt. K.L.S. College of Horticulture and Research station Rajnandgaon. The experiment was laid out by following Complete Randomized Design (CRD) with ten treatments, replicated four times.
The stem cutting of Dragon fruit treated with five growth regulators *viz* IBA, NAA, Humic acid, Humic+ Fulvic acid and Sea weed extract to observe the distinctive responses to rooting and shooting growth of Dragon fruit cutting.
Different growth parameters exhibits the different responses for different growth regulators, The study reveals that, least number of days taken for root initiation (15.42), length of longest root at 30, 60 and 90 DAP (5.11,10.1 and 21.43 cm), average number of roots per cutting (10.75,15.08 and 27.5), average length of roots per cutting (4.13,8.18 and 13.85 cm), Root diameter (0.57,0.70 and1.55 mm), fresh weight and dry weight of root at 90 DAP (2.50 g and 1.21 g respectively), in case of Shoot parameter least number of days taken for sprouting (17.25), number of sprouts per cutting at 30, 60 and 90 DAP (1.13,1.94 and 3.13), Length of sprout and shoot (2.48,6.01 and14.98 cm), shoot diameter (2.58,3.79 and 4.88 mm), fresh weight and dry weight of shoot at 90 DAP (49.53 g and 7.53 g respectively), as well as, highest root to shoot ratio (0.16) were recorded in cutting treated with IBA @ 7000 ppm (T_3). Among the different plant growth regulators, IBA @ 7000 ppm was found to improve root and shoot growth of dragon fruit under shade net condition.

Keywords: Dragon fruit, IBA, NAA, humic acid, humic+fulvic acid, seaweed extract

Introduction
Dragon fruit (*Hylocereus spp*.), a herbaceous perennial climbing cactus, belong to family cactaceae widely known as pitaya, strawberry, pear, night blooming cereus, queen of night, honorable queen. It is botanical known as *Hylocereus* refers to both of its adaptation to habitat (hylos means forest in greek) and the has recently drawn much attention among the Indian growers, not only because of its attractive red or pink color and economic value as fruit, but also valued for its high antioxidant potential, vitamins and minerals content. Dragon Fruit is named as pitaya because of the bracts or scales on the fruit skin and hence the name of pitaya meaning ''the scaly fruit''. It has ornamental value due to the beauty of their large flowers (25 cm) that bloom at night; they are creamy white in color. It is considered as a fruit crop for future (Gunasena and pushpakumara, 2006 and Gunasena *et al*., 2000) [2].
Dragon fruit is a semi epiphytic vine plant which can climb naturally to any natural or artificial support they meet (trees, wood or cement posts, stone walls, *etc*.) (Rondón,1998) due to presence of aerial roots. Many different types of support are used, but mainly vertical supports made of wood or cement and iron posts (N'Guyen, 1996 and Barbeau, 1990) [4, 1] and on horizontal and inclined supports. Plant growth is rapid and continuous, though possibly with a vegetative rest period when the climatic conditions are unfavorable (drought and very low temperatures).
The fruit weights 150-1200 g and difference lie on size and shape of fruits as well as color of pulp. Proximate nutraceutical values in g or mg per 100 g edible portion of white-flesh dragon fruit are as follows: moisture (85.3%), protein (1.1), fat (0.57), crude fiber (1.34), energy (Kcal) (67.7), ash (0.56), carbohydrates (11.2), glucose (5.7), fructose (3.2), sucrose (not detected), sorbitol (0.33); vitamin C (3.0), vitamin A (0.01), niacin (2.8), Ca (10.2), Fe (3.37), Mg (38.9), P (27.75), K (272.0), Na (8.9) and Zn (0.35) and for red-flesh fruit, moisture (82.5-83.0), protein (0.159-0.229), fat (0.21-0.61), crude fiber (0.7-0.9) and ascorbic acid (8-9)

(Jaafar *et al.,* 2009) [3]. Dragon fruit plants can easily propagate through stem cutting. Generally 20-25cm long stem cuttings are used for planting. The cutting should be prepared one–two days prior to planting and the latex oozing out of cut is allowed to dry. These cutting roots profusely and become ready for planting with 5-6 months.

Materials and Methods

The present experiment was carried out on the "Effect of plant growth regulators on propagation of Dragon fruit through stem cutting under shade net condition" during the year 2020-21 under protected condition i.e. in shade net at Horticulture farm, Pt. K.L.S. College of Horticulture and Research Station, Rajnandgaon, (C.G.) The experiment was laid out in Complete Randomized Block Design with10 treatments and 4 replications *viz*., T_0 – Dipped in distilled water, T_1- IBA@ 5000 ppm, T_2 – IBA@ 6000 ppm, T_3- IBA @ 7000 ppm,T_4-NAA @ 100 ppm, T_5- NAA @ 200 ppm,T_6-NAA 300 @ ppm, T_7 –Humic acid @ 2000 ppm, T_8Humic+fulvic acid @ 2000 ppm, and T_9 – Sea weed extract @ 2000 ppm. The cuttings were treated with plant growth regulators as per the treatments by quick dip method for 5 minutes, later they were allowed to dry for 15 minutes under shade and planted in poly bags containing the rooting media. These cuttings are planted in 12 x 30 cm size polyethylene bags, filled with 1:1:1 ratio of soil, farmyard manure and sand.

Result and Discussion

The dragon fruit cuttings treated with different plant growth regulators showed that plant growth regulators were more effective than control for root and shoot parameters under investigation. IBA @ 7000 ppm concentration gave better result in root and shoot parameters followed by IBA @ 6000 PPM, IBA @ 5000 ppm, NAA @ 300 ppm, NAA @ 200 ppm, NAA @ 100 ppm Humic acid @ 2000 ppm, Humic+ Fulvic acid @ 2000 ppm and Sea weed extract @2000 ppm whereas the least performance was observed in control treatment.

The study reveals that, least number of days taken for root initiation (15.42), length of longest root at 30, 60 and 90 DAP (5.11,10.1 and 21.43 cm), average number of roots per cutting (10.75,15.08 and 27.5), average length of roots per cutting (4.13,8.18 and 13.85 cm), Root diameter (0.57,0.70 and1.55 mm), fresh weight and dry weight of root at 90 DAP (2.50 g and 1.21 g respectively), in case of Shoot parameter least number of days taken for sprouting (17.25), number of sprouts per cutting at 30, 60 and 90 DAP (1.13,1.94 and 3.13), Length of sprout and shoot (2.48,6.01 and14.98 cm), shoot diameter (2.58,3.79 and 4.88 mm), fresh weight and dry weight of shoot at 90 DAP (49.53 g and 7.53 g respectively), as well as, highest root to shoot ratio (0.16) were recorded in cutting treated with IBA @ 7000 ppm (T_3).

Table 1: Effect of growth regulators on days required for root initiation in stem cuttings of Dragon fruit

Treatment No.	Treatment details	Days taken for root initiation
T_0	Control (Dipped in distilled water)	25.83
T_1	Indole 3 butyric acid 5000 ppm	17.08
T_2	Indole 3 butyric acid 6000 ppm	16.67
T_3	Indole 3 butyric acid 7000ppm	15.42
T_4	Naphthalene acetic acid 100 ppm	23.33
T_5	Naphthalene acetic acid 200 ppm	22.92
T_6	Naphthalene acetic acid 300 ppm	21.25
T_7	Humic acid 2000 ppm	25.42
T_8	Humic acid + Fulvic acid 2000 ppm	24.17
T_9	Sea weed extract 2000 ppm	22.92
S.Em ±		0.22
C.D @ 5%		0.65
CV		2.09

Table 2: Effect of growth regulators on length of longest root per cutting in Dragon fruit at different days after planting (DAP).

Treatment No.	Treatment details	Length of the longest root (cm)		
		30 DAP	60 DAP	90 DAP
T_0	Control (Dipped in distilled water)	2.63	5.18	8.67
T_1	Indole 3 butyric acid 5000ppm	4.19	8.10	18.91
T_2	Indole 3 butyric acid 6000ppm	4.77	9.48	20.72
T_3	Indole 3 butyric acid 7000ppm	5.11	10.1	21.43
T_4	Naphthalene acetic acid 100 ppm	3.08	6.21	14.29
T_5	Naphthalene acetic acid 200ppm	3.66	7.18	16.49
T_6	Naphthalene acetic acid 300ppm	3.85	7.76	17.23
T_7	Humic acid 2000ppm	2.80	5.36	12.65
T_8	Humic acid +Fulvic acid 2000ppm	3.03	6.03	13.72
T_9	Sea weed extract 2000ppm	3.23	6.04	14.66
S.Em ±		0.04	0.08	0.14
C.D @ 5%		0.13	0.25	0.41
CV		2.59	2.50	1.79

Table 3: Effect of growth regulators on average number of roots per cutting in Dragon fruit at different days after planting (DAP).

Treatment No.	Treatment details	Average number of roots per cutting		
		30 DAP	60 DAP	90 DAP
T_0	Control (Dipped in distilled water)	4.25	6.67	13.58
T_1	Indole 3 butyric acid 5000ppm	8.67	12.42	21.83
T_2	Indole 3 butyric acid 6000ppm	9.83	14.08	24.83
T_3	Indole 3 butyric acid 7000ppm	10.75	15.08	27.5
T_4	Naphthalene acetic acid 100ppm	5.5	9.83	17.25
T_5	Naphthalene acetic acid 200ppm	6.08	10.33	17.83
T_6	Naphthalene acetic acid 300ppm	6.25	10.58	19.08
T_7	Humic acid 2000ppm	5.08	7.58	14.08
T_8	Humic acid + Fulvic acid 2000ppm	5.25	8.75	15.75
T_9	Sea weed extract 2000ppm	5.67	9.5	16.67
S.Em ±		0.08	0.12	0.20
C.D @ 5%		0.25	0.35	0.58
CV		2.62	2.31	2.13

Table 4: Effect of growth regulators on average length of root per cutting in Dragon fruit at different days after planting (DAP).

Treatment No.	Treatment details	Average length of root per cutting		
		30 DAP	60 DAP	90 DAP
T_0	Control (Dipped in distilled water)	2.03	4.12	7.22
T_1	Indole 3 butyric acid 5000ppm	3.38	7.16	13.15
T_2	Indole 3 butyric acid 6000 ppm	3.56	7.20	13.54
T_3	Indole 3 butyric acid 7000ppm	4.13	8.18	13.85
T_4	Naphthalene acetic acid 100ppm	2.47	5.28	10.03
T_5	Naphthalene acetic acid 200ppm	2.68	6.11	10.48
T_6	Naphthalene acetic acid 300ppm	2.76	6.63	10.95
T_7	Humic acid 2000ppm	2.13	4.49	8.76
T_8	Humic acid + Fulvic acid 2000ppm	2.28	4.77	9.36
T_9	Sea weed extract 2000ppm	2.38	4.56	9.69
S.Em ±		0.03	0.06	0.10
C.D @ 5%		0.09	0.19	0.30
CV		2.44	2.30	1.96

Table 5: Effect of growth regulators on root diameter of stem cuttings in Dragon fruit at different days after planting (DAP).

Treatment No.	Treatment details	Root diameter (mm)		
		30 DAP	60 DAP	90 DAP
T_0	Control (Dipped in distilled water)	0.13	0.23	0.81
T_1	Indole 3 butyric acid 5000ppm	0.45	0.64	1.42
T_2	Indole 3 butyric acid 6000 ppm	0.52	0.68	1.50
T_3	Indole 3 butyric acid 7000ppm	0.57	0.70	1.55
T_4	Naphthalene acetic acid 100 ppm	0.23	0.37	1.34
T_5	Naphthalene acetic acid 200ppm	0.30	0.42	1.34
T_6	Naphthalene acetic acid 300ppm	0.33	0.46	1.37
T_7	Humic acid 2000ppm	0.17	0.29	1.07
T_8	Humic acid + Fulvic acid 2000ppm	0.21	0.30	1.11
T_9	Sea weed extract 2000ppm	0.23	0.33	1.20
S.Em ±		0.002	0.005	0.016
C.D @ 5%		0.007	0.017	0.048
CV		1.61	2.67	2.64

Table 6: Effect of growth regulators on fresh weight of the root in stem cuttings of Dragon fruit at 90 days after planting (DAP).

Treatment No.	Treatment details	Fresh weight of the root
T_0	Control (Dipped in distilled water)	1.42
T_1	Indole 3 butyric acid 5000ppm	2.27
T_2	Indole 3 butyric acid 6000 ppm	2.45
T_3	Indole 3 butyric acid 7000ppm	2.50
T_4	Naphthalene acetic acid 100ppm	1.83
T_5	Naphthalene acetic acid 200ppm	1.87
T_6	Naphthalene acetic acid 300ppm	1.94
T_7	Humic acid 2000ppm	1.52
T_8	Humic acid + Fulvic acid 2000ppm	1.58
T_9	Sea weed extract 2000ppm	1.66
S.Em ±		0.021
C.D @ 5%		0.062
CV		2.26

Table 7: Effect of growth regulators on dry weight of the root in stem cuttings of Dragon fruit at 90 days after planting (DAP).

Treatment No.	Treatment details	Dry weight of the root
T_0	Control (Dipped in distilled water)	0.27
T_1	Indole 3 butyric acid 5000 ppm	1.03
T_2	Indole 3 butyric acid 6000 ppm	1.07
T_3	Indole 3 butyric acid 7000ppm	1.21
T_4	Naphthalene acetic acid 100ppm	0.60
T_5	Naphthalene acetic acid 200ppm	0.70
T_6	Naphthalene acetic acid 300ppm	0.74
T_7	Humic acid 2000ppm	0.35
T_8	Humic acid + Fulvic acid 2000ppm	0.43
T_9	Sea weed extract 2000ppm	0.50
S.Em ±		0.007
C.D @ 5%		0.021
CV		2.14

Table 8: Effect of growth regulators on number of days taken for sprouting in stem cuttings of Dragon fruit.

Treatment No.	Treatment details	Number of days taken for sprouting
T_0	Control (Dipped in distilled water)	23.33
T_1	Indole 3 butyric acid 5000 ppm	19.08
T_2	Indole 3 butyric acid 6000 ppm	18.83
T_3	Indole 3 butyric acid 7000ppm	17.25
T_4	Naphthalene acetic acid 100 ppm	21.92
T_5	Naphthalene acetic acid 200 ppm	21.58
T_6	Naphthalene acetic acid 300 ppm	20.83
T_7	Humic acid 2000 ppm	22.75
T_8	Humic acid + Fulvic acid 2000 ppm	22.25
T_9	Sea weed extract 2000 ppm	22.08
S.Em ±		0.26
C.D @ 5%		0.75
CV		2.47

Table 9: Effect of growth regulators on number of sprouts per stem cutting in Dragon fruit at different days after planting (DAP).

Treatment No.	Treatment details	Number of sprouts per cutting		
		30 DAP	60 DAP	90 DAP
T_0	Control (Dipped in distilled water)	0.77	1.11	2.11
T_1	Indole 3 butyric acid 5000 ppm	1.16	1.91	3.08
T_2	Indole 3 butyric acid 6000 ppm	1.27	1.61	3.16
T_3	Indole 3 butyric acid 7000ppm	1.13	1.94	3.13
T_4	Naphthalene acetic acid 100 ppm	1.11	1.69	3.08
T_5	Naphthalene acetic acid 200ppm	0.97	1.61	2.69
T_6	Naphthalene acetic acid 300ppm	0.91	1.55	2.63
T_7	Humic acid 2000ppm	1	1.50	2.88
T_8	Humic acid + Fulvic acid 2000ppm	0.86	1.44	2.63
T_9	Sea weed extract 2000ppm	0.88	1.50	2.88
S.Em ±		0.12	0.14	0.15
C.D @ 5%		0.35	0.41	0.45
CV		3.75	4.25	4.52

Table 10: Effect of growth regulators on sprout and shoot length of stem cuttings in Dragon fruit at different days after planting (DAP)

Treatment No.	Treatment details	Length of the sprout (cm)	Length of the shoot (cm)	
		30 DAP	60 DAP	90 DAP
T_0	Control (Dipped in distilled water)	1.08	2.11	6.14
T_1	Indole 3 butyric acid 5000 ppm	2.11	5.02	13.8
T_2	Indole 3 butyric acid 6000 ppm	2.38	5.58	14.58
T_3	Indole 3 butyric acid 7000ppm	2.48	6.01	14.98
T_4	Naphthalene acetic acid 100 ppm	1.63	3.79	8.02
T_5	Naphthalene acetic acid 200ppm	1.76	5.59	8.44
T_6	Naphthalene acetic acid 300ppm	1.87	4.22	8.63
T_7	Humic acid 2000ppm	1.23	2.84	6.77
T_8	Humic acid + Fulvic acid 2000ppm	1.49	3.35	7.47
T_9	Sea weed extract 2000ppm	1.56	3.49	7.73
S.Em ±		0.01	0.02	0.08
C.D @ 5%		0.04	0.08	0.23
CV		1.95	1.35	1.67

Table 11: Effect of growth regulators on shoot diameter of stem cuttings in Dragon fruit at different days after planting (DAP)

Treatment No.	Treatment details	Shoot diameter(mm)		
		30 DAP	60 DAP	90 DAP
T_0	Control (Dipped in distilled water)	1.04	1.82	2.53
T_1	Indole 3 butyric acid 5000 ppm	2.15	3.54	4.48
T_2	Indole 3 butyric acid 6000 ppm	2.37	3.71	4.70
T_3	Indole 3 butyric acid 7000ppm	2.58	3.79	4.88
T_4	Naphthalene acetic acid 100 ppm	1.67	2.63	3.61
T_5	Naphthalene acetic acid 200 ppm	1.79	2.69	3.78
T_6	Naphthalene acetic acid 300 ppm	1.90	2.79	3.88
T_7	Humic acid 2000 ppm	1.23	2.16	2.91
T_8	Humic acid + Fulvic acid 2000ppm	1.46	2.27	3.10
T_9	Sea weed extract 2000 ppm	1.52	2.36	3.18
S.Em ±		0.02	0.03	0.03
C.D @ 5%		0.06	0.09	0.09
CV		2.42	2.24	1.84

Table 12: Effect of growth regulators on fresh weight of the shoot in stem cuttings of Dragon fruit at 90 days after planting (DAP).

Treatment No.	Treatment details	Shoot fresh weight
T_0	Control (Dipped in distilled water)	22.93
T_1	Indole 3 butyric acid 5000 ppm	45.95
T_2	Indole 3 butyric acid 6000 ppm	47.39
T_3	Indole 3 butyric acid 7000 ppm	49.53
T_4	Naphthalene acetic acid 100 ppm	30.67
T_5	Naphthalene acetic acid 200 ppm	32.68
T_6	Naphthalene acetic acid 300 ppm	33.54
T_7	Humic acid 2000 ppm	24.32
T_8	Humic acid + Fulvic acid 2000ppm	25.82
T_9	Sea weed extract 2000 ppm	26.88
S.Em ±		0.40
C.D @ 5%		1.17
CV		2.40

Table 13: Effect of growth regulators on Dry weight of the shoot in stem cuttings of Dragon fruit at 90 days after planting (DAP).

Treatment No.	Treatment details	Shoot dry weight
T_0	Control (Dipped in distilled water)	3.84
T_1	Indole 3 butyric acid 5000 ppm	7.32
T_2	Indole 3 butyric acid 6000 ppm	7.43
T_3	Indole 3 butyric acid 7000ppm	7.53
T_4	Naphthalene acetic acid 100 ppm	5.59
T_5	Naphthalene acetic acid 200ppm	5.82
T_6	Naphthalene acetic acid 300ppm	5.83
T_7	Humic acid 2000ppm	4.27
T_8	Humic acid + Fulvic acid 2000ppm	4.44
T_9	Sea weed extract 2000ppm	4.57
S.Em ±		0.06
C.D @ 5%		0.19
CV		2.32

Table 14: Effect of growth regulators on Root -Shoot ratio in stem cuttings of Dragon fruit at 90 days after planting (DAP).

Treatment No.	Treatment details	Root –Shoot ratio
T_0	Control (Dipped in distilled water)	0.07
T_1	Indole 3 butyric acid 5000 ppm	0.14
T_2	Indole 3 butyric acid 6000 ppm	0.15
T_3	Indole 3 butyric acid 7000ppm	0.16
T_4	Naphthalene acetic acid 100 ppm	0.11
T_5	Naphthalene acetic acid 200ppm	0.12
T_6	Naphthalene acetic acid 300ppm	0.13
T_7	Humic acid 2000ppm	0.08
T_8	Humic acid + Fulvic acid 2000ppm	0.10
T_9	Sea weed extract 2000ppm	0.11
S.Em ±		0.001
C.D @ 5%		0.003
CV		2.16

Conclusion

From the present study, it is concluded that cutting treated with IBA @7000 ppm performed well in all aspects of rooting and shooting parameters among all 9 plant growth regulators.

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