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 T1 (IBA), T2 (NAA), T3 (IAA), T4 (Azospirillum) and T5 (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 (T0). 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 T5 (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) [56]. 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 |
|-----------|--------------------|---------------|
| T₁        | Indole Butyric Acid| 2g/l          |
| T₂        | Naphthalene Acetic Acid| 2g/l         |
| T₃        | Indole Acetic Acid | 2g/l          |
| T₄        | Azospirillum       | 2g/l          |
| T₅        | Orgafol            | 2g/l          |
| T₆        | 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: The cuttings treated with Orgafol have the quickest root formation.

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| Rooting hormone | Days to rooting | Rooting per cent (%) | Survival rate (%) |
|-----------------|----------------|---------------------|------------------|
| T₁ (IBA)        | 32.0           | 57.5                | 32.50            |
| T₂ (NAA)        | 37.0           | 35.0                | 40.00            |
| T₃ (IAA)        | 35.0           | 72.5                | 50.00            |
| T₄ (Azospirillum)| 28.0           | 45.0                | 67.50            |
| T₅ (Orgafol)    | 18.0           | 80.0                | 87.50            |
| T₆ (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) [20] in Morus nigra, Singh et al., (2014) [23] in Morus alba, Ertuk 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 Kalyoncu et al., (2009) [12], Intorrathed et al., (2018) [11], Singh et al., (2014) [23], Hawramee et al., (2019) [9] in Morus alba, Shah et al., (2006) [22], Ertuk et al., (2010) [7], Singh et al., (2018) [23], 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) [4] 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 |
| T₁ (IBA)        | 2.57      | 14.46    | 32.71    |
| T₂ (NAA)        | 1.29      | 9.58     | 19.37    |
| T₃ (IAA)        | 6.56      | 18.73    | 35.93    |
| T₄ (Azospirillum)| 1.53      | 12.62    | 31.28    |
| T₅ (Orgafol)    | 8.14      | 21.91    | 39.85    |
| T₆ (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   |

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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) [23], 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    | 31.18    | 43.43    |
| T3 (IAA)        | 20.63    | 31.45    | 44.05    |
| T4 (Orgafol)    | 22.38    | 32.00    | 47.65    |
| T5 (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) [23], Khan et al., (2007) [14], Singh et al., (2014) [23], 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 (cm²) |
|-----------------|----------------|
|                 | 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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