

## IMPACT OF INDOLE -3- BUTERIC ACID AND INDOLE -3- ACETIC ACID ON SURVIVAL PERCENTAGE OF *TERMINALIA ARJUNA* (ROXB.) STEM CUTTINGS

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Received-07.12.2019, Revised-26.12.2019

**Abstract:** IBA and IAA concentrations were examined to determine the Survival percentage of *Terminalia arjuna* (Roxb.) by vegetative propagation via rooting in stem cuttings. The experiment was laid out in a completely randomized design (CRD) with three replications. One-year old leafless branch cuttings were treated with 0, 500, 1000, 1500 and 2000 mg L<sup>-1</sup> concentrations of IBA and IAA and planted in poly bags grown under phyto-environmentally controlled mist chamber. Results shown that minimal survival percentage was recorded in untreated cuttings (control), and significantly increased with an increase in concentration of IBA and IAA. Among two auxins, IBA emerged most effective on survival percentage, inducing rooting, sprouting and associated traits. Auxins concentration 2000 mg L<sup>-1</sup> was recorded maximum 66.88% of plants survived and achieved over 70% rooting in cuttings. It also triggered more number of roots, higher root length, shoot proliferation, maximum shoot and root biomass. This paper discusses the role of growth hormones (IBA and IAA) impact on survival percentage of stem cuttings influencing rooting and has a practical implication for the development of protocol for asexual propagation and establishing clonal plantations of *Terminalia arjuna*.

**Keywords:** Auxins, Clonal multiplication, Multipurpose tree, Plus trees

### INTRODUCTION

*Terminalia arjuna* belongs to the Combretaceae family and about 200 species commonly distributed across the world. *Terminalia* genus among various species such as *Terminalia tomentosa*, *Terminalia arjuna*, *Terminalia bellerica*, *Terminalia chebula*, *Terminalia paniculata*, *Terminalia catappa* species are commercially exploited in India. *Terminalia arjuna* used for different purposes viz., timber and non wood products such as gums, dyes, resins, tanning extracts and posses some medicinal alcoholoids. Among them, *Terminalia arjuna* and *Terminalia chebula* are commonly encouraged in plantations in dry tropical regions. *Terminalia arjuna* (Roxb.) commonly known as *Arjun* is the important multipurpose tree source of high medicinal value and used in angina pain, hypertension, congestive heart failure, and dyslipidemia (Amalraj and Gopi, 2016). *Arjuna* distributed throughout tropical and subtropical regions in India mostly near moist tracts along the streams, river banks and moist dry tropical forest areas. The bark or leaf decoction or infusion is considered antibacterial, ant mutagenic, antioxidant and hypo-cholesterolomic and anti inflammatory effects (Anand et al., 2015). The wood has high calorific value, makes excellent fire wood, and produces good quality charcoal for producing gas plants. The *arjuna* is one among the primary host plants for rearing *Antheraea mylitta* insect, which produces commercial important Tassar silk primarily grown in Jharkhand, Chhattisgarh, Odisha, West Bengal, Telangana, Madhya Pradesh and Maharashtra states. It is a backbone for tribal

development because about 1.25 lakh tribal families are associated with tassar culture in the country (Siddiqui and Hussain, 2007). Government of India is further promoting increase production of Kosa-silk to provide livelihoods for people residing in rural areas and this could be possible through clonal plantation of superior phenotypes of Arjun having high protein and nutritive values and use of high yielding eco races of *Antheraea* sp. Commercial exploitation of this plant is hampered by the shortage of superior planting stock, primarily due to the difficulties experienced in propagating species using the conventional method of multiplication method of multiplication by seeds due to poor seed viability, inadequate germination and lower survival under field conditions (Nayagam and Varghese, 2015). Moreover, *Terminalia arjuna* is a cross pollinated species exhibit a wide variability in terms of growth and foliage quality. Selection of novel genotypes for silk worm rearing and development of rapid methods of multiplication are necessary for commercial exploitation.

### MATERIALS AND METHODS

Experiment was conducted in mist chamber of Forest Nursery, College of Forestry, SHUATS, Allahabad, Uttar Pradesh during the year of 2017-18. One year old stem cuttings of *Terminalia arjuna* were collected from selected from 25-30 year mature mother phenotypes during winter months. Old superior mother phenotypes were selected with good qualities of leaves, stem and bark compared to normal population. The leafless stem cuttings about 15 cm length and 1-2 cm in diameter with 4-5 buds

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were taken from the phenotypes. The stem cuttings were treated with different concentrations of IBA and IAA viz., 0, 500, 1000, 1500 and 2000 mg L<sup>-1</sup>. The basal cut ends up to 2.5cm of stem cuttings was dipped in IBA and IAA solutions for 24 hours duration, simultaneously stem cuttings were planted in the polythene bags (10 x 6 inches) containing Sand, FYM and Red soil in equal proportions. One-third length of the cuttings was inserted in the rooting medium and arranged in phyto-environmentally controlled mist propagation unit according to Completely Randomized Design (CRD). The basal ends of the cuttings were dipped in 0.2% Bavistin solution just before planting to prevent attack of

pathogens. Each treatment had 27 cuttings. In all 270 (Table 1: nine treatments viz. four of IBA, four of IAA and one control with 10 cuttings per treatment in three replications) cuttings of species were planted in factorial completely randomized design. Three factor effect factorial experiment in completely randomized design with growth hormone as treatment factor, concentration as nested factor into treatment factor and species as third factor was employed. Observations on survival percentage were recorded at 90 days after planting of stem cuttings. The significance of treatments was tested using F test.

**Table 1.** Treatments×concentration×Auxin

Treatments	Concentration	Auxin
T <sub>0</sub>	0 ppm	Control
T <sub>1</sub>	500 ppm	IBA
T <sub>2</sub>	1000 ppm	IBA
T <sub>3</sub>	1500 ppm	IBA
T <sub>4</sub>	2000 ppm	IBA
T <sub>5</sub>	500 ppm	IAA
T <sub>6</sub>	1000 ppm	IAA
T <sub>7</sub>	1500 ppm	IAA
T <sub>8</sub>	2000 ppm	IAA

## RESULTS AND DISCUSSIONS

Limited survival percent, [Table 2: (23%)], was achieved in untreated cuttings, but the application of plant growth regulators (IBA and IAA) significantly ( $P < 0.05$ ) increased surviving 31% to 66% in stem cuttings. Lower concentrations of IBA and IAA (500 mg L<sup>-1</sup>) were also least effective and statistically at par with untreated cuttings. There is an overwhelming evidence that plant growth regulators such as auxins promote rooting, which can be either naturally occurring within the plant (endogenous) or applied to the plant (exogenous) during vegetative propagation (Kumar et al., 2009; Siddiqui and Hussain, 2007; Singh, 2001). Synthetic auxins like IBA, IAA and NAA are most commonly used to promote root development in clonal propagation. Auxin promotes the starch hydrolysis and the mobilization of sugars and nutrients at the base of the cuttings during the regeneration of adventitious roots (Khare 2007).

The Survival percentage increased with an increase in concentrations of IBA and IAA. A numerically, higher Survival percentage 66.88% and 53.25% were recorded in cuttings treated with 2000 mg L<sup>-1</sup> IBA and IAA respectively, in *Terminalia arjuna*. The minimum Survival percentage of 23.24% was recorded in control treatment of, in *T. arjuna*.

However, there were significant differences found between control and 500 mg L<sup>-1</sup>, 1000 mg L<sup>-1</sup> and 1500 mg L<sup>-1</sup>, 1500 mg L<sup>-1</sup> and 2000 mg L<sup>-1</sup> treatments of IBA and IAA for number of leaves in *Terminalia arjuna*. Survival percentage increased progressively with an increase in IBA and IAA concentrations and lowest Survival percentage was occurred in cuttings untreated cuttings. Similar type of results were also reported by Singh *et al.* (2014) that the 2000 mg L<sup>-1</sup> of IBA treatment gave highest Survival percentage on cuttings in *Morus alba*. The increase in percentage may be due to vigorous rooting induced by the growth regulator enabling the cutting to absorb more nutrient and thereby producing more survival as reported by Stan cato *et al.* (2003).

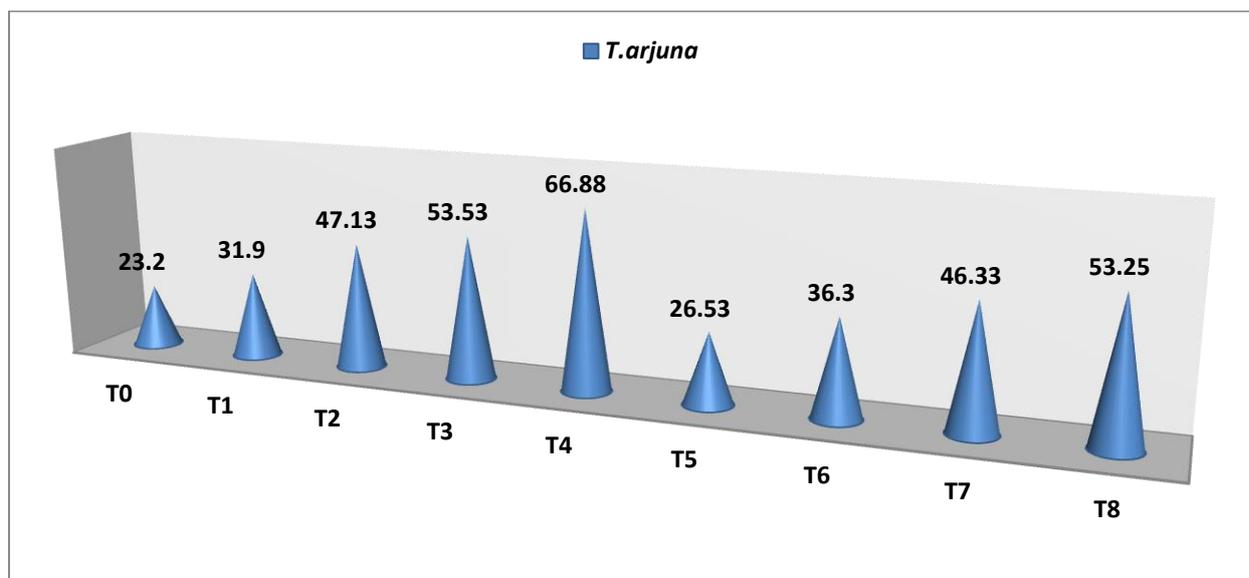
The present study revealed that IBA treatments were more efficient than IAA in inducing rooting of stem cuttings. Further, the survival percent steadily increased with an increase in concentration of auxins from 500 mg L<sup>-1</sup> to 2000 mg L<sup>-1</sup>. These results are consistent and corroborated with the findings of earlier workers, who demonstrated that IBA was most effective auxin in triggering rooting in stem cuttings than IAA and NAA (CSIR 2002; Jayaram kumar, 2006; Singh, 2001). IBA is a strong auxin, while IAA is readily destroyed (Leopold, 1995). IBA may also enhance rooting via increased internal-free

IBA, or may synergistically modify the action of IAA or the endogenous synthesis of IAA; IBA can enhance tissue sensitivity for IAA and increase rooting (CSIR 2002). The effectiveness of higher concentrations of IBA and IAA on survival (%) in this study confirms that high auxin is required to compensate for the low endogenous levels of auxin in mature cuttings especially in difficult to root species. *Terminalia arjuna* is difficult to root species (Leakey et al., 1982), as such it needs higher concentrations of auxins for triggering rooting in

stem cuttings. The auxin treatments significantly increased survival (%) [Table-2]. With the exogenous application of adequate IBA levels, the callus further differentiated into xylem leading to the production of roots. In conclusion, the vascular differentiation of cells and formation of roots was taken directly with the use of higher concentrations of IBA and IAA in *Terminalia* spp, a difficult to root species, whereas the lower concentration ended with callusing and little differentiation in to roots.

**Table 1.** Effect of different concentrations of IBA and IAA on survival percentage of *Terminalia arjuna* (Roxb.).

Treatments	Survival (%)
Control(water)	23.24
IBA 500 mg L <sup>-1</sup>	31.90
IBA 1000 mg L <sup>-1</sup>	47.13
IBA 1500 mg L <sup>-1</sup>	53.53
IBA 2000 mg L <sup>-1</sup>	66.88
IAA 500 mg L <sup>-1</sup>	26.53
IAA 1000 mg L <sup>-1</sup>	36.30
IAA 1500 mg L <sup>-1</sup>	46.33
IAA 2000 mg L <sup>-1</sup>	53.25
F Test	S
SE(±)	1.546
CD at 0.05%	2.165



**Fig 1.** Effects of auxins application on the survival percentage (%) of *Terminalia arjuna* cuttings.



**Fig 2.** Sproutings of *Terminalia arjuna*

The results are in conformity with the reports of earlier workers (Luna R.K. et al. 2006), who stated that IBA treatments increased both survival and rooting percent in cuttings of *Ficus* spp. Several researchers also reported that exogenous application of auxin treatments especially IBA and IAA enhanced root proliferation and as well as root number in many species (Zhang X, et al 1997, Kumar A et al 2000). Increase in length of the roots might be due to an early initiation of roots at higher concentrations of IBA and therefore more utilization of the nutrients due to early formation of the roots.

## CONCLUSION

The present study concludes that significant results were observed in IBA and IAA treatments than control. The study evolved an effective and rapid cutting propagation protocol for mass multiplication of *Terminalia arjuna* (Roxb.). IBA 2000mg L<sup>-1</sup> concentration recorded highest survival percentage among all treated cuttings of *Terminalia arjuna* (Roxb.). It is also suggested to plant cuttings during spring season under phyto-environmentally controlled mist chamber; it will be possible to produce over eighty percent of survival in stem cuttings, which can be an asset for establishing clonal plantations of *Terminalia arjuna* (Roxb.). It also concludes that plant hormones play a vital role in higher root growth and facilitates maximum survival percentage under mist chamber conditions.

## ACKNOWLEDGEMENT

The authors acknowledge the facilities provided by the College of Forestry, SHUATS, Allahabad, India for conducting the research work in the mist chamber. The authors also express the sincere thanks to technical staff for helping in conducting the experiment.

**Authors' contribution:** The first author conducted the research experiment and collected the data. Second author prepared and revised the MS, while the third author analyzed the data and prepared the graphics.

**Ethical approval:** This article does not contain any studies with human participants or animals performed by any of the authors.

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*International Journal of Agriculture and Forestry*, p  
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