Effect of irrigation interval on growth and biomass of mahogany (Swietenia macrophylla King, Meliaceae) seedlings

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Abstract
Swietenia macrophylla King, also known as bigleaf mahogany, is a tropical tree species native to Central and South America. Nursery seedling is a base of good plantation, so if seedling is better further plantation is better. An irrigation is a key factor for growth of seedling. If irrigation schedule is disturbed then growth of seedling also disturbs. Therefore, looking to the importance of effect of irrigation, this experiment was carried out at Forestry College, NAU, Navsari. An attempt has been made to assess the growth and biomass accumulation in the seedlings of Swietenia macrophylla irrigated at three intervals under nursery. There were three irrigation intervals viz., daily, alternate and weekly taken as treatment with CRD design and repeated six times. The best performance in terms of growth as well as dry weight accumulation was observed in daily irrigation followed by alternate day irrigation interval. While, it was minimum in weekly irrigation interval. The results revealed that the growth and dry weight accumulation in S. macrophylla was increased by increasing frequency of irrigation.

Keywords: Different irrigation condition, nursery, Swietenia macrophylla

Introduction
Swietenia macrophylla King, also known as big leaf mahogany, is a tropical tree species native to Central and South America. Swietenia macrophylla has a wide natural distribution, extending from Mexico to Bolivia and Central Brazil (Lamb, 1966) [3]. The depletion of S. macrophylla populations has led to concern for the future of the species and its commercial trade. In 2002, S. macrophylla was listed in Appendix II (species that may face extinction if trade is not controlled) of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Grogon and Barreto, 2005) [2]. The largest plantations of S. macrophylla have been reported in South and South-East Asia and the Pacific region. A significant proportion of the total area, most remarkably in Indonesia and the Philippines, was intended for protection of slopes and water catchments and may not be productive. In addition, S. macrophylla is widely used for avenue planting in some Asian countries including Indonesia, India and Sri Lanka. According to Mayhew and Newton (1998) [4], the earliest recorded introduction of S. macrophylla into any country is to Indonesia in 1870 with seeds from India. It was then planted as ornamental and cultivated in plantations in Java between 1897 and 1902. Swietenia macrophylla has since become a promising tree species for industrial plantations as well as for reforestation and afforestation in Indonesia. The total plantation area of S. macrophylla in Indonesia was about 54,000 ha in the mid1990s, according to Perum Perhutani (1995) [7]. The number of small holder S. macrophylla plantations is increasing, particularly in Java and Kalimantan, because of the species high-quality wood used for furniture and cabinet making. According to a report by the Ministry of Forestry and the National Statistics Agency (2004) [5], Central Java and West Java have the highest number of S. macrophylla trees planted by smallholders, with these two provinces accounting for 60% of the total number of S. macrophylla trees planted by households in Indonesia.

Water affects the life of plants in various ways. It plays an important role in many physiological processes like seed germination, water uptake, transpiration, photosynthesis, growth and respiration etc. It also plays an important role in fertilization, pollination and dissemination of seed. Hence, an attempt has been made to study the growth and dry weight accumulation of S. macrophylla at different irrigation intervals under nursery.
Materials and Methods

To assess the effect of different irrigation intervals on growth performance of *S. macrophylla* seedlings, an experiment was conducted for 6 months at Forestry Nursery, College of Forestry, N.A.U., Navsari. The well established and equal height seedlings were used for this experiment. The polythene bags were kept in nursery beds and then experiment start to observe effect of different irrigation intervals like (1) Daily, (2) On alternate day and (3) Weekly were applied on seedlings.

After completion of the experiment, the seedlings were circumspectly separated by tearing the polythene bags, with hand and dissolving their soil in a trough, full water, to avoid any damage to fine rootlets. Ten seedlings were randomly selected for measurement of different parameters e.g. Collar diameter (mm), Shoot height (cm), Root length (cm), Number of leaves per plant, Plant weight (g), Root: Shoot length Ration, Moisture content (%) (Leaf, Root, Shoot), Dry leaf (g), Dry root (g), Dry shoot (g), All plant Dry weight (g) and Root: Shoot Dry weight Ratio.

Results and Discussion

The data of seedling growth performance of *Swietenia macrophylla* at different irrigation interval under nursery are given Table-1. This revealed that the maximum average collar diameter (9.97 mm), shoot length (68.25 cm), root length (15.25 cm) and number of leaves per plant (68.25) were recorded in daily irrigation and minimum in weekly irrigation (3.61 mm, 24.25 cm, 6.84 cm and 12.88, respectively). The total plant weights recorded under different irrigation condition like daily, alternate day and weekly were 42.38 g, 29.86g and 21.31g, respectively (Table - 1 and Fig.1).

| Treatments | Collar Diameter (mm) | Shoot length (cm) | Root length (cm) | Number of Leaves per plant | Total Plant weight (g) | Root : Shoot length Ration |
|------------|----------------------|-------------------|------------------|---------------------------|------------------------|---------------------------|
| Daily      | 9.97                 | 68.25             | 15.25            | 68.25                     | 42.38                  | 0.22                      |
| Alternate day | 5.40               | 34.75             | 8.62             | 40.00                     | 29.86                  | 0.25                      |
| Weekly     | 3.61                 | 24.25             | 6.84             | 12.88                     | 21.31                  | 0.28                      |
| C.D. @ 5%  | 0.59                 | 4.33              | 1.63             | 6.88                      | 2.15                   | 0.02                      |
| SE(m)      | 0.20                 | 1.46              | 0.55             | 3.29                      | 0.73                   | 0.01                      |
| SE(d)      | 0.28                 | 2.07              | 0.78             | 3.29                      | 1.03                   | 0.01                      |
| C.V. (%)   | 8.95                 | 9.74              | 15.21            | 16.27                     | 6.59                   | 8.05                      |

Plate 1: Different Irrigation time of *S. macrophylla* under different irrigation interval under nursery

Maximum average moisture content in root (86.41%), leaves (82.50%) and shoot (72.79%) and total moisture content in seedlings (80.57%) were found in daily irrigation interval which was followed by alternate day irrigation interval. While, the minimum moisture content in root, leaf and shoot was recorded 82.43%, 80.91% and 72.64%, respectively in weekly irrigation interval (Table - 2).
The variation in dry weight of seedling was found for different irrigation intervals under nursery (Table 3). After 6 month, maximum dry weight of leaf (6.23g), root (2.38g), shoot (4.16 g) and total plant (12.77g) were noted in daily irrigation interval, while above all parameters was registered minimum in weekly irrigation interval i.e. leaf (1.99 g), root (0.90 g), shoot (1.95 g), total plant dry weight (4.84 g) and root : shoot ration dry weight basis (0.46 g).

Table 2: Variation of moisture content in different plant parts of *S. macrophylla* under different irrigation interval under nursery

| Treatments | Leaf moisture (%) | Root moisture (%) | Shoot moisture (%) | Total moisture content in seedlings (%) |
|------------|-------------------|-------------------|-------------------|----------------------------------------|
| Daily      | 82.50             | 86.41             | 72.79             | 80.57                                  |
| Alternate day | 81.17             | 83.23             | 71.65             | 78.68                                  |
| Weekly     | 80.91             | 82.43             | 72.64             | 78.66                                  |
| C.D. @ 5%  | 1.97              | 1.70              | N/A               | 1.03                                   |
| C.D. @ 3%  | 0.67              | 0.57              | 0.45              | 0.35                                   |
| SE(d)      | 0.94              | 0.81              | 0.63              | 0.49                                   |
| C.V. (%)   | 2.27              | 1.93              | 1.74              | 1.24                                   |

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Table 3: Variation of dry weight (Biomass) of seedling of different irrigation condition under nursery

| Treatments | Dry Leaf (g) | Dry root (g) | Dry shoot (g) | Total plant dry weight (g) | Root : Shoot dry weight Ratio |
|------------|-------------|-------------|---------------|-----------------------------|-------------------------------|
| Daily      | 6.23        | 2.38        | 4.16          | 12.77                       | 0.57                          |
| Alternate day | 3.30        | 1.59        | 2.29          | 7.18                        | 0.70                          |
| Weekly     | 1.99        | 0.90        | 1.95          | 4.84                        | 0.46                          |
| C.D.       | 0.42        | 0.26        | 0.30          | 0.76                        | 0.06                          |
| C.D.       | 0.14        | 0.09        | 0.10          | 0.26                        | 0.02                          |
| SE(d)      | 0.20        | 0.12        | 0.14          | 0.36                        | 0.03                          |
| C.V. (%)   | 10.44       | 15.32       | 10.31         | 8.80                        | 9.33                          |

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