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Effect of Different Concentration of Indole-3- Butyric Acid and Cutting Size on Rooting in Gmelina (*Gmelina arborea* Roxb.)

Mayavel, J Soosairaj, K Sreenivasan and A Nicodemus

Institute of Forest Genetic and Tree Breeding, R S Puram, Coimbatore- 641002 (Tamil Nadu)

ABSTRACT

Gmelina is a multipurpose tree species and naturally found in dry and moist deciduous forest. The success of large-scale plantation program fully depends on the planting of quality plant stock. Clonal propagation of selected genotypes will help to capture the full genetic potential of existing variation. The present experiment was conducted to investigate the effect of different concentration of Indole-3-Butyric Acid and size of cuttings for rooting and sprouting behavior of Gmelina cuttings. Rooting experiment was conducted in a completely randomized block design with four replication. The shoot cuttings were collected from the vegetative multiplication garden and graded based on size into different diameter classes. The four diameter classes *viz.,* 10mm,10-20mm,20-30mm and >30mm were formulated to estimate the potential of shoot/ root regeneration. Shoot cuttings were treated with different concentration of IBA *viz.,* 500, 1000, 2000, 3000 and 4000 ppm to assess the effect of IBA on rooting and survival. The cuttings were planted in the root trainer containing the rooting substrate of vermiculite. The root trainer was placed inside the low-cost polytunnel located inside the 75 per cent shade net. The observation of rooting and sprouting parameters were recorded 75 after planting into a rooting substrate. Among different concentration, IBA@ 2000 ppm and 10-20 mm diameter class of cuttings recorded higher value on rooting, sprouting and survival percentage.

Key Words: *Gmelina arborea*, Indole-3-Butyric Acid, Rooting, Survival.

INTRODUCTION

Gmelina (*Gmelina arborea* Roxb) is an indigenous, fast growing, multipurpose tree species belonging to the family of Lamiaceae and largely distributed into Eastern Sub Himalayan tracks, Aravalli Hills, Western Peninsula, North Eastern, Central and certain parts of Southern India (Troup, 1921). Wood is used for plywood, pulp (Moya, 2004), particle board (Chew and Ong, 1989), veneer (Sicad, 1987), structural uses (Gonzalez *et al*, 2004), Carpentry and Packing (Tuke, 1983). It is an ideal species suited for carving, board making, fuelwood and charcoal. The roots, fruits, leaves, bark, and flower is used for treating the scorpion sting, snake bites and diabetes. It is also useful for curing fever, heart disease, nervous disorder, dyspepsia, abdominal pains, piles and burning sensation (Kulkarni *et al,* 2012). It is a preferred species by the farmers, forest departments and ayurvedic industries due to multiple utilities, rapid growth, coppicing ability, higher wood value and maximum economic returns. Many Gmelina plantations were established through seedling raised from unselected seed sources and ultimately led to poor productivity. Poor germination will limit the large-scale production of quality planting stock. Due to difficulties involved in seed propagation of Gmelina, clonal propagation becomes a suitable alternative for deploying large-scale multiplication of superior clones.

Rooting for cutting is the most commonly used technique for clonal propagation and capturing the maximum genetic gain of the parents. However, it possesses some problems in the production process such as poor rooting, shooting and survival percentage and will affect the large-scale planting

Corresponding Author's Email: mayavela@icfre.org

programme. Application of vegetative and cloning techniques were useful for exploiting maximum genetic gain of existing variations (Chauhan and Chauhan, 2011). Clonal propagation provides opportunities to generate self-sufficiency's high-quality planting stock of selected genotypes and several tree species successfully propagated through branch cutting (Tchoundjeu *et al,* 2006). Dhiman *et al* (1988) reported that the *Morus alba* branch cuttings with 18-22 mm diameter have shown improved survival, rooting and growth performance. Husen and Pal (2001) and Nautiyal *et al* (1991) found the cutting treated with 2000ppm IBA shown maximum rooting percent and shoot growth in *Tectona grandis* L. The rooting of cuttings is affected by species nature, size of cutting, the season of propagation, rooting media, metabolic behavior response to external stimuli and presence of reserve food material in cutting. Therefore, the present investigation was aimed to assess the effect of different concentration Indole-3-Butyric Acid and size of cuttings on rooting, growth parameters and survival percentage in *Gmelina arborea*.

MATERIAL AND METHODS

The experiment was conducted in the Modern Nursery of Forest Land Use Climate Division, Institute of Forest Genetics and Tree Breeding, Coimbatore for testing efficiency of IBA concentration and cutting size on rooting traits. The geographic position of the study area is N 11°018'.77'' latitude, E 76°94'.71'' longitude and elevation 312 MSL. The study area is a low fertile land dominated by black cotton soil. The climate of this area receives rains of both South West and North East monsoons. Annual Rainfall is 750 mm and temperature varies from 23ºC to 35 ºC. Institute of Forest Genetics Tree Breeding has established Vegetative Multiplication Garden of Gmelina arborea with 60 clones selected from different parts of southern India. The shoot cuttings were collected form VAG and placed inside the bucket containing water to avoid desiccations. Shoot cutting of 15-20 cm length with one or two buds were prepared after excising the leaves. The cuttings were disinfected with Bavistin 1% solutions for 3-5 min. Rooting experiment was conducted in a completely randomized block design with four replication and each replication 40 cuttings were deployed.

Use of IBA

Powder formulations were prepared by mixing the growth hormones in required quantities to inert talc powder and adjusted to a concentration of 500 ppm, 1000 ppm, 2000 ppm, 3000 ppm and 4000 ppm following the procedure of Hartmann and Kester (1983). Basel end of the cuttings was treated with different concentration *viz.,* 500,1000,2000,3000 and 4000 ppm of IBA for 30 seconds (quick tip method).

Cutting size

Cuttings were graded based on size into different diameter classes. The four diameter classes *viz.,* 10mm,10-20mm,20-30mm and >30mm were formulated to estimate the potential of shoot/root regeneration.

Management of cuttings

The cuttings were planted in root trainer (40cc) container filled with vermiculite as a rooting substrate and placed into a low-cost polytunnel (80-90 % RH and temp 30±2ºC) located inside 75 % shade net and intermittent misting were done inside poly tunnel using rocker sprayer to maintain moisture vapour inside the polytunnel. New sprouts have emerged 7- 10d after planting and rooting were occurs 20-25d after planting. Hardening of rooted cutting was done inside shade house and gradually exposed into full sunlight. Rooted cuttings were transplanted to polythene bags containing sand: soil: farm yard manure (1:2:1) ratio. The growth and rooting traits such as the percentage of callusing, rooting percentage, shoot length, root length, number of roots, number of sprouts, number of leaves and survival percentage were observed 75 d after planting. The data were subjected to statistical analysis the significance and critical difference (CD 0.05%) value was calculated for comparing means.

Table-1, Effect of different concentration of Indole-3-Butyeic acid on rooting of cuttingsin *Gmelina arborea*.

I B A (ppm)	Callusing percentage (%)	Rooting percentage (%)	Shoot length (cm)	Root length (cm)	Number of roots	Number of sprouts	Number of Leaves	Survival (%)
IBA 500	15.58±0.93^{a}	24.75±0.85^{b}	12.25± 0.29^{c}	9.21± 0.29^{b}	12.25±0.49^{c}	3.33±0.27^{a}	3.08±0.18^{b}	15.25±.92^{b}
IBA1000	40.50±1.84^{b}	58.91±1.33^{e}	18.00± 0.50^{d}	12.25± 0.53^{c}	20.00±0.60^{d}	4.66±0.24^{b}	5.08±0.18^{d}	40.00±1.53^{d}
IBA 2000	85.92±1.49^{e}	82.08±1.15^{f}	22.83±1.14^{e}	16.00± 0.81^{d}	20.00±0.59^{e}	6.92 ± 0.26^{c}	8.25±0.20^{e}	75.36±1.14^{e}
IBA 3000	61.66±1.54^{c}	48.41±1.15^{d}	13.08± 0.40$_{c}$	8.25± 0.63^{b}	12.25±0.34^{c}	4.50±0.23^{b}	4.58±0.18^{c}	24.91±1.23^{c}
IBA 4000	68.75±2.67^{d}	37.50±1.39^{c}	7.58± 0.36$_{b}$	5.00±0.27^{a}	8.75±0.52^{b}	3.41±0.24^{a}	3.50±0.15^{b}	16.75± 0.77^{b}
Control	11.83±0.87^{a}	9.08±0.55^{a}	5.52± 0.26^{a}	3.92± 0.30^{a}	4.72±0.27^{a}	2.83±0.24$_{a}$	2.33±0.11^{a}	4.92±0.43^{a}

Means followed by the same letter in the same column are not significantly different at P ≤ 0.05 according to Tukey's Test.

Table-2, Effect of different concentration of Indole-3-Butyeic acid on rooting of cuttings in *Gmelina arborea*.

Size of cutting (mm)	Callusing percentage (%)	Rooting percentage (%)	Shoot length (cm)	Root length (cm)	Number of roots	Number of sprouts	Number of Leaves	Survival (%)
<10	46.66 ±1.49^{a}	40.33 ±1.19^{b}	12.75 ±0.26^{b}	5.08 ±0.3^{a}	3.83 ±0.21^{a}	3.58 ±0.15^{b}	9.91 ±0.25^{b}	22.91 ±0.58^{b}
10-20	90.52 ± 0.51^{d}	89.13 ±0.89^{d}	22.37 ±0.69^{d}	16.08 ±0.36^{d}	10.26 ± 0.28^{d}	6.75 ± 0.20^{d}	12.51 ±0.35^{c}	83.33 ±1.04^{d}
20-30	82.66 ±1.04^{c}	69.15 ±0.60^{c}	14.25 ±0.34^{c}	10.08 ±0.23^{c}	7.91 ±0.39^{c}	4.58 ±0.21^{c}	9.08 ±0.38^{b}	45.16 ±0.68^{c}
>30	78.83 ±1.30^{b}	10.46 ±0.43^{a}	15.90 ±0.40^{a}	18.20 ±0.31^{b}	5.51 ±0.36^{b}	6.76 ±0.20^{a}	4.26 ±0.26^{a}	6.25 ±0.32^{a}

Means followed by the same letter in the same column are not significantly different at P ≤ 0.05 according to Tukey's Test

RESULTS AND DISCUSSION

The effect of different concentration of IBA on rooting and growth parameters in the shoot cuttings of Gmelina are presented in Table1. Analysis of variance reveals that different concentration of Indole-3- Butyric Acid (IBA) resulted in significant differences in the traits such as the percentage of callusing, rooting percentage, shoot length, root length, number of roots, number of leaves and survival percentage. These indicated the rooting and sprouting traits of Gmelina cuttings were significantly promoted by application of IBA. Significant variation were recorded in callusing percentage (11.83 to 85.92), percentage of rooting (9.08 to 82.08), shoot length (5.52 to 22.83), root length (3.92 to 16), number of roots (4.72 to 20), number of sprouts (2.83 to 6.92), number of leaves (2.33 to 8.25) and survival percentage (4.92 to 75.36). However, the most significant effect was recorded on cuttings treated with a concentration of 2000 ppm of IBA (Table 1). The maximum effect on percentage of callusing (85.92), rooting percentage (82.08), shoot length (22.83), root length (16), number of root (20), number of sprouts (6.92), number of leaves (8.25) and survival percentage (75.36) were observed from the cuttings treated with 2000 ppm of IBA. The cutting was treated with water were recorded the lowest value of all the rooting and growth parameters. Last *et al* (1991) and Rose *et al* (1992) recorded the higher advantageous rooting under the concentration of 3 to 10mm. The best rooting and growth performance obtain in to study were in confirms the findings of Husan and Pal (2003) who observed that maximum rooting percentage of 88 per cent was recorded in cuttings treated with 2000 ppm of IBA. Meanwhile, the present finding contradicts with the findings of Patel *et al* (2017). They found the application of NAA 1000 ppm concentration resulted in maximum rooted percentage root dry weight and root-shoot ratio. Increasing or decreasing the concentration of IBA level had the effect the rooting and growth traits of Gmelina cutting.

The diameter of cutting had a significant effect on the shoot and root regeneration of the Gmelina cuttings. The data (Table 2) indicated a wide spectrum of rooting efficacy differed with a size of cutting for rooting, shooting and growth parameters. All the size of cuttings showed callus formation, however diameter class of 10 - 20 mm cuttings had maximum callusing of 90.52 per cent and whereas diameter class of < 10 mm showed a lesser percentage of callusing and subsequently failed root. The diameter class 10-20 mm had the maximum rooting percentage of 89.13 and followed by 69.15 per cent in the diameter class of 20 - 30 mm. Diameter class 10-20 mm also recorded higher value in a number of roots (10.26), the number of shots (12.51) and survival percentage (83.33). Cutting diameter class >30 mm observed maximum root length (18.20), shoot length (15.90) and the number of sprouts (6.76). Higher root length, shoot length and number of sprouts due to the presence of stored food materials in the cuttings. The present investigation confirms the finding of Dhiman *et al* (1988) in Morus alpha, Bowersox (1970) in Populus deltoids, Guleria and Vashisht (2014) in teak. Cuttings having a diameter of > 30 mm recorded the lowest rooting percentage (10.46), number of leaves (4.26), number of roots (5.51) and survival percentage (6.25). Poor rooting percentage of >30 mm class can be attributed due to the age of cuttings, the presence of inhibitory substances, lower rate of photosynthesis and endogenous auxin. The above finding confirms the finding of Husan and Pal (2006) in Teak.

CONCLUSION

The concentration of IBA can influence the shooting, rooting and survival of Gmelina shoot cuttings and however the higher or lower concentration may inhibit the rooting of Gmelina cutting. The present investigation showed that 2000ppm of IBA and cutting size of 10-20 mm has the highest impact on percentage of callusing, rooting percentage, number of roots, number of leaves and survival percentage Hence, it may be recommended that IBA 2000ppm and 10-20 mm size of cuttings can be utilized for large-scale multiplication of selected superior genotypes.

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