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EFFECTS OF AUXINS ON THE STEM CUTTINGS OF *JUSTICIA ADHATODA* L.

MOHAMMED SALA UDDIN* AND MOHAMMAD HARUN-UR-RASHID

Department of Botany, University of Chittagong, Chattogram-4331, Bangladesh

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Abstract

Justicia adhatoda L. (Bashak) is an evergreen, medicinal shrub belongs to the family Acanthaceae. The seeds germination quality of the species is very poor. The effects of auxins *viz.* IAA, IBA and NAA on the stem cuttings of the plant were assessed. A total of 13 treatments were applied on the stem cuttings and planted in sandy bed following completely randomized design. Results revealed that the maximum number of roots (28.67), length of roots (14.10 cm) and biomass (12.78g) were obtained at 90 days after planting in the cuttings treated with IBA 1000 ppm solution. Whereas, number of roots (21.67 and 22.67), length of roots (11.30 and 15.17 cm), biomass (8.56 and 12.17g) were obtained at 90 days after planting in the cuttings treated with IAA and NAA 1000 ppm solution respectively. IBA 1000 ppm solution would be considered as the most suitable for producing maximum number of roots and biomass, as well as NAA 1000 ppm solution for length of roots in Bashak at 90 DAP.

Introduction

Justicia adhatoda L. is an evergreen, perennial, woody medicinal dense shrub belongs to the family Acanthaceae popularly known as Bashak in Bengali (Hossain and Hoq 2016). It is distributed all over the tropical regions of Southeast Asia especially in Bangladesh, India, Sri Lanka, Myanmar and Malaysia (Singh *et al*. 2017). The plant grows in upland habitat, opposite to ascending branches, about 2-3m height, with leathery, opposite, entire, lanceolate, short petiolate leaves, 10-15 X 4-6cm. In winter, it produces flowers and fruits, but production of seed is very low (Hossain and Hoq 2016), and rate of seed germination is poor (Chinapolaiah *et al*. 2019) therefore, vegetative propagation through stem cutting is the most common method for the reproduction of this plant.

There has been no specific research on the effect of auxin on the stem cuttings of Bashak in Bangladesh. Therefore, the present study was undertaken to evaluate the effect of three different auxins *viz.* IAA (Indole-3-acetic acid), IBA (Indole-3-butyric acid) and NAA (α-Naphthalene acetic acid) on the vegetative propagation by stem cuttings of *Justicia adhatoda* L.

Materials and Methods

The experiment was done at the Botanical Garden of University of Chittagong. Cuttings of Bashak were taken 13-15 cm in length having 2-3 nodes. The lower portion cuts of the stems were made slanting below the nodes and the upper cuts were horizontal above the nodes. All the leaves were cut off. IAA/IBA/NAA solution was made by suspending 0.1g analytical auxin hormone into 20 ml alcohol. Subsequently, a stock solution of 1000 ppm IAA/IBA/NAA was prepared by including 80 ml purified water to the solution. At last, 250 ppm, 500 ppm, 750 ppm and 1000 ppm IAA/ IBA /NAA were prepared by including 75 ml, 50 ml, 25 ml and 0 ml, water to the 25 ml,

*Author for correspondence: <salauddin_bot@cu.ac.bd>.

50 ml, 75 ml and 100 ml of stock solution respectively. The experiment consisted of 13 treatments *viz.* T_1=250 ppm IAA, $T_{2=}$ 500 ppm IAA, T_3= 750 ppm IAA, T_4= 1000 ppm IAA, T_5= 250 ppm IBA, T_6= 500 ppm IBA, T_7=750 ppm IBA, T_8= 1000 ppm IBA, T_9= 250 ppm NAA, T_{10}= 500 ppm NAA, T_{11}= 750 ppm NAA, T_{12}= 1000 ppm NAA and T_{13}= control or 0 ppm. Cuttings were treated following the quick dip method (Bhagya and Sreeramu 2013). Basal ends of the cuttings were dipped in treatment solution for ten seconds and then air-dried and finally treated cuttings were planted in sandy bed on the 1st week of June 2019 in rainy season (June-August) which is the proper time of vegetative propagation for maximum plants (Waman *et al*. 2019). Watering and mulching were done as when required. Data for number of roots, length of roots and biomass per cutting were collected at 30, 60 and 90 DAP (Days after planting). The whole experiment was done following complete randomized design. Three replications were used for each treatment**.** Statistical analyses were done using MS Excel 2013 and DMRT was done by XLSTAT.

Results and Discussion

The results revealed that the number of roots at 30, 60 and 90 DAP are varied with the change of different treatments (Table 1, Fig. 6). The value of the number of roots of the treatments *viz*. T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11}, T_{12}, and T_{13} at 90 DAP were found to be 9.33, 16.33, 19.67, 21.67, 11.33, 21.67, 24.33, 28.67, 11.33, 18.67, 21.33, 22.67 and 6.33 respectively following sequence as $T_8 > T_7 > T_{12} > T_6 \geq T_4 > T_{11} > T_3 > T_{10} > T_2 > T_5 \geq T_9 > T_1 > T_{13}$. Maximum number of roots at 30, 60 and 90 DAP were observed in T_8 (IBA- 1000 ppm) and minimum in T_{13} (control). ANOVA of number of roots at 30, 60 and 90 DAP indicated significant value ($P < 0.01$) with treatments (Table 2). Auxin is used to generate root initiation for the stem cuttings (Uddin and Rashid 2021). It was also enumerated that increased number of roots in Guggul (*Commiphora wightii* (Arn.) Bhan.), cuttings treated with IBA (Sure *et al.* 2018). These reports are analogous to the findings of the present experiment.

Table 1. Effects of auxins on the number of roots in the stem cuttings of *Justicia adhatoda*.

Treatments	30 DAP	60 DAP	90 DAP
T_1 (IAA- 250 ppm)	$7.67^{g} \pm 0.58$	$8.67^{f} \pm 1.53$	$9.33^{f} \pm 1.53$
T_2 (IAA- 500 ppm)	$11.67^{f} \pm 0.58$	$14.33^{e} \pm 1.15$	$16.33^{e} \pm 1.53$
T_3 (IAA- 750 ppm)	$12.67^{ef} \pm 1.53$	$16.67^{de} \pm 2.08$	$19.67^{cd} \pm 2.08$
T_4 (IAA- 1000 ppm)	$17.33^{c} \pm 1.15$	$18.67^{cd} \pm 1.53$	$21.67^{bcd} \pm 2.08$
T_5 (IBA- 250 ppm)	$9.33^{g} \pm 1.53$	$10.67^{f} \pm 1.15$	$11.33^{f} \pm 1.53$
T_6 (IBA- 500 ppm)	$18.00^{c} \pm 2.00$	$19.33^{cd} \pm 1.53$	$21.67^{bcd} \pm 2.08$
T_7 (IBA- 750 ppm)	$21.33^{b} \pm 2.08$	$22.33^{b} \pm 2.31$	$24.33^{b} \pm 1.53$
T_8 (IBA- 1000 ppm)	$24.33^{a} \pm 1.15$	$26.67^{a} \pm 1.15$	$28.67^{a} \pm 1.53$
T_9 (NAA- 250 ppm)	$8.33^{g} \pm 0.58$	$10.33^{f} \pm 1.53$	$11.33^{f} \pm 1.53$
T_{10} (NAA- 500 ppm)	$13.00^{ef} \pm 1.73$	$16.33^{de} \pm 1.53$	$18.67^{de} \pm 2.08$
T_{11} (NAA- 750 ppm)	$14.33^{de} \pm 1.53$	$18.67^{cd} \pm 2.08$	$21.33^{bcd} \pm 1.53$
T_{12} (NAA- 1000 ppm)	$16.00^{cd} \pm 1.00$	$20.33^{bc} \pm 2.31$	$22.67^{bc} \pm 2.08$
T_{13} (Control- 0 ppm)	$4.00^{h} \pm 1.00$	$5.67^{g} \pm 1.53$	$6.33^{g} \pm 1.15$

In each rows values with same superscript are non-significant and with different superscript are significant by DMRT (Duncan Multiple Range Test).

Results of length of roots at 30, 60 and 90 DAP are presented in Figs 2 and 6. Length of roots due to different treatments at 90 DAP were 7.63, 9.23, 9.67, 11.30, 6.53, 11.47, 12.27, 14.10, 6.63, 8.73, 11.80, 15.17 and 4.37cm respectively and presented the following magnitude as $T_{12} > T_8 > T_7 > T_{11} > T_6 > T_4 > T_3 > T_2 > T_{10} > T_1 > T_9 > T_5 > T_{13}$. The highest length of roots at 30, 60 and 90 DAP were measured T_{12} (NAA- 1000 ppm) and lowest in T_{13} (control). ANOVA of length of roots at 30, 60 and 90 DAP showed significant value ($P < 0.01$) with treatments (Table 2).

Table 2. Analyses of variance of number of roots, length of roots and biomass on the effect of different concentration of auxins the stem cutting of *Justicia adhatoda.*

SF	DF	F-values								
		Number of roots			Length of roots			Biomass		
T	12	30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP
		53*	36*	42*	15*	50*	71*	27*	67*	186*

SF=Source of variance, T = Treatments, DF = Degree of freedom, DAP = Day after planting. *denotes significant at 1% level.

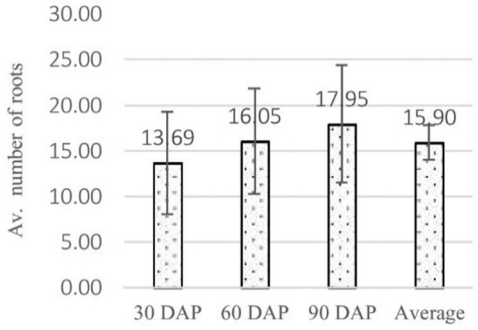

Fig. 1. Change of the average number of roots in the stem cuttings of *Justicia adhatoda* on the effect of auxins.

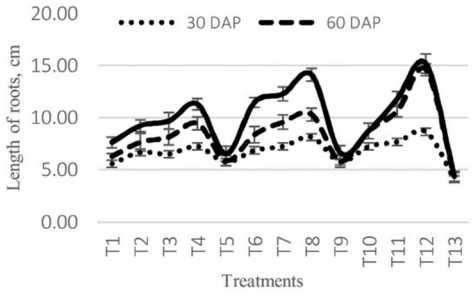

Fig. 2. Change of the length of roots in the stem cuttings of *Justicia adhatoda* at different treatments (T_1 - T_{13}).

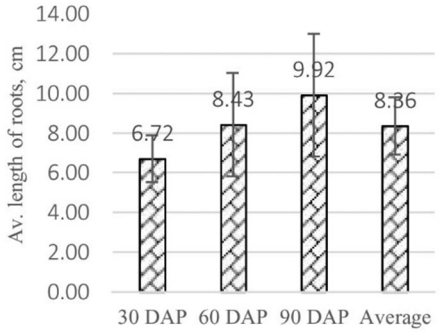

Fig. 3. Change of the average length of roots in the stem cuttings of *Justicia adhatoda* on the effect of auxins.

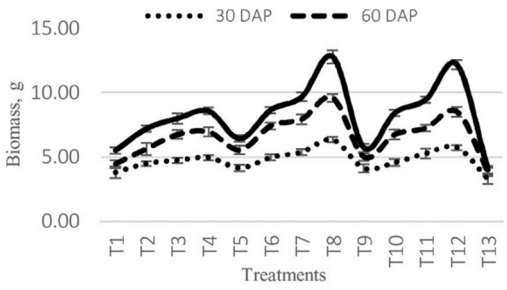

Fig. 4. Change of the total biomass in the stem cuttings of *Justicia adhatoda* at different treatments (T_1 - T_{13}).

Maximum length of rooting and shooting performance by NAA were observed in the stem cutting of *Aloe vera* (L.) Burm. f., *Saracas asoca* (Roxb.) De Wilde. and *Morus alba* L. (Singh *et al*. 2014, Rout *et al*. 2018, Uddin and Rashid 2021). It was also reported that the highest length of rooting and shooting tendency was observed in the stem cutting of *Rauvolfia sepentina* (L.) Benth. ex Kurz. and *Gymnema sylvestre* L. (Kumari and Kumar 2019). These observations are compatible with the present findings.

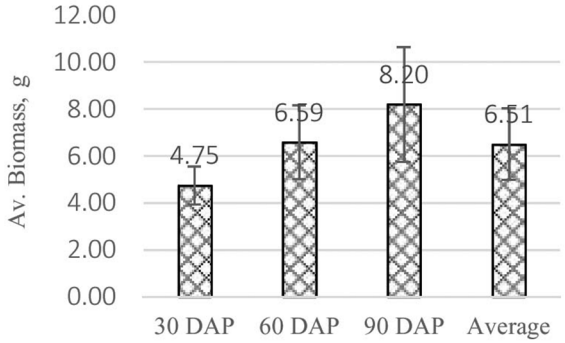

Fig. 5. Change of the average production of total biomass in the stem cuttings of *Justicia adhatoda* on the effect of auxins.

Fig. 6. Change of the rooting and shooting behavior of *Justicia adhatoda* (Photographs) on the effect of auxins (T_1 - T_{13}) at 90 DAP.

The values of the total biomass of all the treatments at 90 DAP were found to be 5.51, 7.20, 7.99, 8.56, 6.43, 8.65, 9.66, 12.78, 5.72, 8.43, 9.46, 12.17 and 4.02g, respectively and maintained the following sequence as $T_8 > T_{12} > T_7 > T_{11} > T_6 > T_4 > T_{10} > T_3 > T_2 > T_5 > T_9 > T_1 > T_{13}$ (Figs 4 and 6). Maximum production of total biomass at 30, 60 and 90 DAP were determined in T_8 (IBA-1000 ppm) and minimum in T_{13} (control). ANOVA of total biomass at 30, 60 and 90 DAP exhibited significant value ($P < 0.01$) with treatments (Table 2).

Considering all the treatments the average number of roots, average length of roots and average biomass at 30, 60 and 90 DAP are presented in Figs 1, 3 and 5, respectively. Highest average number of roots, length of roots and biomass were detected at 90 DAP whereas the lowest at 30 DAP. It is reported that cuttings fresh weight or biomass have been increased in higher concentration of IBA level (Bojja *et al.* 2018, Chinapolaiah *et al.* 2019,). These observations are consistent with the present study.

It may be concluded that IBA 1000 ppm solution is suitable for the maximum number of roots formation and production of biomass in the stem cutting of Bashak (*Justicia adhatoda* L.) and NAA 1000 ppm solution is favourable for maximum length of roots formation. Considering all studied elements IBA 1000 ppm solution is the best concentration for the stem cutting of Bashak.

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