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Studies on orgafol: A promising organic growth promoter, on the growth and development of mulberry cuttings

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Abstract
Organic Growth Promoter provides all natural fertilizers that provide unique advantages over conventional fertilizers. Studies were conducted to study the effect of organic formulations on the growth and development of mulberry cuttings. Stem cuttings of *Morus indica* were treated with T_1 (IBA), T_2 (NAA), T_3 (IAA), T_4 (*Azospirillum*) and T_5 (Orgafol) at a rate of 2g/l by quick dip method and these cuttings were planted in a nursery bed along with a control plot (T_6). Results showed that, among all the treatments, root parameters such as root initiation within a short period (18 days), higher rooting per cent (80%), higher root length (39.85 cm) and shoot parameters such as higher shoot length (47.65 cm), more number of leaves (15.50) and higher leaf area (157.88 cm) and higher survival rate (87.5%) were observed in the cuttings treated with T_5 (Orgafol). This organic growth promoter can be recommended for the growth and development of mulberry cuttings as the nursery duration can be considerably reduced.

Keywords: Mulberry, nursery, organic growth promoter, stem cuttings

Introduction
Sericulture is an agro-based cottage industry which involves in mulberry cultivation and silkworm production. Mulberry cultivation involves the production of mulberry leaves. Mulberry (*Morus indica*) is one of the most important commercial crops grown extensively as a food plant for silkworm (*Bombyx mori*) (Pappachan *et al*., 2017) [20]. So, the growth and development of the mulberry are important in sericulture. Better growth of the mulberry ensures better cocoon production, which increases the economic status of farmers.

In India, Mulberry covers 3 lakh hectares in different agro climatic conditions varying from temperate to tropical (Pappachan *et al*., 2017) [20]. In Tamil Nadu, around 9,491 ha of land is under Mulberry cultivation.

To produce quality mulberry leaves, we may have to go for a nursery. Sapling is a rooted cutting of specific age, i.e., 100-120 days. The advantages of nursery include i) High survival rate due to the existing root system ii) Higher area coverage iii) Better use of planting material iv) Scope of removal of undesirable variety at nursery stage v) Quick, vigorous and better establishment of mulberry garden.

The time of preparation of cuttings in Mulberry greatly affected the extent and success of root formation, the optimum time of cuttings preparation and planting is related to the physiological condition of the plant and environmental conditions (Singh *et al*., 2015)[24].

On rooting development of stem cuttings, cutting position, rooting medium and rooting hormone are some of the critical factors that affect the success. Moreover, Indole-3-butyric acid is probably the best material for general use, because it is non-toxic to plants over a wide concentration range and is effective in promoting rooting of a large number of plant species (Carter and Slee, 1991) [2].

The heavy use of chemicals in Agriculture has weakened the ecological base in addition to the degradation of soil, water resources and quality of the food. At this juncture a keen awareness has sprung on the adoption of "organic farming" as a remedy to cure the ills of modern chemical agriculture (Kannaiyan, 2000) [13]. The awareness about the health and environmental problems due to the continuous use of pesticides resulted in the development of integrated pest

management (IPM) and organic farming (Thomas and Prabhu, 2001) [26]. Organic Growth Promoter provides all natural fertilizers that provide unique advantages over conventional fertilizers. It is environmentally safe and is not harmful to animals, plants and humans. Keeping in view the importance of organic manures, the present investigation was conducted to study the effect of organic formulations on the growth of mulberry cuttings.

Materials and Methods

The field experiment was carried out in the mulberry garden of the Department of Sericulture, Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam located at 11.20° North latitude and 76.56° East longitude at an altitude of 320 m above mean sea level. Six nursery beds each of 0.42 Sq.m were formed.

Treatment details: The following are the treatment details.

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Treatment	Agent	Concentration
T_1	Indole Butyric Acid	2g/l
T_2	Naphthalene Acetic Acid	2g/l
T_3	Indole Acetic Acid	2g/l
T_4	*Azospirillum*	2g/l
T_5	Orgafol	2g/l
T_6	Control	-

Orgafol is an organic formulation of plant growth promoter which includes the following ingredients viz, yeast extract, beef extract, peptone, finely ground bone meal powder and agar to which citric acid was added as a preservative, beeswax was added as an emulsifier and cinnamon was added as an odour masking agent.

Planting material: G4 cuttings were taken from one year old mother plants and cut to a length of 15-20 cm of pencil thickness with 3-4 active buds. The basal end of the cuttings was subjected to the above mentioned treatments through a quick dip method at a rate of 2 g per litre of water and the treated cuttings were planted at an angle of 45°. The nursery was irrigated twice a week.

After 75 days of planting, parameters such as days to rooting, rooting percentage, survivability, root length, shoot length, number of leaves and leaf area were recorded in all the treatments.

Experimental design and statistical analysis

The experiment was conducted with 4 replications and it follows Factorial Completely Randomized Design (FCRD). The data collected from the experiment was statistically analyzed using AGRESS by adopting the standard procedure outlined by Panse and Sukhatme (1978) [19] at a probability level of 5 percent.

Results and Discussion

The effect of the treatments on days to rooting is shown in Table 1. The cuttings treated with Orgafol have the quickest root formation in a very short period (18 days) followed by *Azospirillum* (28 days) and the root formation took a very long period in control (39 days). Similarly faster rooting in a short period was observed in the findings of Shah *et al*., (2006)[22] in *Ficus binnendijkii* cuttings and Mehri *et al*., (2013) [17] in Arbequina cuttings.

Table 1: Effect of the treatments on days to rooting, rooting per cent and survivability

Rooting hormone	Days to rooting	Rooting per cent (%)	Survival rate (%)
T_1 (IBA)	32.0	57.5	32.50
T_2 (NAA)	37.0	35.0	40.00
T_3 (IAA)	35.0	72.5	50.00
T_4 (*Azospirillum*)	28.0	45.0	67.50
T_5 (Orgafol)	18.0	80.0	87.50
T_6 (Control)	39.0	12.5	37.50
Mean	31.5	50.42	52.5
SE(d)	0.3320	0.5577	0.8474
CD (0.05)	0.6975	1.1717	1.7804

The effect of the treatments on rooting per cent is shown in Table 1. The cuttings treated with Orgafol has the highest rooting per cent (80%) when compared with all other treatments. Rooting per cent of IAA treated cuttings was 45% followed by IBA (56.5%) and the lowest rooting per cent was observed in control (12.5%). Orgafol shows highest rooting percent when compared with the other treatments. This observation is in line with the findings of Kalyoncu *et al*., (2009) [12] in black mulberry, Intorrathed *et al*., (2018) [11] in himalayan mulberry, Singh (2018) [25] in *Morus nigra*, Singh *et al*., (2014) [23] in *Morus alba*, Erturk *et al*., (2010) [7] in kiwi and Husen (2003) [10] in *Rauvolfia serpentina* cuttings. Similar results were observed in the findings of Rongting *et al*., (2017) [21] in chrysanthemum and Mehri *et al*., (2013) [17] in Arbequina cuttings and Centeno and Maria (2008) [3] in olive nursery plants.

The effect of the treatments on the survival rate is shown in Table 1. Survival rate was higher in the cuttings treated with Orgafol (87.50%) followed by *Azospirillum* (67.50%) and survivability was very much less in the cuttings treated with IBA (32.50%). Orgafol shows a higher survival rate when compared with other treatments. This observation is in agreement with the findings of Murthy *et al*., (2012) [18] in *Matigara black*, Intorrathed *et al*., (2018) [11] and Kalyoncu *et al*., (2009) [12]. Similar results were observed in the findings of Mehri *et al*., (2013) [17] in Arbequina cuttings.

The effect of the treatments on root length on different days after planting is shown in Table 2. The highest root length was observed in the cuttings treated with Orgafol (39.85 cm) followed by IAA (35.93 cm) and then IBA (32.71 cm) and the shortest root length was observed in control (17.36 cm). Orgafol has the highest root length when compared with the other treatments. These findings are coinciding with the findings of Husen (2003) [10], Intorrathed *et al*., (2018) [11], Singh *et al*., (2014) [23], Hawramee *et al*., (2019) [9] in *Morus alba*, Shah *et al*., (2006) [22], Erturk *et al*., (2010) [7], Singh (2018)[25], Murthy *et al*., (2012) [18] in *Matigara black* and similar results were observed in the findings of Kumari *et al*., (2018) [15] in *Morus alba*, Rongting *et al*., (2017) [21] and Fatema *et al*., (2005) [8] in groundnut.

Table 2: Effect of the treatments on root length on different days after planting

Rooting hormone	Root length (cm)		
	45th day	60th day	75th day
T_1 (IBA)	2.57	14.46	32.71
T_2 (NAA)	1.29	9.58	19.37
T_3 (IAA)	6.56	18.73	35.93
T_4 (*Azospirillum*)	1.53	12.62	31.28
T_5 (Orgafol)	8.14	21.91	39.85
T_6 (Control)	3.82	8.14	17.36
Mean	3.99	14.24	29.42
SE(d)	0.0369	1.3632	0.4075
CD (0.05)	0.0776	2.8641	0.8562

The effect of the treatments on shoot length on different days after planting is shown in Table 3. Shoot length was higher in the cuttings treated with Orgafol (47.65 cm) followed by IAA (47.43 cm) and IBA (43.43 cm) and the shortest shoot length was observed in control (31.80 cm). Orgafol has the longest shoot when compared with the other treatments. This is in agreement with the findings of Husen (2003)[10], Intorrathed *et al*., (2018) [11], Zenginbal *et al*., (2016) [27] in *Morus nigra*, Kalyoncu *et al*., (2009) [12], Singh (2018) [25], Murthy *et al*., (2012) [18], Khan *et al*., (2007) [14] in *Morus alba* and similar results were observed in the findings of Fatema *et al*., (2005) [8] in groundnut.

Table 3: Effect of the treatments on shoot length on different days after planting

Rooting hormone	Shoot length (cm)		
	45th day	60th day	75th day
T1 (IBA)	18.75	31.98	43.43
T2 (NAA)	18.00	27.38	37.93
T3 (IAA)	22.00	31.18	47.43
T4 (*Azospirillum*)	20.63	31.45	44.05
T5 (Orgafol)	22.38	32.00	47.65
T6 (Control)	17.63	23.65	31.80
Mean	19.89	29.61	42.05
SE(d)	0.2490	0.3687	5.2579
CD (0.05)	0.6177	0.7745	11.0466

The effect of the treatments on the number of leaves on different days after planting is shown in Table 4. Leaves were more when treated with Orgafol (15.50) followed by IBA (15.00) and *Azospirillum* (13.50) and very less in NAA (10.50). Orgafol has more number of leaves when compared with other treatments. These findings are coinciding with the findings of Intorrathed *et al*., (2018) [11], Singh (2018) [25], Khan *et al*., (2007) [14], Singh *et al*., (2014) [25], Hawramee *et al*., (2019)[9] and similar results were observed in the findings of Shah *et al*., (2006) [22] in *Ficus binnendijkii*, Mady (2009) [16] in faba bean, El-Tohamy *et al*., (2007) [6] in snap beans, Ahmed *et al*., (2011) [1] in potato, El-Tohamy *et al*., (2008) [5] in eggplant and Kumari *et al*., (2018) [15] in *Morus alba*.

Table 4: Effect of the treatments on the number of leaves on different days after planting

Rooting hormone	Number of leaves		
	45th day	60th day	75th day
T1 (IBA)	7.50	11.00	15.00
T2 (NAA)	4.00	10.50	10.50
T3 (IAA)	6.50	8.25	10.75
T4 (*Azospirillum*)	7.25	10.50	13.50
T5 (Orgafol)	7.75	12.00	15.50
T6 (Control)	6.25	9.00	11.50
Mean	6.54	10.21	12.79
SE(d)	0.8660	0.1227	0.1915
CD (0.05)	1.8195	0.2577	0.4024

The effect of the treatments on leaf area on different days after planting is shown in Table 5. Leaf area was found to be more when treated with Orgafol (157.88 cm) followed by IAA (140.90 cm) and *Azospirillum* (139.24) and very less in control (69.42). Orgafol has a higher leaf area when compared with the other treatments. These findings are coinciding with the findings of Hawramee *et al*., (2019) [9]. Similar results were observed in the findings of Shah *et al*., (2006) [22] in *Ficus binnendijkii*, El-Leithy *et al*., (2006) [4] in *Salvia officinalis*, Mady (2009) [16] in faba bean, Ahmed *et al*., (2011) [1] in potato, Rongting *et al*., (2017) [21] in chrysanthemum and Kumari *et al*., (2018)[15] in *Morus alba*.

Table 5: Effect of the treatments on leaf area on different days after planting

Rooting hormone	Leaf area (cm^2)		
	45th day	60th day	75th day
T1 (IBA)	80.89	109.36	137.83
T2 (NAA)	40.29	68.88	97.47
T3 (IAA)	79.26	110.08	140.90
T4 (*Azospirillum*)	75.74	100.88	139.24
T5 (Orgafol)	62.52	97.10	157.88
T6 (Control)	36.32	39.99	69.42
Mean	62.50	87.72	123.79
SE(d)	0.9567	22.0287	22.1096
CD (0.05)	2.0100	46.2812	46.4513

Conclusion

Based on the results obtained from the current study, it is concluded that Orgafol at a rate of 2 g/l of water serves as an organic growth promoter which increases both the root and shoot parameters of mulberry cuttings. Presently, no such work has been done in mulberry. Hence, this study is found to be a promising method for minimizing the nursery period and to produce good quality mulberry saplings. Also, the growth and development of mulberry saplings can be improved within the nursery period.

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