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Research Article

INFLUENCE OF ROOTING HORMONE AND ROOTING SUBSTRATE ON GROWTH OF APICAL SHOOT CUTTINGS OF MULBERRY (*MORUS INDICA* L.) USING MINI CLONAL TECHNOLOGY AT NURSERY LEVEL

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ABSTRACT

An experiment was conducted at Department of Sericulture, Forest College and Research Institute, Mettupalayam to analyse the effect of rooting hormone and their concentrations, rooting medium on apical shoot cuttings of mulberry. Auxin with various concentrations namely IBA and NAA (1000, 2000, 3000, 4000 and 5000 ppm) and rooting mediums such as Soil, Soil: Sand: FYM (1:1:1), Soil: Coir pith (1:1), Soil: Sand: Vermicompost (1:1:1) and Soil: Coir pith: FYM (1:1:1) were used for this study. Mulberry apical cuttings were treated with different hormonal concentrations and placed in different rooting medium under shade house condition. After planting survival per cent, sprouting per cent, rooting per cent and shoot length of the plants were examined. Among the various interaction effect, IBA at 3000 ppm treated plants placed in Soil: Coir pith: FYM medium performed well in all parameters.

Keywords: Apical cuttings, Mulberry, Rooting hormone, Rooting medium.

INTRODUCTION

Mulberries are typically propagated both sexually and asexually. Seeds are used in sexual propagation. Layering, grafting, and cutting are examples of asexual propagation. Many vegetative propagation techniques are commonly used in many nations based on the characteristics of the soil and the surrounding environment (Edward and Dennis, 1994). Due to heterozygosity in nature, seeds are not commercially viable. Hence the seed grown plants show high degree of variability and also poor survival percentage of 20 to 30 (Vijayan *et al.,* 1997). In India, mulberries are typically grown via semi-hard wood cuttings. These cuttings can be raised in nurseries before being transferred to the main field. Cuttings planted directly into the main field have a low survival rate and slower development. Hence they are raised in nursery for 90 days and then transplanting is done. The advantage of propagating through stem cuttings is the ability of maintaining the good characteristics of mother plant without any alteration and adaptability to various agro-climatic conditions. Even under nursery conditions, success percentage depends on season in which they have grown (Prakash *et al.,* 2017). However, triploid varieties could only be propagated vegetatively due to its sterile nature (Narayan *et al.,* 1989).

Mini clonal technology is a technique which helps in the production of large number of plants in short time with limited space. At its core, mini clonal technology leverages techniques like tissue culture and micropropagation to generate a large number of clones from a single, selected plant. This approach not only accelerates the production process but also enhances the resilience and productivity of mulberry plantations. By maintaining genetic purity and optimizing growth conditions, this technology significantly improves the overall health of the plants and their adaptability to varying environmental conditions (Parthiban and Seenivasan, 2017). The adoption of mini clonal technology in mulberry cultivation holds great promise for boosting silk production, improving quality, and supporting the sericulture industry. It represents a significant advancement in agricultural biotechnology, offering a

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sustainable solution to meet the growing demands for high-quality mulberry crops. Using the juvenile cuttings as a source of planting material is the primary goal of the micro cutting technique. This technique mainly involves treating of apical shoots in rooting medium under greenhouse equipped condition with appropriate temperature and humidity control. The ideal size of mini cuttings taken for growth was 7 to 8 cm with two to three leaf pairs. Compared to stem cuttings, miniature cuttings have a substantially higher efficiency. When compare to the traditional stem-cutting method of propagation mini-cuttings have many advantages leading to operational, technical, economic, environmental and quality benefits. The labour cost is reduced, due to elimination of labour intensive operations. Thus various studies have been carried out in growth of mulberry using stem cuttings but only scanty information is available on propagation of mini cuttings. In this framework the present study was conducted to analyse the rooting hormone and rooting medium effect on apical shoot cuttings of mulberry.

MATERIALS AND METHODS

The experiments were carried out at Department of Sericulture, Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam located at 11˚19'N, 76˚56'E, 300 meters MSL with rainfall of 800 mm. V1 variety was used as mother source to harvest propagules for mini clonal propagation. Apical shoot cuttings were excised from mother garden and the cuttings were further trimmed to mini size. The mini-cuttings were harvested using sterile pruning scissors during early morning hours. Before using the shoot for various hormone treatments, all of its leaves aside from two near the apical point—were removed. A 45˚ angle, slanting cut was made at the base of all the apical cuttings. After preparation, cuttings were given a prophylactic treatment against fungal disease using aqueous solution of 0.2 per cent carbendazim 50 % WP for 20 minutes, subsequently washed with distilled water. After fungicidal treatment mini cuttings were subjected to various auxin treatments such as IBA and NAA with different concentrations *viz.,* 1000 ppm, 2000 ppm, 3000 ppm, 4000 ppm and 5000 ppm (Sabarish, 2017). After auxin treatment, the apical shoot cuttings were planted in polybags containing different rooting medium such as Soil, Soil: Sand: FYM (1:1:1), Soil: Coir pith (1:1), Soil: Sand: Vermicompost (1:1:1) and Soil: Coir pith: FYM (1:1:1). The 1/3 basal cut portion was inserted in different rooting media using sticking technique. In order to make complete wetting on entire cut surface, holes were made in each bag to avoid the damage of cambium and to prevent the removal of rooting hormone. Later the cuttings were planted in rooting medium and kept inside the low cost poly tunnels under shade net. The intended humidity range of 80 to 90 percent was maintained by irrigation once a week. The temperature in the poly tunnel was maintained at 33 ± 1°c. After planting biometric parameters were recorded on survival per cent, rooting per cent, sprouting per cent and shoot length (90 DAP) in all treatments.

Statistical design

All data were subjected to statistical analysis to assess the possible relationship between different parameters and analysis of variance by Factorial Completely Randomized Design with four replications. The stage wise data were analysed separately using AGRES software.

RESULTS AND DISCUSSION

Significant difference in survival per cent was observed due to various concentrations of IBA and NAA. The highest mean survival per cent recorded in IBA @ 3000 ppm (65.32 %) was followed by NAA @ 4000 ppm (57.68%) and the least performance was registered in control (19.77 %) (Table 1). Likewise, among five rooting mediums Soil: Coir pith: FYM registered maximum (40.90 %) followed by M4 (Soil: Sand: Vermicompost) 36.58 per cent, M2 (Soil: Sand: FYM) registered 33.14 per cent, M1 (Soil) registered 31.65 per cent and the least performance was observed in M3 (26.98 %) medium. These results are in agreement with Rahdari *et al.* (2010) in Aralia semi-wood cuttings. High survival per cent is considered as a top priority for care requirement in propagation unit. Koyuncu *et al.* (2014) observed the highest survival per cent (80.00 %) in black mulberry. The longer and more numerous roots as a result of the roots' efficient uptake of water and nutrients account for the higher survival percentage. The higher survival per cent might be attributed to the beneficial physical characteristics of growing media such as organic carbon and water holding capacity (Nagarajan *et al.,* 1985).

Results of the study revealed that among all rooting hormones (IBA and NAA) used, IBA performed better performance. The rooting per cent of *M. indica* are represented in Table 2. IBA @ 3000 ppm recorded the highest mean rooting per cent (61.84 %) followed by NAA @ 4000 ppm (42.66 %) and the lowest rooting per cent was recorded in control (17.48 %). Among five rooting media Soil, Soil: Sand: FYM, Soil: Coir pith, Soil: Sand: Vermicompost, Soil: Coir pith: FYM used, Soil: Coir pith: FYM medium registered maximum mean rooting of 39.24 per cent followed by M2 (31.54 %). Kalyoncu *et al.* (2009) observed that the highest rooting per cent (100 %) was obtained from the application of IBA at 3000 ppm in black mulberry cuttings. This findings were also supported by Fatma and Eylem (2003) who reported that black mulberry cuttings treated with 5 g/lit IBA in bunch planting method was suited for its better rooting. The type of rooting medium also determines the nature of roots produced on the cutting (Nanda and Kochhar, 1985). The efficacy of coir pith provides maximum water retention capacity and soil promotes aeration, whereas the higher nutrient status was confined to Farmyard manure. Similarly, the findings derive support from Askira and Benisheikh (2015) who recorded mixture of cow dung + top soil + washed river sand in 1:1:1 ratio had better rooting success in *D.regia.* The study included the use of two different hormones (IBA, NAA) were assessed for better sprouting per cent at different concentrations. At the same time, different rooting

mediums were also used to increase the sprouting per cent. There were significant interaction effects also. Among different concentrations of IBA and NAA treatments.

Table 1. Effect of rooting hormone and rooting medium on survival per cent of mulberry.

Treatments	Rooting medium					
	M1	M2	M3	M4	M5	Mean
T_1-IBA @ 1000	23.91	24.63	18.33	27.33	34.11	25.66
T_2-IBA @ 2000	36.32	38.54	35.66	43.34	50.13	40.79
T_3-IBA @ 3000	64.75	67.33	36.30	75.06	83.20	65.32
T_4-IBA @ 4000	31.08	26.19	23.14	36.00	38.13	30.90
T_5-IBA @ 5000	22.09	20.88	24.88	26.11	24.15	23.62
T_6-NAA @ 1000	19.88	21.39	21.00	24.14	26.22	22.52
T_7-NAA @ 2000	23.11	26.60	17.81	26.60	28.33	24.49
T_8-NAA @ 3000	32.13	37.33	27.22	32.11	37.33	33.22
T_9-NAA @ 4000	51.20	56.65	51.33	62.33	66.91	57.68
T_{10}-NAA @ 5000	26.63	26.99	24.12	28.03	36.11	28.37
Control	17.11	18.06	17.00	21.37	25.33	19.77
Mean	31.65	33.14	26.98	36.58	40.90	
T = 0.22				T = 0.44**		
SE(d) M = 0.16			CD (0.05)	M = 0.31**		
T×M = 0.50				T×M = 0.98**		

*****Significant @ 5% level Each value is the mean of four replications

M1- Soil M2- Soil: Sand: FYM (1:1:1) M3- Soil: Coir pith (1:1) M4- Soil: Sand: Vermicompost (1:1:1) M5- Soil: Coir pith: FYM (1:1:1)

Table 2. Effect of rooting hormone and rooting medium on rooting per cent of mulberry.

Treatments	Rooting medium					
	M1	M2	M3	M4	M5	Mean
T_1-IBA @ 1000	21.33	22.11	18.06	24.33	28.66	22.89
T_2-IBA @ 2000	42.66	45.06	41.33	42.36	48.72	44.02
T_3-IBA @ 3000	61.11	64.00	54.00	54.11	76.00	61.84
T_4-IBA @ 4000	26.93	31.33	26.03	26.70	42.39	30.67
T_5-IBA @ 5000	25.38	24.38	19.30	20.08	32.33	24.29
T_6-NAA @ 1000	18.33	21.38	18.08	18.33	24.40	20.10
T_7-NAA @ 2000	21.11	23.84	20.00	19.99	27.11	22.41
T_8-NAA @ 3000	25.34	26.11	25.16	25.08	38.37	28.01
T_9-NAA @ 4000	34.40	51.08	31.33	31.45	65.06	42.66
T_{10}-NAA @ 5000	21.38	19.38	16.99	16.93	27.30	20.39
Control	17.30	18.33	15.16	15.30	21.33	17.48
Mean	28.66	31.54	25.94	26.78	39.24	
T = 0.25				T = 0.47**		
SE(d) M = 0.16			CD (0.05)	M = 0.34**		
T×M = 0.56				T×M = 1.07**		

*****Significant @ 5% level Each value is the mean of four replications

M1- Soil M2- Soil: Sand: FYM (1:1:1) M3- Soil: Coir pith (1:1) M4- Soil: Sand: Vermicompost (1:1:1) M5- Soil: Coir pith: FYM (1:1:1)

Table 3. Effect of rooting hormone and rooting medium on sprouting per cent of mulberry.

Treatments	Rooting medium					
	M1	M2	M3	M4	M5	Mean
T_1-IBA @ 1000	29.96	35.11	33.07	34.21	47.22	35.91
T_2-IBA @ 2000	54.36	57.10	62.40	71.86	86.63	66.47
T_3-IBA @ 3000	76.14	73.26	84.14	87.22	94.37	83.02

	T_4-IBA @ 4000	44.35	58.11	69.07	66.84	88.60	65.39
	T_5-IBA @ 5000	33.17	59.39	62.28	53.24	59.24	53.46
	T_6-NAA @ 1000	27.84	28.34	31.24	36.20	43.88	33.50
	T_7-NAA @ 2000	29.88	31.33	40.24	38.42	63.27	40.62
	T_8-NAA @ 3000	53.16	59.00	59.63	64.32	73.26	61.87
	T_9-NAA @ 4000	59.03	65.11	64.20	70.30	80.24	67.77
	T_{10}-NAA @ 5000	48.50	53.00	45.36	52.08	66.40	53.06
	Control	24.65	25.34	29.08	33.04	38.00	30.02
	Mean	43.73	49.55	52.79	55.24	67.37	
	T = 0.33				T = 0.63**		
SE(d)	M = 0.24			CD (0.05)	M = 0.42**		
	T×M = 0.73				T×M = 1.41**		

*****Significant @ 5% level Each value is the mean of four replications
M1- Soil M2- Soil: Sand: FYM (1:1:1) M3- Soil: Coir pith (1:1) M4- Soil: Sand: Vermicompost (1:1:1) M5- Soil: Coir pith: FYM (1:1:1)

Table 4. Effect of rooting hormone and rooting medium on shoot length of mulberry.

	Rooting medium					
Treatments	M1	M2	M3	M4	M5	Mean
T_1-IBA @ 1000	11.88	12.88	11.08	15.51	13.84	13.03
T_2-IBA @ 2000	15.65	15.39	15.22	19.26	16.93	16.49
T_3-IBA @ 3000	19.98	21.07	19.23	27.22	25.98	22.69
T_4-IBA @ 4000	14.27	15.03	13.36	17.82	16.04	15.30
T_5-IBA @ 5000	13.33	14.04	12.24	16.23	15.42	14.25
T_6-NAA @ 1000	10.78	12.34	11.00	13.44	12.34	11.98
T_7-NAA @ 2000	12.08	12.54	10.06	14.24	13.56	12.49
T_8-NAA @ 3000	16.42	16.22	14.88	16.93	16.44	16.17
T_9-NAA @ 4000	21.08	22.34	20.03	24.78	23.72	22.39
T_{10}-NAA @ 5000	15.23	16.08	14.43	16.34	16.34	15.68
Control	11.88	11.99	10.90	13.84	13.08	12.33
Mean	14.78	15.44	13.85	17.78	16.69	
T = 0.1				T = 0.19*		
SE(d) M = 0.07			CD (0.05)	M = 0.14*		
T×M = 0.21				T×M =0.42 *		

*****Significant @ 5% level Each value is the mean of four replications
M1- Soil M2- Soil: Sand: FYM (1:1:1) M3- Soil: Coir pith (1:1) M4- Soil: Sand: Vermicompost (1:1:1) M5- Soil: Coir pith: FYM (1:1:1)

IBA @ 3000 ppm showed the highest sprouting per cent of 83.02 followed by NAA @ 4000 ppm (67.77 %) and IBA @ 2000 ppm (66.47 %). Likewise, five rooting mediums were used *viz.*, M1- Soil, M2-Soil: Sand: FYM, M3-Soil: Coir pith, M4-Soil: Sand: Vermicompost, M5-Soil: Coir pith: FYM. Among that Soil: Coir pith: FYM registered maximum sprouting (67.37 %) followed by Soil: Sand: Vermicompost (55.24 %) presented in Table 3. Mulberry cuttings treated with IBA @ 2000 ppm produced the highest number of sprouted cuttings (9.67), followed by NAA @ 2000 ppm (5.67), in line with the current findings of Singh *et al*. (2014). This might be due to better root growth, absorption and translocation of nutrients to plant parts (Singh, 2001). In addition to that, Husen (2011) Husen and Pal (2006) reported similar findings in *Tectona grandis.* These results are in line with Padekar *et al.* (2018) who studied that stem cuttings of Kartoli performed better in soil+ sand+ FYM rooting medium and registered maximum survival per cent (40.00 %), sprouting per cent, shoot length and number roots per cutting (5.30).

The length of the shoots on micro cuttings treated with IBA and NAA was shown to grow as the number of observation days increased. Shoot length significantly differed between the IBA and NAA treatments. At 90 DAP, the highest mean value of shoot length was recorded in IBA @ 3000 ppm (22.69 cm) followed by NAA @ 4000 ppm (22.39 cm) and the least performance was observed in NAA @ 1000 ppm (11.98 cm) and among five rooting mediums used, Soil: Sand: Vermicompost recorded the

maximum shoot length (17.78 cm) followed by M5 (16.69 cm) and the poorest was observed in M3 (13.85 cm) medium (Table 4). This increase in shoot length might be due to geotropism effect. According to Sabarish (2017), M. sinensis mini cuttings treated with IBA at 5000 ppm displayed the maximum shoot length (22.65 cm) at 90 DAP. These results are consistent with his findings. In addition to that, similar findings were also reported in *D. sissoo* (Husen, 2004) *Tectona grandis* (Guleria *et al.*, 2014) and other plant species (Husen and Mishra 2001 Husen and pal 2007). These results are in concomitant to Das and Jha (2018) who recorded the maximum growth traits of *Taxus baccata* cuttings performed well in Forest soil: FYM: peat rooting medium.

CONCLUSION

The current investigation's findings, in summary, point to IBA @ 3000 ppm as the optimal concentration for mulberry apical branch cuttings in order to promote plant growth. In the case of rooting medium Soil: Coir pith: FYM suited for cuttings desirable growth. Presently, scanty of information is available for propagation of mulberry through mini-cuttings. This Mini-clonal technology is mostly used for propagation of tree species. This is suggested due to its great rooting capability, ability to produce a larger annual plant population, and affordable, high-quality root system. Thus, the present study has proposed the effective rooting hormone and its concentration, suitable rooting medium for mass multiplication of mulberry in shorter time and space.

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