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Influence of Varying Length of Stem Cutting and IBA Concentrations on Root and Shoot Growth in Dragon Fruit cv Giant White (*Hylocereus undatus*)

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ABSTRACT

Dragon fruitis a plant of high nutritional and economic potential as exotic fruit crops in national and international markets. With increasing consumer demand, the question of availability of quality planting materials arises. It's being a cross pollinated crop propagation by seed does not produce true-to-type. However, effective multiplication by stem cuttings is most preferred for large scale production of planting materials. The experiment was carried out under polyhouse, Faculty of Horticulture, BCKV, Mohanpur, Nadia, West Bengal, India during the months of May-August 2019. The investigation was to know the effect of different length of cuttings, IBA concentrations and their interaction on rooting and shooting in dragon fruit cv Giant Whitein Factorial Randomized Block Design with 5 (five) replications with two factors which include 4 (four) levels of IBA concentrations viz., 3000, 4000, 5000 and 6000 ppm and 3 (three) different lengths of cuttings viz., 15, 20 and 30 cm. Parameters measures were days required for shoot initiation, shoot growth, number of roots per cuttings, fresh and dry weight of roots per plant and dry matter content of roots. The results of the investigation clearly revealed a significant effect of IBA, length of cuttings and their interaction on rooting and shooting parameters.The investigation revealed that the cuttings treated with IBA at 6000 ppm showed significantly better results than other concentrations of IBA with respect to various rooting and shooting parameters followed by IBA at 5000 ppm. The cutting length of 30 cm showed significantly better results than other length of cuttings with respect to various rooting and shooting parameters.

Keywords Dragon fruit, IBA, Cutting length, Rooting, Shooting.

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INTRODUCTION

Dragon fruit (*Hylocereus* sp.) are diploid (2n = 22) and belongs to the family Cactaceae. It is a promising tropical epiphytic cactus, originated from Mexico (Luders and McMohan 2006) North, South and Central America (Barbeau 1993). It is a long day plant with beautiful one-time night blooming flower and

nicknamed as 'Wondrous Fruit' of the 21st century and "Queen of the Night" or "Noble Woman". It contains high levels of anti-oxidants and anti-proliferation properties. The fresh fruit contains 82.5-83.0 % moisture, 0.16-0.23 % protein, 0.21-0.61 % fat and 0.7- 0.9 % fiber 100 gram of fresh fruit pulp contains 6.3- 8.8 mg calcium, 30.2- 36.1 mg phosphorus, 0.5-0.61 mg iron and 8-9 mg vitamin C. It is also a plant of high economic potential as exotic fruit cropand is being traded in national and international markets fetching higher prices. Fruit is the latest novice to the horticulture world of super fruits and are set to ring a revolution in the Indian horticulture scenario. In India dragon fruit is cultivated in an area of less than 100 acres mainly in Maharashtra, Gujarat, Andhra Pradesh, Karnataka, Tamil Nadu (Dhruve *et al.* 2018) and some parts of West Bengal.The dragon fruit has been gaining popularity among the fruit's growers and the consumers. The lack of planting materials is one of the major constraints in expanding the area of dragon fruit under cultivation. With increasing consumer demand, the question of availability of quality planting materials arises.Propagation by seed does not produce true-to-type plants due to cross pollination. Currently, seed propagation could not meet the current market demand (Gunasena *et al*. 2006). However, effective multiplication by cuttings is most preferred for large scale production of planting materials as well as early production of the variety. In addition, the fruiting stage is attained more rapidly with cuttings in almost 14 (fourteen) months after planting as opposed to 4-5 years for plants grown from seed. 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 such as stem cuttings. Research on stem cuttings of dragon fruit is very meager regarding planting medium, cutting length, hormones and their specific doses.

MATERIALS AND METHODS

An investigation was carried out under polyhouse adjacent to the Faculty of Horticulture, Bidhan Chandra KrishiViswavidyalaya, Mohanpur, Nadia, West Bengal, India during the months of May-August 2019 to know the effect of different length of cuttings, IBA concentrations and their interactions on rooting and shooting in dragon fruit in Factorial Randomized Block Design setup with 5 replications comprising of 12 treatment combinations with two factors which include 4 levels of IBA concentrations (H) viz., 3000, 4000, 5000 and 6000 ppm and 3 different lengths of cuttings viz., 15, 20 and 30 cm. Data on shoot emergence was recorded as soon as new growth of buds appeared after planting of cuttings, shoot growth was measured in cm using measuring scale from the base to the tip of the shoot starting from 30 to 90 days of shoot emergence at every 30 days interval and the number of shoots per cuttings was counted at 90 days after planting (DAP). The number of roots per cuttings, root length, fresh weight of roots,dry weight of root and dry matter content of roots per cuttings were recorded after 90 to 110 DAP at 10 days interval and was appropriately analyzed by applying Factorial Randomized Block Design (FRBD) setup. The level of significance was tested for different variables at 5%.

RESULTS AND DISCUSSION

Shoot parameters

Perusal of the data presented in Table 1 showed that among the various concentrations of IBA, cuttings treated with IBA at 6000 ppm significantly emerged new shoots earliest at 18 DAP. The 30cm cutting length significantly reduced the days to shoot emergence (24.7DAP). The interaction between concentrations of IBA and different length of cuttings also varied significantly. The earliest shoot emergence (17 DAP) was observed in the cutting treated with IBA at 6000 ppm with 30 cm cutting length. The earliest shoot emergence with higher concentration of IBA, can be attributed to the presence of more endogenous auxins in longer cuttings which brought early breakage of bud dormancy and resulted in early shoot emergence (Iqbal *et al.*1999). The maximum number of shoots (1.7) per cutting was found in the cuttings treated with IBA at 6000 ppm. Among the various lengths of cuttings, 30 cm cutting length gave significantly maximum number of shoots (1.6) per plant and it was significantly superior to 15 and 20cm cutting length which produced 1.55 and 1.45 numbers of shoots per plant, respectively. The interaction between various concentrations of IBA and

Table 1. Effect of IBA and length of cuttings on rooting and shooting in dragon fruit cv Giant White (*Hylocereusundatus*). NB: H_1L_1- IBA at 3000 ppm + 15 cm cutting; H_1L_2-IBA at 3000 ppm + 20 cm cutting; H_1L_3 - IBA at 3000 ppm + 30 cm cutting; H_2L_1 - IBA at 4000 ppm + 15cm cutting; H_2L_2 - IBA at 4000 ppm +20 cm cutting; H_2L_3 - IBA at 4000 ppm +30 cm cutting; H_2L_1- IBA at 5000 ppm + 15 cm cutting; H_2L_2 – IBA at 5000 ppm + 20 cm cutting; H_3L_3 - IBA at 5000 ppm +30 cm cutting; H_3L_1- IBA at 6000 ppm +15 cm cutting; H_3L_2 - IBA at 6000 ppm + 20 cm cutting; H_4L_3 - IBA at 6000 ppm + 30 cm cutting. DAP-Days After Planting.

Treatment	Shoot initiation (DAP)	Number of shoots/ plants	Shoot growth (cm) at 90 DAP	Total number of roots at 90 DAP	Root length (cm) at 90 DAP	Fresh weight of roots (g) at 90 DAP	Dry weight of (g) at 90 DAP	Dry matter content of root
H_1	32.5	1.33	16.8	18.3	15.8	1.73	0.39	22.6
H_2	29.4	1.53	19.5	19	16.8	2.17	0.52	19.5
H_3	31.6	1.53	20.3	14	17	2.02	0.39	25.20
H_4	18	1.73	19.3	23.6	20.9	2.49	0.64	23.08
L_1	30.45	1.45	13.7	13.75	14.62	1.64	0.28	11.71
L_2	28.4	1.55	16.6	20.40	16.22	2.30	0.57	26.60
L_3	24.7	1.6	26.3	23.65	22.12	2.36	0.60	29.50
H_1L_1	37.1	1.2	10.6	13	13.9	1.34	0.14	4.39
H_1L_2	30	1.2	16.1	19.16	14	1.74	0.51	38.1
H_1L_3	30.5	1.6	23.7	19.2	19.6	2.12	0.53	25.2
H_2L_1	32.6	1.6	15.4	10.8	14.4	2.03	0.32	12.8
H_2L_2	30	1.6	18.3	16,0	15.6	2.06	0.65	21.6
H_2L_3	25.6	1.4	24.8	25.2	20.4	2.44	0.6	24.1
H_3L_1	32.6	1.6	18.9	14.2	13.5	1.2	0.17	14.0
H_3L_2	36.2	1.6	13.0	22.0	15.7	2.6	0.39	16.7
H_3L_3	26	1.4	28.9	27.6	21.8	2.26	0.61	44.8
H_4L_1	19.6	1.4	10.8	17	16.7	2.02	0.51	15.6
H_4L_2	17.4	1.8	19.5	24	19.6	2.82	0.74	29.7
H_4L_3	17	2	27.6	22.8	26.6	2.65	0.68	23.8

	CD (5%)	SEm (±)	CD (5%)	SEm (±)	CD (5%)	SEm (±)	CD (5%)	SEm (±)	CD (5%)	SEm (±)	CD (5%)	SEm (±)	CD (5%)	SEm (±)	CD (5%)	SEm (±)
H	6.39	3.18	0.44	0.22	5.14	2.19	0.46	0.23	0.53	0.26	0.09	0.04	0.06	0.03	0.06	0.03
L	5.54	2.75	0.38	0.19	4.45	1.90	0.45	0.22	0.84	0.41	0.07	0.03	0.05	0.02	0.05	0.02
H × L	19.23	3.94	0.80	0.39	8.90	3.80	1.24	0.25	1.12	0.57	0.27	0.13	0.20	0.09	9.51	4.23

different length of cuttings also varied significantly. The maximum number of shoots per plant (2) was found in the cuttings treated with IBA at 6000 ppm with 20 cm cutting length and was statistically at par with all the treatment combinations. Maximum number of shoots per plant would be attributed to enhancement of physiological functions in the cuttings favorably at this concentration (Iqbal *et al.* 1999). The above results are in accordance with Dhurve (2018) and Enrique *et al.* (2010) in dragon fruit. However, the maximum number of shoots on 30cm cuttings is due to presence of a greater number of shooting zone as compared to 15 and 20cm cutting length. These results are in harmony with the outcome of Lima (2013), Marques *et al*. (2011),Cavalcante and Martins (2008) in dragon fruit.Table 1 revealed that at 90 DAP, the cuttings treated with IBA at 5000ppm showed significantly maximum shoot growth (20.3 cm) and were significantly superior among all the concentrations of IBA. Among the different length of cuttings, 30 cm cutting produced the maximum shoot growth per plant (26.3 cm) at 90 and DAP and was significantly superior to 20 and 15 cm cutting. The interaction between various concentrations of IBA and different length of cuttings also varied significantly. At 90 DAP, the maximum shoot growth (28.9cm) was observed in the cuttings treated with 5000 ppm IBA with 30 cm cutting length followed by IBA at 6000 ppm with 30 cm cutting length (27.6cm).

Root parameters

It is evident from the Table 1, at 90 DAP the cuttings treated with IBA at 6000 ppm gave maximum number of roots per cuttings (23.6) and was superior to all the

concentrations of IBA. Among the various lengths of cutting, 30 cm cutting length showed maximum number of roots per plant (23.65) the interaction between the various concentrations of IBA and different length of cuttings also varied significantly. At 90 days after planting, the maximum number of roots per plant (27.6) was observed in the cuttings treated with IBA at 5000 ppm with 30cm cutting length. Induction of maximum number of roots in IBA treated cuttings might be due to the fact that stimulation of cambial activity is involved in root initiation by growth regulators in many species (Ullah *et al.* 2005). Like many other species, rooting ability of dragon fruit was also sensitive to the IBA application Dhurve *et al.* (2018). The maximum number of roots with 30cm cutting length might be due to the higher amount of reserved material stored which plays a vital role in growth and development of root while small length cuttings had less amount of reserved materials. This may lead to higher cutting length to develop maximum and better rooting. Rooting frequency was found to be significantly influenced by cutting size (Browne *et al.* 1997).The data presented in Table 1 indicate that there were significant differences among the various concentration of IBA on maximum root length per cutting. At 90 DAP, the individual root length was found maximum (20.9) in the cuttings treated with IBA at 6000ppm. Cutting at 90 DAP, 30 cm cutting length produce the maximum individual root length (22.12 cm). There was a significant interaction between concentrations of IBA and length of cuttings in the study. At 90, cuttings treated with IBA at 6000 ppm with 30 cm cutting length showed the maximum individual root length (26.6 cm) per plant. The effect of IBA on the rooting process might be due to its effect on cell wall turgidity, which accelerates cell division (Hartmann *et al.* 2002). This finding was similar to Salleh (2007) who concluded the increased dose of IBA at 300 to 1000 ppm gave significant difference for 30 cm cutting length in dragon fruit.The data pertaining the maximum fresh weight of roots (1.33g) was recorded in cuttings treated with IBA at 6000 ppm followed by IBA at 4000 ppm (2.49g) at 90 DAP. Among the different length of cuttings, at 90 DAP, the fresh weight of roots (2.36g) was found maximum in 30cm cutting length. There was a significant interaction between the various concentrations of IBA and different length of cuttings. At 90 DAP, cuttings treated with IBA at 6000 ppm with 20 cm cutting length showed maximum fresh weight of roots (2.82g). It is evident from the Table 1 that dry weight of roots per plant was found maximum (0.64g) in the cuttings treated with IBA at 6000 ppm at 90 DAP which was significantly superior to other concentrations of IBA. Among the different length of cuttings, at 90 DAP, cuttings of 30cm cutting length gave maximum dry weight of roots (0.60g) followed by 20cm cutting length (0.57g). The interaction between various concentrations of IBA and length of cuttings varied significantly. At 90 DAP, the maximum dry weight of roots (0.74g) per plant was found in the cuttings treated with IBA at 6000 ppm with 20cm cutting length.The dry matter accumulation on the roots was significantly influenced by various concentrations of IBA. The dry matter content of roots was found maximum (28.47%) in the cuttings treated with IBA at 5000ppm at 90 at DAP. There was no significant difference among various concentrations of IBA on dry matter content of roots per plant at 100 DAP.The dry matters content was recorded maximum (25.20%) in the cuttings treated with IBA at 5000 ppm at 90 DAP. Among the various length of cuttings, 30 cm cutting length gave maximum dry matters content of roots (29.50g) at 90. The interaction between various concentrations of IBA and length of cuttings was significantly varied. At 90, the dry matter content of roots was found maximum (44.8%) in the cuttings treated with IBA at 5000 ppm with 30 cm length of cutting and was significantly superior to all other concentrations of IBA.IBA at higher concentrations induces re-differentiation of mature parenchyma cells into cambial tissue and supply of food material to cambial tissue by rapid hydrolysis of reserve carbohydrates stored in the stem cuttings. It helps in rapid cell division and cell elongation in cambial tissue which might have resulted maximum fresh weight of roots, dry weight of roots and dry matter content of roots per cutting. These results are in harmony with the outcome of Seran and Thiresh (2015) and Rahad *et al.* (2016), Dhurve *et al.* (2018) in dragon fruit.

CONCLUSION

The results of the investigation clearly revealed a significant effect of IBA, length of cuttings and their interaction on rooting potential and shoot growth in

NB : T_1-IBA 3 at 000 ppm + 15cm cutting; **T_2**-IBA at 3000 ppm + 20cm cutting; **T_3** - IBA at 3000 ppm + 30cm cutting; **T_4** - IBA at 4000 ppm + 15cm cutting; **T_5** - IBA at 4000 ppm +20cm cutting; **T_6** - IBA at 4000 ppm +30cm cutting; **T_7** - IBA at 5000 ppm + 15cm cutting; **T_8** – IBA at 5000 ppm + 20cm cutting; **T_9** - IBA at 5000 ppm +30cm cutting; **T_{10}** - IBA at 6000 ppm +15cm cutting; **T_{11}** - IBA at 6000 ppm + 20cm cutting; **T_{12}** - IBA at 6000 ppm + 30cm cutting.

Fig. 1. Effect of IBA and length of cuttings on rooting and shooting in dragon fruit cv Giant White (*Hylocereusundatus*). NB: T_1-IBA 3at 000 ppm + 15cm cutting; T_2-IBA at 3000 ppm + 20 cm cutting; T_3 - IBA at 3000ppm + 30cm cutting; T_4 - IBA at 4000ppm + 15 cm cutting; T_5 - IBA at 4000 ppm +20 cm cutting; T_6 - IBA at 4000 ppm +30 cm cutting; T_7 - IBA at 5000 ppm + 15 cm cutting; T_8 – IBA at 5000 ppm + 20 cm cutting; T_9 - IBA at 5000 ppm +30 cm cutting; T_{10} - IBA at 6000 ppm +15 cm cutting; T_{11} - IBA at 6000 ppm + 20 cm cutting; T_{12} - IBA at 6000 ppm + 30 cm cutting.

dragon fruit cv Giant White (*Hylocereusundatus*) Fig.1. The cuttings treated with IBA at 6000ppm showed significantly better results than other concentrations of IBA with respect to various rooting and shooting parameters followed by IBA at 5000 ppm. The cutting length of 30cm showed significantly better results than other length of cuttings with respect to various rooting and shooting parameters.

Further research can be taken up on the efficacy of cladode or stem of different maturity can be tried, multiplication can be investigated in different seasons of the year, rooting media can be standardized and apart from IBA other growth substances can be tried for the multiplication of dragon fruit.

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