Journal of Natural Sciences Research
ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online)
Vol.3, No.14, 2013

Assessment Of Iba (Indole Butyric Acid) Levels And Planting Time For Rooting And Growth Of Alstonia Cuttings

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ABSTRACT
An experiment to assess different levels of IBA (Indole Butyric Acid) and planting time on rooting and growth of Alstonia cuttings was conducted at Ornamental Horticulture Nursery, Department of Horticulture, The University of Agriculture Peshawar, Pakistan. The experiment was carried out using RCBD design with split plot arrangement. There were five levels of IBA 0, 5, 10, 15 and 20% that were prepared by mixing IBA with talc powder. Cuttings were obtained from healthy, vigorous growing trees which were 15-20 cm long and 2-3 nodes. Leaves were removed from the cuttings and were treated with IBA than planted in plastic bags filled with mixture of sand, clay and FYM with the ratio of 1:1:1 on three different planting times 15th March, 30th March and 14th April. IBA level of 10% showed best results regarding leaf area plant^{-1}(26.032 cm^2), sprout length(18.096 cm), stem diameter (14.44 mm), number of roots plant^{-1} (15.613), root diameter (3.412 mm) while number of leaves plant^{-1} (17.27), root length (14.24 cm) and survival percentage (70%) was best recorded when treated with IBA at level of 5%. However, sprouting percentage and days to bud sprouting were not significantly affected by different levels of IBA. It is observed from the study that there was no significant effect of planting time over any parameter however good results were observed in cuttings planted at 14th April regarding leaf area plant^{-1}, sprout length, stem diameter, number of roots plant^{-1}, number of leaves plant^{-1}, root length, root diameter and survival percentage while sprouting percentage and days to bud sprouting were best when planted at 15th March. IBA at 10% level and 14th April as planting time resulted in overall best performance and hence recommended for treating and planting cuttings of Alstonia.
Keywords: Alstonia, Growth attribute, Planting times, IBA.

I. INTRODUCTION

Alstonia is a widespread genus of evergreen trees and shrubs from the family Apocynaceae. Alstonia scholaris (L.) was first named as Echites scholaris by Linnaeus in 1767 (Brown, 1811). Alstonia commonly called as Devil tree consists of about 40-60 species (according to different authors), native to tropical and subtropical Africa, Central America, southeast Asia and Australia, with most species in the Malaysian region. These trees can grow very large, such as recorded with a height of 38 m and spread of about 10 m. The stem of Alstonia is erect with spongy bark and bitter sap. The leaves occur in whorls of 4 to 6 leaves having darker green upper side with whitish under surface. It grows well in medium to rich soil, an open sunny weather and is vulnerable to drought and frost. Fairly moist situation are good for its growth and dry regions have negative effect on its growth (Troup, 1975).

The bark of Alstonia scholaris has medicinal value and is useful in malaria, epilepsy, asthma and several other skin disorders. The bark is also found as remedy for fever and useful in chronic diarrhea and dysentery. The latex and powdered leaves are used for boils, ulcers and pains. Young leaves are also used as cure for beri beri (Anuradha, et al. 1995).

In tropical countries, one of the most difficult problems in propagation of forest species is seed supply. According to Sasaki et al. (1978) forest trees do not bear fruits regularly when subjected to certain conditions. They produce low quality seeds because of frequent insect and fungal attacks and other environmental conditions. It is therefore, very difficult to predict the yield and quality of seeds for a reforestation program. Vegetative propagation of tropical species by cuttings is an important alternative for production of high quality and uniform planting stocks for a large scale reforestation. Stem cuttings offer several advantages over seeds. It saves time and labor in seed collection and storage and produces uniform planting material reflecting the genetic purity of superior parent stock. Stem cutting is also inexpensive and easier to practice than other vegetative propagation methods, such as tissue culture. Finally, it can produce a continuous supply of planting stock throughout the year for reforestation activities (Ahmad and Hamza, 1993).

Stem cuttings of many favorite woody plants are quite easy to root but certain woody spp. do not root easily. Treating these cuttings with root-promoting compounds can be a valuable tool in stimulating rooting of plants which might otherwise be difficult to root (Evans and Blazich, 1999).

The most thoroughly studied group of plant hormones is auxins. Some of the important role of auxins includes stimulation of cells division, cells enlargement, cell elongation, continued growth of callus, differentiation of cells in callus, root formation on cuttings, stem elongation as well as synthesis of RNA, enzymes, protein and cell wall components (Mayer and Anderson, 1970). The discovery of auxins as plant growth regulating chemicals in the 1930s and their ability to stimulate adventitious rooting in stem cuttings marked a major milestone in the modern history of plant propagation. The basal quick-dip method, the powder application method, and the dilute soak method have been the most commonly used methods for applying auxin to cuttings (Blythe et al. 2007).

It is well known that the success of rooting of woody stem cuttings, in the majority of ornamental plants and fruit trees depends mainly on the physiological stage of the mother plant, the time of planting of the cutting and the type of growth regulators used (Day and Loveys, 1998; Hartmann and Loreti, 1965; Darwesh, 2000).

Objectives:

To understand the adaptive response of Alstonia cuttings to IBA and planting time the study was conducted with the following objectives.

- To investigate optimum level of IBA for rooting of Alstonia cuttings.
- To explore a suitable planting time for rooting of Alstonia cuttings.
- To find an optimum interaction between IBA levels and planting time.

II. MATERIALS AND METHOD

The experiment "Assessment of IBA (Indole Butyric Acid) levels and planting time for rooting and growth of Alstonia cuttings" was carried out at the Ornamental Nursery Farm of Horticulture Department, The University of Agriculture Peshawar during the months of March-April 2012. The experiment was carried out using split plot design. Experiment was replicated three times. Planting time was assigned as main plot while treatments of IBA were placed in sub-plots.

Control : T_0 = no growth regulators

IBA : T_1 = 5%
T_2 = 10%
T_3 = 15%
T_4 = 20%

Planting time: PT_1 = 15th March
PT_2 = 30th March
PT_3 = 14th April

Preparation of IBA:

Required percentage i.e. 0%, 5%, 10%, 15% and 20% of IBA was prepared by mixing IBA with Talc powder. Talc powder was used as mixing agent because its particles are very fine and small, IBA uniformly mixes in it and each cutting receive same amount of IBA.

Preparation of cuttings:

The cuttings were obtained from healthy, vigorous-growing tree. The cuttings used were about 15-20 cm long with 2-3 nodes. The leaves were removed from the cuttings.

Treatment of cuttings:

The cuttings were dipped in the mixture of IBA and talc powder in such a way that the cut portion received maximum amount of growth regulator.

Planting after treatment:

The cuttings treated with IBA were planted in plastic bags filled with mixture of sand, clay and farm yard manure with the ratio of 1:1:1. Ten cuttings were planted in each treatment with a total number of 150 cuttings in each planting time and a total of 450 cuttings for the whole experiment. Cuttings were than kept under white polythene tunnel for retaining their moisture.

Data was recorded on the following parameters.

Days to bud sprouting:

Days to first bud sprouting per cutting were observed after planting and average was calculated.

Sprouting percentage (%):

The sprouted cuttings were counted and percentage was calculated using the following formulae.

Total no. of sprouted cuttings × 100

Plant sprouting %age = Total no. of planted cuttings

Sprout length (cm):

Sprout length was measured from the point of sprout to the last terminal tip of the branch with the help of measuring tape.

Stem diameter (mm):

Thickness of the surviving shoots that were emerged from the cuttings was measured with the help of vernier caliper and than average was calculated.

Number of leaves plant^{-1}:

Numbers of leaves per cutting were counted and then mean was calculated.

Leaf area (cm^2):

The leaf area was measured from randomly selected plants in each treatment and then mean was calculated.

Number of roots plant^{-1}:

The numbers of roots plant^{-1} were counted and average was calculated.

Root length (cm):

Root length of randomly selected plants in each treatment was measured from base of the root to the root tip and then mean was calculated.

Root diameter (mm):

Thickness of the roots that emerged from the cutting was measured with the help of vernier caliper and than average was calculated.

Plant survival percentage (%):

The percentage of cuttings that survived was calculated with the following formulae.

Total no. of survived cuttings × 100

Plant survival %age = Total no. of sprouted cuttings

Statistical procedure

To observe the difference between different treatments as well as their interactions the data collected on different parameters was subjected to analysis of variance (ANOVA) technology. Least significant difference (LSD) test was further carried out for mean where the difference was significant. Statistical computer software, MSTATC (Michigan state university, USA), was applied for computing both ANOVA and LSD (Steel and Torrie, 1980).

III. RESULTS AND DISCUSSIONS

Days to bud sprouting

Data regarding days to sprouting is presented in mean Table 1 The analysis of variance showed that days to sprouting were not significantly affected by different levels of IBA, planting time or IBA. However it was observed that maximum days to sprouting (10.71) were observed in cuttings treated with 20% IBA while minimum days to sprouting (10.23) were observed in cuttings treated with no IBA. Cuttings planted on 14th April took fewer days (10.58) regarding days to sprouting while cuttings planted on 15th March took more time (10.60) to sprout.

Table 1: Mean table for days to bud sprouting as affected by IBA levels and planting time

Sprouting Percentage (%)

IBA Levels (%)	Planting Time			Mean
	15th March	30th March	14th April	
0	10.58	9.99	10.13	10.23
5	10.65	10.85	10.66	10.71
10	10.49	10.60	10.66	10.58
15	10.48	10.75	10.55	10.59
20	10.80	10.72	10.72	10.74
Mean	10.60	10.58	10.54	

Data regarding sprouting percentage is presented in mean Table 2 The analysis of variance showed that sprouting percentage was not significantly affected by different levels of IBA, planting time or IBA. However, it was observed that higher sprouting percentage (72.22) was observed in cuttings treated with 5% IBA while lowest sprouting percentage (66.66) was observed in cuttings treated with no IBA. Similarly cuttings planted on

15th March showed high sprouting percentage (72.667) while cuttings planted on 30th March showed lowest sprouting percentage (66.000).

Table 2: Mean table for sprouting percentage as affected by IBA levels and planting time

Sprout length (cm)

IBA Levels (%)	Planting Time			Mean
	15th March	30th March	14th April	
0	73.333	63.333	66.667	67.778
5	76.667	73.333	66.667	72.222
10	70.000	60.000	70.000	66.667
15	76.667	60.000	73.333	70.000
20	66.667	73.333	70.000	70.000
Mean	**72.667**	**66.000**	**69.333**	

Mean data is showed in Table 3. According to ANOVA, IBA significantly affected sprout length, while there was a non-significant effect of planting time and its interaction. Mean values regarding IBA treatments shows that maximum sprout length (18.096) was observed in cuttings treated with 10% IBA followed by 5% IBA (16.053), 15% (15.476) and 20% (14.058) respectively. While the least sprout length (9.338) was recorded in cuttings treated with no IBA. No significant effect was observed in cuttings planted at different times though greater sprout length (15.072) was observed in cuttings planted on 14th April, followed by (14.671) planted on 30th March while the lowest sprout length (14.069) was observed in cuttings planted on 15th March. Interaction did not show any specific relationship however the increased sprout length (18.450) was observed in plots where cuttings were treated with 10% IBA and planted on 14th April, whereas the least sprout length (8.760) was noted in same planting time and cuttings treated with no IBA.

Number of roots plant^{-1}were increased when cuttings were treated with IBA at the rate of 10%. The increased number of roots plant^{-1} enhanced nutrients uptake and resulted in more photosynthates production. Food in the form of photosynthates provided the plant with the required energy for cell division and cell elongation and hence maximum sprout length was observed. These results were similar to the findings of Sharma et al. (1991) who observed that IBA treatment resulted in the highest root number and tallest plant.

Table 3: Mean table for sprout length as affected by IBA levels and planting time

LSD for IBA at 5% probability level = 1.6777

IBA Levels (%)	Planting Time			Mean
	15th March	30th March	14th April	
0	9.850	9.403	8.760	9.338 d
5	13.383	17.197	17.580	16.053 b
10	18.380	17.457	18.450	18.096 a
15	15.227	15.293	15.907	15.476 bc
20	13.507	14.003	14.663	14.058 c
Mean	**14.069**	**14.671**	**15.072**	

Stem diameter (mm)

Mean values is presented in Table 4. According to ANOVA, IBA significantly affected stem diameter, while there was a non-significant effect of planting time and their interaction on stem diameter of Alstonia plants. Plants with thicker stem diameter (14.44) and (13.24) were observed in cuttings treated with IBA at the rate of 10 and 5% respectively followed by 15% IBA (10.91) whereas 20% IBA and 0% IBA produced plants with least stem diameter (9.70) and (8.53) respectively. There was a non significant effect of planting time on stem diameter however best results (12.11) were recorded in cuttings planted on 14th April. No specific trend was observed in interaction however thickest stems (14.67) were observed in cutting treated with 10% IBA and planted on 30th 14th April.

These results are opposing the findings of Elgimabi, (2009) regarding planting time. Increase in stem diameter may be due to the reason that when cuttings were treated with 10% IBA they produced more number of roots plant^{-1} with maximum leaf area which enhanced nutrients uptake and utilization. Thus more food was available for the healthier growth of the plants. These findings support the work of Ahmad et al. (2002) who observed thicker stem in hardwood cuttings when treated with IBA at 5000 ppm.

Table 4: Mean table for stem diameter as affected by IBA levels and planting time
LSD for IBA at 5% probability level = 1.0067

IBA Levels (%)	Planting Time			Mean
	15th March	30th March	14th April	
0	7.75	8.70	9.16	8.53 e
5	12.37	13.17	14.18	13.24 b
10	14.37	14.29	14.67	14.44 a
15	9.84	11.36	11.55	10.91 c
20	8.85	9.26	10.99	9.70 d
Mean	**10.63**	**11.35**	**12.11**	

Number of leaves Plant^{-1}

The mean data is presented in Table 5. ANOVA showed that number of leaves plant^{-1} were significantly affected by different levels of IBA while different planting times and their interaction have shown a non significant effect regarding number of leaves plant^{-1}. IBA at the rate of 5, 10, and 15% produced number of leaves (17.276), (16.501) and (16.501) plant^{-1} respectively that were not significantly different from one another but significantly different from the cuttings treated with 20% IBA (14.204) and cuttings treated with no IBA. While least number of leaves (9.554) plant^{-1} was observed in cuttings treated with no IBA. Planting time has shown a non significant effect however more number of leaves (14.844) plant^{-1} were observed in cuttings planted on 14th April followed by (14.716) planted on 15th March and least number of leaves (14.455) plant^{-1} were noted in cuttings planted on 30th March. No specific trend was noted in interaction however more number of leaves (17.870) plant^{-1} was observed in cutting treated with 05% IBA and planted on 14th April, whereas the least number of leaves (8.783) plant^{-1} was noted in cuttings treated with no IBA and planted on 30th March.

Maximum number of leaves plant^{-1} was produced in cuttings treated with 05% IBA. This may be due to IBA that produced healthier lengthy roots and hence absorbed more nutrients and water contents that have great influence on the number of leaves produced by the plant. These results are in conformity with the findings of Pathak et al. (2002) who observed that the cuttings of chrysanthemum when treated with IBA at 2500 ppm produced more branches and more number of leaves.

Table 5: Mean table for number of leaves plant^{-1} as affected by IBA levels and planting time
LSD for IBA at 5% probability level = 1.4990

IBA Levels (%)	Planting Time			Mean
	15th March	30th March	14th April	
0	10.120	8.783	9.760	9.554 c
5	16.567	17.390	17.870	17.276 a
10	16.327	16.820	16.357	16.501 a
15	16.397	15.480	15.590	15.822 a
20	14.170	13.800	14.643	14.204 b
Mean	**14.716**	**14.455**	**14.844**	

Leaf Area (cm^2)

Mean values are presented in Table 6. According to ANOVA, different levels of IBA has shown a significant effect on leaf area plant of Alstonia plants, while there was a non-significant effect of planting time and their interactions. The highest leaf area (26.032) was observed in cuttings treated with IBA at the rate of 10% followed by cuttings treated with IBA at the rate of 5% (23.389), IBA at 15% (22.291) and IBA at the rate of 20% (19.676) respectively, whereas the least leaf area (16.277) was noticed in cuttings treated with no IBA. Non significant effect pertaining to leaf area whereas higher leaf area (21.721) was noted in cuttings planted on 14th April followed by (21.574) planted on 15th March and the least leaf area (21.304) was observed in cuttings planted on 30th March. No linear relationship was observed as far as interaction between IBA and planting time was concerned. However maximum leaf area (26.253) was observed in cuttings treated with 10% IBA and planted on 30th March, whereas the least leaf area (15.540) was noted in cuttings treated with no IBA. The findings regarding planting time opposed the findings of Elgimabi, (2009) who reported significant effect of planting time on growth.

It has been observed that cuttings planted on 14th April, with IBA at the rate of 10% showed best results regarding leaf area. The reason behind this may be that uptake of nitrates depends on the number of roots and further more depends on the energy supplied by the plants themselves. Therefore the plants need to improve the photosynthetic rate and produce more photosynthates. Plants struggle to achieve this goal by expanding their leaves and hence more leaf area was observed. These results were similar to the findings of Siddiqui and Hussain (2007) who reported that with application of IBA leaf area was increased.

Table 6: Mean table for leaf area as affected by IBA levels and planting time

LSD for IBA at 5% probability level = 1.8484

IBA Levels (%)	Planting Time			Mean
	15th March	30th March	14th April	
0	17.073	15.540	16.217	16.277 d
5	23.170	22.160	24.837	23.389 b
10	26.513	26.253	25.330	26.032 a
15	22.030	22.757	22.087	22.291 b
20	19.083	19.810	20.133	19.676 c
Mean	**21.574**	**21.304**	**21.721**	

Number of roots plant^{-1}

Mean value is presented in Table 7. According to ANOVA, IBA is having a significant effect on number of roots plant^{-1} while planting time and their interaction have shown a non significant effect. More number of roots (15.613) plant^{-1} were observed in cuttings treated with IBA at the rate of 10% followed by 5% IBA (14.691) and 15% IBA (13.603) whereas 20% IBA and 0% IBA produced plants with the least number of roots (8.640) and (4.964) plant^{-1} respectively. Planting time has shown no significant effect on number of roots plant^{-1} but more number of roots (11.291) plant^{-1} were noted in cuttings planted on 14th April followed by 30th March (11.174) while lowest number of roots (10.243) plant^{-1} were noted in cuttings planted on 15th March. As already mentioned that there is no interaction against number of roots plant^{-1}, however highest number of roots (16.220) plant^{-1} were observed in cutting treated with 10% IBA and planted on 14th April while minimum (4.847) were recorded in control cutting with no IBA.

These results are in conformity with Alagesaboopathi (2011) who had also observed significant difference in number of roots of Andrograohis lineata cuttings when treated with different concentrations of IBA.

Table 7: Mean table for number of roots plant^{-1} as affected by IBA levels and planting time

LSD for IBA at 5% probability level = 1.0682

IBA Levels (%)	Planting Time			Mean
	15th March	30th March	14th April	
0	4.890	4.847	5.157	4.964 d
5	13.103	14.840	16.130	14.691 a
10	15.157	15.463	16.220	15.613 a
15	10.017	11.050	10.743	10.603 b
20	8.047	9.670	8.203	8.640 c
Mean	**10.243**	**11.174**	**11.291**	

Root Length (cm)

Data pertaining root length is presented in mean Table 8. The analysis of variance showed that root length is significantly affected by different levels of IBA while different planting times and interaction between them has shown a non significant effect on root length of Alstonia cuttings. The mean value shows that maximum root length (14.244) was observed in cuttings treated with 5% IBA while minimum root length (4.581) was recorded in cuttings treated with no IBA. Different planting times have shown a non significant effect on root length of Alstonia cuttings but maximum root length (11.681) was recorded in cuttings planted on 14th April. No specific trend was observed as far as interaction was concerned, however longest roots (15.617) were observed in cuttings treated with 5% IBA and planted on14th April while roots with least length was observed in cuttings treated with no IBA.

These results might be due to the reason that plants were having high number of leaves which needed more nutrients and water for food production. So the roots grew deeper in to the soil for locating more nutrients and thus resulted in an increased length. These results supported the findings of Alagesaboopathi (2011) who reported that IAA and IBA produced significantly longer roots than the control. They also observed that roots were profuse and branched in nature and that the percentage of rooting and root length were improved by using IBA and IAA.

Table 8: Mean table for root length as affected by IBA levels and planting time

LSD for IBA at 5% probability level = 1.2226

IBA Levels (%)	Planting Time			Mean
	15th March	30th March	14th April	
0	3.997	4.487	5.260	4.581 d
5	13.723	13.393	15.617	14.244 a
10	12.813	13.230	14.530	13.524 a
15	10.930	12.207	12.797	11.978 b
20	9.363	10.930	10.203	10.002 c
Mean	**10.165**	**10.751**	**11.681**	

Root Diameter (mm)

Mean values pertaining root diameter is presented in Table 9. According to ANOVA, IBA significantly affected root diameter, while there was a non-significant effect of planting time and their interaction on root diameter of Alstonia plants. IBA at the rate of 10% was recorded with maximum root diameter (3.4122) followed by 5%, 15% and 20% (2.5078), (2.0789) and (1.6789) respectively whereas cuttings treated with no IBA produced roots with the least root diameter (1.3900). There was no significant effect of planting time over root diameter but roots with maximum diameter (2.2053) were observed in cuttings planted on 30th March followed by 14th April (2.1667) while the least root diameter (2.1067) was observed in cuttings planted on 15th March. Mean values also shows that no linear relationship was observed in interaction, however cuttings planted on 14th April with IBA at the rate of 10% showed best results (3.3033) regarding root diameter while the least stem diameter (1.3000) was observed in cuttings treated with no IBA.

These results resemble the findings of Al-obeed (2000) who found thicker root in Guvava stem cuttings when treated with IBA.

Table 9: Mean table for root diameter as affected by IBA levels and planting time

LSD for IBA at 5% probability level = 0.2788

IBA Levels (%)	Planting Time			Mean
	15th March	30th March	14th April	
0	1.3200	1.3000	1.5500	1.3900 e
5	2.5167	2.4500	2.5567	2.5078 b
10	3.0233	3.1000	3.3033	3.1422 a
15	1.9433	2.1400	2.1533	2.0789 c
20	1.4500	2.0367	1.5500	1.6789 d
Mean	**2.1067**	**2.2053**	**2.1667**	

Survival percentage (%)

Data regarding survival percentage is presented in mean Table 10 .The analysis of variance showed that survival percentage is significantly affected by different levels of IBA while different planting times and interaction between them has shown a non significant effect on survival percentage of Alstonia cuttings. The mean value shows that highest survival percentage (70) was observed in cuttings treated with 5% IBA while lowest survival percentage (30) was recorded in cuttings treated with no IBA. Different planting times has showed no significant effect on survival percentage but maximum survival percentage (52.667) was recorded in cuttings planted on 14th April followed by 15th March (52.003) while the lower survival percentage of (52.333) was observed in cuttings planted on 30th March. The interaction value showed that highest survival percentage (73.333) was recorded in cuttings planted on 14th April with IBA level at the rate of 5 %. However a non significant effect was observed among interactions.

The high survival percentage of cuttings treated with 5% IBA may be due to the reason that plants established lengthier roots with high number of leaves plant^{-1}. This enhanced nutrients uptake and photosynthates production and provided sufficient food contents for the metabolic activities of the plants. These results supported the findings of Ahmad et al. (2002) who reported high survival percentage in cuttings of Bougainvillea when treated with IBA.

Table 10: Mean table for survival percentage as affected by IBA levels and planting time
LSD for IBA at 5% probability level = 9.4830

IBA Levels (%)	Planting Time			Mean
	15th March	30th March	14th April	
0	30.000	30.000	30.000	30.000 d
5	66.667	70.000	73.333	70.000 a
10	63.333	60.000	60.000	61.111 ab
15	56.667	53.333	50.000	53.333 bc
20	43.333	43.333	50.000	45.556 c
Mean	**52.005**	**51.333**	**52.667**	

IV. SUMMARY, CONCLUSION AND RECOMMENDATION

An experiment to assess different levels of IBA (Indole Butyric Acid) and planting time on rooting and growth of Alstonia cuttings was conducted at Ornamental Horticulture Nursery, Department of Horticulture, The University of Agriculture Peshawar, Pakistan. The objectives of the study were to investigate optimum level of IBA for rooting of Alstonia cuttings, to explore a suitable planting time for rooting of Alstonia cuttings and their optimum interaction. Five levels of IBA 0%, 5%, 10%, 15% and 20% were prepared by mixing IBA with talc powder. Cuttings were obtained from healthy, vigorous growing trees which were 15-20 cm long and 2-3 nodes. Leaves were removed from the cuttings and were treated with different levels of IBA than planted in plastic bags filled with mixture of sand, clay and FYM with the ratio of 1:1:1 on three different planting times 15th March, 30th March and 14th April.

Large number of leaves (17.276) plant^{-1} was observed in cuttings treated with IBA at the rate of 5% while the least number of leaves (9.554) plant^{-1} were recorded in cuttings treated with no IBA. Similarly more number of leaves (14.844) plant^{-1} was observed in cuttings planted on 14th April while least number of leaves (14.455) plant^{-1} was noted in cuttings planted on 30th March. The data regarding leaf area showed that highest leaf area (26.032 cm^2) was observed in cuttings treated with IBA at the rate of 10% and the lowest leaf area (16.277 cm^2) was noticed in cuttings of Alstonia treated with no IBA. Non significant affect of planting times was observed in cuttings regarding leaf area however, higher leaf area (21.721 cm^2) was noted in cuttings planted on 14th April and the least leaf area (21.304 cm^2) was observed in cuttings planted on 30th March. In case of sprout length 10% IBA resulted in maximum sprout length (18.096 cm) while least sprout length of (9.338 cm) was recorded in cuttings treated with no IBA. No significant effect was observed in cuttings planted on different times though increased sprout length (15.072 cm) was observed in cuttings planted on 14th April while the least sprout length (14.069 cm) was observed in cuttings planted on 15th March. Stem diameter was significantly affected by IBA and plants with thickest stem diameter (14.44 mm) were observed in cuttings treated with 10% IBA and least stem diameter (8.53 mm) was observed in cuttings treated with no IBA. Best results (12.11 mm) were recorded in cuttings planted on 14th April regarding stem diameter. More number of roots (15.613) plant^{-1} was observed in cuttings treated with IBA at the rate of 10% whereas the least number of roots (8.640) plant^{-1} was noted in cuttings treated with no IBA. Results regarding planting time revealed that there was a non significant effect of planting time over number of roots plant^{-1} however, more number of roots (11.291) plant^{-1} were recorded in cuttings planted on 14th April and least number of roots plant^{-1} were observed in cuttings planted on 15th March. IBA at the rate of 10% was recorded with maximum root diameter (3.4122 mm) whereas cuttings treated with no IBA produced roots with the least root diameter (1.3900 mm). As far as planting time is concerned highest root diameter (2.2053 mm) was observed in cuttings planted on 30th March while the least root diameter (2.1067 mm) was observed in those cuttings which were planted on 15th March. It has been observed that the highest survival percentage (70%) was observed in cuttings treated with 5% IBA while lowest survival percentage (30%) was recorded in those cuttings which were not treated with IBA. Regarding planting time the highest survival percentage (52.667%) was recorded in cuttings planted on 14th April while the lowest survival percentage of (52.333%) was observed in cuttings planted on 30th March. It has been also observed that increased root length (14.244 cm) was observed in cuttings treated with 5% IBA while least root length (4.581cm) was recorded in cuttings treated with no IBA. Non significant effect was observed regarding planting time however, maximum root length (11.681 cm) was recorded in cuttings planted on 14th April. The results showed that days to sprouting were not significantly affected by different levels of IBA and planting time however maximum days to bud sprouting (10.71) were observed in cuttings treated with 20% IBA while minimum days to bud sprouting (10.23) were observed in cuttings treated with no IBA. Similarly cuttings planted on 14th April took fewer days to bud sprout (10.58) while cuttings planted on 15th March took more days (10.60) to bud sprout. Likewise, sprouting percentage was also not significantly affected by different levels of IBA or planting time. Still it has been observed that higher sprouting percentage (72.22%) was observed in cuttings treated with 5% IBA while lowest sprouting percentage (66.66%) was observed in cuttings treated with IBA at the rate of 10%. Cuttings planted on 15th March showed high sprouting percentage of (72.667%) while cuttings planted on 30th March showed lowest sprouting percentage (66.000%).

Conclusion

The following conclusions were made from the findings of above experiment.

1. IBA level of 10% showed best results regarding leaf area plant^{-1}, sprout length, stem diameter, number of roots plant^{-1}, root diameter.
2. Cuttings planted at 14th April showed good results regarding leaf area plant^{-1}, sprout length, stem diameter, number of roots plant^{-1}, root diameter, number of leaves plant^{-1}, root length and survival percentage.

Recommendations

The following recommendations are drawn from the study for future

1. Since IBA level at 10 % has shown best results regarding rooting and growth, therefore recommended for rooting of Alstonia cuttings.
2. Further research should be conducted with more number of planting times extending to June-July.

IV. ACKNOWLEDGEMENT

I bow my head to "ALMIGHTY ALLAH" the omnipotent and omnipresent, for His blessing, especially the faculties that he endowed upon me and I was able and capable enough to undertake the task and complete it in a befitting manner. I offer my countless salutations upon the "HOLY PROPHET MUHAMMAD"(peace be upon him) the entire source of guidance for humanity as a whole fore ever. I am extremely thankful to my Supervisor, Dr. Gohar Ayub, Professor, Dr. Muhammad Zubair (Late) for their guidance, positive criticism, unstinting help and valuable piece of advice in planning and execution of my research. No words exist in the world to pay tribute to my "SWEET PARENTS" and family for giving tons of love, prayers and support.

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