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C Kiruthika
Research Scholar, Department of Sericulture, Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam, Tamil Nadu, India

Susikaran S
Assistant Professor, Department of Sericulture, Forest College and Research Institute, Tamil Nadu Agricultural University. Mettupalayam, Tamil Nadu, India

Parthiban KT
Dean (Forestry), Forest College and Research Institute, Tamil Nadu Agricultural University. Mettupalayam, Tamil Nadu, India

Krishnamoorthy SV
Professor (Entomology), Department of Agrl. Entomology, CPPS, TNAU, Coimbatore, Tamil Nadu, India

Corresponding Author:
C Kiruthika
Research Scholar, Department of Sericulture, Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam, Tamil Nadu, India

Role of Auxins on growth of apical shoot cuttings of mulberry (*Morus indica* L.) using Mini clonal technology

C Kiruthika, Susikaran S, Parthiban KT and Krishnamoorthy SV

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Abstract
An experiment was conducted to analyse the effect of rooting hormone, auxin and their concentration on rooting and growth traits of mulberry (*Morus indica* L.) variety 'V1' using Mini-clonal technology. Experimental material consists of two hormones such as, Indole-3-Butyric Acid (IBA) and Napthalene Acetic Acid (NAA) with different concentrations (1000, 2000, 3000, 4000, 5000 ppm) and control were replicated four times. Apical shoot cuttings were treated with different hormonal concentrations and placed in suitable rooting medium under greenhouse conditions. Parameters namely rooting per cent, numbers of roots per plant, root length (cm), number of leaves per plant were recorded at 90th day. Among all treatments IBA at 3000 ppm performed well for rooting and growth traits of mini cuttings of mulberry.

Keywords: V1 variety, apical shoot cutting, rooting hormone

1. Introduction
Mulberry (*Morus indica*) belongs to the family of Moraceae. It is a fast growing deciduous woody perennial tree and has deeper root system. There are about 68 species of mulberry species are available across the world and the most commonly used species in India are *M. indica* (Indian mulberry), *Morus alba* (White mulberry), *Morus serrata* and *Morus laevigata* (Datta, 2000) [2]. Most of the species in genus *Morus* are diploid and has 28 chromosomes. Mulberry can survive under various climatic conditions ranging from temperate to tropical and is found between 28°N and 55°N latitude. The ideal range of temperature required is 24°C to 28°C with annual rainfall of 600 to 2500 mm. It has been cultivated throughout the year in the southern parts of India namely Tamil Nadu, Karnataka, Andhra Pradesh and Telangana [10].

Usually, all parts of mulberry possess various medicinal properties especially bark and fruits have potential antioxidant, antiviral, antihyperglycemic, hypolipedimic activities (Singh, 2008) [26]. Indian sericulture industry is revolved on the maximum production of quality mulberry leaves. Hence, more attention has been given to their improvement in the recent past. Leaf quality is influenced by various factors *viz.*, genotypes, cultivation practices, preservation techniques, age and position of leaf and moisture content. Propagation of mulberry plants are done through various methods like seed, stem cuttings and grafting (Hawramee *et al.*, 2019) [9]. According to the prevailing environmental conditions and soil properties, different methods of vegetative propagation are adopted.

In mulberry, seed propagation is not viable, as they exhibit only 20 to 30 per cent survival rate with poor germination (Vijayan *et al.*, 1997) [32] hence, grafting and cutting propagation methods are used (Hartmann *et al.*, 1990) [5]. In India mulberry is generally propagated through semi hard wood cuttings by either directly planted in main field or raised in nursery and transplanted to field. Often, direct planting of cuttings in main field leads to poor survival rate and undesirable growth. Even under nursery conditions, the rate of successful root growth of cuttings mainly relied upon growing seasons (Prakash *et al.*, 2017) [23] as well as their maintenance and management cost (Sabarish, 2017) [27].

There are several factors which can affect the rooting potential of stem cuttings include the nature of species, cultivar needs, source, condition of stock plant and pest and disease attack. Besides these growing conditions such as media, mist, bottom heat, use of hormones, fertilizer and supplemental lighting are also significantly influenced (Hartmann *et al.*, 2002) [6].

Mini clonal technology provides one alternative tool for production of large number of plants in short time and space and exhibits improved rooting potential, rooting speed, quality root system with reduced cost when compared to stem cuttings (Parthiban and Seenivasan, 2017) [19]. There are many tree species successfully executed by mini cutting technique *viz.*, *Melia dubia*, *Casuarina sp*., *Eucalyptus sp*., *Tectona grandis* and *Dalbergia sissoo* (Parthiban *et al.*, 1999) [20]. The main focus on mini cutting technique is to use the juvenile cuttings as source of planting material. Apical shoots are used as mini cuttings which are placed in rooting medium in greenhouse equipped with appropriate temperature and humidity control. The actual size of mini cuttings taken for growth is 7 to 8 cm with two to three leaf pairs. The efficiency of mini apical cuttings is significantly higher than stem cuttings (Parthiban and Seenivasan, 2017) [19]. Auxin group of hormones plays a vital role in root formation and Indole-3-Butyric Acid (IBA) is widely used hormone in nursery which is commonly used at a wide range of concentrations along with NAA (Ruppert, 1974) [23]. They show an indirect influence by enhancing the speed of transformation of rooting primordia and movement of sugars to the base of cuttings and these led to formation of active roots. However, only limited studies have been conducted in evaluating the role of auxin on mulberry growth and development. In this context the present study was conducted to elucidate the potential of auxin on rooting efficiency of mulberry apical cuttings.

2. Materials and Methods

An experiment was carried out at Forest College and Research Institute, Department of Sericulture, Mettupalayam located at 11°19'N, 76°56'E, 300 meters MSL, 800 mm rainfall. Apical shoot cuttings taken from a ruling variety V1, variety of Indian mulberry. These mini cuttings were harvested from their mother plants using sterile pruning secateurs in early morning to avoid the over expression of sunlight. Later they were trimmed to 7 to 8 cm length using scissors. Selected cuttings were kept in cooled container to prevent the desiccation and before planting they were treated with fungicidal solution Carbendazim 50% WP for 20 minutes followed by washing in distilled water. Rooting hormone of IBA and NAA were separately prepared at different concentrations *viz*., 1000, 2000, 3000, 4000 and 5000 ppm in powder form. Instead of stock solution talc based formulations were prepared by mixing required quantity of rooting hormone (100mg, 200mg, 300mg, 400mg, and 500mg/100g of talc respectively) with boric acid crystal, bavistin and talc powder. The treated cuttings were planted in suitable rooting medium (Soil+ FYM+ Coir pith) and kept inside the low cost polytunnel under shade net at a temperature of 25-35°C and relative humidity of 75 to 80 per cent with intermittent spraying of water using rose cans and subsequently kept in a mist chamber. After 90 days observations were recorded on rooting per cent, number of roots per plant, number of leaves per plant, root length (cm) in all treatments.

2.1 Statistical Design

The experimental data were laid out in Completely Randomized Design (CRD) with four replications. Data were subject to Analysis of Variance (ANOVA) for significance as per the procedure devised by Panse and Sukhatme (1978) [18] and means were separated at 95 per cent (P=0.05) significance level.

3. Results and Discussion

3.1 Effect of rooting hormone on rooting per cent of apical cuttings of mulberry

In case of different concentrations of IBA and NAA, IBA at 3000 ppm recorded highest rooting per cent compared to other treatments. Rooting per cent in IBA at 3000 ppm was 74.00% followed by NAA at 4000 ppm was 31.00%. Hormone application promotes and increases the root formation. The highest rooting per cent was obtained from black mulberry cuttings in 3000 ppm IBA application (100%) (Kalyoncu *et al.*, 2009) [14]. Koyuncu and senel, 2003[13] reported that black mulberry cuttings treated with 5g l^{-1} IBA dose in bunch planting method suits for its better rooting. The increase in Auxin concentrations led to increase in rooting per cent in oleander plant up to 3000 ppm IBA and subsequent increase in IBA leads to decrease in rooting reported by Habibi, 2010 [7]. A higher dose of auxin (200 ug per cutting) had shown to inhibit rooting in cuttings of certain clones of *Triphlochitonscleroxylon* (Leakey *et al.*, 1982b) [16]. Similarly, In our study when Auxin concentration increases beyond 3000 ppm rooting per cent was decreased. There are similar findings which supports the Auxin application could increase the rooting per cent in many species (Husen *et al.*, 2015 [8]; Singh *et al.*, 2014 [28]; Singh *et al.*, 2011 [30] in *Bougainvillea glabra*; Singh *et al.*, 2013 [29] in *Citrus lemon* cv. Cuttings; Packialakshmi and Sudhagar, 2019 [21] in teak mini cuttings).

3.2 Effect of rooting hormone on number of roots of apical cuttings of mulberry

Results revealed that, using of two hormones such as IBA and NAA, maximum number of roots recorded in IBA compared to NAA. IBA @ 3000 ppm registered maximum number of roots (16.42) at 90 DAP followed by NAA @ 4000 ppm (14.62). Apical cuttings treated with IBA at 3000 ppm produced more number of roots which might be due to optimum hormonal effect that accumulates essential internal substances and facilitates their downward movement in *Psidium guajava* by Rani *et al.*, 2018 [24]. Ullah *et al.*, 2005[31] reported that induction of more roots in cuttings due to stimulation of cambium activity by hormonal application in many species. The variation in dose response to the number of roots might be attributed to the varietal and climatic differences in the location (Pallavi *et al.*, 2018) [17].

3.3 Effect of rooting hormone on root length of apical cuttings of mulberry

Present investigation revealed that, among all treatments IBA recorded maximum root length. At 90 DAP the maximum root length registered in IBA at 3000 ppm was 23.06 cm followed by NAA at 4000 ppm (22.32 cm) and NAA at 5000 ppm (20.96 cm). Similarly hormonal influence which led to maximum root length was reported by Krishankumar, 2018 [12] in mulberry. According to Ghatnatti, 1997 [4] maximum root length was possible to the action of auxin activity which might be caused due to hydrolysis and translocation of carbohydrates towards the cuttings base lead to cell division and cell elongation. Baroudi *et al.*, 2017 [1] reported that softwood cuttings of mulberry (*Morus alba*) treated with 2000 ppm IBA performed well in terms of root length, number of roots and rooting per cent. The present findings are similar to the findings of Galavi *et al.*, 2013 [3] in *Vitis vinifera* and Kumar (2011) [15] in *Melia dubia*.

3.4 Effect of rooting hormone on number of leaves of apical cuttings of mulberry

In the present investigation, among the different treatments (IBA and NAA), IBA at 3000 ppm recorded the maximum number of leaves with 27.75 at 90 DAP followed by IBA at 4000 ppm recorded 23.50. The increase in number of leaves with 2000 ppm IBA might be due to more number of roots, plant height and more number of branches in mulberry cuttings reported by Pallavi *et al.*, 2018 [17]. Similarly the influence of IBA on number of leaves might be due to activation of shoot growth leading to an increased number of nodes that leads to development of more number of leaves reported in *Psidium guajava* L. (Wahab *et al.*, 2001) [33], *Ficus Hawaii* (Ismail and Asghar, 2007) [11], Kiwi cuttings (Riaz *et al.*, 2007) [25] which supports the current study.

Table 1: Effect of IBA on growth attributes in apical shoot cuttings of *Morus indica*

Treatments (IBA)	On 90 DAP			
	Rooting per cent	Number of roots/plant	Root length (cm)/plant	Number of leaves/plant
T_1- IBA @ 1000	23.33	8.96	14.53	16.00
T_2- IBA @ 2000	40.22	10.27	17.06*	19.25
T_3- IBA @ 3000	74.00*	16.42*	23.06*	27.75*
T_4- IBA @ 4000	47.00	13.76	20.37*	23.50
T_5- IBA @ 5000	40.76	11.28	18.65*	20.50
Control	0.00	0.00	0.00	0.00
Mean	45.07	12.13	12.13	21.40
SEd	0.94	1.93	1.93	3.44
CD at 0.05%	2.02	4.12	4.12	7.34

Significant @ *P*=0.05 level

Table 2: Effect of NAA on growth attributes in apical shoot cuttings of *Morus indica*

Treatments (NAA)	On 90 DAP			
	Rooting per cent	Number of roots/	Root length (cm)/plant	Number of leaves/plant
T_1- NAA @ 1000	0.00	0.00	0.00	0.00
T_2- NAA @ 2000	16.00	7.45	14.45	9.25
T_3- NAA @ 3000	24.00	12.24*	17.63*	14.50*
T_4- NAA @ 4000	31.00*	14.62*	22.32*	20.25*
T_5- NAA @ 5000	27.00	12.73*	20.96*	17.00*
Control	0.00	0.00	0.00	0.00
Mean	21.40	9.40	15.07	12.19
SEd	3.44	0.16	0.20	0.27
CD at 0.05%	7.34	0.34	0.44	0.58

Significant @ *P*=0.05 level

4. Conclusion

In perusal, the findings of the present investigation suggests that IBA at 3000 ppm evoking the effective concentration for important growth traits in mulberry apical cuttings using mini-clonal technology. Presently, no such protocols available for propagation of mulberry through mini-cuttings. This Mini-clonal technology is mostly used for propagation of tree species. This is proposed because of high rooting potential, more number of plants per year, quality root system with reduced cost. Hence, the present study has standardized the rooting hormone and its effective concentration for mass multiplication of mulberry in shorter time and space.

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