Effect of IBA Concentration and Time of Plum Cutting and Air Layering

S. N. Mozumder[1], M. I. Haque[1], Monira[2], S. Ahmad[3] and S. Akter[4]
[1]Senior Scientific Officer, [4]Chief Scientific Officer
Regional Spices Research Center,
Bangladesh Agricultural Research Institute
Gazipur - 1701. Bangladesh
[2]MS Student, [2]Associate Professor, Department of Botany
Jagannath University, Dhaka, Bangladesh

Abstract: **Experiments were conducted at the Regional Spices Research Center, BARI, Gazipur during January 2013 to August 2014 to evaluate effect of IBA concentration and time of cutting and air layering in plums. Cutting were placed with six levels of IBA treatments Viz 0, 500, 1000, 1500, 2000 ppm and dusting. Profuse shoot growth was observed but no root was emerged in cuttings and all cuttings were died after a few (25-30) days. Air layering was done in four time (Mid-June, Mid-July, Mid-August and Mid-September) with five levels of IBA Significant variations on death of layers, rooting and leaf production due to layering time with six IBA concentrations (0, 500, 1000, 1500, 2000 ppm and dusting). Layering time and IBA concentration showed significant effect on rooting and success rate of layers. The number of successful layer was significantly higher in June (14.3, 57.33%) and July (13.3, 53.33%) layering with 2000 ppm IBA application and the success was nil (0.0) in September layering without or lowest (500 ppm) concentration of IBA.**

INTRDODUCTION

Vegetative propagation are essential for increase its cultivation maintaining genetic purity of the variety. Vegetative propagation using IBA are Eco-friendly and no harmful reports so far known on use of IBA for cuttings and layering establishment. Moreover, plantation of such a valuable plants increase farmer's profitability and livelihood. Increasing income through cultivating plum may encourage farmers to disseminate this crop thus will improve environmental condition creating of new vegetation. Air Layering and cutting are most used and popular means of Alubokhara propagation (*Food & Agriculture Organization, 2011).* The weather condition in rainy season of Bangladesh, many fruit plants showed good shoot and root growth in cuttings and air layering. In case of plum, profuse shoot growth was observed but no root was emerged in cuttings and all cuttings were died after a few days without hormone treatment. Few information are available on successful use of plant growth regulator i.e. Indole-3 butyric acid (IBA) for root initiation in plums in various countries but no such reports are available in Bangladesh condition. Neto *et. al*. (2006) reported that IBA 1000mg L^{-1}, was the best in the rooting of plum cuttings. Therefore, the present study was designed to know the efficacy of IBA and standardization of the time of cutting and layering with IBA concentration for successful vegetative propagation of plum in Bangladeshi weather condition.

MATERIALS AND METHODS

Experiments were conducted at the Regional Spices Research Center, BARI, Gazipur during January 2013 to August 2014 to evaluate the performance and propagation of plums under the environmental condition of Bangladesh. The experiment was conducted levels of IBA viz. 0, 500, 1000, 1500, 2000ppm and dusting with IBA powder. Growth regulators were applied on layering for four times in June, July, August and September. Cuttings were placed in the last week of June applying all hormone treatments. For better root development, better soil media having sufficient organic matter with good water holding capacity is essential. Soil mixture was prepared with 50% loamy soil and 50 well decomposed cow dung and kept for 2 weeks for better work. Treatment wise hormone solution was taken with a small piece of cotton and applied on the cut surface (from where bark was removed) of the shoot. For dusting treatment same areas of shoots were touched onto the IBA dust so that some of the IBA dust was attached with the cut portion. As the cut surfaces remain wet, dusts were pasted on the distal cut portion. No hormone 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 cut portion was covered with 150-200 g of moist soil mixture, covered with polythene and tied tightly with jute or cotton rope. When a number of roots are established, the air layering seems suitable to separate from the mother plant. A half cut was given at 2-3 cm below the cut portion of air layering. After one week the layering was separated by gentle full cut from the previously cut place and extra branches and leaves are trimmed out. The trimmed layering shoot was planted in previously prepared polybag removing the ploythene and kept one week under shade then 2 weeks in partial shade for establishment. A number of roots and shoots were established, the air

layering seems suitable to plant in the field. Data on length and number of roots per layering was count braking the stool at 45 days of layering while success of detached layers and number of leaves at 30 days after separation from the mother plant. Data on length and number of roots per layering was count breaking the stool at 45 days of layering. The sample 5 layers were broken and the numbers of roots were counted and lengths of roots were measured with a digital calculator. After separation from the mother plants, success of detached layers and number of leaves were counted at 30 days of planting in the polybag. The data were compiled properly and analyzed statistically by MSTAT and MS-Excell Program and mean comparison was done following the Dancan's Multiple Range Test (Zaman, *et al.* 1987).

RESULTS AND DISCUSSION

Effect of IBA concentration on plum cutting

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. Few information are available on successful use of plant growth regulator i.e. Indole-3 butyric acid (IBA) for root initiation in Plums in various countries but no such reports are available in Bangladesh condition. In present work on plum, profuse shoot growth was observed but no root was emerged in cuttings and all cuttings were died after a few (25-30) days (table 1). There were no significant variations among the treatments (IBA level) in respect to days to bud break or sprouting of shoots, number of shoots per cutting and date of starting death of cuttings.

Table 1. Effect of IBA concentration on the performance of plum cutting

IBA Conc. (ppm)	Days to shoot sprouting	Number of shoots /cutting at 10 DAP	Days to start of death	% success
0	5.5	8.8	21.3	00
500	5.7	7.8	21.6	00
1000	5.4	8.0	22.4	00
1500	5.4	8.8	21.9	00
2000	5.9	8.1	21.9	00
Dust	5.8	8.0	20.3	00
Level of Significance	NS	NS	NS	--
CV%	9.65	7.64	6.48	--

Means having same letter(s) or without letter are not significantly different by DMRT. 'ns' means not significant.

The success of cutting in all treatments was nil. This finding completely dissimilar with Boyhan *et al.* (1995) who obtained 47 to 94 percent success in different varieties of plum cuttings in USA. Sándor (2011) found that the autumn propagation period gives the best and most reliable results from the point of view of the rooting of hardwood plum cuttings at under 15°C is advisable, and IBA stimulant should be left of completely. The weather condition of Bangladesh especially high temperature (25-35 ^{0}C) might be unfavorable for rooting in plum cutting.

Effect of layering time on success of air layering

The time of layering was significantly affected on the success of layering (table 2). September layering took more 3 to days compared to June, July and August month's layering for root initiation and separation of layers from the mother plant. The number of successful layer was significantly higher in June layering (6.39, 25.56%) closely followed by July (6.17, 24.67%) and the success rate was very low (3.83, 15.33) in September layering. The lower success in September layering is due to fall of temperature and lower humidity in October delayed and hampered rooting as well as shoot initiation.

Table 2. Effect of air layering time on success of plum propagation

Time of layering	Days to rooting	Days to Separation	No. of layers	% success
June	32.8b	55.1	6.39a	25.56a
July	32.8b	55.6	6.17a	24.67b
August	33.4b	56.3	5.22b	20.89ab
September	37.2a	59.3	3.83c	15.33c
Level of Significance	*	NS	*	*
CV%	6.76	6.04	14.45	14.45

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.

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 3). Few (0.5 to 0.9%) air layering shoots were died in the polybag after separation from the mother plant. June, July and August layering gave more number (≥4) of longer (≥4 cm) roots than September layering (≤3 and ≤3cm).

Table 3. Effect of IBA concentration on death and growth of plum layers

Time of layering	No. of dead layers	% death	No. roots /layer	Length of root at 45 DAS (cm)	Length of root at cut (cm)	No. leaves at (30 DAS)
June	0.7	10.95bc	4.0a	4.2a	13.05a	9.4
July	0.9	14.59b	3.8a	4.3a	12.35a	8.9
August	0.5	9.58c	4.1a	4.2a	11.73a	9.9
September	0.7	18.28a	2.4b	2.6bb	6.97b	8.6
Level of Significance	NS	*	*	*	*	NS
CV%	22.44	12.77	15.37	10.86	10.87	15.78

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.

Number of leaves was similar in treatments. Hot humid weather favors rooting and leaf initiation that caused more rooting and leaves in June to August layering. Number of leaves per layer was similar in all time of layering from June to September.

Effect of IBA concentration on plum layering

IBA concentration had significant effect on the success of layering (table 4). 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 IBA concentration.

The number of successful layer was significantly higher (11.9, 47.67%) in the highest concentration of IBA (2000 ppm) followed by dusting (7.3, 29%) and 1500 ppm (6.9, 27.67%) and it was lower in control (1.3, 5.33%). These findings are resembled with the findings of Sharma *et. al*. (1989) the highest rooting percentage in plum was obtained with IBA treatment of cuttings with 2000 mg l^{-1} during summer. Andrea et al, (1996) obtained the maximum success (87.5%) of plum cuttings from 1500 ppm K-IBA solution. Neto *et. al.* (2006) and

Canli and Safer (2009) obtained the highest success using 1000 ppm IBA in plum 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 and lower level of IBA concentration (Mozumder, *et. al.,* 2014).

Table 4. Effect of IBA concentration on success of plum layering

IBA Conc. (ppm)	Days to rooting	Days to Separation	No. of layers	% success
0	36.5a	58.8	1.3d	5.33d
500	35.7ab	57.8	1.6d	6.33d
1000	33.0b	56.0	3.4c	13.67c
1500	33.4b	56.8	6.9b	27.67b
2000	32.9b	55.1	11.9a	47.67a
Dust	32.8b	55.0	7.3b	29.00b
Level of Significance	*	NS	*	*
CV%	6.76	6.04	14.45	14.45

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.

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 5). Few (0.3 to 1.3) air layering shoots were died in the polybag after separation from the mother plant. Higher concentration IBA resulted more number (≥4) of longer (≥4 cm) roots compared to control and lower concentration of IBA. Number of leaves were increased with increasing IBA concentration. The highest number of leaves (10.7/layer) was recorded from the application of 2000 ppm IBA and lowest (7.8/layer) was found from control. 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.

Table 5. Effect of IBA concentration on death and growth of plum layers after detachment

IBA Conc. (ppm)	No. of dead layers	% death	No. roots /layer	Length of root at 45 DAS (cm)	Length of root at cut (cm)	No. leaves /layer at (30 DAS)
0	0.3b	23.08a	2.8c	3.1b	7.93b	7.8c
500	0.3b	18.75a	3.0c	3.2b	8.75b	8.0c
1000	0.4b	11.76b	3.8ab	4.2a	11.70a	9.3b
1500	0.8a	11.59b	4.2a	4.2a	12.28a	9.4ab
2000	1.3a	10.92b	4.1ab	4.2a	12.93a	10.7a
Dust	1.0a	13.70b	3.6b	4.2a	12.58a	10.1ab
Level of Significance	*	**	*	*	*	*
CV%	22.44	12.77	15.37	10.86	10.87	15.78

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.

Combined effect of layering time and IBA concentration

Layering time and IBA concentration showed significant effect on rooting and success rate of layers (Table 6). September layering with lower concentration of IBA or control treatment took more 2-3 days compared to June, July and August month's layering for root initiation and separation of layers from the mother plant. Early rooting (31.7 days) was found in June and July layering with IBA dusting while it was significantly delayed (44.7 days) in September layering without IBA treatment. Plum layers took about 8 weeks to separation that was not affected due to layering time or hormone application.

The number of successful layer was significantly higher in June layering (14.3, 57.33%**)** closely followed by July (13.3, 53.33%) with 200 ppm IBA application and the success was nil (0.0) in September layering without or lowest (500 ppm) concentration of IBA. The lower success in September layering with low IBA is due to fall of temperature and lower hormonal activity hampered rooting.

Table 6. Combined effect of layering time and IBA on success of plum propagation

Time	IBA Conc. (ppm)	Days to rooting	Days to Separation	No. of separated layers	% success
Mid June	0	34.3b	58.3	1.7ij	6.67ij
	500	33.3b	55.0	2.0hij	8.00hij
	1000	30.7b	52.7	4.3fgh	17.33fgh
	1500	34.3b	57.0	7.7cde	30.67cde
	2000	32.3b	54.3	14.3a	57.33a
	Dust	31.7b	53.3	8.3cd	33.33cd
Mid July	0	32.7b	58.3	2.0hij	8.00hij
	500	33.0b	54.3	2.3hij	9.33hij
	1000	32.7b	54.3	3.7ghi	14.67ghi
	1500	32.0b	56.7	8.0cd	32.00cd
	2000	33.0b	55.0	13.3a	53.33a
	Dust	33.3b	55.0	7.7cde	30.67cde
Mid August	0	34.3b	55.0	1.7ij	6.67ij
	500	34.0b	56.7	2.0hij	8.00hij
	1000	34.0b	58.3	3.3ghi	13.33ghi
	1500	33.7b	57.7	6.7c-f	26.67c-f
	2000	32.7b	55.0	11.0b	44.00b
	Dust	31.7b	55.0	6.7c-f	26.67c-f
Mid September	0	44.7a	63.3	0.0j	0.00j
	500	42.3a	65.0	0.0j	0.00j
	1000	34.7b	58.7	2.3hij	9.33hij
	1500	33.7b	56.0	5.3efg	21.33efg
	2000	33.7b	56.0	9.0bc	36.00bc
	Dust	34.3b	56.7	6.3def	25.33def
Level of Significance		*	NS	**	**
CV%		6.76	6.04	14.45	14.45

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.

Significant variations on death of layers after detaching from mother plant, rooting and leaf production due to layering time with various IBA concentrations (Table 7). The maximum rate (41.18%) of dead layer was found in June layering without IBA treatment and it was minimum (4.48%) with 1500 ppm IBA in August layering. Higher concentration IBA resulted more number of roots in early June-July layering compared to control and lower concentration of IBA treatment in later layering.

The length of root did not differ significantly at 45 and 60 days (at the time of cutting) with the combination of different IBA concentration with time of layering (Table 7). Number of leaves were increased with increasing IBA concentration.

Table 7. Combined effect of layering time and IBA on death and growth of plum layers after detachment

Time	IBA Conc. (ppm)	No. of dead layers	% death	No. roots /layer	Length of root at 45 DAS (cm)	Length of root at cut (cm)	No. leaves /layer at (30 DAS)
Mid June	0	0.7bcd	41.18a	3.9ab	4.3	11.3	9.0ab
	500	0.7bcd	35.00a	3.9ab	4.2	12.2	8.0b
	1000	0.3cd	6.98e	4.1ab	4.1	13.1	9.3ab
	1500	0.7bcd	9.09d	4.0ab	4.4	13.7	9.3ab
	2000	1.0abc	6.99e	4.1ab	4.3	14.1	10.7a
	Dust	0.7bcd	8.43d	4.0ab	4.2	13.9	10.3a
Mid July	0	0.3cd	15.00c	3.4b	4.0	10.2	7.3b
	500	0.3cd	13.04c	3.9ab	4.7	11.7	7.7b

	1000	0.7bcd	18.92b	3.7ab	4.5	12.5	8.7ab
	1500	1.0abc	12.50cd	4.4a	4.2	13.2	9.0ab
	2000	1.7a	12.78cd	4.0ab	4.3	13.3	11.3a
	Dust	1.3ab	16.88bc	3.6ab	4.2	13.2	9.3ab
Mid August	0	0.3cd	17.65bc	3.9ab	4.2	10.2	8.3b
	500	0.3cd	15.00c	4.2ab	4.1	11.1	9.3ab
	1000	0.3cd	9.09d	4.1ab	4.3	11.3	10.0ab
	1500	0.3cd	4.48ef	4.3ab	4.2	12.2	10.3a
	2000	1.0abc	9.09d	4.2ab	4.3	13.3	11.0a
	Dust	0.7bcd	10.45cd	3.7ab	4.3	12.3	10.3a
Mid September	0	0.0d	0.0f	0.0c	0.0	0.0	0.0
	500	0.0d	0.0f	0.0c	0.0	0.0	0.0
	1000	0.3cd	13.04c	3.5ab	3.9	9.9	9.0ab
	1500	1.0abc	18.87b	3.9ab	4.0	10.0	9.0ab
	2000	1.3ab	14.44c	3.9ab	4.0	11.0	9.7ab
	Dust	1.3ab	20.63b	3.3b	3.9	10.9	10.3a
Significance level		*	*	*	NS	NS	*
CV%		22.44	12.77	15.37	10.86	10.87	15.78

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.

The maximum number of leaves (11.3/layer) was recorded from the application of 2000 ppm IBA in Mid-July layering and lowest (7.3/layer) was found from control in the same time of layering. There was no successful layering in September without IBA or with 500 ppm IBA that had no roots or leaves. IBA accelerate cell division and root initiation high temperature and humidity resulted more rooting and leaves with higher doses of IBA in June and July layering

The result from these observations were fully or partially resembled with some findings such as Sharma *et, al*. (1989) get 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) get the maximum success with 1000 ppm IBA concentration. All the findings were varied because those experiments were conducted in different environment, soils, climates and times.

Conclusion

Success of cutting was unsuccessful with or without IBA treatment. Layering time and IBA concentration significantly influence on the success and rooting of layers under Bangladesh condition. June to August layering with 2000 ppm IBA treatment found better for successful air layering for vegetative propagation of plums in Bangladesh.

Recommendation

As the maximum success of air layering was obtained from the highest level of IBA concentration (2000 ppm), further study can be undertaken using increased IBA concentration.

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