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Effect of Super Absorbent Polymer with various Watering Intervals on Seedling Growth of *Swietenia mahagoni* (L.) Jacq.

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ABSTRACT: An experiment was conducted at College of Forestry, Sirsi to know the effect of SAP with various watering intervals on seedling growth of *Swietenia mahagoni* in nursery. The experiment was laid out in factorial completely randomized design with six levels of SAP (0, 0.5, 1.0, 2.0, 3.0 and 4.0 g per seedling) and four watering intervals (2, 4, 6 and 8 days) and replicates three times. Results showed that SAP, watering intervals and their interactions had a significant effect on growth parameters of *Swietenia mahagoni* in nursery. At 200 days of observation, the higher seedling height (25.7 cm), collar diameter (5.37 mm), number of leaves per plant (16.2), root dry weight (11.87 g), shoot dry weight (19.46 g) and root to shoot ratio (0.57) were recorded at 4 g of SAP per seedling which was on par with 3 g per seedling. Significantly lowest values were observed at control. For watering intervals, maximum seedling growth parameters were recorded at 2 days watering interval which were found on par with 4 and 6 days interval. Significantly lowest values were observed at 8 days interval. It clearly shows healthy seedlings of *Swietenia mahagoni* can be raised by application of SAP @ 3 g per seedling + 6 days watering interval. Under water scarcity situations, watering can also be applied at 8 days interval if SAP is applied at 4 g per seedling.

Keywords: *Swietenia mahagoni,* Super Absorbent Polymer, growth parameters.

INTRODUCTION

Production of healthy seedlings is the pre-requisite for the successful plantation in the field in any afforestation and reforestation programmes. Nursery management represents the growing superior seedlings with greatest concentration of technology and investment like irrigation, fertilizer application, and pest management. Among these factors, soil moisture is one of the important factors influencing growth of seedlings, in terms of root and stem growth, availability of nutrients *etc.* and hence maintenance of proper water supply in the soil regime is one of the controlling factors in the production of high quality planting material (Kumar, 2015). In recent years, less and uneven distribution of rainfall has resulted in lesser availability of water in forest nursery areas. In the dry zone, it is predicted by HadCM3 general circulation model that there would be a decrease in rainfall and an increase in soil moisture deficit, which would demand high irrigation water requirement (Silva *et al.,* 2006). This has caused extreme problems for seedlings survival and growth in the arid and semiarid nursery areas (Ahmed *et al.,* 2013). It necessitated judicious and efficient use of available water in the nursery area. This calls for the use of materials which helps in holding and releasing moisture slowly in the soil which in turn help in efficient utilization of water and nutrients. This may also helps in reducing the amount of water to be applied during the nursery period. This technique not only helps in reducing water cost but also helps in saving man power which is known to add cost to total cultivation cost. Use of super absorbent polymers with the function of water retention was suggested to improve the utilization of water resources (Ekabafe *et al.,* 2011). Super absorbent polymers (SAP's) are basically polyelectrolytes with a three dimensional cross-linked structure and these polymer chains are linked to each other through acryl amide monomers that can absorb large volumes of aqueous fluids within a short time and under stress conditions can desorbs the absorbed water. These can be used under water deficit stress conditions to create a water reserve near the rhizosphere zone (roots) and benefit crop /seedling growth (Zohuriaan *et al*., 2008). Super absorbent polymer has a positive effect on water retention in various types of soils. In view of delay in time to reach permanent wilting point and increased sink

capacity, it prolongs plant survival under water stress. Allahdadi (2002) reported that the SAP compound help to increase the amount of available moisture and to reduce water stress of plants resulting in increased growth and plant performance. Since super absorbent polymers can ease the burden of water shortage, proper use is helpful in arid and semiarid areas. Khadem *et al.* (2010) reported that adding of this super absorbent polymer into soil can also improve soil water holding capacity, decrease evapo-transpiration, improves soil biological activities, enhances soil agglomeration, mitigate the drought stress and improves the plant growth. From this material, the gap between two irrigations can be increased, therefore water and cost of energy can be saved (Sivapalan, 2006). However, the use of SAP in nurseries on standard practice is lacking in India.

*Swietenia mahagoni*a member of the family Meliaceae, commonly known as Jamaican Mahogany or Mahogany which is native to Central America. It is a medium evergreen tree with handsome spreading habits. Better developments have been observed in areas receiving a rainfall of 1000-1500 mm, in localities not far from the sea, and at the elevations near sea level. High economic valuable species and a relatively fast growing tree species reaches a height of 30 m and a girth of 4.5 m. It has potential use for large scale timber production plantations. Wood is hard and durable, reddish brown with a golden luster. Timber is highly priced for decorative furniture, woodcraft and musical instruments. It is an ideal timber for plywood and veneer. The heartwood is highly resistant to decay and insect attack, the wood works well and finishes to an exceptionally smooth, lustrous surface. Also used in jewelry boxes, medicine cabinets and ship building (Debashis, 2016). The bark contains tannin and may serve as an antipyretic and astringent, that is taken orally as a decoction for diarrhea, as a source of vitamins and iron, and as a medicine to induce hemorrhage. Because of its uses, the *Swietenia mahagoni* seedlings are in demand in recent years for establishment of commercial plantations, garden boundary or around the courtyard. Due to increased interest among farmers of drier region to adopt this species in their agroforestry systems, there is a need to evaluate use of SAP in nurseries to reduce water requirement.

MATERIALS AND METHODS

The present study was carried out at the poly house, Department Silviculture and Agroforestry, College of Forestry, Sirsi, Uttara Kannada district during the year 2020-21. The experiment was laid out in factorial completely randomized design with three replications. The experimental treatments comprised of six levels of SAP (0, 0.5 g, 1 g, 2 g, 3 g, 4 g per seedling) and four watering intervals (2, 4, 6 and 8 days). A common potting mixture having two portions of red earth, one portion of sand and one portion of FYM was prepared. Then, this potting mixture was filled in polythene bags of size 8˝ × 12˝ and super absorbent polymer was mixed well in these filled polythene bags as per the treatments. These polythene bags were arranged according to the prescribed experimental layout in polyhouse. In each treatment, there were 20 polybags. The treatments were repeated three times (3 replications). Known amount of water was applied according to different watering intervals. The observations on growth parameters of *Swietenia mahagoni viz*., plant height, collar diameter and number of leaves/plant were recorded at an interval 25 days for a period of 100 days starting from 100 days after sowing from 10 random selected seedlings in each treatment and mean was worked out. For recording shoot and root dry weight, five randomly selected seedlings from each treatment were uprooted and washed thoroughly in tap water to remove adhering soil particles. The root and shoot portion were separated immediately after washing. The shoot and root dry weight after drying in oven at 70ºC for two days was recorded using digital electronic balance and expressed in grams per seedlings. Root and shoot dry weights were recorded after 200 days after sowing. The data obtained was statistically analysed by using ANOVA technique as per factorial CRD design.

$$\text{Root to shoot ratio} = \frac{\text{Root dry weight}}{\text{Shoot dry weight}}$$

RESULTS AND DISCUSSION

Water and nutrients are the important factors influencing the growth of seedlings. Hence, maintenance of proper water supply in the soil regime is one of the controlling factors in the production of high quality seedlings. The decreased rainfall in recent years which resulted in lesser availability of water in nursery areas forced us to use of materials which helps in holding applied water for longer period and releasing it slowly to the seedlings. Use of super absorbent polymer with the function of water retention was suggested to improve the utilization of water.

The growth of seedling of *Swietenia mahagoni* in the nursery was also influenced to a great extent with application of super absorbent polymer. At final plant observation (200 days after sowing), the maximum seedling height (25.7 cm), collar diameter (5.37 mm), numbers of leaves (16.2) were recorded with application of SAP @ 4 g/seedling which were found on par with SAP @ 3 g/seedling and were found significantly superior over control. Further, the SAP @ 2 g/seedling was found on par with 3 g SAP per seedling with respect to seedling height, collar diameter and number of leaves (Table 1). Instances of increase in plant height and other parameter with application of hydrogel material were reported by El-Hady *et al.* (1981) and Lawrence *et al.* (2009). Similarly, the root dry weight (11.87 g), shoot dry weight (19.46 g) and root to shoot ratio (0.57) were also higher with SAP @ 4 g per seedling and were found on par with that of 3 and 2 g of SAP per seedling and were found significantly superior over no SAP (Table 1). Instances of increase in biomass (shoot and root weight) of crops due to use of hydrogel material were reported by several workers (Banejshafei, 2000; Hameda *et al.,* 2011; Rasanjali *et al.,* 2019). This might be due to its ability of SAP to absorb and retain water in soil when applied. A favourable soil moisture regime might have

helped the plants to run their photosynthetic activity smoothly leading to improved growth.

Watering intervals also exhibited positive effect on plant parameters of *Swietenia mahagoni* seedlings. The maximum seedling height (24.5 cm), collar diameter (5.34 mm) and number of leaves (15.1) were found at 2 days interval and were found on par with 4 days interval and were found significantly superior over 8 days interval (Table 1). These results are in line with those of Azavedo *et al.* (2002) who reported the beneficial effect of SAP in increasing the irrigation interval without damaging the coffee plant. Similarly, Kumaran *et al.* (2001) reported the reduction in frequency of irrigation in tomato due to application of SAP. The reduced frequency or increased period between two irrigations with addition of SAP may be due to its capacity to retain more water and releasing it slowly. Increased water retention capacity of SAP when applied to soil were reported by several workers (Watt and Peake, 2001; Sivapalan, 2006; Ekabafe *et al.,* 2011; Vijayalakshmi *et al.*, 2012). Similarly, the root dry weight (11.65 g), shoot dry weight (18.38 g) and root to shoot ratio (0.60) recorded at 2 days interval were found on par with that of 4 and 6 days interval and were found significantly superior over 8 days interval. Similar results reporting increased period between two irrigations due to application of SAP were reported by Baasiri *et al.* (1986).

Among the interactions of SAP levels and watering intervals, SAP @ 4 g + 2 days interval recorded maximum seedling height (27.3 cm), collar diameter (6.43 mm) and number of leaves (17.4) and were found on par with SAP @ 3 g + 4 days interval and SAP @ 3 g + 6 days interval. These results clearly indicates that period between two irrigations can be increased to 6 days instead of regular practice of two days if SAP used at 3 or 4 g/seedling. Similar results indicating increase in period between two irrigations without negative effect on growth when SAP was used were reported by several workers. (Hutterman *et al.,* 1990; Jahangir and Jafar 2008; Ramesh *et al.,* 2015),

Table 1: Influence of different concentrations of super absorbent polymer (SAP) and watering intervals on seedling growth parameters of *Swietenia mahagoni* in nursery.

Treatments	Seedling height (cm)	Collar diameter (mm)	Number of leaves	Root Dry Weight (g)	Shoot Dry Weight (g)	Root to shoot ratio
Super absorbent polymer(S)						
S_1 - No SAP (control)	18.7	3.75	11.4	4.97	10.52	0.38
S_2 - SAP @ 0.5 g per seedling	21.3	4.28	12.6	8.96	14.46	0.46
S_3 - SAP @ 1 g per seedling	21.7	4.41	13.0	9.82	14.58	0.49
S_4 - SAP @ 2 g per seedling	23.8	4.98	14.4	11.74	18.99	0.51
S_5 - SAP @ 3 g per seedling	24.9	5.09	15.3	11.84	19.38	0.55
S_6 - SAP @ 4 g per seedling	25.7	5.37	16.2	11.87	19.46	0.57
SEm ±	**0.51**	**0.15**	**0.36**	**0.37**	**0.42**	**0.03**
CD @ 5%	**1.54**	**0.45**	**1.05**	**1.05**	**1.19**	**0.09**
Watering Intervals (I)						
I_1 - 2 days interval	24.5	5.34	15.1	11.65	18.38	0.60
I_2 - 4 days interval	23.7	5.01	14.4	10.33	17.15	0.53
I_3 - 6 days interval	22.2	4.45	13.4	9.25	15.98	0.46
I_4 - 8 days interval	20.3	3.78	12.4	8.23	13.41	0.39
SEm ±	**0.44**	**0.12**	**0.30**	**0.43**	**0.34**	**0.02**
CD @ 5%	**1.26**	**0.36**	**0.86**	**1.23**	**0.97**	**0.07**
Interactions (S × I)						
$S_1 \times I_1$	21.6	4.38	12.8	6.33	13.73	0.32
$S_1 \times I_2$	18.9	3.90	12.7	5.03	10.37	0.40
$S_1 \times I_3$	19.4	3.51	11.1	4.90	9.77	0.40
$S_1 \times I_4$	15.0	3.22	9.0	3.63	8.20	0.40
$S_2 \times I_1$	24.0	4.58	15.0	10.20	17.60	0.50
$S_2 \times I_2$	22.7	4.62	13.9	10.13	16.83	0.43
$S_2 \times I_3$	21.1	3.85	10.7	7.87	13.43	0.43
$S_2 \times I_4$	17.4	4.07	10.9	7.63	9.97	0.47
$S_3 \times I_1$	24.5	5.04	13.5	12.63	16.67	0.55
$S_3 \times I_2$	23.3	4.46	15.2	9.47	16.03	0.57
$S_3 \times I_3$	20.1	4.53	12.3	8.90	13.60	0.50
$S_3 \times I_4$	18.8	3.61	11.0	8.27	12.03	0.33
$S_4 \times I_1$	25.3	5.84	15.2	12.90	18.97	0.60
$S_4 \times I_2$	26.0	5.06	13.7	12.53	20.60	0.60
$S_4 \times I_3$	21.6	4.73	14.0	11.63	19.33	0.47
$S_4 \times I_4$	22.2	4.27	14.8	9.90	17.07	0.37
$S_5 \times I_1$	24.5	5.76	16.6	14.93	21.63	0.78
$S_5 \times I_2$	26.5	6.20	15.4	12.27	19.17	0.57
$S_5 \times I_3$	25.0	5.15	15.4	10.87	20.00	0.43
$S_5 \times I_4$	23.6	3.25	13.6	9.30	16.70	0.43
$S_6 \times I_1$	27.3	6.43	17.4	12.90	21.70	0.83
$S_6 \times I_2$	24.7	5.82	15.5	12.57	19.90	0.63
$S_6 \times I_3$	25.9	4.95	16.9	11.33	19.73	0.50
$S_6 \times I_4$	24.9	4.26	14.9	10.67	16.50	0.33
SEm ±	**1.10**	**0.31**	**0.73**	**0.74**	**0.83**	**0.06**
CD @ 5%	**3.14**	**0.90**	**2.10**	**2.11**	**2.39**	**0.18**

CONCLUSIONS

SAP has more water absorption capacity in the soil and slowly desorbs to the root zone of plants whenever there is lack of moisture content in soil. It can be concluded from the data that healthy seedlings of *Swietenia mahagoni* can be raised by application of SAP @ 3 g per seedling + 6 days watering interval. Under water scarcity situations, watering can also be applied at 8 days interval if SAP is applied at 4 g per seedling without compromising much on quality and growth of seedlings.

FUTURE SCOPE

In the future, preparing a water retaining agent with a broad agricultural application prospect should consider not only its water absorption and water retention in soil, but also mechanical strength, reusability, degradability, safety and cost also.

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