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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 nursery seeding is better further plantation is better. An irrigation is a key factor for growth of seedling. If irrigation schedule is disturbed than 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) (Grogan 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 an 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 mid 1990s, 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.

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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 circumspcctly 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).

Table 1: Growth performance of *S. macrophylla* under different irrigation interval under nursery

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	2.32	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



Daily irrigation

Alternate day irrigation

Weekly irrigation

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

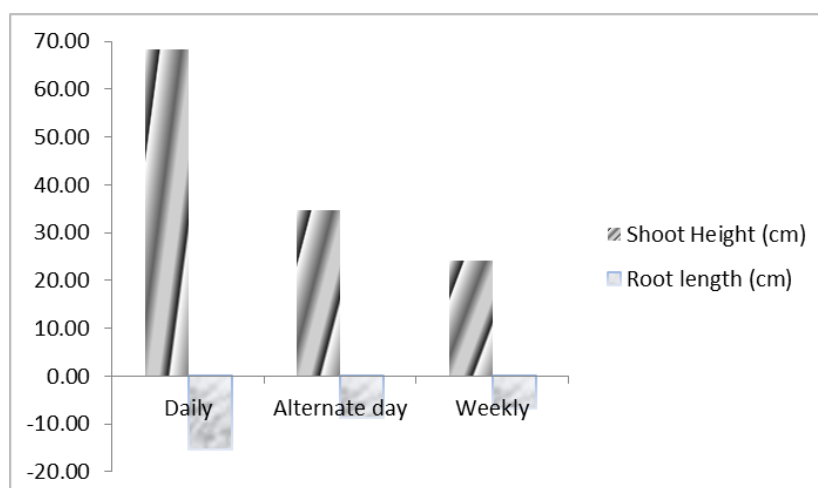


Fig 1: Variation in root and shoot growth among different irrigation interval under nursery

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).

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
SE(m)	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

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 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
SE(m)	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

In view of the above, it is evident that the seedling growth was enhanced significantly with application of daily irrigation as compared to those seedlings grown under alternate day and weekly irrigation intervals. The experiment firmly concludes that seedling growth of *S. macrophylla* is significantly enhanced under daily irrigation interval. These findings are in agreement with those of Sharma and Afolayan (1987) ^[9] who observed better growth of *Sporobolus pyramidalis* seedling in daily irrigation as compared to those which were watered twice or once in a week. Ramakrishna *et al.* (2007) ^[8] also found the maximum plant height with continuous submergence, which was significantly superior to that in case of three days drainage. Naugraiya and Pathak (1987) ^[6] observed that the alternate day irrigation gave maximum shoot and root length, but the maximum root and shoot dry weight were recorded at twice a day irrigation set. Tripathi and Saxena (1986) ^[14] found better growth in terms of dry weight in alternate day irrigation, followed by daily and twice a week irrigation, respectively. Singh and Singh (2007) ^[8] found that *Dalbergia sissoo* seedling are moderately tolerant to water stress and had high growth when soil water stress and had high growth when soil water was > 50% of soil field capacity. Bala *et al.* (2008) ^[1] have recorded the best performance of biomass production in *Eucalyptus camaldulensis* in I3W2 as compared to I3W1, where more water was added per irrigation. Irrigation increases gross primary productivity, water use efficiency and wood production (Singh *et al.* 1989, 1990 and 1993) ^[12, 13].

Conclusion

From above findings it is concluded that daily irrigation to seedlings in nursery significantly increased collar diameter, shoot length, root length, number of leaves per plant, plant weight, Root: Shoot ratio length basis, moisture content in leaf, root and shoot, dry weight of leaf, root and shoot, total plant dry weight and Root: Shoot ratio dry weight basis. The weekly irrigation interval resulted in significantly lowest for all parameters under study.

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