Root and shoot growth of semi-hard wood cuttings of Mulberry (*Morus indica L.*) influenced by water imbibitions using wet cloth wrapping technique

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Abstract: An experiment was conducted at Pandit Jawaharlal Nehru College of Agriculture and Research Institute (PAJANCOA&RI), Karaikal, Union Territory of Puducherry, India; to investigate shoot and root growth of semi-hard wood cuttings in Mulberry (*Morus indica* L.) varieties 'Victory 1' and 'S_{36}', influenced by water imbibitions using "wet cloth wrapping technique". Semi-hard wood cuttings were subjected to different days of water treatments using wet cloth wrapping method. The experiment was laid out and data's were analyzed using single factor ANOVA. The cuttings were subjected with different days of water treatments, which are then planted in the rooting media and kept under shade net condition. For preparing rooting media, soil, sand and farm yard manure (FYM) in ratio of 1:1:1 by v/v were mixed thoroughly, cleaned for stones and grasses, then the mixture was filled in polythene bags. Parameters namely number of sprouts, sprout length, number of leaves per sprouts, root length and number of roots per cuttings were taken at 60^{th} day. The cuttings subjected with 20 days of water treatments of the variety 'Victory 1' performed best with regards to root length and number of roots per cutting. It was also observed that cuttings subjected with 25 days of water treatment have performed best over other treatments with regards to number of leaves per cuttings and number of sprouts per cuttings of the varieties 'Victory 1' and 'S_{36}'.

Key words : Mulberry, cuttings, water imbibitions, root length, number of roots, sprout length, transplanting, nursery.

Introduction:

Mulberry (*Morus sp.*) is known to be originated from China, India, Turkey, Russia and Middle Eastern countries (Islam et al., 2003). Mulberry has been cultivated over thousands of year and has been adapted to a wide area of tropical, subtropical and temperate zones of Asia, Europe, North and South America and Africa (Ozgen et al., 2009). The world's most common mulberry application is the use of its leaves in the domestication of silkworm, and the most important countries in this respect are China and India. On the other hand, Central Asia and the Middle East consume mulberry fruit (Sanchez, 2000). The main species are *Morus nigra, Morus alba, Morus rubra, Morus australis, Morus latifolia* and *Morus multicaulis* (Yasin et al. 2003).

Mulberry has been cultivated throughout the year in the southern parts of India namely Karnataka, Andhara Pradesh, Tamil Nadu and Telangana, for Sericulture.

In India, mulberry semihard wood cuttings are used as propagating material which are either directly planted in the mainfield or can be nursery raised and then transplanted after 90 days. Direct planting of mulberry cuttings in main field leads to poor establishment rate and hence they are raised under nursery condition and then transplanted after 90 to 120 days. However, even under nursery raised condition, percentage of success depends on season at which they are grown. The success rate of sprouted and rooted saplings under nursery rose condition will be best, when they are raised during monsoon seasons (South west and North east monsoons of India). The cuttings planted in August, performed the best in all aspects namely number of sprouted cutting, average number of sprouts, length of longest sprout, diameter of thickest sprout, number of leaves on new shoots, shoot percentage, fresh and dry weight of shoot, root percentage, number of primary root, secondary root, length of longest root, fresh and dry weight of roots (Singh, et al., 2015). Water imbibitions of mulberry cuttings induces early sprouts and root growth; and for this reason cuttings which are grown during rainy season performed better success rate. Hence, an attempt has been made to induce the early sprouts and root growth of mulberry cuttings influenced by water imbibitions subjected with 'wet cloth wrapping technique'. Early shoot and root growth of cuttings may be hardened and can be transplanted at the earliest. Pre-ponement of transplanting schedule of mulberry rooted and sprouted saplings at 60^{th} day instead of recommended 90^{th} day using 'Wet cloth wrapping technique' would benefit sericulture farmers. In this regard, a research has been carried out on the effects of water imbibitions on mulberry semi-hardwood cuttings on shoot and root growth, influenced by wet cloth wrapping technique, at PAJANCOA & RI, Karaikal, U. T. of Puducherry, India.

Materials and Methods:

Selection of planting materials:

Semi-hardwood cuttings were selected from a well established garden of 8 - 12 months old. Full grown thick main stem (pencil thickness size) free from pest and disease damages having a diameter of 10-12 mm was chosen for preparation of cuttings. The cutting with length of 15-20 cm with 3-4 active buds were selected for the experiment and a slant cut was made with

an angle of 45^{o} at the bottom end. Care was taken to make a sharp cut at both the ends of cuttings without splitting the bark using a 'Secature'. The experiment was conducted in two ruling varieties namely Victory 1(High yielding type) and S_{36} (Succulent leaves for Chawki rearing). The variety 'Victory 1' is a hybrid obtained from S_{30} and Ber C776; while the variety S_{36} was developed through EMS treatment of Berhampore local. The varieties S_{36} and Victory 1 were developed at CSTRI, Mysore, India and were recommended to sericulture farmers in the year 1984 and 1996 respectively.

Rooting media:

For preparing rooting media, soil, sand and farm yard manure (FYM) in ratio of 1:1:1 by v/v were mixed thoroughly, cleaned for stones and grasses, then the mixture was filled in polythene bags (Plate 2).

Wet cloth wrapping technique:

The experiment was performed with five sets of cloth wrapped cuttings; each consisting of ten numbers and was treated with different days of water treatment namely 5, 10, 15, 20 and 25 days respectively of the variety 'Victory 1' and 'S_{36}'. The wrapped cuttings were kept in an enamel tray with thin film of water and were sprinkled over with water during morning and evening hours. The wrapped cuttings in the enamel tray were kept under room temperature (25 ± 2^{o} C) during the entire treatment period. Exactly on 6^{th},11^{th}, 16^{th}, 21^{st} and 26^{th} day, corresponding with 5, 10, 15, 20 and 25 days of water treatments, the cuttings were planted on rooting media at a depth of 5cm to 7 cm. The planted cuttings in the polythene bags were maintained under shade net condition for 60 days (including the water treated conditions), with watering once in seven days.

Nursery Grown Cuttings:

A Nursery bed was prepared under non-shady conditions using loamy soil with a size of 3 x 1.7 meters and was irrigated once in a weak. Exactly 20 cuttings each from the variety Victory 1 and S_{36} were selected and a total of 40 cuttings were planted in the raised bed. Upon attaining 60 days of nursery raised conditions (DNRC), 10 cuttings each from the variety Victory 1 and S_{36} were taken for observation of shoot and root growth. Again on 90 DNRC, another 10

cuttings each from the variety Victory 1 and S_{36} were taken for observation of shoot and root parameters (Plate 2).

Root and shoot parameters:

Parameters like average number of sprout, average shoot length, average number of leaves, average number of roots, and average length of roots per cuttings were taken for analysis purpose.

Statistical analysis:

The shooting and rooting performance of various treatments were analyzed using Analysis of variance (ANOVA) on SPSS statistical software.

Results and discussion:

Effects of water imbibitions on rooting performance of mulberry cuttings:

In case of rooting performance of variety Victory 1, significantly maximum number of roots per cuttings was found under the treatments 60 DNRC (14.3), 90 DNRC (17.4) and 20 days (11.4). The results indicated, cuttings subjected with 20 days of water treatments influenced by wet cloth wrapping technique had performed best over others. Kalyoncu et al., 2009, reported highest rooting percentage was recorded in softwood top cuttings of mulberry (*Morus alba* L.), which were planted in pumice medium under misting system under greenhouse condition for 48 days. Heavy flushing was also observed during rainy periods, a time of intensive vegetative growth, which may tend to increase rooting percentage (Singh et al., 2015). They also reported that, poor rooting in the cuttings which were planted during cooler time of the season might be due to the fact that these cuttings might have been carrying higher inhibitor to promote ratio or it might be due to higher nitrogen to carbohydrate ratio. It was also observed that the least number of roots per cuttings was observed in the treatment 5 days (1.8), while the treatments 10 days (4.4), 15 days (3.3) and 25 days (7.4) were performed in a similar trend (Table. 2; Plate 1).

Regarding the variety S_{36}, number of roots per cuttings was found significantly superior in the control treatments 90 DNRC (17.4) and 60 DNRC (14.3). However, the cuttings subjected with 25 days of water treatments (9.2) were on par with the treatment 60 DNRC. The cuttings subjected with 5 days (4.9), 10 days (4.0), 15 days (3.8) and 20 days (5.1) of water treatments shows similar trends of root growth (Table. 2). The results clearly indicated, water imbibitions

on the variety S_{36} did not have major effects on the number of roots per cuttings. According to Singh et al. (1961) hardwood cuttings produced a higher rooting percentage with vigorous root system than semi-hardwood cuttings. Poor performance of roots per cuttings of the variety S_{36} might be due to inheritance.

In case of average root length per cuttings of the variety Victory 1, significantly treatments namely 60 DNRC (5.85) and 90 DNRC (7.78) performed best over others. However, cuttings subjected with 20 days (5.43) and 25 days (4.08) of water treatments; and 60 DNRC (5.85), were on par with each other. This has indicated, cuttings subjected with 20 days and 25 days of water treatments were superior over other water treated cuttings. Whereas, cuttings subjected with 5 days (0.57), 10 days (2.37), 15 days (1.14) of water treatments had not performed well with regard to average root length (Table 2). Harrison-Murraya (1991) observed that the seasonal timing, or the period of the year in which cuttings are taken, can play an important role in rooting. Blazich (1987) reported that time of year when cuttings are taken is an important factor influencing rooting of woody plants from stem cuttings. Prolings and Therios (1976) showed that creating humid atmosphere by means of artificial mist around the planted cuttings either in concealed pot culture house or in open conditions has proved to enhance the process of rooting.

With regards to variety S_{36}, significantly maximum root length was recorded under the control treatment 90 DNRC (6.86) over the others. The results also recorded, cuttings subjected with 5 days (2.2), 10 days (2.96), 15 days (2.86), 20 days (2.82) and 25 days (3.35) of water treatments; and 60 DNRC (4.24) had performed similar trends, indicating water imbibitions on mulberry cuttings did not have any effects on root length with respect to the variety S_{36} (Table 2).According to Singh et al, (1961) hardwood cuttings produced a higher rooting percentage than semi-hardwood cuttings. They also noted that the best time for taking cutting in Phalsa was July-August than in September.

Effects of water imbibitions on shooting performance of mulberry cuttings:

In case of shooting performance of varieties Victory 1 and S_{36}, number of sprouts per cuttings which are subjected with different days of water treatments namely 5 days (1.2 and 1.1), 10 days (1.4 and 1.1), 15 days (1.2 and 1.0), 20 days (1.6 and 0.8), 25 days (1.8 and 1.0), 60 DNRC (1.0 and 1.0) and 90 DNRC (1.5 and 1.4) seems to be non-significant at 0.05%. The

results indicated, irrespective of different days water treatments, the number of sprouts per cuttings seem to be in a similar trend between treatments in both the varieties Victory 1 and S_{36} (Table.1). The results have clearly indicated, there was an early growth with respect to number of sprouts per cuttings which are subjected with water imbibition influenced by wet cloth wrapping technique. Hence, water imbibitions of cuttings have physiologically activated the dormant buds earlier, than recommended nursery raised cuttings (60 and 90 DNRC). Similar findings were reported by Singh et al., 2015, who reported that mulberry (*Morus alba*. L) hard wood cuttings grown under mist chamber condition during the month of mid July performed maximum average sprouted cuttings (4.11). In propagating deciduous species, hardwood and semi-hardwood cuttings can be taken during the dormant season when buds are not active and before buds start to force out in the rainy season (Singh et al, 2015). Evans (1992) contended that probably the best time to take cuttings from the field is at the beginning of the rainy season.

With regards to average shoot length per cuttings, significantly the maximum number of shoot length was recorded under 60 DNRC (23.95; 21.94) and 90 DNRC (24.88; 22.93) of the variety Victory 1 and $S_{36.}$ The shoot length of cuttings was 4.12 and 7.87; 13.79 and 10.13; 10.85 and 9.06; 9.08 and 8.65; 13.82 and 10.95 under 5, 10, 15, 20 and 25 days of water treatments of the variety Victory 1 and $S_{36,}$ respectively. The shoot length of cuttings was almost in a similar trend under 5, 10, 15, 20 and 25 days of water treatments influenced by wet cloth wrapping technique. However, minimum number of shoot length (4.12) was observed under 5 days of water treatments in the variety Victory 1 (Table.1; Plate 1). The results indicated, the water imbibitions of semi-hard wood cuttings did not have an impact on the shoot length. However, the nursery rose cuttings have performed best with respect to the shoot length. This may be due to the geotropism effects, as the nursery rose cuttings were kept at a slant position during the entire nursery period. However, the cuttings which were subjected with different days of water treatments were kept in a horizontal position (Plate 1). This may be the reason for poor shooting performance of cuttings which were subjected with water imbibitions.

The average number of leaves per cuttings of the variety Victory 1 under different water treatments are 2.58 (5 days), 4.3 (10 days), 3.28 (15 days), 2.82 (20 days), 4.23 (25 days), 5.00 (60 DNRC) and 5.00 (90 DNRC), which were not significant at 0.05% (Table. 1; Plate 1). The result clearly indicated, wet cloth wrapping of cuttings have significant role in inducement of early growth with respect to number of leaves per cuttings. Singh et al, 2015 reported, favorable

climatic conditions play an important role to increase the number of leaves. The appropriate planting time, application of IBA as well as genetic makeup of genotype use might have played some role in augmenting the number of leaves per cuttings (Singh and Singh, 2002)

In case of average number of leaves per cutting of the variety S_{36}, significantly maximum number of leaves per cutting was recorded under 60 DNRC (4.6), 90 DNRC (5.0), 25 days (4.12) and 10 days (3.75). The results furnished the cuttings which were subjected with water treatments for 25 days performed best over others. The results also indicated, least number of leaves per cutting was observed under the treatment 20 days, whereas number of leaves per cuttings under the treatments 5 days and 15 days were on par with each other (Table.1; Plate 1). Hence, similar trends were followed as like that of the variety Victory 1 with regards to number of leaves per cuttings. Singh et al, 2015, reported shooting efficiency would be better when it is done in control conditions such as mist chamber.

Conclusion:

The conclusion drawn from the present study are discussed below,

- The results indicated that the wet cloth wrapping technique had made major impact on the rooting and shooting performance of cuttings.
- Mulberry cuttings grown during rainy season alone have a better success rate. But using ‘wet cloth wrapping technique’ mulberry growers can have higher success rate even during non-rainy season.
- Water imbibitions of semi-hardwood cuttings using wet cloth wrapping technique have made an early induction of shoot and root growth over the conventional nursery raised rooted saplings, by breaking the dormancy of vegetative buds at the earliest.
- The cuttings subjected with 20 and 25 days of water treatments of the variety ‘Victory 1’ performed best with regards to root length and number of roots per cutting.
- Regarding the variety S_{36}, cuttings subjected with different days of water treatments influenced by wet cloth water treatments did not have a major impact on root length, number of roots and shoot length per cuttings.
- The cuttings subjected with different days of water treatments of the variety ‘Victory 1’ and S_{36} performed best with regards to number of sprouts and leaves per cuttings.
- ‘Wet cloth wrapping technique’ may be practiced in planting material which are of horticultural importance for better success rate, propagated through hardwood, softwood and semi-hardwood cuttings.

Acknowledgement:

I am indebted to thank Dr. Kumar. K, Prof. and Head, Dept. of Agrl. Entomology, PAJANCOA & RI, Karaikal, India, for his meticulous support during the experimental period. I am also thankful to Mr. Ayoob. K. C, Assistant Professor (Statistics) for helping in statistical analysis of data. I extend my thankfulness to Dr. Kandibane. M, Assistant Professor (Entomology) and Dr. Marichamy. M.S, Assistant Professor (Horticulture), for their guidance in proper conduct of the experiment.

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Table. 1. Effects of water imbibitions influenced by wet cloth wrapping technique on the shooting performance of mulberry (*Morus indica*. L) varieties 'Victory 1' and 'S_{36}'

SI. No.	No. of Days of water treatment	Average no. of Sprout per Cuttings (in numbers)		Average Shoot length per cuttings (in Cm)		Average no. of leaves per cuttings (in numbers)	
		Victory 1	S_{36}	Victory 1	S_{36}	Victory 1	S_{36}
1.	5 days	1.2^{NS}	1.1^{NS}	4.12^{cb}	7.87^{b}	2.58^{NS}	2.85^{bcd}
2.	10 days	1.4^{NS}	1.1^{NS}	13.79^{b}	10.13^{b}	4.3^{NS}	3.75^{abcd}
3.	15 days	1.2^{NS}	1.0^{NS}	10.85^{bc}	9.06^{b}	3.28^{NS}	2.15^{cd}
4.	20 days	1.6^{NS}	0.8^{NS}	9.08^{bc}	8.65^{b}	2.82^{NS}	1.77^{d}
5.	25 days	1.8^{NS}	1.0^{NS}	13.82^{b}	10.95^{b}	4.23^{NS}	4.12^{a}
6.	60 DNRC	1.0^{NS}	1.0^{NS}	23.95^{a}	21.94^{a}	5.0^{NS}	4.6^{a}
7.	90 DNRC	1.5^{NS}	1.4^{NS}	24.88^{a}	22.93^{a}	5.0^{NS}	5.0^{a}
	S.E at 0.05%	-	-	**4.21**	**3.49**	-	**1.05**
	C.D	-	-	**8.42**	**6.97**	-	**2.09**

DNRC-Days of nursery raised conditions; **S.E** – Standard Error; **C.D** – Critical difference: **ANOVA** was calculated at 0.05%; **NS**- Non-Significant.

Table. 2. Effects of water imbibitions influenced by wet cloth wrapping technique on the rooting performance of mulberry (*Morus indica*. L) varieties 'Victory 1' and 'S_{36}'

SI. No.	No. of Days of water treatment	Average no. of root per Cuttings (in numbers)		Average length of root per cuttings (in Cm)	
		Victory 1	S_{36}	Victory 1	S_{36}
1.	5 days	1.8^{d}	4.9^{cb}	0.57^{d}	2.2^{b}
2.	10 days	4.4^{c}	4.0^{cb}	2.37^{cd}	2.96^{b}
3.	15 days	3.3^{cb}	3.8^{cb}	1.14^{d}	2.86^{b}
4.	20 days	11.4^{ab}	5.1^{cb}	5.43^{b}	2.82^{b}
5.	25 days	7.4^{bc}	9.2^{bc}	4.08^{b}	3.35^{b}
6.	60 DNRC	14.3^{a}	12.4^{ab}	5.85^{ab}	4.24^{b}
7.	90 DNRC	17.4^{a}	16.4^{a}	7.78^{a}	6.86^{a}
	S.E at 0.05%	**2.88**	**2.77**	**1.14**	**1.14**
	C.D	**5.75**	**5.53**	**2.27**	**2.27**

DNRC-Days of nursery raised conditions; **S**.E – Standard Error; C.D – Critical difference: ANOVA was calculated at 0.05%

Plate 1. Step wise development of root and shoot growth in water imbibed Mulberry cuttings influenced by wet cloth wrapping technique

Plate 2. Mulberry semi-hard wood cuttings under raised bed and rooting media (Poly bag)