

Effect of Indole Butyric Acid (IBA) and growing conditions on success and survivability of stem cutting in passion fruit (*Passiflora edulis* Sims.)

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Abstract: The experiment was carried out at the FTIP-BAU Germplasm Centre, Bangladesh Agricultural University, Mymensingh during the period from September to December, 2014 to investigate the effect of indole butyric acid (IBA) and growing conditions on success and survivability of stem cutting in passion fruit. The experiment consisted of three growing conditions viz., shade condition, bed condition and open condition and five different concentrations of IBA viz 0, 50, 100, 150 and 200 ppm. The experiment was conducted in Randomized Complete Block Design (RCBD) with three replications. Most of the studied parameters showed the significant variation in case of cuttings grown under different environmental conditions. Shade condition took the minimum days to first shoot initiation (9.80 days), maximum number of shoots (1.40), length of shoots (11.16 cm), number of leaves (4.76), number of roots (9.60), length of roots (14.87 cm), fresh weight of roots (0.39 g), dry weight of roots (0.05 g), percentage of success (54.00%), respectively per cutting at 70 days after planting (DAP) and percentage of cutting survivability (50.14%) at 120 days after planting (DAP). Treatment of cuttings with five different concentrations of indole butyric acid (IBA) had significant effect on most of the parameters studied. The minimum days to first shoot initiation (9.56 days), maximum number of shoots (1.54), length of shoots (12.17 cm), number of leaves (5.31), number of roots (15.29), length of roots (10.58 cm), fresh weight of roots (0.45 g), dry weight of roots (0.07 g), percentage of success (44.44%), respectively per cutting at 70 days after planting (DAP) and percentage of cutting survivability (42.84%) at 120 days after planting (DAP) were obtained from the treatment of IBA at 100 ppm. The combined effects of different growing conditions and different IBA concentrations exerted significant effect. The minimum days for first shoot initiation (8.33 days), maximum number of shoots (1.80), length of shoots (14.52 cm), number of leaves (6.87), number of roots (20.00), length of roots (18.00 cm), fresh weight of roots (0.54 g), dry weight of roots (0.09 g), percentage of success (70.00%), respectively per cutting at 70 days after planting (DAP) and percentage of cutting survivability (67.67%) at 120 days after planting (DAP) were obtained from shade condition with 100 ppm IBA. The minimum values of all the parameters were recorded in open condition with 200 ppm IBA. Bed condition with IBA treatment showed better performance than the open condition with IBA treatment. In this study, the highest success and survivability of passion fruit cuttings were found from the treatment combination of shade condition with 100 ppm IBA treatment.

Key words: Passion fruit (*Passiflora edulis*), indole butyric acid (IBA), growing conditions.

Introduction

Passion fruit (*Passiflora edulis* Sims.) belongs to the family Passifloraceae and originated in the Amazon region of Brazil and now commercially cultivated in Hawaii, Australia, New Zealand, Fiji, South Africa and Kenya (Chapman, 1963; Rashid *et al.*, 1987). It is one of the newly introduced exotic fruits in Bangladesh. In Bangladesh, passion flower is known as 'jhumkalota' and considering taste, flavor and color with tang-juice the passion fruit is also called a 'tangfal' (Ullah *et al.*, 2009). There are two recognized forms of *P. edulis*. i) the purple passion fruit ii) the yellow passion fruit. The purple passion fruit (*Passiflora edulis*), is adapted to the coolest subtropics or to high altitudes in the tropics, while the yellow passion fruit (*P. edulis* f. *flavicarpa*) is more suited to tropical low land conditions. Suitable planting time for passion fruit is Sep-Oct. Optimum temperatures for the purple variety are between 18-25°C and for the yellow variety 25-30°C and annual rainfall requirements ranging from 1000 to 2500 mm. It is a long day plant, requiring day lengths in excess of 10.5 h to flower and fruit (Watson and Bowers, 1965; Vallani *et al.*, 1976). Passion fruit plant is a subtropical, shallow rooted, woody perennial vine crop and is cultivated for its ornamental, medicinal and nutritive characteristics (Shivanna, 2012). It is an excellent fruit having high amount of beta carotene, potassium and dietary fiber. The fruit is both eaten and juiced; passion fruit juice is often added to other fruit juices to enhance aroma (Ripa *et al.*, 2009). Rashid *et al.* (1987) mentioned that passion fruit is used not only as fresh fruit also as juice, jam and jelly. It contains 700- 2400 IU carotene and 20-30 mg vitamin C per 100 g of juice. Passion fruit species are normally propagated through seeds that create a low yield of fruits and are of poor quality due to high

genetic variations. However, most passion fruit species can also be propagated by cuttings, grafting and layering. The propagation through stem cutting is the easiest method but treatment with growth regulators when applied in optimum concentration promote rooting in stem cuttings. Application of indole butyric acid (IBA) has a great influence on the success and survivability of cuttings.

Materials and Methods

The study was carried out at the Fruit Tree Improvement Program (FTIP), BAU Germplasm Centre (GPC), Bangladesh Agricultural University, Mymensingh during the period from, September to December, 2014 to study the effect of indole butyric acid (IBA) and growing conditions on success and survivability of stem cutting in passion fruit. The soil of the experimental area was silty loam in texture belonging to the old Brahmaputra Flood plain of AEZ 9 having non-calcareous dark grey flood plain soil. The experimental site is situated under sub tropical climate characterized by comparatively heavy rainfall during the month of September and scanty rainfall during the rest of the period of the year. The total rainfall of the locality was (409.8 mm), the average maximum and minimum temperature were 29.38°C and 20.2°C, respectively and the average relative humidity was 84.83% and sunshine was 156.4 hours during the months from September to December, 2014. Passion fruit suitable for propagation by stem cutting which was collected from the mother plants of passion fruit grown in the BAU Germplasm Centre, Bangladesh Agricultural University (BAU), Mymensingh and different concentrations of IBA were used to enhance the roots of stem cutting of passion fruit. IBA was collected from a registered chemicals supplier. The experiment was conducted using

Randomized Complete Block Design (RCBD) with 3 replications. For each treatment combination per replication 10 cuttings were planted in each unit plot. The experiment consisted of i) three growing conditions viz., shade, bed and open conditions and ii) five different concentrations of IBA were 0, 50, 100, 150 and 200 ppm, respectively. Thus in total 450 (3×5×3×10) cuttings were made. Before planting, the basal parts of the stem cuttings were soaked in the solutions of different concentrations of IBA for overnight and planted in the poly bags and nursery bed at 45° angles. When the first shoot was initiating, then the data regarding days required to first shoot initiation, length of shoots, leaf number were studied. After 70 days of planting the cuttings were uprooted and the parameters like roots number, length of the longest root, fresh weight of roots, dry weight of roots were recorded. Finally the percentages of success and survivability were calculated by using the formulae (i) Percentage of success = {(Number of successfully stem cutting) ÷ (Number of cutting planted per treatment) × 100}; (ii) Percent survivability = [(Total no. of successful cuttings) – (Total no. of cuttings after success)] ÷ (Total no. of successful cutting)]. Data recorded for each parameter and the significance of differences between treatments means were compared by Least Significant Difference (LSD) test (Gomez and Gomez, 1984).

Results and Discussion

Effect of growing conditions (shade, bed and open) on stem cuttings of passion fruit

In case of shade condition it required short time interval (9.80 days) for first shoot initiation where nursery bed (11.46 days) and open condition (12.90 days) took long time interval (Fig. 1). The cuttings grown under shade

(polyhouse) condition showed the highest number of shoots (1.40) and the lowest number of shoots (1.00) under open condition at 70 days after planting (Fig. 2a).

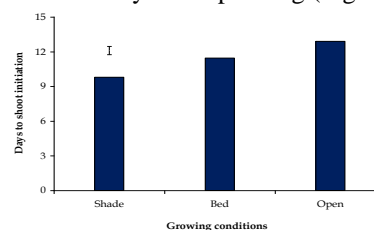


Fig. 1. Effect of growing conditions on days to shoot initiation. Vertical bar represents LSD at 5% level of significance

The highest length of shoots was measured in cuttings grown under shade condition (11.16 cm) but the lowest length of shoots (8.58 cm) was found in cuttings grown under open condition at 70 DAP (Fig. 2b). The cuttings grown under shade (polyhouse) condition produced the highest number of leaves (4.76) and the lowest number of leaves (2.70) was recorded under open condition cuttings at 70 DAP (Fig. 2c).

The highest number of roots (9.60) was found in cuttings grown under shade condition but the lowest number of roots (7.47) was found in cuttings grown under open condition at 70 DAP (Table 1). The highest length of roots (14.87 cm) was measured in cuttings grown under shade condition but lowest length of roots (2.61 cm) was found in cuttings grown under open condition at 70 DAP (Table 1). The highest fresh weight (0.39 g) of root was measured in shade condition cuttings, but cuttings grown under open condition showed the lowest (0.20 g) fresh weight of roots (Table 1). The highest dry weight of roots (0.05 g) was measured in shade condition cuttings but the lowest dry weight of roots (0.03 g) found under open condition cuttings at 70 DAP (Table 1).

Table 1. Effect of different growing conditions on different parameters of passion fruit

Growing conditions	No. of roots/cutting	Length of roots/cutting (cm)	Fresh wt. of roots/cutting (g)	Dry wt. of roots/cutting (g)
Shade	9.60	14.87	0.39	0.05
Bed	8.07	6.43	0.30	0.04
Open	7.47	2.61	0.20	0.03
LSD _{0.05}	0.420	0.203	0.015	0.001
LSD _{0.01}	0.567	0.274	0.020	0.002
Level of significance	**	**	**	**

** = Significant at 1% level of probability

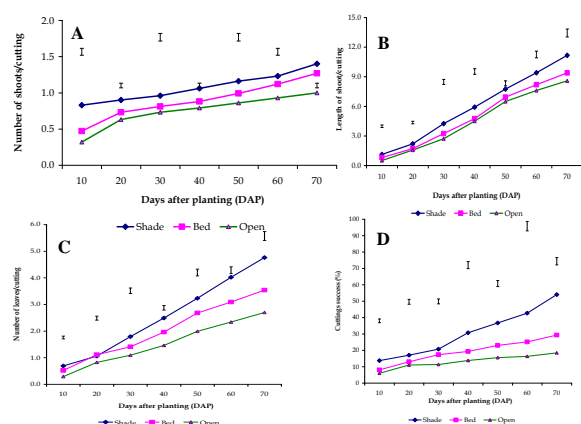


Fig. 2. Effect of growing conditions on (A) no. of shoot, (B) length of shoot, (C) no. of leaves, (D) cutting success. Vertical bars represent LSDs at 5% level of significance

The highest percentage of cutting success (54.00%) was observed in shade condition and the lowest percentage of cutting success (18.40%) was under open condition at 70 DAP. The bed condition cuttings showed the percentage of success (29.33%) at 70 DAP (Fig. 2d).

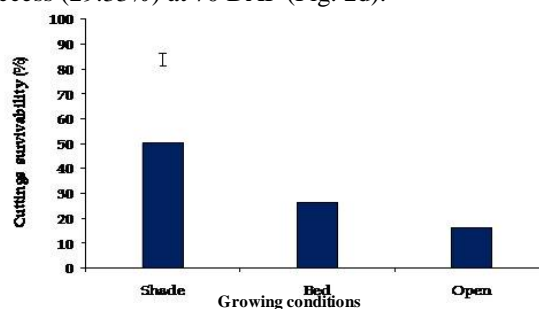


Fig. 3. Effect of growing conditions on percentage of cutting survivability. Vertical bar represents LSD at 5% level of significance

After 120 days of planting, the highest cutting survivability (50.14%) was found in shade condition and the lowest survivability of cutting (16.20%) was under open condition and plants survivability (26.08%) was found in bed condition (Fig. 3).

Effect of indole butyric acid (IBA) on stem cuttings of passion fruit

In case of 200 ppm IBA, it required longer time for shoot initiation (13.96 days) comparing with 100 ppm IBA, where shorter time (9.56 days) was needed (Fig. 4).

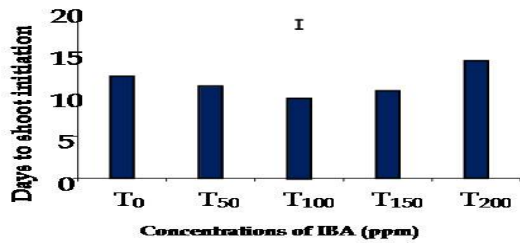


Fig. 4. Effect of different concentration of IBA on days to shoot initiation. Vertical bar represents LSD at 5% level of significance

The maximum number of shoots (1.54) was found in 100 ppm IBA and the minimum number of shoots (0.96) was found in 200 ppm IBA at 70 DAP (Fig. 5a). The highest length of shoots (12.17 cm) was measured in cuttings treated with 100 ppm at 70 DAP but the lowest length of shoots (7.39 cm) was measured in cuttings treated with 200 ppm IBA at 70 DAP (Fig. 5b). The maximum number of leaves per stem cutting (5.31) was recorded in 100 ppm IBA and the minimum number of leaves (2.43) was recorded in 200 ppm IBA at 70 DAP (Fig. 5c).

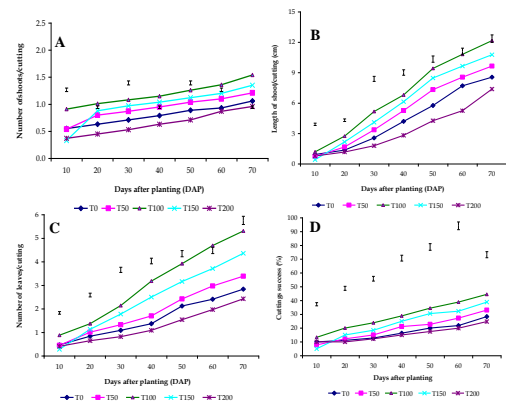


Fig. 5. Effect of different concentration of IBA on (A) no. of shoot, (B) length of shoot, (C) no. of leaves, (D) cutting success. Vertical bars represent LSDs at 5% level of significance

The maximum number of roots per cutting (15.29) with 100 ppm and the minimum number of roots (4.55) with 200 ppm IBA at 70 DAP. The longest length of root (10.58 cm) were measured in 100 ppm IBA and the shortest length of root (4.76 cm) were found in 200 ppm IBA at 70 DAP. The highest fresh weight of roots (0.45 g) was found in 100 ppm IBA treated cuttings and the lowest fresh weight of roots per stem cuttings (0.18 g) was found in 200 ppm IBA treated cuttings. The highest dry weight of roots per stem cutting (0.07 g) was measured in 100 ppm IBA and the lowest dry weight of roots (0.02 g) was measured in 200 ppm IBA (Table 2).

Table 2. Effect of different concentrations of IBA on different parameters of passion fruit

Concentrations of IBA	Number of roots/cutting	Length of roots/cutting (cm)	Fresh weight of roots/cutting (g)	Dry weight of roots/cutting (g)
T ₀	6.33	6.59	0.22	0.03
T ₅₀	6.82	8.37	0.29	0.04
T ₁₀₀	15.29	10.58	0.45	0.07
T ₁₅₀	8.89	9.56	0.35	0.05
T ₂₀₀	4.55	4.76	0.18	0.02
LSD _{0.05}	0.543	0.263	0.019	0.001
LSD _{0.01}	0.732	0.354	0.026	0.002
Level of significance	**	**	**	**

The highest percentage of cutting success (44.44%) was achieved at 100 ppm IBA treated cuttings and the lowest percentage of cutting success (24.78%) was achieved at 200 ppm IBA treated cuttings (Fig. 5d).

The highest percentage of cutting survivability (42.84%) was achieved at 100 ppm IBA and the lowest percentage of cutting survivability (20.43%) was recorded at 200 ppm IBA (Fig. 6).

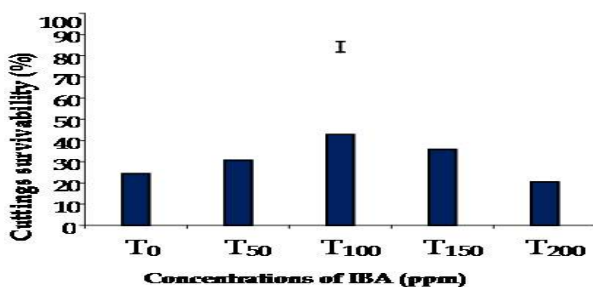


Fig. 6. Effect of different concentrations of IBA on percentage of cutting survivability. Vertical bar represents LSD at 5% level of significance

Combined effects of growing conditions (shade, bed and open) and different concentrations of indole butyric acid (IBA) on stem cuttings of passion fruit

The minimum time (8.33 days) was required under shade condition cuttings with 100 ppm IBA while the maximum time (15.33 days) was needed for shoot initiation under open condition cuttings with 200 ppm IBA (Fig. 7).

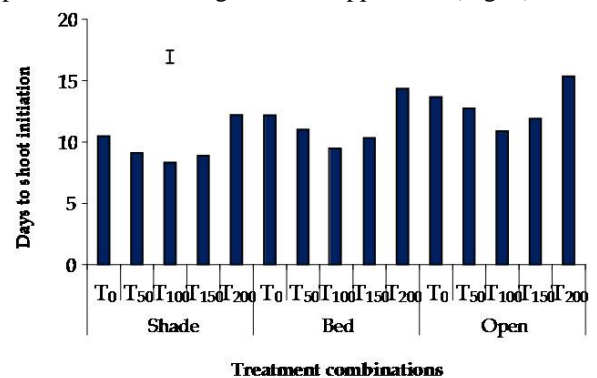


Fig. 7. Combined effects of growing conditions and different concentrations of IBA on days to shoot initiation. Vertical bar represents LSD at 5% level of significance

Bed condition with IBA treatments showed better performance than open field condition with IBA treatment. The highest success and survivability were found in the

treatment combination of shade condition with 100 ppm IBA treatment at 70 days after planting (Tables 3 and 4).

Table 3. Combined effects of growing conditions and different concentrations of IBA on different parameters of passion fruit

Treatment combinations		Number of roots/cutting	Length of roots/cutting (cm)	Fresh weight of roots/cutting (g)	Dry weight of roots/cutting (g)
Growing conditions	Concentrations of IBA				
Shade	T ₀	7.00	13.67	0.30	0.04
	T ₅₀	7.33	14.33	0.40	0.05
	T ₁₀₀	20.00	18.00	0.54	0.09
	T ₁₅₀	8.33	16.83	0.45	0.07
	T ₂₀₀	5.33	11.50	0.24	0.02
Bed	T ₀	6.67	3.83	0.22	0.03
	T ₅₀	7.00	8.00	0.27	0.04
	T ₁₀₀	13.00	9.73	0.47	0.06
	T ₁₅₀	9.33	9.00	0.35	0.05
	T ₂₀₀	4.33	1.60	0.20	0.02
Open	T ₀	5.33	2.27	0.15	0.02
	T ₅₀	6.13	2.77	0.19	0.03
	T ₁₀₀	12.87	4.00	0.33	0.05
	T ₁₅₀	9.00	2.83	0.25	0.03
	T ₂₀₀	4.00	1.17	0.10	0.01
LSD _{0.05}		0.940	0.455	0.033	0.003
LSD _{0.01}		1.268	0.614	0.045	0.004
Level of significance		**	**	**	**

Table 4. Combined effects of growing conditions and different concentrations of IBA on percentage of cutting success at different DAP

Treatment combinations		Cuttings success (%) at different DAP						
Growing conditions	Concentrations of IBA	10	20	30	40	50	60	70
Shade	T ₀	10.00	13.33	15.00	20.00	26.67	30.00	43.33
	T ₅₀	13.33	16.67	20.00	30.00	30.00	40.00	56.67
	T ₁₀₀	20.00	25.00	30.00	43.33	53.33	63.33	70.00
	T ₁₅₀	15.00	20.00	25.33	40.00	50.00	53.33	63.33
	T ₂₀₀	10.00	10.00	13.33	20.00	23.33	26.67	36.67
Bed	T ₀	10.00	10.00	13.33	16.67	20.00	20.67	25.00
	T ₅₀	10.00	10.00	15.00	20.00	23.33	25.00	25.00
	T ₁₀₀	10.00	20.00	25.00	26.67	30.00	33.33	40.00
	T ₁₅₀	0.00	15.00	20.00	20.00	25.00	26.67	33.33
	T ₂₀₀	10.00	10.00	13.33	13.33	16.67	20.00	23.33
Open	T ₀	10.00	10.00	10.00	12.33	13.33	15.00	16.67
	T ₅₀	0.00	10.00	10.00	13.33	15.00	16.67	17.67
	T ₁₀₀	10.00	15.00	16.67	16.67	20.00	20.00	23.33
	T ₁₅₀	0.00	10.00	10.00	15.00	16.67	16.67	20.00
	T ₂₀₀	10.00	10.00	10.00	11.67	12.67	13.00	14.33
LSD _{0.05}		0.679	0.888	0.669	1.288	1.088	1.713	1.331
LSD _{0.01}		0.916	1.198	0.902	1.737	1.467	2.312	1.796
Level of significance		**	**	**	**	**	**	**

The highest percentage of cutting survivability (67.67%) was recorded in shade condition with 100 ppm IBA and the lowest percentage of cutting survivability (10.00%) was found under open condition cuttings with 200 ppm IBA at 120 DAP (Fig. 8).

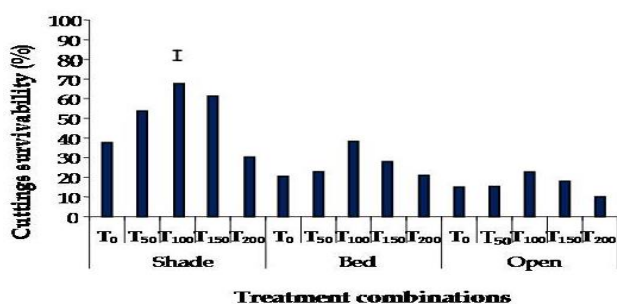


Fig. 8. Combined effects of growing conditions and different concentrations of IBA on percentage of cutting survivability. Vertical bar represents LSD at 5% level of significance

In this experiment, the success and survivability rates of stem cuttings of passion fruit were greatly influenced by both growing condition and by hormone like IBA. From the findings of this study it may be concluded that among all the factors, shade condition showed the highest success on root formation of passion fruit. Also it was observed that the root number, root length, fresh and dry weight of root, was found the highest when it was grown under shade condition. On the other hand, treatment with IBA at 100 ppm from different concentrations significantly

influenced all the parameters studied. The highest success and survivability of cutting were found in the treatment combinations of shade condition with 100 ppm IBA and the lowest success and survivability of cutting were found in the treatment combination of open condition with 200 ppm IBA.

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