

Effect of Time and IBA Concentration on the Performance of Cinnamon Cutting and Layering

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Abstract – An experiment was conducted at the Regional Spices Research Center, Bangladesh Agricultural Research Institute, Gazipur during April, 2017 to September, 2018 to find out the effect of IBA concentration and time of air layering and cutting in Cinnamon. Air layering and cutting was done in five times (Mid-April, Mid-May, Mid-June, Mid-July and Mid-August) with six levels of IBA concentration viz. 1000, 2000, 3000, 4000, 5000 ppm and control (no IBA). Success of cutting was not satisfactory with or without IBA treatment. Layering time and IBA concentration significantly influence on the success and rooting of layers under Bangladesh condition. May to July layering using 4000ppm IBA treatment found better on successful air layering for vegetative propagation of Cinnamon in Bangladesh.

Keywords – Cinnamon, IBA Concentration, Layering, Success, Time.

I. INTRODUCTION

The aroma and flavour of cinnamon derive from its essential oil and principal component, cinnamaldehyde, as well as numerous other constituents including eugenol.

Cinnamon is a high valued spice obtained from the inner bark of tree species from the genus *Cinnamomum*. It is used as an aromatic condiment having valuable aroma, higher nutritive and medicinal value widely used in Bangladesh for preparation of a versatile kinds of foods, sweet and savoury dishes, snacks, beverage, cosmetics and medicines. Moreover, cinnamon has many medicinal benefits and act as antioxidant, anti-inflammatory, anti-diabetic, antimicrobial, reduce cardiovascular diseases having cholesterol and lipid-lowering effects (Rao and Gan. 2014). The demands of cinnamon in Bangladesh are usually meet up by importing from other countries which required a huge expenditure. The quality of imported cinnamon is poor due to admixture of other *Cassia* species, longer transport and storage duration. Spices Research Center of Bangladesh Agricultural research institute (BARI) has been released a variety (BARI Cinnamon-1) in 2014. Production of cinnamon can be increased using BARI Cinnamon-1 having good aroma, pungency, sweetness, medium high yield and stress tolerant habit. Homesteads, hilly and highlands are suitable for cinnamon cultivation in Bangladesh. Lack of quality saplings are the major constraints for expanding cinnamon growing areas. Standard technology for cinnamon propagation in Bangladesh is not yet been developed. Research information regarding this crop is very much scanty in our country and less thrust has so far been given on it in the past. To increase cinnamon production, intensive research on its propagation for dissemination of BARI Cinnamon-1 variety is very much essential. Vegetative propagation is required establishment of mother trees for expansion of true cinnamon garden. Development of appropriate propagation technique of cinnamon is essential for rapid dissemination of BARI Cinnamon-1 to increase cinnamon production as well as ensure quality quill production. The study was undertaken to develop standard propagation techniques using proper concentration of rooting hormone at proper

time of application for rapid multiplication of bay leaf and cinnamon to ensure quality sapling production.

II. MATERIALS AND METHODS

The experiment was conducted in a factorial Complete Randomized Design (CRD) with six levels of IBA viz. 1000, 2000, 3000, 4000, 5000ppm and control (without IBA) with five times of cutting and layering in the middle (15th) of each April, May, June, July and August at the Regional Spices Research Centre, BARI, Gazipur during April, 2017 to September 2018. Proximal slanting cut end of 30 cuttings for each treatment were placed in the hormone solutions for five minutes then kept 15 minutes to discard extra solution. After treating with hormone, the cuttings were planted in the 15 cm raised beds of soil, sand and compost mixture at a spacing of 15×10 cm.

Same treatments were applied at the upper cut portion of layering branches. For better water holding capacity and root development in layering, soil mixture was prepared with 50% loamy soil and 50% well decomposed cow dung and kept open for 2 weeks. Treatment wise hormone solution was taken with a small glass dropper pot applied on the cut surface (from where bark was removed) of the shoot. No hormone but distilled water was applied for control treatment. Each replication of a single treatment consisting 10 layering shoots and a total of 30 for 3 replications was used and tagged properly. The stool or gooti of air layering was made by covering the cut portion with 160-180g of moist soil mixture, covered by polythene and tied tightly with jute rope. When a number of roots are established and visible through polythene, the air layering seems suitable to separate from the mother plant. A half cut was given at 2-3 cm below the stool of air layering. After one week, the layering was separated by gentle full cut from the previously cut place and extra branches and leaves were trimmed out. The trimmed layering shoot was planted in previously prepared polybag after removing the polythene and kept one week under shade then 3 weeks in partial shade for establishment. Air layering seems suitable to plant in the field when a number of roots and shoots were established in polybag. Data on length and number of roots per layering was count breaking the stool just after detachment of layering. The samples of three live stools of layer were broken and the numbers of roots were counted and lengths of roots were measured with a digital slide calipers at 60 days after separation. After separation from the mother plants, success of detached layers and number of leaves were counted at 60 days of planting in the polybag. Data is taken on success rate, days to bud break, leaf and shoot growth, vigour of the saplings, establishment rate, disease and insect pest reaction.

III. RESULTS AND DISCUSSION

Very few shoots were emerged but died within few weeks after placing of cutting. No root was emerged in cuttings and all cuttings of cinnamon were died after every months placement. There were no variation or any success in treated or untreated cuttings.

Layering time and IBA concentration showed significant effect on rooting, success and survival rate of cinnamon layers. Layering time and IBA concentration in cinnamon showed significant effect on rooting, success and survival rate of layers.

Most of the tropical fruit plants showed good shoot and root growth in cuttings and air layering during the hot humid weather condition in rainy season of Bangladesh. In present work on cinnamon, no shoot growth was observed and no root was emerged in cuttings even treated with all doses of IBA. All cuttings were died after 30-40 days. The success of cutting in all treatments was nil. Sandor (2011) found that the autumn propagation

period gives the best and most reliable results from the point of view of the rooting of hardwood cuttings at under 15°C and IBA stimulant should be left of completely. The weather condition of Bangladesh might be unfavorable for rooting in BARI cinnamon-1 cuttings might be due to shy rooting habit of this variety.

Effect of Layering Time on Success of Air Layering

The time of layering was significantly affected on the success of layering (Table 1). Early rooting was observed in May layering (72.8 days) which was statistically similar with April, June and July while August layering took more days (84.4) for root visibility. Similar result was observed in separation of layers from the mother plant. Rooting success was similar in all five months but establishment rate was declined after June (Table 1 and Fig. 1).

Table 1. Performance of Cinnamon leaf layering at different time.

Layering Time	Days to Root Visible	Days to Separation	Rooting (%)	Establish (% 60 DAS)	% Dead at 60 DAS	Roots Layer	Length of Root (cm)	No. of Branch	Leaves /Layer
April	78.8	94.9	48.89ab	39.74ab	60.26b	2.15a	6.21a	1.89a	4.04a
May	72.8	93.2	50.00a	45.20a	54.80c	2.02a	7.21a	2.00a	3.99a
June	76.3	92.2	50.00a	42.14a	57.86bc	2.16a	6.93a	2.04a	4.01a
July	72.9	90.8	51.67a	38.54b	61.46b	2.13a	6.29a	1.98a	4.04a
August	84.4	101.7	40.00b	22.09c	77.91a	1.44b	4.44b	1.56b	2.79b
Significance	NS	NS	*	*	*	NS	*	*	*
CV%	16.66	18.10	10.93	11.89	12.28	18.08	5.38	10.08	18.96

Means having same letter(s) or without letter are not significantly different by DMRT. 'ns' '**' and '***' means not significant, significant at 5% and 1% probability level, respectively.

Successful layer was slightly higher in July layering (51.67%) where the highest number of successful layers was 5.17 (Fig 1) but establishment number (2.67) and rate (45.2%) was highest in May layering. Lower establishment number and rate was recorded in August (1.33, 22.09%, respectively) layering (Table 1 and Fig. 1). This result seems that cinnamon is shy and slow rooting habit that caused longer time for rooting. The effect of time of layering was significantly affected on the death of detached layers, number and length of roots, and leaves per layers (Table 2.1).

Death rate of detached layer was higher (77.91%) in August layering and it was minimum in May (54.8%). The lower success in August layering might be due to fall of temperature and lower humidity in October delayed and hampered rooting as well as shoot initiation. Wamananand (2018) mentioned that first week of July is the most suitable time for air layering in cinnamon as it supported better rooting percentage (87.5%) in cinnamon (*Cinnamomum verum* L.) under wet humid tropical conditions.

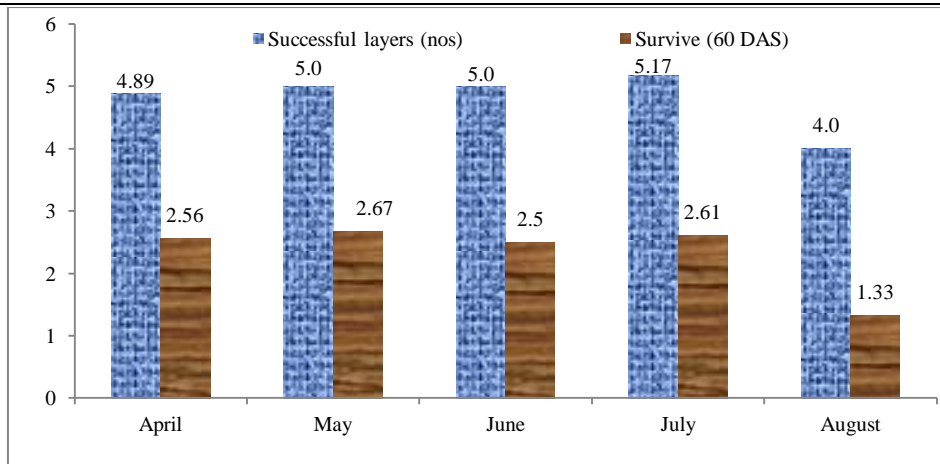


Fig. 1. Success and establishment rate of bay leaf layering at different time.

April, May, June and July layering gave more number (≥ 2) of longer (≥ 6 cm) roots, and leaves (≥ 4) compared to August layering. Hot humid weather favors rooting and leaf initiation that cause more rooting and leaves in April to July than August layering. As the growth rate of cinnamon is slow, the number of root, shoot and leaves are less compared to other plants.

Effect of IBA Concentration on Cinnamon Layering

IBA concentration had significant effect on rooting and success of air layering in cinnamon (Table 2 and Figure 2). Control treatment and lower dose of IBA took more times to initiate roots compared to higher doses of IBA concentration. Days to separation of layers from the mother plant was not significantly affected by different IBA concentrations. The number of successful layers (7.73) and percentage of rooting was significantly higher (73.33%) in 4000 and 5000ppm IBA concentration applied followed by 3000ppm (6.53, 65, 33%) and it was lower in control (0.93, 9.33%) that described in the table 2 and fig. 2. The number of established layer (4.2) and rate of layers establishment (56.48%) was significantly higher in 5000ppm of IBA followed by 4000 ppm (4.0, 53.62%) and it was nil in control (0%). These findings are resembled with the findings of Sharma *et al.* (1989) who obtained highest rooting percentage in plum with higher concentration of IBA treatment during summer. Andrea *et al*, (1996) obtained the maximum success (87.5%) of plum cuttings from 1500 ppm K-IBA solution.

Table 2. Performance of Cinnamon layering at different IBA concentrations.

IBA Conc. ppm	Days to Root Visible	Days to Separation	Rooting (%)	Establish (%) 60 DAS)	% Death at 60 DAS	Roots Layer	Length of Root (cm)	No of Branch	Leaves /Layer
1000	81.1b	95.0bc	24.67c	24.44	75.56	1.53b	5.43b	1.53b	3.41b
2000	74.5bc	94.0bc	42.67b	42.65	57.35	2.42a	7.59a	2.23a	4.39a
3000	69.7c	87.5c	65.33ab	48.05	51.95	2.65a	8.24a	2.52a	4.90a
4000	69.0c	87.5c	73.33a	53.62	46.38	2.63a	7.90a	2.55a	4.97a
5000	68.7c	87.5c	73.33a	56.48	43.52	2.64a	8.13a	2.54a	4.98a
Control	99.3a	116.0a	9.33d	0.00	100.00	0.00c	0.00c	0.00c	0.00c

IBA Conc. ppm	Days to Root Visible	Days to Separation	Rooting (%)	Establish (%) 60 DAS	% Death at 60 DAS	Roots Layer	Length of Root (cm)	No of Branch	Leaves /Layer
Significance	*	*	*	NS	*	NS	*	*	*
CV%	16.66	18.10	10.93	11.89	12.28	18.08	5.38	10.08	18.96

Means having same letter(s) or without letter are not significantly different by DMRT. 'ns' '*' and '**' means not significant, significant at 5% and 1% probability level, respectively.

Neto *et. al.* (2006) and Canli and Safer (2009) obtained the highest success using 1000 ppm IBA in cherry cutting and layering. Indole-butyric-acid (IBA) enhanced root development and root growth by enhancing cell division resulted the maximum success of layering compared to control as well as lower level of IBA concentration (Mozumder, *et. al.*, 2014). There was significant variation of death of layers after detaching from the mother plant, rooting and leaf production with various levels of IBA treatment (Table 2). A number of air layering shoots were died in the polybag after separation from the mother plant. Application of IBA resulted more number (≥ 2) of longer (≥ 6 cm) roots compared to control. Number of leaves increased with increasing IBA concentration.

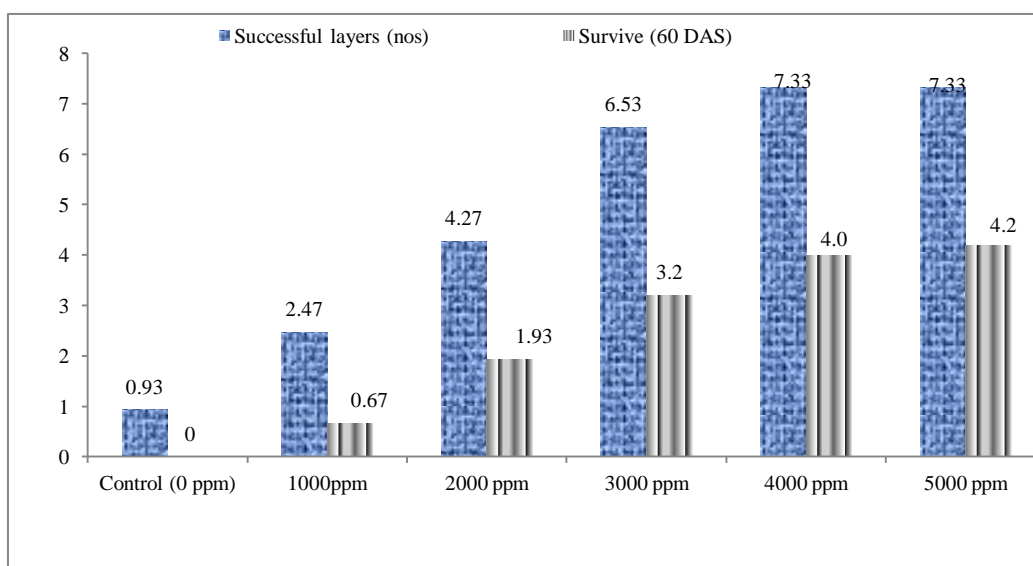


Fig. 2. Success and establishment rate of bay leaf layering at different IBA concentrations.

The highest number of leaves (4.98/layer) was recorded from the application of 5000 ppm IBA which was statistically similar in all IBA levels and it was nil (0/layer) in control. This result corroborates with the findings of Misra and Singh(1990) that all IBA and NAA concentrations significantly increased rooting of air layers. Highest percentage rooting was obtained with 5000 ppm IBA (95%) compared with 21.7% in the control). This treatment also resulted in the highest percentage survival of rooted air-layers (68.3%) compared with 5% in the control). IBA was more effective than NAA in promoting rooting in air-layers. IBA helps to accelerate cell division and root initiation in upper parts of the cut portion of the plant resulted more rooting and leaves with higher doses of IBA.

Combined Effect of layering Time and IBA Concentration in Cinnamon

Layering time and IBA concentration showed significant effect on rooting and success rate of layers (Table 3a and 3b) in Cinnamon.

Table 3a. Combined effect of layering time and IBA on success of Cinnamon propagation.

Time	IBA Conc.	Days to Root Visible	Days to Separation	Successful Layers (nos)	Rooting (%)	Survive (60 DAS)
April	1000	84.0	95.0	2.67	26.67	0.67
	2000	76.7	95.0	4.67	46.67	1.67
	3000	72.0	87.0	6.33	63.33	3.67
	4000	72.0	87.0	7.33	73.33	4.67
	5000	71.7	87.0	7.33	73.33	4.67
	Control	96.7	118.3	1.00	10.00	0.00
May	1000	80.0	95.0	2.67	26.67	1.00
	2000	72.7	93.3	4.33	43.33	2.67
	3000	64.7	87.0	6.33	63.33	3.33
	4000	64.0	87.0	7.67	76.67	4.33
	5000	64.0	87.0	7.67	76.67	4.67
	Control	91.3	110.0	1.33	13.33	0.00
June	1000	80.7	95.0	2.67	26.67	1.00
	2000	74.7	91.7	4.33	43.33	2.00
	3000	71.3	85.0	6.67	66.67	3.67
	4000	70.3	85.0	7.67	76.67	4.00
	5000	70.3	85.0	7.67	76.67	4.33
	Control	90.7	111.7	1.00	10.00	0.00
July	1000	80.3	95.0	2.67	26.67	0.67
	2000	74.3	95.0	4.67	46.67	2.67
	3000	67.3	88.3	7.33	73.33	3.33
	4000	67.3	88.3	7.67	76.67	4.33
	5000	66.3	88.3	8.00	80.00	4.66
	Control	82.0	90.0	0.67	6.67	0.00
August	1000	80.7	95.0	1.67	16.67	0.00
	2000	74.3	95.0	3.33	33.33	0.67
	3000	73.0	90.0	6.00	60.00	2.00
	4000	71.3	90.0	6.33	63.33	2.67

Time	IBA Conc.	Days to Root Visible	Days to Separation	Successful Layers (nos)	Rooting (%)	Survive (60 DAS)
	5000	71.0	90.0	6.00	60.00	2.67
	Control	136.0	150.0	0.67	6.67	0.00
Significance		NS	NS	*	*	
CV%		16.66	18.10	10.93	10.93	7.59

Means having same letter(s) or without letter are not significantly different by DMRT. 'ns' '**' and '***' means not significant, significant at 5% and 1% probability level, respectively.

August layering with lower concentration of IBA or control treatment took more time compared to April, May, June and July month's layering for root initiation and separation of layers from the mother plant.

Table 3b. Combined effect of layering time and IBA on success of Cinnamon propagation.

Time	IBA Conc.	Establish (% 60 DAS)	% Dead at 60 DAS	Roots Layer	Length of Root (cm)	No Branch	Leaves /Layer
April	1000	22.22	77.78	1.67	5.33	1.67	4.50
	2000	35.00	65.00	2.83	7.97	2.33	5.00
	3000	56.19	43.81	2.67	7.97	2.47	5.03
	4000	62.50	37.50	2.94	8.07	2.43	4.93
	5000	62.50	37.50	2.79	7.93	2.47	4.77
	Control	0.00	100.00	0.00	0.00	0.00	0.00
May	1000	38.89	61.11	2.00	8.30	2.00	4.87
	2000	61.11	38.89	2.42	8.23	2.58	4.50
	3000	53.33	46.67	2.49	8.93	2.51	4.78
	4000	56.55	43.45	2.48	8.77	2.62	5.07
	5000	61.31	38.69	2.70	9.00	2.30	4.73
	Control	0.00	100.00	0.00	0.00	0.00	0.00
June	1000	38.89	61.11	2.33	8.53	2.33	4.33
	2000	48.89	51.11	2.77	8.00	2.42	4.85
	3000	55.56	44.44	2.80	7.93	2.56	4.93
	4000	52.38	47.62	2.42	8.20	2.53	4.82
	5000	57.14	42.86	2.63	8.90	2.42	5.13
	Control	0.00	100.00	0.00	0.00	0.00	0.00
July	1000	22.22	77.78	1.67	4.97	1.67	3.33

Time	IBA Conc.	Establish (% 60 DAS)	% Dead at 60 DAS	Roots Layer	Length of Root (cm)	No Branch	Leaves /Layer
	2000	51.59	48.41	2.40	8.83	2.47	4.93
	3000	43.92	56.08	2.90	8.57	2.67	5.33
	4000	55.56	44.44	2.95	7.57	2.49	5.37
	5000	57.94	42.06	2.85	7.80	2.61	5.27
	Control	0.00	100.00	0.00	0.00	0.00	0.00
August	1000	0.00	100.00	0.00	0.00	0.00	0.00
	2000	16.67	83.33	1.67	4.93	1.33	2.67
	3000	31.27	68.73	2.42	7.80	2.42	4.42
	4000	41.11	58.89	2.33	6.90	2.67	4.67
	5000	43.49	56.51	2.25	7.03	2.92	5.00
	Control	0.00	100.00	0.00	0.00	0.00	0.00
Significance		NS	NS	NS	NS	NS	NS
CV%		6.68	8.61	6.09	6.07	10.64	6.41

Means having same letter(s) or without letter are not significantly different by DMRT. 'ns' '**' and '***' means not significant, significant at 5% and 1% probability level, respectively.

Early rooting (64 days) was found in May layering with 4000 and 5000ppm IBA concentration while it was significantly delayed (136 days) in August layering without IBA treatment. Bay leaf layers took about 12-13 weeks to separation that was slightly affected due to layering time but greatly for hormone application. The number of successful layer was significantly higher in July layering (8.0, 80%) with 5000ppm IBA closely followed by May, June and August (7.67, 76.67%) with 4000 & 5000ppm IBA application and the success was nil (0.67, 6.67%) in July and August layering without IBA. The lower success without IBA may be due to fall of temperature and lower hormonal activity hampered rooting. Significant variations on survivability of layers after detaching from mother plant, rooting and leaf production due to layering time with various IBA concentrations (Table 3a and 3b). The maximum number and rate of survived layers (4.67, 61.31%) was found in July layering with 5000 ppm IBA treatment followed by May layering (4.66, 57.94%) with 5000 ppm IBA while no layers was survived finally without IBA application.

Higher concentration IBA results more number of roots in early June-July layering compared to control and lower concentration of IBA treatment in later layering might be the cause of such variation. The number and length of root did not differ significantly with the range of 1.67 to 2.95 per layers and 5.33-9.0 cm at 60 days with the combination of differed IBA concentration and time of layering (Table 3.b). Number of branches and leaves were increased with increasing IBA concentration in all months of layering. This result slight different from the findings of Kakon *et al.*, 2008 who showed that among different varieties BARI guava-1 showed the best performance with IBA at 1200 ppm concentration among the treatments having significant effect on almost

all parameters. The maximum number of leaves (5.37/layer) per layer was recorded from the application of 5000 ppm IBA in July layering and lowest (2.67/layer) was found from 2000ppm IBA in the August layering. There was no successful layering in April, July and August without IBA that had no roots or leaves. IBA accelerate cell division and root initiation at a high temperature and humidity resulted more rooting and leaves with higher doses of IBA in May to July layering.

Singh (2001) found that use of IBA was beneficial in enhancing the callus formation, number, length and diameter of both primary and secondary roots and survival of air-layered twigs. This findings are partially similar with the report of Rymbai *et al.* (2010) that air layers of guava have been successfully achieved by exogenous application of IBA at 4000ppm. The result from these observations were fully or partially resembled with some findings such as Sharma *et al.*; (1989) also got maximum success with 2000 ppm IBA, Andrea *et. al.* (1996) obtained from 1500 ppm IBA while Canli and safer (2009) and Neto *et. al.* (2006) got the maximum success with 1000 ppm IBA concentration. Yadav (1989) found that highest concentration of IBA (5000 ppm) proved significantly better for rooting and survival of air layers of kagzi lime. All the findings were varied because those experiments were conducted in different plants species, environment, soils, climates and times.

IV. CONCLUSION

Success of layering was not satisfactory with or without IBA treatment. Layering time and IBA concentration significantly influence on the success and rooting of layers under Bangladesh condition. May to July layering using 4000ppm IBA treatment found better on successful air layering for vegetative propagation of Cinnamon in Bangladesh.

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