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Short communication

Efficacy of IAA concentration and cutting length on rooting of stem cuttings in *Spondias pinnata* Linn.

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ABSTRACT

An experiment was laid out in factorial randomized block design with 12 treatments and 3 replications which included three levels (10, 15 and 20 cm) of cutting length and four levels of IAA treatment (0 control, 500, 1000 and 1500 ppm). Each cutting was treated with different concentrations of IAA for 15 sec. Investigation revealed that 15 cm length of cuttings treated with 1500 ppm IAA gave the best results in terms of earliest bud (13.27 DAP) and leaf (16.32 DAP) initiation, highest success (66.67%), shoot length (34.89 cm), root length (13.49 cm), collar diameter (20.50 mm), root number (9.53), root diameter (6.91 mm), fresh shoot weight (45.47g), fresh leaf weight (14.07 g), dry shoot weight (21.15 g), dry root weight (2.67 g) and total biomass (29.80 g/plant).

Key words: Cutting length, IAA, *Spondias pinnata* Linn., stem cuttings, mist chamber.

Indian hog plum (*Spondias pinnata* Linn.), *Amra*, is a minor fruit in West Bengal. It has a high medicinal value. Two novel bioactive compounds (spondiol and glycospondin) in the fruit showed high anti-oxidant activity and inhibited platelet aggregation. Natural regeneration of hog plum is very poor due to hard seed coat dormancy. Vegetative propagation, therefore, is and important method to reproduce this plant species. This plant species are propagated true to type through layering, grafting, budding, cutting *etc*. Among these, the use of stem cuttings is the easiest and common method for growing plants. The use of plant growth regulators play a pivotal role in rooting of cuttings and root growth. Auxins are very effective for root initiation in many plant species and among the auxins, IAA is typically the principal auxin used for rooting of cuttings. As very little works has been done pertaining to rooting in *Spondias* sp. cuttings, this experiment was carried out with the objective to standardize IAA treatment along with standard cutting length for better rooting.

Healthy and uniform stem cuttings were obtained from one-year-old branches of two-year-old plants, planted in Instructional Field of Uttar Banga Krishi Viswavidyalaya, during 2014 monsoon. Stem cuttings were dipped in fungicide solution for 2-3 min. and subsequently washed by distilled water before giving hormonal treatment. After treatment, they were planted in polythene bag filled with substrate (sand: soil: FYM; 1:2:1). Each treatment was replicated thrice and each replication consisted of ten cuttings. The polybags were then kept in the mist chamber with a temperature ~27.5°C and 93% relative humidity.

In this experiment, the effect of two factors was examined along with their combined effects. The two factors were three levels of cutting length, *viz*., 10 (C_1), 15 (C_2) and 20 (C_3) cm and four levels of IAA treatment 500 ppm (I_1), 1000 ppm (I_2), 1500 ppm (I_3) IAA and and no treatment (I_4) (Control) for 15 sec.

The per cent cutting success was calculated. Days taken for first bud and leaf initiation were observed by counting days after planting of cuttings. Number of buds was counted daily up to 45 days after planting. After 45 days of planting of cutting, three random rooted cuttings from each replication were selected and root, shoot length, collar diameter and root diameter were measured with the help of digital Vernier calipers. Collar diameter was measured at the base 2 cm above the stem of the cutting in two directions. The number of roots was counted manually. Fresh and dry root, shoot and leaf weight were measured separately with the help of electronic digital balance (Mettler Toledo PB 153-L). Total biomass was also calculated.

The experiment was laid out in factorial randomized block design with 15 treatments and 3 replications. Analysis of variance for each parameter was performed using ProcGlm of Statistical Analysis System (SAS) software (version 9.3). Mean separation for different treatment under different parameters were performed using Least Significant Different (LSD) test ($p \leq 0.05$). Normality of residuals under the assumption of ANOVA was tested using Kolmogrov-Smirnov,

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Shapiro-Wilk, Cramer-Von Mises and Anderson Darling procedure using Proc-Univariate procedure of SAS (version 9.3). Data transformation was done following the method of Gomez and Gomez (3).

Results (Table 1a & b) represent that success percentage of cutting of *Spondias pinnata* ranged from 15 to 66.67%. Maximum cutting success (66.67%) was obtained in T_8 followed by T_9 (63.33%) and minimum success (15%) was obtained in T_{10} treatment combinations. The data on cutting success percentage was statistically significant under all the treatments. Reduction in cutting success was observed in shorter and longer sized cuttings and highest in medium sized cuttings. Pinto *et al.* (8) reported that for *Spondias cytherea,* cuttings of 15 cm was sufficient for good rooting and emergence of new shoots. According to Reinhard (9), the behaviour of stem cuttings varied with age, genotype and physiological status of mother plant, which was one of the reasons for good performance of the medium sized stem cuttings. Auxin IAA has a great effect on cutting success. Better formation of roots in auxin treated cuttings might be due to accumulation of metabolites at the site of application, synthesis of

Table 1a. Effect of length of cutting and IAA concentration on rooting of *Spondias* cuttings.

Treatment	Cutting success (%)	Days taken for first bud initiation (DAP)	No. of buds	Days taken for first leaf initiation (DAP)	Shoot length (cm)	Collar dia. (mm)	Root length (cm)	No. of roots	Root dia. (mm)
C_1	46.67(43.11)b	16.89a	2.43c	21.53a	22.19b	15.97a	9.19a	10.80b	1.71b
C_2	50.00(45.00)a	16.53a	4.00a	19.98a	23.70a	16.36a	9.38a	14.27a	2.02a
C_3	50.00(45.00)a	16.70a	3.80b	20.89a	22.83b	16.16a	9.31a	11.20ab	1.76b
LSD (p≤0.05)	1.86	NS	0.46	NS	2.45	NS	NS	1.88	0.57
I_1	46.67(43.11)c	16.89ab	2.43c	21.53a	22.19b	15.97bc	9.19b	10.80c	1.71bc
I_2	50.00(45.00)b	16.14b	4.20b	18.22b	24.16b	16.68ab	9.46b	14.33b	2.22b
I_3	63.33(52.71)a	13.34c	5.90a	16.40b	24.77a	18.44a	11.31a	16.87a	4.11a
I_4	15.00(22.79)d	17.69a	2.30d	22.20a	14.09c	12.72c	8.32b	4.27d	1.52c
LSD(p≤0.05)	2.15	1.40	0.53	2.40	2.82	3.33	1.93	2.18	0.66

**Means with the same letter are not significantly different. Values in parenthesis are angular transformed value.

Table 1b. Effect of length of cutting and IAA concentration on rooting of *Spondias* cuttings.

Treatment	Cutting success (%)	Days taken for first bud initiation (DAP)	No. of buds	Days taken for first leaf initiation (DAP)	Shoot length (cm)	Collar dia. (mm)	Root length (cm)	No. of roots	Root dia. (mm)
T_1 (C_1I_1)	46.67 (43.11)	16.89	2.43	21.53	22.19	15.97	9.19	10.80	1.71
T_2 (C_2I_1)	50.00 (45.00)	16.53	4.00	19.98	23.70	16.36	9.38	14.27	2.02
T_3 (C_3I_1)	50.00 (45.00)	16.70	3.80	20.89	22.83	16.16	9.31	11.20	1.76
T_4 (C_1I_2)	50.00 (45.00)	16.14	4.20	18.22	24.16	16.68	9.46	14.33	2.22
T_5 (C_2I_2)	56.67 (48.85)	14.81	5.63	16.70	24.59	18.26	9.81	16.20	2.64
T_6 (C_3I_2)	56.67 (48.85)	14.87	4.40	17.39	24.28	17.36	9.80	16.07	2.50
T_7 (C_1I_3)	63.33 (52.71)	13.34	5.90	16.40	24.77	18.44	11.31	16.87	4.11
T_8 (C_2I_3)	66.67 (54.76)	13.27	7.33	16.32	34.89	20.50	13.49	19.53	6.91
T_9 (C_3I_3)	63.33 (52.71)	13.33	6.27	16.37	27.05	20.16	11.67	19.53	4.65
T_{10} (C_1I_4)	15.00 (22.79)	17.69	2.30	22.20	14.09	12.72	8.32	4.27	1.52
T_{11} (C_2I_4)	45.00 (42.13)	16.99	2.40	21.72	17.47	14.16	8.92	9.73	1.56
T_{12} (C_3I_4)	28.00 (31.95)	17.29	2.30	22.05	14.42	12.92	8.73	5.53	1.56
LSD (p≤0.05)	3.73	2.41	0.91	NS	4.89	NS	NS	3.77	1.14

**Values in parenthesis are angular transformed value.

new protein, callus formation, cell division and cell enlargement. The results are in line with the findings reported by Murthy *et al.* (6).

Day taken for first bud initiation of cutting ranged from 13.27 to 17.69 DAP. Earliest first bud initiation (13.27 DAP) was obtained in T_8 followed by T_9 (13.33 DAP). Most delayed bud initiation (17.69 DAP) was obtained in T_{10}. The data were statistically significant under all the treatments. Earliest bud initiation might be that application of IAA stimulated the accumulation of dry mass in shoot bud differentiation, which was probably the result of an increase in the metabolic activity in stem cuttings and greater metabolite flow to the growing shoot bud differentiation. Number of buds was ranged from 2.3 to 7.33. Highest number of buds (7.33) was obtained in T_8 and minimum number of buds (2.3) was obtained in T_{10}. The data were statistically significant under all the treatments. The reason might be that IAA treatment increased the accumulation of food reserve, resulting in higher bud formation. It is evident from the Table 1b that days taken for first leaf initiation of cutting of *Spondias pinnata* was ranged from 16.32 to 22.20 DAP. Earliest leaf initiation (16.32 DAP) was obtained in T_8 followed by T_9 (16.37 DAP). Most delayed first bud initiation (22.20 DAP) was recorded in T_{10}. The data pertaining on days taken for first leaf initiation were statistically significant under all the treatments. Earliest leaf initiation might be that application of IAA stimulated the accumulation of dry mass in shoot bud differentiation, which was probably the result of an increase in the metabolic activity in stem cuttings and greater metabolite flow to the growing shoot bud differentiation, resulted earlier leaf initiation.

Shoot length of cutting was ranged from 14.09 cm to 34.89 cm. Highest shoot length (34.89 cm) was obtained in T_8 and lowest shoot length (14.09 cm) was recorded in T_{10}. The data were statistically significant under all the treatments. Highest shoot length was recorded due to increase in linear growth of stem by way of cell elongation. The results are in line with the findings of Alagesaboopathi (1). Collar diameter of cutting was ranged from 12.72 to 20.50 mm. Highest collar diameter (20.50 mm) was obtained in T_8 followed by T_9 (20.16 mm). Least diameter (12.72 mm) was obtained in T_{10}. The data were statistically significant under all the treatments. The reason might be that IAA treatment increased the food reserve and dry mass required for cell elongation, resulted higher collar diameter. Root length was ranged from 8.32 cm to 13.49 cm. Highest root length (13.49 cm) was obtained in T_8 and lowest length (8.32 cm) was obtained in T_{10}. It was statistically significant under all the treatments. The results are in line of the findings reported by Murthy *et al.* (6). Number of roots of cutting of *Spondias pinnata* was ranged from 4.27to 19.53. Highest number of roots (19.53) was in T_8 followed by T_9 (19.53). Lowest number of roots (4.27) was obtained in T_{10}. Reduction in number of root was observed in shorter and longer size of cuttings and highest in medium sized cutting. According to Good and Tukey (4), poor performance of shorter stem cuttings was due to inadequate supply of nutrients and leaching of nutrients in shorter cuttings. Whereas, the under-performance of large sized cuttings might be attributed to reason that these cuttings were more woody and might had converted most of food material for lignification, which resulted in over lignified stem caused lower rooting and shooting percentage. Janick (5) reported that an important component of the capacity for a stem to root was the nutritional status of the plant. The vigorous rooting enabled the cuttings to absorb more nutrients and produce more leaves. Similar result was reported by Okunlola (7). Increased number of roots in cuttings treated with auxin had been considered due to enhanced hydrolysis of nutritional reserves under the influence of auxin. The results are in line with the findings reported by Basak *et al.* (7) and Murthy *et al.* (6). Root diameter of cutting was ranged from 1.52 to 6.91 mm. Highest root diameter (6.91 mm) was obtained in T_8 followed by T_9 (4.65 mm) and minimum diameter (1.52 mm) was obtained in T_{10}. The data were statistically significant under all the treatments. The reason might be that IAA treatment increased the food reserve and dry mass required for cell elongation, resulted higher root diameter.

Results (Table 2a & b) indicated that fresh shoot weight of cutting was ranged from 22.48 g to 45.47 g. Highest fresh shoot weight (45.47 g) was obtained in T_8 followed by T_9 (41.22 g) and minimum fresh shoot weight (22.48 g) was obtained in T_{10}. The data on fresh shoot weight were statistically significant under all the treatments. IAA increased the fresh weight of the plant by virtue of production of more number and lengthy roots. As the roots grew, these absorbed water and nutrients from soil lead to more growth adding to increased weights of shoot. The results are in line with the findings reported by Seran and Umadevi (10). Fresh leaf weight of cutting of *Spondias pinnata* ranged from 7.21 to 14.07 g. Highest fresh leaf weight (14.07 g) was obtained in T_8 and least fresh leaf weight (7.21 g) was obtained in T_1. The data were statistically significant under all the treatments. IAA increased the fresh weight of the plant by virtue of production of more number and lengthy roots. As the roots grew, these absorbed water and nutrients from soil leading to more growth adding to increased

Table 2a. Effect of different of cutting and IAA concentration on biomass content of *Spondias* cuttings.

Treatment	Fresh shoot wt. (g)	Fresh leaf wt. (g)	Fresh root wt. (g)	Dry shoot wt. (g)	Dry leaf wt. (g)	Dry root wt. (g)	Total biomass (g/plant)
C_1	25.30b	8.74a	1.96b	10.59a	2.70a	0.61a	13.90b
C_2	29.28a	9.40a	2.73a	12.14a	3.05a	0.82a	16.01a
C_3	27.73ab	9.06a	2.08ab	11.25a	2.84a	0.63a	14.72ab
LSD (p≤0.05)	2.87	NS	0.97	NS	NS	NS	2.12
I_1	25.30c	8.74bc	1.96c	10.59c	2.70c	0.61c	13.90c
I_2	32.88b	10.04b	3.06b	13.82b	3.80b	1.11b	18.73b
I_3	38.23a	12.14a	4.54a	17.15a	4.51a	2.36a	24.02a
I_4	22.48d	7.21c	0.99c	9.98c	1.97c	0.27c	12.22d
LSD (p≤0.05)	3.13	1.90	1.22	2.62	0.83	0.53	2.45

**Means with the same letter are not significantly different.

Table 2b. Effect of length of cutting and IAA concentration on biomass content of *Spondias* cuttings.

Treatment	Fresh shoot wt. (g)	Fresh leaf wt. (g)	Fresh root wt. (g)	Dry shoot wt. (g)	Dry leaf wt. (g)	Dry root wt. (g)	Total biomass (g/plant)
T_1 (C_1I_1)	25.3	8.74	1.96	10.59	2.7	0.61	13.90
T_2 (C_2I_1)	29.28	9.4	2.73	12.14	3.05	0.82	16.01
T_3 (C_3I_1)	27.73	9.06	2.08	11.25	2.84	0.63	14.72
T_4 (C_1I_2)	32.88	10.04	3.06	13.82	3.8	1.11	18.73
T_5 (C_2I_2)	34.41	11.68	4.16	15.28	4.16	1.89	21.33
T_6 (C_3I_2)	33.35	10.72	3.52	14.73	3.95	1.66	20.34
T_7 (C_1I_3)	38.23	12.14	4.54	17.15	4.51	2.36	24.02
T_8 (C_2I_3)	45.47	14.07	8.26	21.15	5.98	2.67	29.80
T_9 (C_3I_3)	41.22	13.88	7.41	19.39	5.69	2.43	27.75
T_{10} (C_1I_4)	22.48	7.21	0.99	9.98	1.97	0.27	12.22
T_{11} (C_2I_4)	22.75	7.67	1.94	10.36	2.45	0.4	13.21
T_{12} (C_3I_4)	22.61	7.63	1.07	10.04	2.13	0.37	12.54
LSD (p≤0.05)	5.74	1.59	1.94	4.54	1.44	0.91	4.25

weights of shoot. Fresh root weight was ranged from 0.99 to 8.26 g. Maximum fresh root weight (8.26 g) was obtained in T_8 followed by T_9 (7.41 g). Minimum fresh root weight (0.99 g) was obtained in T_{10}. The data on fresh root weight were statistically significant under all the treatments. IAA increased the fresh weight of the plant by virtue of production of more number and lengthy roots. As the roots grew, these absorbed water and nutrients from soil leading to more growth adding to increased weights shoot (Seran and Umadevi, 10). Dry shoot weight of cutting was ranged from 9.98 g to 21.15 g. Highest dry shoot weight (21.15 g) was obtained in T_8 followed by T_9 (19.39 g). Minimum dry shoot weight (9.98 g) was obtained in T_{10}. The data were statistically significant under all the treatments. Similar result was reported by Pinto *et al.* (8) for *Spondias cythera* and *S. purpurea* cuttings of 15 and 20 cm length. Dry leaf weight was ranged from 1.97 to 5.98 g. Highest dry leaf weight (5.98 g) was obtained in T_8 followed by T_9 (5.69g). Lowest dry leaf weight (1.97 g) was obtained in T_{10}. The data were statistically significant under all the treatments. Similar result was reported by Pinto *et al.* (8). Dry root weight of cutting of *Spondias pinnata* was ranged from 0.27 to 2.67 g. Maximum weight (2.67 g) was obtained in T_8 and least dry root weight (0.27 g) in T_{10}. The data were statistically significant under all the treatments. Similar result was reported by Pinto *et al.* (8). Total biomass ranged from 12.22 to 29.80 g/plant. Highest total biomass (29.80 g/plant) was obtained in T_8 followed by T_9 (27.75 g/plant). Lowest total biomass (12.22 g/plant) was obtained

in T_{10}. The data on total biomass were statistically significant under all the treatments. Similar results were also reported by Seran and Umadevi (10).

Based on these results, it is concluded that, dipping in auxin solutions can stimulate root production by amra cuttings and among the different treatments, dipping the 15 cm length of cutting in a solution of 1500 ppm IAA appears adequate to obtain satisfactory root development of cuttings. Application of this technology would allow rapid multiplication of material in Indian hog-plum breeding programmes without risk of change of genetic makeup of plants produced through cross-pollination and preservation of horticultural valuable characteristics of selected materials.

REFERENCES

1. Alagesaboopathi, C. 2012. Effect of IAA and IBA on the rooting of *Andrographis macrobotrys* Nees stem cuttings- an endangered medicinal plant of India. *Int. J. Rec. Scientific Res*. **3**: 68-70.

2. Basak, U.C., Das, A.B. and Das, P. 1995. Metabolic changes during rooting in stem cuttings of five mangrove species. *Plant Growth Reg*. **17**: 141-46.

3. Gomez, K.A. and Gomez, A.A. 1983. *Statistical Procedures for Agricultural Research*, Wiley-Inter science Publication (John Wiley and Sons), New York, USA, pp. 275-315.

4. Good, G.I. and Tukey, H.B. 1956. Leaching of metabolites from cuttings propagated under intermitten tmist. *Proc. American Soc. Hort. Sci*. **89**: 725-33.

5. Janick, J. 1986. *Horticultural Science*, (4th Edn.), W.H. Freeman and Company, 337 p.

6. Murthy, K.S.R., Reddy, M.C., Kondamudi, R. and Pullaiah, T. 2013. Micropropagation of *Stemona tuberosa* Lour. - An endangered and rare medicinal plant in Eastern Ghats of India. *Indian J. Biotech.* **12**: 420-24.

7. Okunlola, A.I. 2013. The effects of cutting types and length on rooting of *Duranta repens* in the nursery. *Global J. Human Soc. Sci., Geo., Geo-Sci., Env. Disaster Manag*. **13**: 1-4.

8. Pinto, J.R.D.S., Freitas, R.M.O.D., Araujo, P.C. and Praxedes, S.C. 2011. Propagation of *Spondias* species by cuttings of different lengths treated with sugars. *Res. J. Agron*. **5**: 28-31.

9. Reinhard, H. 2003. *The Jatropha Booklet* : *A Guide to the Jatropha System and its Dissemination in Zambia*, *GTZ-ASSP-Project Zambia*, Mazabuka, p. 13.

10. Seran, T.H. and Umadevi, T. 2011. Influence of indole acetic acid (IAA) on the establishment of stem cuttings of lemon (*Citrus limon* L.). *J. Agril. Res*. **49**: 517-24.

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