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Research Article

Effect of Arbuscular Mycorrhizal Fungi on the Growth of Mahogany (*Swietenia macrophylla* King.) Seedlings under Nursery Condition

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ABSTRACT

A study was conducted to determine the effect of arbuscular mycorrihzal fungi (AMF) on the growth of Swietenia macrophylla seedlings under nursery condition. It was found that inoculation with AMF at nursery stage can help the plant to grow healthier especially in height and collar diameter. So AMF is recommended to be used as a bio-fertiliser for seedlings at early stage. These seedlings will tolerate the field plantation shock more effectively than non-inoculated seedlings especially in drought scenario.

Keywords: *Mahogany, AMF, Nursery, Bio-fertiliser.*

INTRODUCTION

Swietenia macrophylla King, an important tree species, has been planted extensively in Southern Asia including India, Indonesia, Sri Lanka and Phillipines (Krisnawati et al., 2011). With growing demand of timber farmers tend to add chemical fertilisers during the early stage of growth in the species in a plantation which is harmful to the environment. As an alternative biofertilsers shall be preffered. Arbuscular mycorrihzal fungi (AMF) are associated with about 80% of the terrestrial plant species (Smith & Read, 2008 & Cekic et al., 2012). They help in increasing the biomass of the plants by improving the plant nutrition absorption (especially in phosphorous acquisition), soil structure, resistance against drought and pathogens (Lambers et al., 2008; Walder et al., 2012 & Posada et al., 2018). The tree seedlings when inoculated with AMF in nursery make the healthy and show vigorous growth (Jha et al., 2017). It makes AMF as an excellent bio-fertiliser. The effects of AMF on tree seedlings under nursery condition are well established in *Dalbergia sissoo* (Sahgal et al., 2004), *Populus x Canescens* (Beniwal et al., 2010), *Fagus sylvatica* (Beniwal et al., 2011), *Santalum album* (Binu et al., 2015) and *Tectona grandis* (Ajeesh et al., 2017). Studies shows that *S. macrophylla* naturally found associated with AMF mostly of four genres like *Gigaspora*, *Glomus*, *Acoulospora* and *Ambispora* (Rodríguez-Morelos et al., 2014).

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Considering the fact, an experiment was conducted to analyse the growth of *S. macrophylla* with association of three AMF species viz. *Funneliformis mosseae*, *Acaulospora mellea*, and *Glomus etunicatum* under nursery condition.

MATERIALS AND METHODS

Site location:

The study site was located at College of Forestry, Kerala Agricultural University, Kerala, India. It has a latitude of 10° 32' N, longitude of 76° 26' E and a 22m elevation from mean sea level (MSL).

Mass multiplication of AMF:

Pure culture of three native AMF species were collected from The Energy Research Institute (TERI), New Delhi containing 500 spores per 50 g. For mass multiplication vermiculite was used for medium, maize (*Zea mays*) used as host plant and Hogland's solution added for nutrition (Hogland & Arnon, 1950).

Raising of seedlings:

Seeds of *S. macrophylla* were sown in polythene bags containing soil which has been fumigated with 5% Formaldehyde.

Inoculation:

Seedlings when reached one month old, then 10 g of AMF inoculum were added (Giri et al., 2005).

Experiment lay-out:

The experiment was laid out in a complete randomized design with three treatments and control with three replications each.

Observation:

Shoot height, collar diameter and number of leaves, root colonisation percentage and total spore count was recorded in nursery. The root colonisation percentage was estimated using clearing and staining method by Phillips and Hayman (1970) and spore count was done using wet sieving and decanting method by Gerdemann and Nicolson (1963).

RESULTS

Table 1: Meteorological observations during the experiment

Year	Month	Maximum temperature (°C)	Minimum temperature (°C)	Rainfall (mm)	Relative humidity (%)	Mean evaporation (mm)	Number of Rainy days
2016	October	31.5	22.7	37.0	81	2.8	4
	November	32.9	22.2	13.8	69	3.0	1
	December	32.4	22.3	52.9	69	3.3	3

Table 2: Shoot height, collar diameter and number of leaves of mahogany seedlings as influenced by AMF under nursery conditions at 30 days of inoculation

Treatments	Height (cm)	Collar diameter (mm)	Number of leaves
F. mosseae	16.75	1.54[a]	5.94
A. mellea	17.13	1.66[a]	6.23
G. etunicatum	16.78	1.54[a]	6.02
Control	14.21	1.31[b]	6.06
F value	**2.377[ns]**	**12.216***	**0.434[ns]**
CoV	**9.351**	**4.739**	**5.27**

*-Significant at 5% level, ns – Non-significant at 5% level

Table 3: Shoot height, collar diameter and number of leaves of mahogany seedlings as influenced by AMF under nursery conditions at 60 days of inoculation

Treatments	Height (cm)	Collar diameter (mm)	Number of leaves
F. mosseae	23.14	2.45[a]	6.95
A. mellea	24.11	2.38[ab]	6.85
G. etunicatum	23.66	2.34[b]	6.49
Control	19.97	2.07[c]	6.90
F value	**3.56[ns]**	**34.033***	**1.941[ns]**
CoV	**7.57**	**2.150**	**3.802**

*-Significant at 5% level, ns – Non-significant at 5% level

Table 4: Shoot height, collar diameter and number of leaves of mahogany seedlings as influenced by AMF under nursery conditions at 90 days of inoculation

Treatments	Height (cm)	Collar diameter (mm)	Number of leaves
F. mosseae	30.59[a]	3.66[a]	9.07
A. mellea	31.28[a]	3.61[a]	9.68
G. etunicatum	31.21[a]	3.70[a]	8.92
Control	26.28[b]	3.22[b]	8.71
F value	**5.067***	**13.195***	**1.611[ns]**
CoV	**6.17**	**3.003**	**6.295**

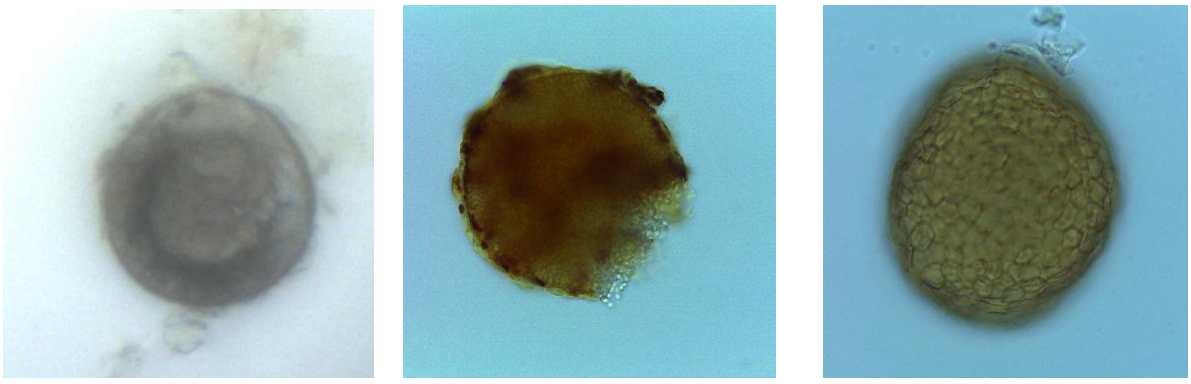
*-Significant at 5% level, ns – Non-significant at 5% level

Table 5: Root colonisation percentage leaves of mahogany seedlings as influenced by AMF under nursery conditions

Treatments	Root colonisation percentage (%)		
	30 days	**60 days**	**90 days**
F. mosseae	27.2	23.2	35.68
A. mellea	23.5	29.6	35.5
G. etunicatum	28.7	23.6	39.15
Control	0	0	0
Mean	**26.46**	**25.46**	**36.77**

Table 6: Root colonisation percentage leaves of mahogany seedlings as influenced by AMF under nursery conditions

Treatments	Total spore count (per 10 g)		
	30 days	**60 days**	**90 days**
F. mosseae	59	71	101
A. mellea	54	71	96
G. etunicatum	51	59	95
Control	0	0	0
Mean	**54.66**	**67**	**97.33**



(A) (B) (C)

Fig. 1: Spores of *F. mosseae* (A), *A. mellea* (B) and *G. etunicatum* (C)

DISCUSSION

The selection of AMF species was done on the soil type and AMF species diversity of the soils of Kerala. The soils of Kerala is well drained sandy clay loam Ultisol (Raj et al., 2016) and predominantly home of AMF genus *Glomus* and *Acaulospora* (Gopal et al., 2005). The AMF have the ability to reach beyond root expansion zone of plant and get water and nutrients for the plant (Smith & Read 2008). So plants which have been inoculated with AMF have maore access towards nutrients and

can grow vigorously. The present study showed that seedlings with AMF inoculation have positive impact on their growth than the non-inoculated seedlings. However, different AMF species had similar impact on the growth of the seedlings. There was a significant increase in height of inoculated seedlings at 90 days comparing to the non-inoculated seedlings. The collar diameter of inoculated seedlings was significantly higher than the non-inoculated seedlings. Similar result has been reported in different tree species like *Dalbergia sissoo* (Sahgal et al., 2004), *Acacia mangium* (Ghosh & Verma 2006 & Jeyanny et al., 2011), *Casuarina equisetifolia* (Zhang et al., 2010), *Prunus persica* (Wu et al., 2011), *Fagus sylvatica* (Beniwal et al., 2011), *Citrus spp* (Ortas & Usttuner 2014), *Santalum album* (Binu et al., 2015) and *Tectona grandis* (Ajeesh et al., 2017). However, the leaf numbers don't vary significantly which may be due to the early stage of growth (Querejeta et al., 1998). The root colonisation percentage and spore count can vary from 4 to 95% (Birhane et al., 2018). The root colonisation percentage and total spore count was found moderate in this experiment. As the result indicates it is recommended to add AMF inoculant applied at the early stage of seedlings will make them healthy and will withstand transplantation shock easily.

CONCLUSION

S. macrophylla seedlings showed a significant increase in growth performance when inoculated with AMF under nursery condition. So AMF can be used as an alternative of chemical fertiliser which definitely help in reducing the environmental pollution.

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