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Effect of chemicals and biomix on shoot growth and success of cuttings in dragon fruit (*Hylocereus undatus*)

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Abstract
The present investigation entitled "Effect of chemicals and biomix on growth, success and survival of cutting in dragon fruit (*Hylocereus undatus*) on shoot parameters" was carried out at Department of Horticulture College of Agriculture, Badnapur during the year 2020- 2021. The experiment was laid out in randomized block design with ten treatments and replicated thrice. The details of treatment are T_1 - IBA @ 5000 ppm, T_2 - IBA @ 6000 ppm, T_3 - IBA @ 7000 ppm, T_4- PHB @ 500 ppm, T_5- PHB @ 750 ppm, T_6- PHB @ 1000 ppm, T_7 - Biomix @ 0.5%, T_8 - Biomix @ 1.0%, T_9 - Biomix @ 1.5%, T_{10}- Control (No Treatment). IBA @ 7000 ppm recorded Minimum number of days required to initiate first shoot (14.83), maximum number of shoots per cutting at 30 days (1.00), at 60 days (1.80) and at 90 days (2.47), maximum length of shoots per cutting at 30 days (2.65 cm), at 60 days (8.40 cm), and at 90 days (17.54 cm), maximum fresh weight of shoot (56.67 g), maximum dry weight of shoot (11.33 g), maximum shooting percentage (95.00%) and the minimum value for all these parameters was observed in control (T_{10}).

Keywords: Dragon fruit, stem cutting, IBA, PHB, biomix, shoot growth

Introduction
Dragon fruit (*Hylocereus undatus*) is a perennial climbing cactus, belongs to the family Cactaceae. It is commonly called Pitaya, Strawberry pear, Night-blooming cereus, Queen of night, Honorable queen, Cereus triangularis, Kamlam and Jesus in the cradle and Belle of the night. The origin is tropical and subtropical forest regions of Mexico and Central South America (including Southern Mexico, the Pacific side of Guatemala, Costa Rica). Dragon fruit has spread to tropical and sub-tropical America, Asia, Australia, and the Middle East from the center of origin. Vietnam is the world's largest producer of dragon fruit. The total area of dragon fruit cultivation in Vietnam is approximately 50,000 ha with production 12,50,000 MT and is expected to cross 17,00,000 MT by 2025. (Waghmare *et al*., 2021) [10]. The average composition of Dragon fruit is water (89.4 gm), protein (0.5 gm), fat (0.1 gm), crude fiber (0.3 c), ash (0.5 gm), calcium (6 mg), phosphorus (19 mg), iron (0.4 mg), niacin (0.2 mg), Ascorbic acid (25 mg), Brix value (11-19), P^H value (4.7-5.1). (Gunasena *et al.*, 2006) [2]. Dragon fruit can also be propagated vegetatively by grafting. Grafting is, however, not very common as cuttings are an easy and convenient method of propagation. However, the grafting method is beneficial when using selected rootstock and scions. The vegetative propagation in Dragon fruit is of utmost desirable in order to propagate true-to-type plants. Hence, vegetative methods of propagation, *viz*. stem cuttings, is inexpensive, rapid, simple, and do not require particular techniques in the case of other methods. The reports on an investigation on the propagation of Dragon fruit from cuttings and the use of growth regulators for better shoot growth success and survival are scanty. Therefore, the study was undertaken to propagate Dragon fruit using different chemicals, biomix, for rapid multiplication.

Materials and Method
The experiment was carried out at Department of Horticulture, College of Agriculture, Badnapur during the year 2020-2021. The experiment was laid out in randomized block design with ten treatments and replicated thrice. The details of treatment are T_1 - IBA @ 5000 ppm, T_2 - IBA @ 6000 ppm, T_3 - IBA @ 7000 ppm, T_4- PHB @ 500 ppm, T_5- PHB @ 750 ppm, T_6- PHB @ 1000 ppm, T_7 - Biomix @ 0.5%, T_8 - Biomix @ 1.0%, T_9 - Biomix @ 1.5%, T_{10}- Control (No Treatment). Planting of Dragon fruit cuttings in polythene bags of size (4" × 6"). The polythene bags were punctured to improve the drainage and filled with a garden mixture prepared by mixing one part of the soil, one part of sand, one part of well-rotted FYM

(1:1:1 proportion of soil, sand and FYM). The cuttings of Dragon fruit (*Hylocereus undatus*) used for this research were selected from 3 years old mother plant. Cutting will be selected from one year old shoot with 10 to 15 cm length and 4-5 nodes. Treatment wise solutions of IBA, PHB and Biomix were prepared. The required quantities of chemicals were weighed on the chemical balance. The weighed quantity of chemical powder was dissolved in 5ml of ethyl alcohol (50%) then the required quantity of distilled water was added to make the solutions of desired concentrations. The treatments were applied and observation were recorded for Number of days required to initiate first shoot, Number of shoot per cutting, Shoot length (cm), Fresh and dry weight of shoot (g), Shooting percentage (%). The data was analyzed statistically and presented as per method suggested by Panse and Sukhatme (1985) [4].

Results and Discussion

Effect of chemicals and biomix on number of days required to initiate first shoot

The data indicated in Table 2 revealed that, minimum number of days required to initiate first shoot (14.83) was reported in treatment T_3 (IBA 7000 ppm) which was at par with treatment T_2 (15.33). The next best treatments were T_1, T_6, T_5, T_4, T_9 and T_8 showed intermediate effect. While, maximum number of days required to initiate first shoot (25.17) was recorded in treatment T_{10} (*i.e.* control). It could be attributed to the activation of hydrolytic enzymes, which improves the utilization of reserve carbohydrates, nitrogen, and other nutrients stored in stem cuttings (Chandramouli, 2001) [1]. Similar findings were reported by Srivastava *et al.* (2005) [8] in Kiwifruit and Siddiqua *et al.* (2018) [7] in dragon fruit.

Effect of chemicals and biomix on number of shoots

The data presented in Table 1 reported that effect of chemicals and biomix on number of shoots was recorded at 30, 60 and 90 days. At 30 days of cutting maximum number of shoots per cutting (1.00) was reported in treatment T_3 (IBA 7000 ppm) which was followed by the treatment T_2 (0.93) and was at par with each other. The next best treatments were T_1, T_9, T_6, T_5, T_4, T_8 and T_7 which showed intermediate effect. While, minimum number of shoots per cutting (0.30) was recorded in treatment T_{10} (control).

At 60 days of cutting maximum number of shoots per cutting (1.80) was reported in treatment T_3 (IBA 7000 ppm) which was at par with the treatment T_2 (1.70) and T_6 (1.57). The treatments *viz.*, T_9, T_1, T_5, T_4, T_8 and T_7 showed intermediate effect. While, minimum number of shoots per cutting (1.13) was recorded in treatment T_{10} control.

Almost similar trend was recorded at 90 days of cutting. The maximum number of shoots per cutting (2.47) was reported in treatment T_3 (IBA 7000 ppm) which was at par with the treatment T_2 (2.20). The treatments followed byT_6, T_9, T_5, T_4, T_1, T_8 and T_7 showed intermediate effect. While, minimum number of shoots per cutting (1.33) was recorded in treatment T_{10} (control). The more number of shoot formation with the growth regulators might be due to the vigorous root system which increased the nutrient uptake under the influence of IBA, hence vigorous growth of the plant. Similar finding as reported by Khajehpour *et al.* (2014) [3] in olive.

Effect of chemicals and biomix on shoot length (cm)

The data pertaining to shoot length as influenced by chemicals and biomix is presented in Table 1.

At 30 days of cutting, the maximum length of shoots per cutting (2.65 cm) was reported in treatment T_3 (IBA 7000 ppm) which was at par with treatment T_2 (2.57 cm). The next best treatments were followed by T_1, T_6, T_9, T_5, T_4 and T_8 and showed intermediate effect. Significantly minimum length of shoots per cutting (1.05 cm) was reported in control. The emergence of longest shoots on cuttings might be attributed to the well-developed root system in such cuttings which might have tended to promote shoot growth by ensuring adequate mobilization of water and nutrients from the soil or substrate to the growing apices. Consequently, there was a faster growth rate of the newly emerged shoots (Pratima and Rana, 2011) [5].

Table 1: Effect of chemicals and biomix on Number of shoots and shoot length in dragon fruit (*Hylocereus undatus*)

Tr. No.	Treatment details	Number of shoots			Shoot length (cm)		
		30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP
T_1	IBA 5000 ppm	0.70	1.43	1.63	1.99	5.00	12.17
T_2	IBA 6000 ppm	0.93	1.70	2.20	2.57	7.61	17.00
T_3	IBA 7000 ppm	1.00	1.80	2.47	2.64	8.40	17.54
T_4	PHB 500 ppm	0.63	1.37	1.73	1.81	5.65	11.21
T_5	PHB 750 ppm	0.67	1.39	1.80	1.87	5.90	12.10
T_6	PHB 1000 ppm	0.68	1.57	1.87	1.97	6.00	13.00
T_7	Biomix 0.5%	0.50	1.27	1.40	1.43	4.83	9.20
T_8	Biomix 1.0%	0.56	1.32	1.40	1.74	5.17	10.21
T_9	Biomix 1.5%	0.70	1.47	1.83	1.93	5.67	12.00
T_{10}	Control (No Treatment)	0.30	1.13	1.33	1.05	3.09	3.85
S.Em ±		0.08	0.10	0.12	0.12	0.37	0.34
CD @ 5%		0.25	0.31	0.37	0.41	1.12	1.02

At 60 days of cutting maximum length of shoots per cutting (8.40 cm) was recorded in treatment T_3 (IBA 7000 ppm) which was at par with treatment T_2 (7.60 cm). The next best treatments were followed by T_1, T_6, T_5, T_4, T_9 and T_8.The treatment T_7 showed intermediate effect. Significantly minimum length of shoots per cutting (3.09 cm) was reported in (T_{10}) control.

At 90 days maximum length of shoots per cutting (17.54 cm) was reported in treatment T_3 (IBA 7000 ppm) which was followed by the treatment T_2 (17.00 cm) and which were at par with each other. The next best treatments were followed by T_6, T_1, T_5 and T_9, The treatment T_4 and T_8 showed intermediate effect. Significantly minimum length of shoots per cutting (3.85 cm) was observed in control. Similar results were obtained by Siddiqua *et al.* 2018 [7] in dragon fruit.

Effect of chemicals and biomix on shoot biomass (g) (fresh and dry weight of shoot)

The data depicted in Table 2 revealed that maximum fresh weight of shoot (56.67g) was reported in treatment T_3 (IBA 7000 ppm) which was followed by the treatments T_2 (56.00 g) and were at par with each other. Next best treatments were followed byT_5, T_6, T_9 and T_1.While other treatmentsT_4, T_8 and T_7 showed intermediate effect. Significantly minimum fresh weight of shoot (37.80 g) was reported in treatment T_{10} *i.e.* (control).

Table 2: Effect of chemicals and biomix on number of days required to initiate first shoot, shoot biomass, shooting percentage in dragon fruit (*Hylocereus undatus*)

Tr. No.	Treatment details	Number of days required to initiate first shoot	Shoot Biomass (g)		Shooting percentage (%)
			Fresh weight of shoot (g)	Dry weight of shoot (g)	
T_1	IBA 5000 ppm	17.67	49.40	9.37	83.33
T_2	IBA 6000 ppm	15.33	56.00	11.10	92.67
T_3	IBA 7000 ppm	14.83	56.67	11.33	95.00
T_4	PHB 500 ppm	20.17	48.87	9.33	82.67
T_5	PHB 750 ppm	19.17	52.40	9.60	83.33
T_6	PHB 1000 ppm	18.17	52.00	10.00	84.67
T_7	Biomix 0.5%	21.00	43.67	8.69	73.33
T_8	Biomix 1.0%	20.33	45.20	8.95	78.33
T_9	Biomix 1.5%	20.23	50.00	9.39	83.33
T_{10}	Control (No Treatment)	25.17	37.80	6.77	71.67
S.Em ±		0.90	1.02	0.37	3.42
CD @ 5%		2.68	3.07	1.10	10.25

The data with regards to dry weight of shoot reveled that maximum dry weight of shoot (11.33g) was reported in treatment T_3 (IBA 7000 ppm) followed by treatment T_2 (11.10 g) which were at par with each other. While other treatments T_4, T_8 and T_7showed intermediate effect. Significantly minimum dry weight (6.76) was reported in treatment control. This might have resulted from development of effective root system and increase in number and length of roots per cutting which might have influenced the uptake of nutrients and water. Similar results were reported by Ram *et al.* (2005) [6] in pomegranate.

Effect of chemicals and biomix on shooting percentage (%)

The data indicated in Table 2 showed that, maximum shooting percentage (95.00%) was reported in treatment T_3 (IBA 7000 ppm) which was at par with treatment T_2 (92.67%). The next best treatments wereT_6, T_1, T_5, T_9, T_4 and T_8 which were at par with each other. While, minimum shooting percentage (71.67%) was recorded in treatment T_{10} control. The more number of shoot formation with the growth regulators might be due to the vigorous root system which increased the nutrient uptake under the influence of IBA. The result obtained in the present study is in agreement with that reported by Thota *et al.* (2014) [9] in fig, similar results were also reported by Siddiqua *et al.* (2018) [7] in dragon fruit.

Conclusion

In present investigation, minimum number of days required to initiate first shoot (14.83), maximum number of shoots per cutting at 30 days (1.00), at 60 days (1.80) and at 90 days (2.47), maximum length of shoots per cutting at 30 days (2.65 cm), at 60 days (8.40 cm), and at 90 days (17.54 cm), maximum fresh weight of shoot (56.67 g), maximum dry weight of shoot (11.33 g), maximum shooting percentage (95.00%) was noticed in treatment T_3 (IBA @ 7000 ppm). However, maximum number of days required to initiate first shoot (25.17), minimum number of shoots per cutting at 30 days (0.30), at 60 days (1.13) and at 90 days (1.33), minimum length of shoots per cutting at 30 days (1.05 cm.), at 60 days (3.09 cm.) and at 90 days (3.85 cm.), minimum fresh weight of shoot (37.80 g), minimum dry weight of shoot (6.77), minimum shooting percentage (71.67%) was recorded in treatment T_{10} (control).

From the experiment, it may be concluded that the application of IBA @ 7000 ppm by quick dip method was found superior in all shoot parameters and it was closely at par with IBA @ 6000 ppm. The treatment T_{10} was found inferior among all treatment.

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