Effect of Cutting Type and IBA Concentration on Propagation of Passion Fruit (*Passiflora edulis* Sims)

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ABSTRACT

This study was carried out in two consecutive seasons (2022 and 2023) at the Agricultural Research Center Horticultural Research Institute, Giza, Egypt, where different concentrations of indole butyric acid (IBA) were applied to rooting ability and leaf growth of cuttings. We investigated the effect on the promotion of Vegetative propagation by passion fruit cuttings. These cuttings are from healthy fifth-year mother trees already grown in the Horticultural Laboratory nursery at the Agricultural Research Center in Giza, Egypt. The cut length was 10-14 cm, 3 knots, the trunk thickness was 5-7 mm, and it was made by cutting the upper part obliquely and flattening the lower part. Cuttings, on the other hand, are cleaned by removing the old leaves, except for two new leaves. Rapidly dip the bottom (1-2 cm) of the cuttings into various concentrations of IBA (0, 1000, 2000, and 3000 ppm) for 15-20 seconds. Cuttings planted in medium then contained a mixture of soil + sand + FYM (1:1:1 v/v/v) in a 40 x 60 cm plastic box at a 45-degree angle. These cuttings were planted twice (March and August in both seasons) in a greenhouse under a mist irrigation system and automatically sprayed with water every hour for 5 minutes. The results showed that cuttings treated with 3000 ppm IBA and planted in March had the highest survival rate in both seasons, with improved root number, root length, and shoot and leaf numbers.

Keyword: Passion fruit, cuttings, growth regulator, IBA, rooting, viability.

INTRODUCTION

Passiflora edulis Sims., a member of the Passifloraceae family, originated in the Amazon region of Brazil and is now commercially grown in Hawaii, Australia, New Zealand, Fiji, South Africa and Kenya (Chapman, 1963; Rashid et al., 1987) Passion fruit juice and leaves are used medicinally in many countries. Passion fruit flowers have a mild calming effect and promote sleep. Passionflower is used to treat nervous, hyperactive children, bronchial asthma, insomnia, and neuropathy (Daniel, 1993), asthma, whooping cough, bronchitis, and other severe coughs.

Passionflower is known as 'junkarota' and passion fruit is also called 'tanfal' because of its taste, aroma and juice-laden color (Ullah et al., 2009). P. edulis has two recognized forms. i) Purple passion fruit ii) yellow passion fruit. Purple passion fruit (*Passiflora edulis*) is adapted to the coolest subtropical or tropical highlands, while yellow passion fruit (*P. edulis f. flavicarpa*) are better suited to tropical lowland conditions. The best time to plant passion fruit is September-October. The optimum temperature for purple varieties is 18-25 °C, for yellow varieties 25-30 °C, with an annual rainfall requirement of 1000-2500 mm. It is a long-day crop, requiring a day length of 10.5 hours or more for flowering and fruiting (Watson and Bowers, 1965; Vallani et al., 1976). Passion fruit is a subtropical, shallow-rooted perennial woody liana cultivated for its ornamental, medicinal and nutritional value (Shivanna, 2012). It is an excellent fruit rich in beta-carotene, potassium and dietary fiber. The fruit can be eaten or juiced. Passion fruit juice is often added to other fruit juices to enhance flavor (Ripa et al., 2009). Rashid *et al.* (1987) stated that passion fruit is used not only as a fresh fruit, but also as a juice, jam and jelly. Contains 700-2400 IU of carotene and 20-30 mg of vitamin C per 100 g of juice. Passion fruit seeds are usually propagated by low quality seeds with low fruit yields and high genetic variation. However, most passion fruit species can also be propagated by cuttings, grafting, or layering. Propagation by cuttings is the easiest method, but rooting is encouraged by cuttings when treated with optimal levels of growth regulators. The use of indole butyric acid (IBA) has a significant impact on cutting success and viability. Many synthetic plant growth media have been used to root cuttings, but only indole butyric acid (IBA) has been shown to be overall superior (Hartman and Kester, 1993). So far, only limited studies have been conducted on passion fruit stem cuttings for plant propagation.

Passion fruit production is primarily by propagation from seed. This is easily obtained when processing fruit. However, propagation from seed has some drawbacks. This includes, among other things, large genetic variations observed in offspring. Passion fruit is a cross pollinated plant. Therewith, plants propagated from seed are not "true to type",. This leads to (desirable or undesirable) variability in the yield of fruit produced by these plants. Seed-grown plants are more susceptible to soil-borne pathogens and have poorer germination (Almeida *et al.*, 1991; Faleiro et al., 2019; Lima et al., 2019). Regardless of the problem, seed propagation remains the primary method of passion fruit propagation in commercial production (Kishore et al., 2006). Asexual reproduction, usually by grafting or cuttings, can eliminate genetic variation seen in seed reproduction (Chaves et al., 2004; Miranda et al., 2009; Carvalho Pires et al., 2010; Gurung et al., 2015). Faleiro et al., 2019). Because these plants are clones, they are "exactly in type" with the parent plant from which the cuttings or scions are derived. Propagation by cuttings has the advantage of being less labor intensive compared to grafting (Salomao et al, 2002). Timba et al. (1985) studied the effect of his IBA on rooting of passion fruit cuttings. Four concentrations of the IBA (0, 1000, 3000 and 8000 ppm) were applied to the cuttings. They reported that the best rooting was observed in cuttings treated with 3000 ppm IBA, with the highest root numbers and root dry weights. Other his IBA treatments also increased root formation over time. Meretti et al. (2007) studied the effects of season, foliage, and his IBA on rooting of sweet passionflower (*Passiflora alata* Curtis) cuttings. Treatments included IBA (0, 1000, 2000, 3000 ppm) and the presence or absence of half leaves. Treatment with 3000ppm IBA showed better results regardless of cutting type. Leafless cuttings showed a higher root percentage (80.9%) and half-leaf cuttings showed better results in terms of roots, dry weight and longest root length.

It has also been observed that cuttings are more uniform disease resistant and more productive than plants propagated from seed (Junqueira et al., 2005; Gurung et al., 2015; Davies et al., 2018) and Lima et al., 2019). Propagation by cuttings can also reduce the time to establishment because the plants do not emerge from seeds. Seeds need additional time to germinate before beginning growth and can take a year or more to bear fruit, but cuttings can bear fruit the same year they are propagated. Therefore, if you initiate passion fruit propagation from seeds and cuttings at the same time, the cuttings will form and bear fruit before the seeds are planted. Many passion fruit species produce fruit, but few are edible by humans. Some edible and fruit-bearing Passiflora species are derived from the upper-section Passiflora genus and others from the upper-section Rourifolia genus (Ulmer and MacDougal, 2004).

MATERIALS AND METHODS

This study was conducted for two consecutive seasons (2022 and 2023) in the horticultural laboratory nursery of the Agricultural Research Center, Giza, Egypt, to investigate the effects of varying concentrations of indole butyric acid (IBA) on the root strengthening of passion fruit cuttings and Good roots formation. Passion fruit cuttings are taken from healthy 5-year-old mother trees already grown in the horticultural laboratory nursery at the Agricultural Research Center in Giza, Egypt. The cut length was 8–11 cm with 3 segments, the trunk thickness was 5–7 mm, and the cut surface was beveled at the top and flat at the bottom. Cuttings, on the other hand, are cleaned by removing the old leaves, except for the two new ones. Rapidly dip the bottom (1-2 cm) of the cuttings into various concentrations of IBA (0, 1000, 2000, and 3000 ppm) for 10-15 seconds. Cuttings planted in medium then contained a mixture of sand + soil + FYM (1: 1:1 v/v/v) in a 40 x 60 cm plastic box at a 45 degree angle. These cuttings were planted twice (March and August in both seasons) in a greenhouse under a mist irrigation system and automatically sprayed with water every hour for 5 minutes. All cuttings were then treated with mild sulfur and the fungicide Vitafaxe prior to planting and again two months later to prevent fungal infection. Appropriate disease control was initiated immediately if signs of infection appeared on leaves. Four months after planting, all cuttings were removed from the container using a high-pressure water jet and the potting soil was removed. All new roots were traced back to their origin and the number of new roots on each cut stem was recorded before planting on other stems in the field. These cuttings were placed into four treatments in a randomized complete block design (RCBD), with each treatment represented by three replicates, each consisting of 10 cuttings planted in each unit plot in the greenhouse. I was. Freshly sectioned tissues of various sizes were immersed in an aqueous solution of indole-3-butyric acid (IBA) with various treatments by rapid immersion (10-15 seconds). Additionally, the following data were recorded: Surviving cuttings were counted cutting survival rate (%), number of roots (after 4 months), caliper root length (cm), caliper root diameter (cm), new leaves/number of cuttings, cuttings growth rate (cm) using a ruler. Measurements were recorded 4 months after planting date under greenhouse conditions.

Statistical analysis:

The data obtained were subjected to analysis of variance. Means were compared at the 5% level using the New-LSD method, data were tabulated, and statistical factor analysis was performed using the randomized complete block design method (Snedecor and Cochran, 1989). Following Steel and Torrie (1980), we converted percentages to arcsines to obtain binomial percentages.

RESULTS AND DISCUSSION

1. Survival percentage (%):

Survival was greatly influenced by IBA, planting date, and interactions within the three cutting types used in the two seasons. Apical cuttings recorded higher survival rates than semi-broadleaf cuttings in the first and second seasons four months after planting (Table, 1). In terms of planting date, cuttings planted in March had the highest survival rate than cuttings planted in August in both seasons.

Table (1). Effect of IBA and planting date on survival percentage for tree types of passion fruit cuttings during 2022 and 2023 seasons.

Treatments	Apex cuttings		Mean	Stem cuttings		Mean	Wood cuttings		Mean	General Mean
	March	August		March	August		March	August		
Season, 2022										
0.00	25.1	23.3	**24.2**	18.2	17.4	**17.8**	5.1	4.2	**4.65**	**15.5**
IBA 1000 ppm	67.3	65.5	**66.4**	60.4	60.2	**60.3**	40.3	40.1	**40.2**	**55.6**
IBA 2000 ppm	81.8	80.2	**81.0**	72.3	71.5	**71.9**	55.2	54.4	**54.8**	**69.2**
IBA 3000 ppm	93.2	90.4	**91.8**	88.5	82.3	**85.4**	66.5	64.3	**65.4**	**80.8**
Mean	**80.7**	**78.7**	**79.7**	**59.8**	**57.8**	**58.8**	**41.7**	**40.7**	**41.1**	**59.9**
New LSD at P≤5% for		**IBA (A)**		**Planting date**	**Cutting type (B)**		**A×B**	**A×C**	**B×C**	**A×B×C**
		1.22		**1.05**	**1.33**		**0.58**	**1.27**	**1.7**	**2.03**
Season, 2023										
0.00	25.3	25.1	**25.2**	19.2	18.8	**19**	5.1	4.3	**4.7**	**16.3**
IBA 1000 ppm	70.3	70.1	**70.2**	64.3	60.5	**62.4**	41.2	40.3	**40.7**	**57.7**
IBA 2000 ppm	80.4	80.2	**80.3**	79.8	75.2	**77.5**	56.3	55.1	**55.7**	**71.1**
IBA 3000 ppm	96.2	93.4	**94.8**	89.9	85.3	**87.6**	68.4	78.2	**73.3**	**85.2**
Mean	**82.3**	**81.2**	**81.7**	**63.3**	**59.9**	**61.6**	**42.7**	**44.4**	**43.6**	**62.3**
New LSD at P≤5% for		**IBA (A)**		**Planting date**	**Cutting type (B)**		**A×B**	**A×C**	**B×C**	**A×B×C**
		1.02		**0.49**		**0.58**	**0.58**	**0.58**	**0.58**	**0.58**

In addition, treatment with IBA at 3000 ppm treatment in both seasons resulted in the highest survival rate 4 months after planting. In this experiment, passion fruit cutting success and survival were strongly influenced by both planting date and hormone IBA. From the results of this study, it can be concluded that among all factors, planting in March had the highest survival rate and the most successful rooting of passion fruit. In addition, root number, root length, and root fresh weight were observed. The greatest success in amputation and viability was seen with the March treatment combination containing 3000 ppm IBA compared to controls. The overall photo suggests that high concentrations of IBA have greater root development potential and lower mortality compared to controls (Manan et al., 2002). Similar results were reported by his Manan et al. (2002) and Diwaker and Katiyar (2013).

2. Roots number:-

The highest root numbers (12.74 and 12.97 cm) were found in apical cuttings planted in March, while the lowest root numbers (1.67 and 1.69 cm) were found in August of the first or second season, found in semi-broad-leaved cuttings (Table, 2). For IBA, 3000ppm produced the highest number of roots 4 months after planting compared to other concentrations in both seasons. Furthermore, the interaction of IBA, cutting type, and planting date showed that apical cuttings treated with 3000 ppm IBA and planted in March produced the highest number of roots compared to other interactions. (15.28 in first season, 15.33 in second season). These results are consistent with those of Meletti et al. (2007), Davies et al. (2018), Faleiro et al. (2019) and Lima et al. (2019). They found that IBA treatment provided the best root response. They reported that IBA treatment was essential for good rooting and development of passion fruit cuttings.

Photo (1): Effect of IBA at 3000 ppm on number of root for passion fruit.

Table (2). Effect of IBA and planting date on root number of passion fruit cuttings tree species in the 2022 and 2023 seasons.

Treatments	Apex cuttings		Mean	stem cuttings		Mean	wood cuttings		Mean	General Mean
	March	August		March	August		March	August		
Season, 2022										
0.00	0	0	**0**	0	0	**0**	0	0	**0**	**0**
IBA 1000 ppm	9.61	7.43	**8.52**	7.11	6.23	**6.67**	1.21	1.11	**1.16**	**5.45**
IBA 2000 ppm	13.33	12.75	**13.04**	9.37	8.41	**8.89**	2.42	2.22	**2.32**	**8.08**
IBA 3000 ppm	15.28	13.42	**14.35**	10.95	9.99	**10.47**	3.55	3.35	**3.45**	**9.42**
Mean	**12.74**	**11.2**	**11.97**	**6.85**	**6.15**	**6.50**	**1.79**	**1.67**	**1.73**	**6.73**
New LSD at P≤5% for		**IBA (A)**	**Planting date**		**Cutting type (B)**		**A×B**	**A×C**	**B×C**	**A×B×C**
		0.22	**0.5**		**0.08**		**0.41**	**0.02**	**0.32**	**0.04**
Season, 2023										
0.00	0	0	**0**	0	0	**0**	0	0	**0**	**0**
IBA 1000 ppm	9.86	7.48	**8.67**	7.10	6.30	**6.7**	1.23	1.11	**1.17**	**5.51**
IBA 2000 ppm	13.73	11.57	**12.65**	9.59	8.47	**9.03**	2.31	2.27	**2.29**	**7.99**
IBA 3000 ppm	15.33	13.69	**14.51**	11.21	10.55	**10.88**	3.61	3.39	**3.5**	**9.63**
Mean	**12.97**	**10.91**	**11.94**	**6.97**	**6.33**	**6.65**	**1.78**	**1.69**	**1.74**	**6.77**
New LSD at P≤5% for		**IBA (A)**	**Planting date**		**Cutting type (B)**		**A×B**	**A×C**	**B×C**	**A×B×C**
		0.20	**0.33**		**0.12**		**0.58**	**0.05**	**0.43**	**0.05**

3. Root length (cm).

The results in Table (3) show that apical cuttings treated with 3000 ppm IBA and planted in March produced the longest root lengths (14.32 and 14.69 cm), while semi-broadleaf cuttings planted in August (6, 12, and 14.69 cm) 6.99 cm) showed the shortest root length. cm) was found each in both seasons. In addition, at 3000 ppm treatment, IBA showed the longest root length (10.40 and 10.71 cm) in cuttings 4 months after planting in both seasons, while 1000 ppm IBA had the longest root length in both seasons. Short root lengths (6.14 and 6.30 cm) were seen. . In addition, using IBA at 3000 and planting in March, throughout both seasons they had significantly increased root length per cutting compared to planting in August (photo 1).

Table (3): Effect of IBA and planting date on root length (cm) of passion fruit cuttings species in the 2022 and 2023 seasons.

Treatments	Apex cuttings		Mean	Stem cuttings		Mean	Wood cuttings		Mean	General mean
	March	August		March	August		March	August		
Season, 2022										
0.00	0	0	**0**	0	0	**0**	0	0	**0**	**0**
IBA 1000 ppm	10.21	9.11	**9.66**	8.87	8.65	**8.76**	0	0	**0**	**6.14**
IBA 2000 ppm	13.53	12.13	**12.83**	9.35	8.33	**8.84**	5.51	5.11	**5.31**	**8.99**
IBA 3000 ppm	14.32	13.98	**14.15**	10.91	10.23	**10.57**	6.88	6.12	**6.5**	**10.40**
Mean	**12.68**	**11.74**	**12.21**	**7.28**	**6.80**	**7.04**	**3.09**	**2.80**	**2.95**	**7.40**
New LSD at P≤5% for	**IBA (A)**	**Planting date**		**Cutting type (B)**			**A×B**	**A×C**	**B×C**	**A×B×C**
	0.22	**0.58**		**0.58**			**0.25**	**0.51**	**0.54**	**0.44**
Season, 2023										
0.00	0	0	**0**	0	0	**0**	0	0	**0**	**0**
IBA 1000 ppm	10.33	9.75	**10.04**	8.99	8.75	**8.87**	0	0	**0**	**6.30**
IBA 2000 ppm	13.76	12.84	**13.3**	9.68	8.98	**9.33**	5.98	5.84	**5.91**	**9.51**
IBA 3000 ppm	14.69	14.17	**14.43**	10.99	10.22	**10.60**	7.21	6.99	**7.1**	**10.72**
Mean	**12.92**	**12.25**	**12.59**	**7.41**	**6.98**	**7.20**	**3.29**	**3.20**	**3.25**	**7.68**
New LSD at P≤5% for	**IBA (A)**	**Planting date**		**Cutting type (B)**			**A×B**	**A×C**	**B×C**	**A×B×C**
	1.05	**0.75**		**0.58**			**0.51**	**0.2**	**0.12**	**0.31**

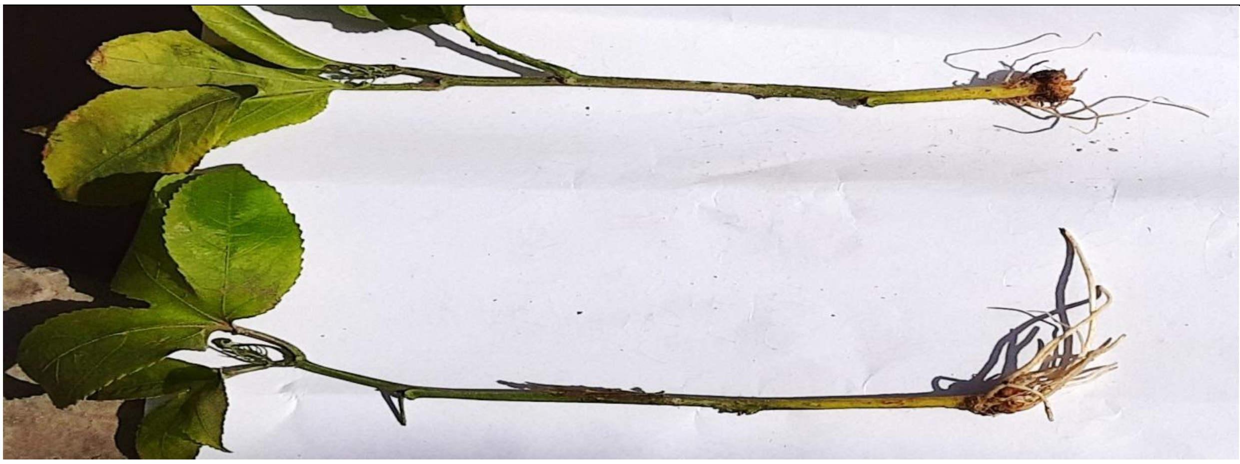

Photo (2): Effect of IBA at 3000 on root length.

4. Number of newly formed leaves:

The Apex cuttings were planted in March produced the highest leaves number (3.34) and the lowest leaves number (0.89) was recorded in semi hardwood cuttings witch planted in August in the first season (Table, 4). The maximum number of leaves per cutting (4.23) was observed in apical cuttings treated with 3000ppm IBA and planted in March. However, minimal leaf numbers were recorded for semi-broadleaf cuttings treated with 1000 ppm IBA for two seasons (Table, 5). Application of IBA to passion fruit cuttings has a significant effect on increasing the number of leaves, one of the sites of natural auxin production in cuttings, in addition to the main activities of photosynthesis, respiration and transpiration

(Wahab et al., 2001). This is likely due to the fact that IBA produced healthier and longer roots that better absorbed more nutrients and water, resulting in an increased number of leaves produced by the plants. Similar results were reported by his Bemkaireima et al. (2012) reported in Passion Fruit.

Table (4). Effect of IBA and planting date on the number of leaves newly formed from passion fruit cuttings in the 2022 and 2023 seasons.

Treatments	Apex cuttings		Mean	Stem cuttings		Mean	Wood cuttings		Mean	General Mean
	March	August		March	August		March	August		
Season, 2022										
0.00	0	0	**0**	0	0	**0**	0	0	**0**	**0**
IBA 1000 ppm	2.56	2.54	**2.55**	2.1	2.1	**2.1**	0	0	**0**	**1.55**
IBA 2000 ppm	3.22	3.14	**3.18**	2.54	2.42	**2.48**	1.22	1.23	**1.22**	**2.29**
IBA 3000 ppm	4.23	4.11	**4.17**	3.55	3.23	**3.39**	2.51	2.31	**2.41**	**3.32**
Mean	**3.34**	**3.26**	**3.30**	**2.04**	**1.93**	**1.99**	**0.93**	**0.88**	**0.90**	**2.07**
New LSD at P≤5% for	**IBA (A)**		**Planting date**		**Cutting type (B)**		**A×B**	**A×C**	**B×C**	**A×B×C**
	0.02		**0.02**		**0.58**		**0.45**	**0.33**	**0.53**	**0.08**
Season, 2023										
0.00	0	0	**0**	0	0	**0**	0	0	**0**	**0**
IBA 1000 ppm	2.56	2.54	**2.55**	2.1	2.1	**2.1**	0	0	**0**	**1.55**
IBA 2000 ppm	3.43	3.14	**3.285**	2.53	2.42	**2.475**	1.22	1.23	**1.225**	**2.32**
IBA 3000 ppm	4.44	4.24	**4.34**	3.57	3.27	**3.42**	2.53	2.37	**2.45**	**3.40**
Mean	**3.47**	**3.31**	**3.39**	**2.05**	**1.94**	**1.99**	**0.93**	**0.9**	**0.91**	**2.10**
New LSD at P≤5% for	**IBA (A)**		**Planting date**		**Cutting type (B)**		**A×B**	**A×C**	**B×C**	**A×B×C**
	0.24		**0.58**		**0.44**		**0.52**	**0.33**	**0.25**	**0.18**

5. Shoots number:-

The data contained in Table (5) show that the minimum number of shoots per cutting was recorded for apical cuttings treated with 3000 ppm IBA and planted in March. Cuttings were treated with 3000 ppm IBA for two seasons while the maximum number of shoots in stem cuttings was recorded. The effect of IBA on passion fruit stem cuttings at 3000 ppm reduced the time required for shoot formation compared to other concentrations that required longer times. This is thought to be due to a better root system, absorbing more nutrients for plant growth and promoting shoot formation in cuttings. IBA reduced sprout formation in apical cuttings by apical buds, whereas sprout formation was prevented in these cuttings. These results are consistent with those of Pires et al. (2010) and Bemkaireima et al. (2012) for passion fruit.

Table (6). Effect of IBA and planting date on the number of leaves newly formed from passion fruit cuttings in the 2022 and 2023 seasons.

Treatments	Apex cuttings		Mean	Stem cuttings		Mean	Wood cuttings		Mean	General mean
	March	August		March	August		March	August		
Season, 2022										
0.00	0	0	**0**	0	0	**0**	0	0	**0**	**0**
IBA 1000 ppm	2.27	2.23	**2.25**	2.38	2.64	**2.51**	1.21	1.11	**1.16**	**1.97**
IBA 2000 ppm	2.46	2.42	**2.44**	2.42	2.36	**2.39**	2.48	2.24	**2.36**	**2.39**
IBA 3000 ppm	1.21	1.11	**1.16**	3.75	3.33	**3.54**	2.51	2.37	**2.44**	**2.38**
Mean	**1.98**	**1.92**	**1.95**	**2.13**	**2.08**	**2.11**	**1.55**	**1.43**	**1.49**	**1.85**
New LSD at P≤5% for	**IBA (A)**		**Planting date**		**Cutting type (B)**		**A×B**	**A×C**	**B×C**	**A×B×C**
	0.02		**0.58**		**0.08**		**0.51**	**0.22**	**0.32**	**0.12**
Season, 2023										
0.00	0	0	**0**	0	0	**0**	0	0	**0**	**0**
IBA 1000 ppm	2.67	2.55	**2.61**	2.43	2.63	**2.53**	1.24	1.14	**1.19**	**2.11**
IBA 2000 ppm	2.46	2.44	**2.45**	2.57	2.43	**2.5**	2.92	2.32	**2.62**	**2.52**
IBA 3000 ppm	1.36	1.28	**1.32**	3.98	3.38	**3.68**	2.87	2.37	**2.62**	**2.54**
Mean	**2.16**	**2.09**	**2.12**	**2.24**	**2.11**	**2.17**	**1.75**	**1.45**	**1.60**	**1.97**
New LSD at P≤5% for	**IBA (A)**		**Planting date**		**Cutting type (B)**		**A×B**	**A×C**	**B×C**	**A×B×C**
	0.03		**0.33**		**0.14**		**0.58**	**0.32**	**0.51**	**0.02**

REFERENCES

Almeida, L.D., M.A.C. Boaretto, R.D. Santana, G.D. Nascimento, P.J. Souza, and A.R.S. Jos´e. (1991). Estaquia e com- portamento de maracujazeiros (Passiflora edulis SIMS f. flavicarpa Deg.) prop- agados por vias sexual e vegetativa. Rev. Bras. Frutic. 13:153–156.

Bemkairema, K., Angami, T and Singh, M. S. (2012) Response of different size and growth regulator on cuttings of passion fruit var. Purple (*Passiflora edulis var. edulis* Sims). *The Asian J. of Hort.* 7 (2): 515-520.

Carvalho Pires, M., J.R. Peixoto, and O.K. Yamanishi (2010). Rooting of pas- sion fruit species with indole-3-butyric acid under intermittent misting condi- tions. Acta Hort. 894:177–183.

Chapman, T. (1963). Passion fruit growing in Kenya. Economic Botany. Baltimore 17(3): 165-168.

Chaves, R.D.C., N.T.V. Junqueira, I. Manica, J.R. Peixoto, A.V. Pereira, and J.D.F. Fialho. (2004). Enxertia de mar- acujazeiro-azedo em estacas herb´aceas enraizadas de esp´ecies de *passifloras* nati- vas. Rev. Bras. Frutic. 26:120–123.

Davies, F.T., Jr., R.L. Geneve, S.B. Wil- son, H.T. Hartmann, and D.E. Kester. (2018). Hartmann and Kester's plant propagation: Principles and practices. 9th ed. Pearson Education, New York, NY.

Diwaker and P. N. Katiyar (2013). Regeneration of kagzi lime *(citrus aurantifolia* swingle) through stem cuttings with the aid of IBA and PHB. *Hort. Flora Res. Spectrum,* 2 (3): 271-273.

Faleiro, F.G., N.T.V. Junqueira, T.G. Junghans, O.N. de Jesus, D. Miranda, and W.C. Otoni. (2019). Advances in pas- sion fruit (*Passiflora* spp.) propagation. Rev. Bras. Frutic. 41:1–17.

Gurung, N., G.S.K. Swamy, and S.K. Sarkar. (2015). Rooting response of passion fruit cuttings under mist house and closed media sachet (CMS). Environ. Ecol. 33:1019–1021.

Hartman, H.T. and Kester, D.E. (1993). *Plant propagation principles and practices, Fifth Edition*. Prentice Hall, New Delhi, pp. 200-241.

Junqueira, N.T.V., M.F. Braga, F.G. Faleiro, J.R. Peixoto, and L.C. Bernacci. (2005). Potential of wild passion fruit species as sources of disease resistance, p. 80–108. In: F.G. Faleiro, N.T.V Junqueira, and M.F. Braga (eds.). Passionfruit: Germplasm and breeding. Embrapa Cer- rados, Planaltina, Brazil.

Kishore, K., K.A. Pathak, D.S. Yadav,K.M. Bujarbaruah, R. Bharali, and R. Shukla. (2006). Passion Fruit Tech. Bul. 2– 4.

Lima, L.K.S., O.N. de Jesus, T.L. Soares,S.A.S. de Oliveira, F. Haddad, and E.A. Girardi. 2019. Water deficit increases the susceptibility of yellow passion fruit seedlings to fusarium wilt in controlled conditions. Scientia Hort. 243:609–621.

Manan, A., M. A. Khan., W. Ahmad and A. Sattar (2002). Clonal Propagation of Guava (*Psidium guajava* L.) *Int. J. Agric. & Biol*. 1560–8530/04–1–143– 144.

Miranda, D., M. Perea, and S. Magnitskiy (2009). Propagacio´n de especies pasi- flor´aceas, p. 69–96. In: D. Miranda, G. Fischer, C. Carranza, S. Magnitskiy, F. Casierra-Posada, W. Piedrah´ıta, and L.E. Flo´rez (eds.). Cultivo, poscosecha y comercializacio´n de las pasiflor´aceas en Colombia: Maracuy´a, granadilla, gulupa y curuba. Colombian Society of Horticul- tural Science, Bogot´a, Colombia.

Pires, M. C., J. R. Peixoto and O. K. Yamanishi (2010) Rooting of Passion Fruit Species with Indole–Butyric Acid under Intermittent Misting Condition. ISHS *Acta Hort*. 894:1st International symposium on Tropical Horticulture.

Rashid, M.M., Quadir, M.A. and Hossain, M.M. (1987). Bangladesher Phal. Rashid Publishing House.

Ripa, F.A., Haque, M., Nahar, L. and Islam, M.M. (2009). Antibacterial, cytotoxic and anti- oxidant activity of *Passiflora edulis* Sims. European Journal of Scientific Research. 3(4): 592–59.

Salomao, L.C.C., W.E. Pereira, R.C.C. Duarte, and D.L.D.Siqueira (2002). Propagaxc~ao por estaquia dos mar- acujazeiros doce (*Passiflora alata* Dry- and.) e amarelo (*P. edulis* f. *flavicarpa* O. Deg.). Rev. Bras. Frutic. 24:163–167.

Shivanna, K.R. (2012). Reproductive assurance through unusual autogamy in the absence of pollinators in passiflora edulis (passion fruit). Current Science 103(9): 1091-1096.

Steel, R. G. D. and Torrrie, J. H. (1980). Reproduced from Principles and Procedures of Statistics. Printed with the Permission of C. I. Bliss, pp. 448-449.

Ullah, M.M., Rouf, M.A., Alam, A., Das, C.K. and Ahmed, A. (2009). Modern Cultivation of Passion Fruit (In Bengali)(1st Edn) Hill Agricultural Research Station, BARI, Khagrachari.

Ulmer, T. and J.M. MacDougal. (2004). Passiflora: Passionflowers of the world. Timber Press, Portland, OR.

Vallani, P.C., Lam-Sanchez, A., Ruggiero, A. and Ferreira, F.R. (1976). Crop plants of the tropics and subtropics. Acta Horticulturae 57: 233-6.

Wahab, F., G. Nabi., N. Ali and M. Shah (2001). Rooting of response semi- hardwood cuttings of guava (*Psidium guajava* L.) to various concentrations of different auxins. *J. Biol. Sci.* 1(4):184- 187.

Watson, D.P. and Bowers, F.A.I. (1965). Temperate and subtropical fruit production. Hawaii Farm Science 14: 3-5.

تأثير نوع العقلة وتركيز إندول حمض البيوتيريك (IBA) على إكثار فاكهة الباشون

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أجريت هذه الدراسة في موسمين متتاليين ٢٠٢٢ و ٢٠٢٣ في مركز البحوث الزراعية، معهد بحوث البساتين، الجيزة، مصر ، لدرسة تأثير تركيزات مختلفة من إندول حمض البيوتيريك (IBA) على إكثار فاكهة الباشون خضريا وتحسين تجذير العقل ونموها وأخذت هذه العقل من أشجار خالية من الأمراض بعمر خمس سنوات منزرعة بمشتل معهد بحوث البساتين وكان طول العقلة من ١٠-١٤ سم وعليها ٣ عقد وسمكها من ٥-٧ مم وتم تجهيز العقل بقطع الجزء العلوي بطريقة مائلة ومستوى فى الجزء السفلي وتمت إزالة كل الأوراق القديمة باستثناء ورقتين جديدتين وتم غمس الجزء السفلي من العقل (١-٢ سم) في تركيزات مختلفة من إندول حمض البيوتيريك ٠و١٠٠٠و٢٠٠٠و ٣٠٠٠جزء في المليون) لمدة ١٥-٢٠ ثانية ثم زرعت هذه العقل في وسط يحتوى على خليط من التربة و الرمل والفوم بنسبه ١:١:١ بالحجم مائلة بزاوية ٤٥ درجة في صناديق بلاستيكه مقاس٤٠ × ٦٠ سم. و زرعت هذه العقل فى ميعادين (مارس وأغسطس في كلا الموسمين) داخل الصوبة تحت نظام الري بالضباب التى تعمل برش الماء آليًا لمدة ٥ دقائق كل ساعة وأظهرت النتائج أن العقل المعاملة بتركيز ٣٠٠٠ جزء في المليون من إندول حمض البيوتيريك وزراعت في مارس كان لها أعلى معدل نجاح وأنتجت أعلى عدد من الجذور، وأطول الجذور، وعدد الفروع والأوراق في كلا الموسمين.