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Study of different IBA levels on nursery behaviour of dragon fruit cutting

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Abstract
A field experiment on "Study of different IBA levels on nursery behaviour of dragon fruit cuttings" was conducted at Experimental farm and Analytical laboratory, Department of Fruit Science, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the year 2018-19 with objectives to study the effect of different IBA levels on rooting of cutting of dragon fruit cutting under Akola condition. To find out the effect of different levels on rooting of cutting of dragon fruit. The experiment was laid out in Completely Randomized Design (CRD) with six treatments which were replicated four times. The stem cutting of dragon fruit treated with Indole Butyric Acid (IBA), to study the introduction of dragon fruit were successfully grow in Akola condition. The results obtained during course of investigation are summarized in following paragraphs. The result reveals that, in respect of root growth parameter, maximum number of root (55.15), maximum root length (20.62 cm), root diameter (2.06 mm), average length of root (17.47 cm), fresh weight of root (2.09 g) length of longest root (24.23 cm), root volume (1.88 cc), average number of root (43.91 cm), dry weight of root (0.61g).This observations were found maximum at 2000 ppm IBA concentration .In respect of shoot growth parameter, Early sprouting (36.99 days), shoot length (24.39 cm), length of longest shoot (31.75 cm), shoot diameter (5.90mm), fresh weight of shoot (47.77 mm), dry weight (8.39 mm), number of sprouts per cutting (4.51mm) was observed maximum at 2000 ppm IBA concentration. From the above experiment application of IBA 2000 ppm was found to improve rooting, shooting and survivability (95.87%) of stem cutting in Dragon fruit and could be commercially used for propagation under Akola condition.

Keywords: IBA levels, nursery behaviour, dragon fruit cutting

Introduction
Dragon fruit is a perennial climbing cactus, belongs to the family Cactaceae. It is one of the newly introduced exotic fruit crop in India. The origin is tropical and subtropical forest regions of Mexico and Central South America (Mizrahi and Nerd, 1996) [17]. Dragon fruit is suitable for everyone to eat. Flesh and seeds are edible parts and they are eaten altogether. It supplies fibre which is digestive and helpful for healthy liver. Dragon fruits consist of phytoalbumins, which may have anti-oxidant qualities which help to stop the development of cancer cells. Dragon fruit also reported to have health benefits including prevention of memory losses, control of blood glucose level in diabetic patients, prevention of oxidation, aiding in healing of wounds etc. In addition, it has the ability to promote the growth of probiotics in the intestinal tract (Zainoldin and Baba, 2012) [45]. The vegetative propagation in Dragon fruit is utmost desirable in order to propagate true-to-type plants. Hence, vegetative methods of propagation viz., stem cuttings is done which is inexpensive, rapid, simple and does not require the particular techniques as in case of other methods. The reports on an investigation on the propagation of Dragon fruit from cuttings and use of growth regulators for better root growth are scanty Dragon fruit is propagated by stem cuttings which may be planted directly in the field or in pots (Zee *et al*., 2004) [46]. Cuttings are dipped in rooting hormone before planting to boost root formation. In many plant species, vegetative propagation is normally practiced using stem cuttings (Abdullah *et al*., 2005; Henrique *et al*., 2006) [1, 12]. In some species, rooting occurs in cuttings without auxin treatment but in others cuttings do not root easily (Hartman *et al*., 2002; Blythe *et al*., 2004) [11, 4]. There is a possibility for expansion of dragon fruit cultivation in Sri Lanka. This experiment was carried out to study the effect of Indole butyric acid (IBA) on establishment of stem cuttings and to select the optimum concentration of IBA for better growth of stem cuttings of dragon fruit. The rooting property of auxins and their importance in plant propagation have been widely recognized for long time (Thiman and Went, 1934) [42].

Hence, the necessity of exogenous auxin application to induce root formation in cuttings has been reported in many species Indole butyric acid (IBA) is the most widely used auxin to stimulate the rooting of cuttings. IBA has high ability to promote root initiation (Weisman *et al*., 1988) [44] IBA is considered the most suitable and reliable rooting hormone and can be utilized for propagation of dragon fruits through cutting.

Materials and Methods

The experiment was laid out in Completely Randomized Design (CRD) with six treatments which replicated four times. The experiment was carried out by planting cuttings in (11.5 × 26cm) size polyethene bags. The polyethene bags were improve the drainage and filled with different rooting media which was prepared according to treatment. Pot mixture was prepared by mixing well decomposed FYM, soil and sand at proportion 2:1:1. Single super phosphate @ 2g/bag was added. (Dhruve *et al.*, 2018) [5] Dragon fruit cuttings of white fleshed variety were procured from National Institute of Abiotic Stress Management (NISM), Baramati. Uniform cuttings were collected from one-year old shoot with 4-5 nodes each. Length of cuttings used for planting was ranging from 15-20 cm. the new shoots were removed from cuttings and trimmed to a required length by removing the small portion from both the ends of cuttings just above and below node. Slant cut was given at the basal end of the cuttings to expose maximum absorbing surface for effective rooting cuttings were shade dried for one day prior to planting to dry the ooze coming from the fresh cuttings. The basal portions of selected cuttings are treated with Indole Butyric Acid (IBA) solution. Treatment wise IBA solutions were prepared as per the procedure laid down by Hartman and Kester (1989) [10]. The required quantities of IBA powder was dissolved in 5 ml of ethyl alcohol (50%) then required quantity of distilled water was added to make the solution of desired concentrations. The basal portion of cutting where slanting cut was given was dipped in different concentrations of IBA formulation for 10 minutes, later they were allo wed to dry for 15 minutes under shade and planted in poly bags containing rooting media. Weeding and watering was done at regular interval whenever needed. The rooting medium was drenched with carbendazim (0.15%) at forth nightly interval to check disease interval. Six plants of each treatment and each replication were selected, marked, and kept under observations for recording various observations. The data collected on various observations, during the course of investigation were statistically analysed by Completely Randomized Design (CRD) as suggested by Panse and Sukhatme (1967) [22].

Results and Discussion

Root growth Observations

The data in Table 1 shows that maximum number of roots per cutting was observed (55.15) by treatment T_4 i.e. 2000 ppm; which was superior over rest of the treatment and followed by T_5 (50.34) i.e. 2500 ppm. The minimum number of roots per cutting was observed in treatment T_1(42.43) i.e. 500 ppm IBA concentration. These results are conformity with Singh and Kumar (1970) [39] in phalsa, Prasad *et al*.; (1988) [23] in guava cutting, Reddy and Reddy (1989) in fig cutting treated with 2500 ppm IBA. The data in respect of length of root per cutting was observed maximum (20.62 cm) by treatment T_4 i.e. 2000 ppm IBA which was significantly superior over rest of treatment and followed by T_5 i.e. 2500 ppm (18.70 cm). The minimum root length was observed at T_1(12.65 cm) i.e. 500 ppm. Similar results are conformity with Upadadhyau *et al*.; (2007) [43] in pomegranate cutting. Maximum root length was observed by Siddiqua A. *et al*.; (2018) [35] in dragon fruit cutting. Also, Ghosh A. *et al*.; (2017) [8], Kaur S. *et al*.; (2018) [15], Rakibuzzaman M. *et al.* (2018) [24] and Kuntagol P. *et al*. (2018) [16] observed maximum root length in phalsa, pomegranate, stevia and fig cuttings respectively. The data presented in Table 1. The data presented in Table 1 indicated that root diameter of dragon fruit was significantly influenced by IBA. Highest root diameter was observed in T_4 i.e. 2000 ppm IBA (2.06 mm) which was significantly superior over rest of treatment and followed by treatment T_5 i.e. 2500 ppm IBA concentration (1.92 mm). The minimum root diameter was observed in T_1i.e. 500 ppm (1.21 mm) IBA concentration. The present finding can be confirmed by Singh and Singh (2005) [38] in poinsettia, Same result is found by Siddiqua A. *et al.* (2018) [35] in dragon fruit cutting. Ahmad H. *et al.* (2016) [2] in dragon fruit cutting. Ali M. *et al.* (2017) [3] in kiwifruit cutting the data presented in Table 1 indicated that length of longest root of dragon fruit was significantly influenced by IBA. The maximum length of longest root was observed (24.23 mm) by the treatment T_4 i.e. (2000 ppm); which was superior over rest of the treatment except T_5 (23.30 mm) i.e. 2500 ppm which was statistically at par with T_4. The minimum length of longest root was observed in T_1(16.658 mm) i.e. 500 ppm IBA concentration.

Similar result was reported by Srivastava *et al.* (2005) in kiwi fruit. Also, Siddiqu *et al.* (2018) [35] and Dhruve L. *et al.* (2018) [5] observed maximum length of longest root in dragon fruit cuttings. The maximum root volume was observed (1.88 cc) by the treatment T_4i.e. 2000 ppm; which was superior over rest of treatment except T_5 (1.82 cc) i.e. 2500 ppm which was statistically at par with treatment T_4. The minimum root volume was observed at T_1 (1.385 cc) i.e.500 ppm IBA concentration. similar result was supported by Shashidhar (2014) [33] in Litchi. Also, Siddiqua A. *et al.* (2018) [35] in dragon fruit cutting. Samim A.K. *et al.* (2018) [28] in Barbados cherry. The data presented in Table 1. The data presented in Table1 indicated that average length of root of dragon fruit cuttings was significantly influenced by IBA. The maximum average length of root was observed in T_4i.e.2000 ppm IBA (18.06 cm) which was significantly superior over rest of treatment and followed by treatment T_5 i.e. 2500 ppm IBA concentration (15.08 cm). The minimum average length of root was observed in T_1i.e. 500 ppm (12.42 cm) IBA concentration. Above result are conformity with Siddiqua *et al.* (2018) [35] in dragon fruit cuttings and Samim *et al.* (2018) [28] in barbadose cherry. Sharma *et al.* (2002) [31] in *Gradenia lucida*. Seran and Thiresh (2015) [29] observed in dragon fruit. Ali *et al.* (2017) [3] in kiwi.

The data regarding average number of roots of dragon fruit recorded for each treatment and presented in Table 1. The maximum average number of roots was observed (43.91) by the treatment T_4 i.e. 2000 ppm; which was superior over rest of treatment except T_5 (40.76) i.e. 2500 ppm which was statistically at par with treatment T_4. The minimum root volume was observed at T_1 (33.69) i.e.500 ppm IBA concentration. The results obtained with IBA were in conformity of several researchers but effective concentration of auxin for increased rooting varies with plants. Siddiqua *et al.* (2018) [35] in dragon fruit, Seran and Thiresh (2015) [29] in dragon. Kareem *et al.* (2016) [13] in guava cutting. The data presented in Table 1 indicated that fresh weight of root of dragon fruit was significantly influenced by IBA. The maximum fresh weight of root was observed in T_4 i.e. 2000 ppm IBA (2.09 g) which was significantly superior over rest of treatment and followed by treatment T_5(1.83 g) i.e. 2500 ppm IBA concentration. The minimum root diameter was observed in T_1i.e. 500 ppm (1.36 g) IBA concentration. Similar findings were recorded by Ahmad H. *et al.* (2016) [2], Dhruve *et al.* (2018) [5] and Siddiqua A. *et al.* (2018) [35] in dragon fruit cutting. Also, Samim *et al.* (2018) [28] Barbados cherry. Galavi M. *et al.* (2013) [7] in guava cutting. The data regarding dry weight of roots of dragon fruit recorded for each treatment and presented in Table 1.

The maximum dry weight of roots was observed (0.61 g) by the treatment T_4 i.e. 2000 ppm; which was superior over rest of treatment except T_5 (0.60) i.e. 2500 ppm and T_6 (0.59) i.e. 3000 ppm which was statistically at par with treatment T_4. The minimum root volume was observed at T_1 (33.34) i.e.500 ppm IBA concentration.

Also, Ahmad *et al.* (2016) [2], Siddiqua *et al.* (2018) [35] and Dhruve *et al.* (2018) [5] observed same result in dragon fruit cutting Samim *et al.* (2018) [28] in Barbados cherry. Galavi *et al.* (2013) [7] observed same result in guava. Seran and Thiresh (2015) [29] observed maximum fresh weight (10.25g) in dragon fruit.

Shoot growth observations

Observation for the first sprouting to the cutting was recorded 15 days interval for each treatment i.e. 15, 30, 45, 60 days and data was recorded when first sprouting initiate to the cutting. The data regarding days required to first sprouting recorded for each treatment and presented in Table 2. Early sprouting was observed when dragon fruit cuttings were treated with treatment T_4 (36.99) i.e. 2000 ppm IBA concentration, which was significantly superior over rest of treatment followed by T_5 (43.10) i.e. 2500 ppm. The treatment T_1i.e. 500 ppm observed late sprouting as compare to other treatments (51.90). Above result are conformity with obtained by Dhruve *et al.* (2018) [5] in dragon fruit cuttings. Ghosh A., *et al.* (2017) [8] in phasla cuttings. Also, Kareem, *et al.* (2016) [13] recorded in guava cuttings. Samim, *et al.* (2018) [28] recorded in Barbados cherry. Siddiqua, *et al.* (2018) [35] recorded in dragon fruit cuttings.

Table 1: Effect of IBA concentration on root growth parameters of dragon fruit cutting

IBA	Number of roots per cutting	Root length (cm)	Root diameter (mm)	Length of longest root (cm)	Root volume (cc)	Average length of root (cm)	Average number of roots	Fresh weight of root (g)	Dry weight of root (g)
T1 (500ppm)	42.43	12.65	1.21	16.65	1.38	12.42	33.69	1.36	0.5
T2 (1000 ppm)	45.48	13.23	1.33	20.06	1.45	13.32	36.81	1.56	0.55
T3 (1500 ppm)	47.57	15.23	1.46	21.21	1.6	14.77	37.96	1.64	0.58
T4 (2000 ppm)	55.15	20.62	2.06	24.23	1.88	18.06	43.91	2.09	0.61
T5 (2500 ppm)	50.34	18.7	1.92	23.3	1.82	15.08	40.76	1.83	0.6
T6 (3000 ppm)	49.32	17.19	1.69	21.86	1.73	14.92	38.73	1.71	0.59
'F' test	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG
SE (m) ±	0.53	0.42	0.04	0.42	0.03	0.36	0.27	0.05	0.01
CD at 5%	1.6	1.27	0.13	1.26	0.09	1.08	0.83	0.15	0.029

The maximum shoot length was observed in T_4i.e.2000 ppm IBA (24.39 cm) which was significantly superior over rest of treatment and followed by treatment T_5(20.15 cm) i.e. 2500 ppm IBA concentration. The minimum root diameter was observed in T_1i.e. 500 ppm (13.85 cm) IBA concentration. The data regarding shoot length recorded for each treatment and presented in Table2. Above result are conformity with Singh (2014) [40] in mulberry cuttings. Also, Seran and Thiresh (2015) [29] and Siddiqua A. *et al.* (2018) [35] was observed similar findings in dragon fruit cuttings. Samim, *et al.* (2018) [28] recorded in Barbados cherry. The maximum length of longest shoot was observed in T_4i.e.2000 ppm IBA (31.75 cm) which was superior over rest of treatment except treatment T_5(29.56 cm) i.e. 2500 ppm which is statistically at par with treatment T_4. The minimum length of longest root was observed in T_1i.e. 500 ppm (22.74 cm) IBA concentration. The data regarding on length of longest shoot for each treatment and presented in Table 2. Above result are conformity with Dhruve *et al.* (2018) [5] and Seran and Thiresh (2015) [29] n dragon fruit cuttings.

The maximum shoot diameter was observed in T_4i.e.2000 ppm IBA (5.90 mm) which was superior over rest of treatment except treatment T_5(5.76 mm) i.e. 2500 ppm IBA concentration which was statistically at par with treatment T_4. The minimum shoot diameter was observed in T_1i.e. 500 ppm (4.81 mm) IBA concentration. The data regarding on shoot diameter for each treatment and presented in Table 2. The present results are in conformation with the earlier findings of Shukla *et al*., (2010) [34] in peach and Diwakar and Katiyar (2013) [6] in kagzi lime. Also, Siddiqua A. *et al.* (2018) [35] observed in dragon fruit. Samim *et al.* (2018) [28] in Barbados cherry. Kaur *et al.* (2018) [15] in pomegranate. The maximum fresh weight shoot was observed in T_4 i.e. 2000 ppm IBA (47.77 g) which was superior over rest of treatment except treatment T_5(46.27 g) i.e. 2500 ppm and T_6(44.70 g) i.e. 3000 ppm of IBA concentration which was statistically at par with treatment T_4. The minimum shoot diameter was observed in T_1i.e. 500 ppm (37.71 g) IBA concentration. The data regarding fresh weight of shoot for each treatment and presented in Table 2. Above result are conformity with, Siddiqua *et al.* (2018) [35] and Dhruve *et al.* (2018) [5] in dragon fruit cuttings. Also, similar finding was noticed by Kaur and Kaur (2017) [14] in fig cutting. Ghosh *et al*. (2017) [8] in phalsa cutting. Seran and Thiresh (2015) [29] in dragon fruit cutting. The maximum dry weight shoot was observed in T_4i.e. 2000 ppm IBA (8.39 g) which was superior over rest of treatment except treatment T_5(7.37 g) i.e. 2500 ppm and T_6(7.24 g) i.e. 3000 ppm of IBA concentration which was statistically at par with treatment T_4. The minimum shoot diameter was observed in T_1i.e. 500 ppm (37.71 g) IBA concentration. The data regarding dry weight of shoot for each treatment and presented in Table2.Similar finding was noticed by Kaur and Kaur (2017) [14] in fig cutting. Ghosh *et al.* (2017) [8] recorded in phalsa cutting, Seran and Thiresh (2015) [29] and Dhruve *et al.* (2018) [5] recorded in dragon fruit cutting. Siddiqua *et al.* (2018) [35] also recorded dragon fruit cuttings. The maximum number of sprouts per cuttings was observed in T_4i.e. 2000 ppm IBA (4.69) which was superior over rest of treatment except treatment T_5(4.51) i.e. 2500 ppm IBA concentration which was statistically at par with treatment T_4. The minimum shoot diameter was observed in T_1 i.e. 500 ppm (37.71 g) IBA concentration. The data regarding number of sprouts per cuttings for each treatment and presented in Table 2. Above result are conformity with Dhruve *et al.* (2018) [5] in fruit cuttings. Siddiqua *et al.* (2018) [35]. Also, Siddhiqui M. and Hussain S. (2007) [36] cuttings (Ficus Hawaii). Neetam and Shukla (2018) [21] in jasmine cutting. The maximum survival percentage of cuttings was observed in T_4i.e. 2000 ppm IBA (95.87%) which was superior over rest of treatment except treatment T_5(94.44%) i.e. 2500 ppm IBA concentration which was statistically at par with treatment T_4. The minimum survival percentage was observed in T_1i.e. 500 ppm (88.57%) IBA concentration. The data regarding survival percentage for each treatment and presented in Table 2. Above result are conformity with Upadadhyau and Badyal (2007) [43] in pomegranate, (Kathrotia and Singh, (1995) in phalsa; Singh *et al.*; (2003) in long pepper. Also in fig cutting by Kuntagol, *et al.* (2018) [16] Arkendu Ghosh in phalsa cutting Rakibuzzaman *et al.* (2018) [24] in stevia cutting. Dhruve *et al.* (2018) [5] found in dragon fruit cutting. IBA was found to be best auxin for general use because it was nontoxic to plants over wide range of concentrations than NAA or IAA (Hartman *et al.* 2002) [11], and also found to be effective in promotion of rooting and survival of a large number of plant species (Henrique *et al.* 2006) [12].

Table 2: Effect of IBA concentration on shoot growth parameters of Dragon fruit cutting

IBA	Days to sprout	Shoot length (cm)	Length of longest shoot (cm)	Shoot diameter (mm)	Fresh weight of shoot(g)	Dry weight of shoot (g)	Number of sprouts per cuttings	Survival percentage
T1 (500 ppm)	51.9	13.85	22.74	4.81	37.71	5.24	1.9	88.57 (62.33)
T2 (1000 ppm)	48.87	15.84	24.9	4.95	40.56	6.02	3.44	89.79 (63.88)
T3 (1500 ppm)	45.59	18.97	26.57	5.12	43.57	6.51	3.41	92.29 (67.35)
T4 (2000 ppm)	36.99	24.39	31.75	5.9	47.77	8.39	4.69	95.87 (73.47)
T5 (2500 ppm)	43.1	20.15	29.46	5.76	46.27	7.37	4.51	94.44 (70.80)
T6 (3000 ppm)	44.78	19.36	28.45	5.18	44.7	7.24	3.54	93.65 (69.47)
'F' test	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG
SE (m) ±	0.44	0.82	0.73	0.22	1.16	0.25	0.18	0.38
CD at 5%	1.32	2.24	2.19	0.67	3.49	0.74	0.54	1.15

Result

Root growth parameters in respect of number of number of roots per cuttings, root diameter, root volume, root length, length of longest root, average number of root fresh weight of root, dry weight of root. Maximum number of root (55.15), maximum root length (20.62 cm), root diameter (2.06 mm), average length of root (17.47 cm), fresh weight of root (2.09 g) length of longest root (24.23 cm), root volume (1.88 cc), average number of root (43.91 cm), dry weight of root (0.61g). This observations were found maximum at 2000 ppm IBA concentration. This because at this concentration environmental condition found favorable for better root growth and at this concentration more branching of adventitious roots were found from main branch. Minimum root growth parameters were observed at 500 ppm IBA concentration. Shoot growth parameters in respect of day required to first sprouting, shoot length, length of longest shoot, shoot diameter fresh weight and dry weight of shoot, number of sprouts per cutting. In addition to this survival percentage of cuttings. Early sprouting (36.99), shoot length (24.39 cm), length of longest shoot (31.75 cm), shoot diameter (5.90mm), fresh weight of shoot (47.77 mm), dry weight (8.39), number of sprouts per cutting (4.51) was observed maximum at 2000 ppm IBA concentration. This because at this concentration environmental condition found favorable for better shoot growth and maximum number of sprout and shoot length found at 2000 ppm concentration after this concentration growth rate of roots slowly decline because excess concentration of auxin causes toxic effect on roots and shoots of cutting. Minimum shoot growth parameters were found at 500 ppm IBA concentration.

Conclusion

From the result of an experiment conducted to study the, study of different IBA levels on nursery behavior of Dragon fruit cuttings. Following conclusion should be drawn: On the basis of findings reported in present investigation the response of application of IBA on root growth, shoot growth and survival percentage of dragon fruit was found to be significant. In respect of different level of IBA concentration, better performance of IBA was observed at 2000 ppm of IBA concentration for all root and shoot growth parameters. Introduction of Dragon fruit cutting successfully grow in Akola condition with 95.87% of survival percentage occur under 2000 ppm of IBA concentration.

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