Indian Journal of Ecology (2023) 50(2): 404-407
DOI: https://doi.org/10.55362/IJE/2023/3911

Manuscript Number: 3911
NAAS Rating: 5.79

Augmentation of Rooting and Shooting in Stem Cuttings of Dragon Fruit [*Hylocereus Costaricensis* (Web.) Britton and Rose]

Pankaj Kumar Meena, Sutanu Maji* and Meezan Ali

Department of Horticulture, Babasaheb Bhimrao Ambedkar University, Lucknow-226 025, India
**E-mail: majisutanu@gmail.com*

***Abstract*:** Introduction of new remunerative crop in horticultural diversity is now required to boost farmers' income. Dragon fruit is one of the new exotic fruits cum ornamental crops which is getting new market dimention in Indian market, however, mostly imported due to less production area. To enhance its production rapid large scale multiplication is needed to establish more orchards. Fewer studies have been done in India to promote successful healthy planting materials of dragon fruit. In this experiment an attempt has been made to study influence of IBA on rooting and shooting of stem cuttings of dragon fruit to produce quality planting materials easily. The application of IBA on stem cutting has a positive role for success and among the various concentrations 3500 ppm IBA is the best for stem cutting of dragon fruit at subtropical climatic condition in respect of more number, length and diameter of roots and newly emerged shoots.

Keywords: Cutting, Dragon fruit, *Hylocereus*, Propagation

Dragon fruit (*Hylocereus spp.*) is one of the newly introduced exotic minor fruit crop in India. It is botanically climbing vine cactus with areal roots that bear glabrous attractive berry with large scale is the main character of this fruit (Fournet 2002), under the cactaceae family. It is native of tropical forest region of Mexico and Central and South America (Mizrahi 2014). Generally, there are four major groups of dragon fruit namely *Hylocereus undatus* (white flesh with pink skin), *H. costaricensis* (with violet red flesh and pink skin), *H. polyrhizus* (red flesh with red to pink skin), *H. (Selenicerus) megalanthus* (white flesh with yellow skin). Dragon fruit touted for their broad aspects of health benefit potentials and medicinal properties which increase its demand worldwide very rapidly including India. The 95 % of its demand in Indian market is meeting up by importing from other countries, because of very less cultivation in India except few pockets (Ali et al 2018, Maji 2019). Thus, new orchard development of dragon fruit is necessary to increase cultivation area and for this rapid propagation of quality planting material is need of hour. Propagation through seed is easy but, germinated plants are not true to type because of cross pollination and take more time to bear. Therefore, dragon fruit is generally propagated vegetatively through stem cuttings for easy and rapid multiplication. Use of bioregulators helps for better rooting success and auxins are well known to stimulate rooting of cuttings (Hartman et al 2002). It has been repeatedly confirmed that auxin is required for initiation of adventitious root on stem and division of first root initial cell are dependent upon either applied or endogenous auxins like IBA. However, concentration of root promoting hormone like IBA varying from 100 ppm to 10000 ppm in dragon fruit stem cutting as reported by various scientists in different agro-climatic zones (Seran and Thiresh 2015, Ahmad et al 2016, Siddiqua et al 2019). Hence, this investigation was conducted to find out the influence of IBA on root and shoot characteristics of dragon fruit stem cuttings under subtropical climate at Lucknow of Uttar Pradesh, India.

MATERIAL AND METHODS

The present study was conducted under poly house structure at Babasaheb Bhimrao Ambedkar University, Lucknow, UP, India, geographically which is at an elevation of 123 meter above Mean Sea Level (MSL) in the subtropical climate of central Uttar Pradesh at 26˚55´ North latitude and 80˚59´ East longitude. Cuttings were experimented for rooting during month of September, 2018 when average temperature was about 36°C and had high humidity.

Preparation of stem cutting: Cuttings were collected from fresh, mature, undamaged (free from insect, pest, disease attack and physical injury) two year old mother vines [*H. costaricensis* (Web.) Britton and Rose] from Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, India due to its attractive pink coloured fruits. A slanted cut was made on the stem end of cutting for more rooting and easy identification of distal end and proximal end of cutting. Length of cuttings was maintained at 25 ± 2 cm.

Preparation of rooting media: Sand, soil and farm yard manure were mixed in the ratio of 2:1:1 thoroughly by hand

and spade. Prepared rooting media was filled in polyethylene bags of 15 × 9 cm size with 235 gauges.

Treatment of cuttings: The experiment was laid out in a Complete Randomized Design (CRD) with 11 treatment combinations which are replicated thrice. Selected cuttings with uniform size were treated with Indole - 3 - Butyric Acid (IBA), purchased from Spectrochem Pvt. Ltd. Mumbai (India) at different concentrations (T_1 – 0 ppm Control, T_2 - 500 ppm, T_3– 1000 ppm, T_4 – 1500 ppm, T_5 – 2000 ppm, T_6 – 2500 ppm, T_7 – 3000 ppm, T_8 – 3500 ppm, T_9 – 4000 ppm, T_{10} – 4500 ppm, T_{11} – 5000 ppm). The stock solution (10000 ppm) was used to prepare the required concentration of solution according to treatment. The cuttings were treated with 2% Bavistin solution and dried in shade, cool place before IBA treatment. After treatment cuttings were planted in poly bags containing rooting media, keeping indentation margin upside.

Observations recorded: Sprouted cuttings were randomly selected for recording the observation from each replication of every treatment throughout the study on the destructive basis. Observations were recorded at 30, 60, 90 days after treatment (DAT) of stem cutting. Root length, number of roots per cutting, diameter of root was measured. Shoot characteristics were recorded at 90, 120 and 150 DAT of stem cutting in respect of length of newly emerged shoot, number of shootlet / cutting, shoot width.

Statistical analysis: The statistical analysis of recorded data was done using OPSTAT software run by CCSHAU, Hisar, India (Sheoran et al 1998) and treatment mean were compared with critical difference at 5 % level of significance.

RESULTS AND DISCUSSION

Number of initiated root/ cutting: The numbers of new initiated roots are significantly influenced by application of rooting hormone IBA at 30, 60 and 90 DAT. Maximum number of roots were recorded 3.67, 6.00 and14.00, respectively in treatment T_8 (IBA @ 3500 ppm) at 30, 60 and 90 days after planting compared to minimum in control (1.33, 4.33,7). Control treatment showed minimum number of roots at every stages of growth. Induction of roots number in cuttings is might be due to presence of food material in cuttings and due to effect of plant growth hormone stimulated the cambial activity in treated stem cuttings. Acceleration in root initiation is increased due to IBA treatment, it induced water uptake capacity of roots and cell wall elasticity further may have accelerated cell division and in turns into number of roots in stem cuttings of dragon fruit (Ayesha and Thipesh 2018). The increased average number of root per cutting by application of IBA was also observed in earlier findings (Seran and Thiresh 2015, Ahmad et al 2016, Dhruve et al 2018). Thus, application of the different concentration of IBA positively influenced number of initiated roots per cutting as it influence the initiation of roots in cutting.

Length of roots: Maximum average length of root showed significant difference between different IBA treatment combinations. Maximum length of root (3.91, 2.70, 15.17 cm) was recorded in treatment with IBA at 3500 ppm in compared to minimum length (2.70, 9.26, 12.27 cm) in control at 90, 120, 150 DAT, respectively. The results were consequences with the findings of Seran and Thiresh (2015), Ayesha and Thippesha (2018) and Dhurve et al *(*2018). It might be due to

Table 1. Effect of different concentration of IBA on root characteristic of dragon fruit stem cuttings

IBA concentration (ppm)	Average number of roots/cutting			Average length of roots (mm)			Average diameter of roots (mm)		
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
0 ppm (Control)	1.33	3.33	7.00	2.70	9.26	12.27	0.17	0.66	0.73
500	1.67	4.00	10.33	2.77	9.56	12.28	0.29	0.67	1.13
1000	3.00	4.33	12.00	2.74	9.33	12.68	0.27	0.76	1.36
1500	2.67	4.33	9.00	3.12	9.51	14.07	0.51	0.67	1.14
2000	3.00	5.00	12.00	3.16	9.61	14.32	0.49	0.85	1.23
2500	2.00	4.33	11.00	3.60	11.02	12.41	0.41	0.68	1.39
3000	2.33	5.00	10.00	3.59	11.03	14.44	0.49	0.87	1.56
3500	3.67	6.00	14.00	3.91	11.17	15.48	0.83	0.96	1.86
4000	3.00	5.33	12.00	3.48	10.22	15.34	0.43	0.74	1.32
4500	2.33	4.67	13.00	3.74	10.56	12.96	0.53	0.95	1.36
5000	3.00	4.00	9.00	3.59	10.49	13.52	0.39	0.90	1.26
CD (p = 0.05)	N/S	1.36	1.80	0.52	1.23	1.91	0.31	N/S	0.43

Note: DAT - Days after treatment, N/S- Non significant

Table 2. Effect of different concentration of IBA on shoot characteristics of dragon fruit stem cuttings

IBA concentration (ppm)	Average number of shoots/cutting			Average length of shoots (mm)			Average width of shoots (mm)		
	90 DAT	120 DAT	150 DAT	90 DAT	120 DAT	150 DAT	90 DAT	120 DAT	150 DAT
0 ppm (Control)	0.47	1.10	1.67	71.42	98.55	112.23	24.64	29.94	32.30
500	0.90	1.10	1.70	81.47	103.52	115.17	25.61	30.63	32.65
1000	1.13	1.70	2.03	106.36	125.17	132.38	25.66	32.42	33.34
1500	1.37	1.43	1.73	104.04	126.47	140.88	30.73	31.76	33.34
2000	1.10	1.50	2.23	92.33	115.05	134.58	31.26	31.62	33.08
2500	1.40	1.73	2.20	112.10	115.84	130.75	26.59	31.63	32.85
3000	1.40	1.70	2.10	117.55	136.54	154.73	31.65	32.16	40.50
3500	1.43	2.17	2.57	121.05	140.54	161.34	31.95	34.40	42.06
4000	1.00	1.33	2.30	98.78	135.38	152.93	28.25	33.79	40.06
4500	1.10	1.27	1.80	101.49	117.38	135.83	29.04	31.48	34.58
5000	1.30	1.53	1.77	102.52	117.53	130.69	26.28	33.42	34.48
CD (p=0.05)	N/S	N/S	N/S	1.46	1.40	1.58	1.43	1.82	1.55

effect of auxin because rooting was favored by a high C/N ratio and presence of higher percentage of starch, sucrose, reducing sugars. The auxin treatment markedly enhanced starch depletion and the same was correlated with enhanced rooting and triggering elongation process.

Average root diameter: Maximum diameter (0.83, 0.96, 1.86 mm) of root was in the cuttings when treated with IBA @ 3500 ppm as compared to minimum root diameter (0.17.0.66, 0.73 mm) observed in control, respectively at 30,60, and 90 DAT. Ahmed et al *(*2016) also recorded average diameter of root as similar to present result. This might be due to IBA, which acted as a root promoting hormone influencing root primordia and length of root with number of root. Thus, IBA positively and significantly affect the root diameter also. Rana and Babita (2016) also reported the beneficial effect of IBA on rooting of kiwi fruit.

Number of shootlet/ cutting: Numbers of new shootlet per cutting were affected positively but non- significantly by treatment of plant growth hormone (IBA). However, maximum number of new shootlet were (1.43, 2.17, 2.57) recorded on cuttings treated with IBA @ 3500 ppm (T_8) while, minimum number of new shootlet (0.47, 1.10, 1.67) were at untreated cuttings (control) at 90, 120, 150 DAT, respectively. Similar kind of result was noticed by Singh (2017) in pomegranate and by Baghel et al (2016) in guava. IBA might activate dormant bud and by the activation of hydrolytic enzymes, which acted upon reserve food material stored in the cutting, the supply of respiratory substrates to glycolytic enzymes leads to release of energy and helps in sprouting and production of new shoot.

Length of newly emerged shoot: Lengths of newly emerged shootlet were significantly different among the treatments. Application of IBA at 3500 ppm (T_8) showed maximum length of new shootlet (121.05, 140.54, 161.34 mm) at 90, 120 and 150 DAT, respectively, while minimum length of shoot was observed (71.42, 98.55, 112.33 mm) in control treatment. It might be due to that length of newly emerged shootlet is positively influenced by indole-3-butyric acid since it increase endogenous level of auxin and auxin are well known for stimulation of root and shoot in plants (Hartman et al 2012). Therefore, auxin might positively increase length of new shoot in stem cutting of dragon fruit. Earlier researchers Kumawat et al (2014), Seran and Thiresh (2015), Ahmad et al *(*2016) and Dhurve et al (2018) also found similar results.

Width of new shoot: The significantly higher shoot width (31.95, 34.40, 38.76 mm) was in cuttings under treatment T_8 (IBA @ 3500 ppm), while minimum shoot width (24.64, 29.94, 32.30 mm) respectively at 90, 120 and 150 DAT was seen in control treatment. These results corroborated with the

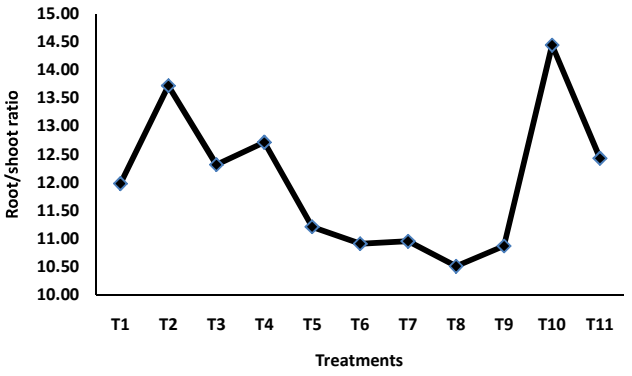

Fig. 1. Root/shoot ratio (number basis) of newly emerged rooted cuttings of dragon fruit at 150 DAT

findings of Ha et al (2014) which might be due to the fact that its influence on cell division and enlargement which directly enhanced width of shoot also.

Root: shoot ratio: This ratio on the basis of number of roots and shoots at 150 DAT) clearly depicted that application of IBA @ 3500 ppm had low ratio indicating very good growth of root as well as newly emerged shoot as compared to other treatments (Fig. 1).

CONCLUSION

The dragon fruit stem cuttings treated with IBA at 3500 ppm was found superior in all the root and shoot growth parameters among all the treatments studied and producing healthy and vigorous plants. Therefore, Indole -3-butyric acid at 3500 ppm can be utilized for producing healthy and vigorous planting material of dragon fruit to get 100% success with superior growth through stem cutting at subtropical climatic area.

REFERENCES

Ahmad H, Mirana AS, Mahbuba S, Syed M, Tareq and Jamal Uddin AFM 2016. Performance of IBA concentrations for rooting of dragon fruit (*Hylocereus undatus*) stem cuttings. *International Journal of Business, Social and Scientific Research* **4**(4): 231-234.

Ali M, Maji S and Prasad M 2018. Dragon fruit (*Hylocereus* sp.): a new fruit crop for Indian farmers. *Abstract in National conference on Strategies & Challenges in doubling farmers' income through horticultural technologies in subtropics.* 21-22 June 2018. ICAR-CISH, Lucknow, Uttar Pradesh, India. P. 114

Ayesha D and Thippesha D 2018. Influence of plant growth regulators on rooting of stem cuttings in dragon fruit [*Hylocereus undatus* (Haworth) Britton & Rose]. *International Journal of Chemical Studies* **6**(5): 1834-1839.

Baghel M, Raut UA, Ramteke V 2016. Effect of IBA concentrations and time of air layering in Guava cv. L 49. *Research Journal of Agricultural Sciences* **7**(1): 117-120.

Dhurve L, Suchitra V, Vani Sudha V, Subbaramamma P and Saravanan L 2018. Rooting and shooting behavior of red and white pulped varieties of dragon fruit (*Hylocereus undatus*) in relation to indole butyric acid concentrations. *International Journal of Agricultural Sciences* **14**(1): 229-234.

Fournet J 2002. *Flore illustree des phanerogames de Guadeloupe et de Martinique, Tome 1. Famille des Cactaceae, Inra-Cirad-Gondwana*, Paris, France. pp 224-240.

Ha D, Tran and Yen CR 2014. Morphological characteristics and pollination requirement in Red Pitaya (*Hylocereus spp.*). *International Journal of Agriculture and Biosystem Engineering* **8**(3): 202-206.

Hartmann HT and Kester DE, Davies FT and Geneve RL 2002. .*Hartmann and Kester's Plant Propagation: Principles and Practices, 7th Ed.* Prentice- Hall, London. Upper Saddle River. Pp 298-342.

Kumawat R, Maji S, Govind and Meena, DC 2014. Studies on seed germination and seedling growth of papaya (*Carica papaya* L.) cv. Coorg Honey Dew as influenced by media and chemical. *Journal of Crop and Weed* **10**(2): 281-286.

Maji S 2019. In: *Dragon Fruit: The Super Fruit*. Book Pub. International.

Mizrahi Y 2014. Vine-cacti pitayas: The new crops of the world. *Revista Brasileira de Fruticultura* **36**(1) https://doi.org/10.1590/0100-2945-452/13.

Rana VS and Babita 2016. Effect of rooting media and IBA on rooting behavior and vegetative growth of kiwifruit (*Actinidia deliciosa* Chev.). *Indian Journal of Ecology* **43**: 343-345.

Seran TH and Thiresh A 2015. Root and shoot growth of dragon fruit (*Hylocereus undatus*) stem cutting as influenced by Indole Butytic Acid. *Agricultural and Biological Sciences Journal* **1**(2): 27-30.

Sheoran OP, Tonk DS, Kaushik LS, Hasija RC and Pannu RS 1998. Statistical Software Package for Agricultural Research Workers. Recent Advances in information theory, Statistics & Computer Applications by D.S. Hooda & R.C. Hasija Department of Mathematics Statistics, CCS HAU, Hisar (139-143)

Siddiqua A, Thippesha D, Venugopala Reddy, M and Deeksha Raj N 2019. Effect of different plant growth regulators on shooting of stem cuttings in dragon fruit [*Hylocereus undatus* (Haworth) Britton & Rose]. *International Journal on Current Microbiology and Applied Science* **8**(5): 1621- 1627

Singh KK 2017. Effect of IBA concentrations on the rooting of pomegranate (*Punica granatum* L.) cv. Ganesh hardwood cuttings under mist house condition. *International Journal of Horticulture and Floriculture* **5**(4): 318-323.

Received 28 November, 2022; Accepted 07 March, 2023