



P-ISSN: 2349-8528

E-ISSN: 2321-4902

IJCS 2019; 7(3): 4257-4260

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Received: 27-03-2019

Accepted: 29-04-2019

#### AS Goveanthan

Department of Environmental Sciences, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

#### MP Sugumaran

Department of Environmental Sciences, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

#### C Buvaneswaran

Institute of Forest Genetics and Tree Breeding, (ICFRE), Coimbatore, Tamil Nadu, India

#### S Radhakrishnan

Department of Silviculture, Forest College and Research Institute, Mettupalayam, Tamil Nadu, India

#### P Jeyakumar

Department of Crop Physiology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

#### P Thangavel

Department of Environmental Sciences, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

#### Correspondence

#### MP Sugumaran

Department of Environmental Sciences, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

## International Journal of Chemical Studies

# Performance of various tree species in Miyawaki plantation in Anna university campus, Coimbatore

AS Goveanthan, MP Sugumaran, C Buvaneswaran, S Radhakrishnan, P Jeyakumar and P Thangavel

### Abstract

A study was conducted to find the performance of tree species under Miyawaki method of planting in Anna University Regional Zone, Coimbatore and the plantation was taken up during 2016. Sixteen fast growing trees namely *Pongamia pinnata*, *Thespesia populnea*, *Terminalia catappa*, *Albizia saman*, *Holoptelea integrifolia*, *Azadirachta indica*, *Melia azedarach*, *Peltophorum pterocarpum*, *Limonia acidissima*, *Albizia lebbek*, *Spathodea campanulata*, *cassia siamea*, *Adenanthera pavonina*, *Swietenia macrophylla*, *Ficus religiosa* and *Mailnkara hexandra* were planted in close density planting method. The performance of these trees was assessed with biometrical traits (height, basal diameter) and eco-physiological traits (transpiration, photosynthesis and stomatal conductance). Among the Sixteen species, *Spathodea campanulata* exhibited highest growth, productivity and also superior in eco physiological traits which suits better suits for Miyawaki afforestation. The tree species, *Cassia siamea* performed well next to *Spathodea campanulata* in terms of biometric, productivity and eco-physiological parameters. *Holoptelea integrifolia*, *Swietenia macrophylla* and *Limonia acidissima* have recorded the lowest parameters. The tree species, *Spathodea campanulata* and *cassia siamea* are highly suitable for afforestation in wastelands and also for urban forest in Miyawaki method of planting.

**Keywords:** Various tree species, plantation

### Introduction

The Miyawaki technique in around 550 areas in Japan, as well as in Malaysia, Southeast Asia, Brazil, Chile, and in a few zones of China, were observed to be fruitful, permitting brisk natural rebuilding efforts of firmly corrupted zones (Miyawaki 1989) [8]. The eco-physiological conduct of species inside multi day uncovers an exhibition of animal categories in its biomass creation, which in the end speaks to the carbon sequestration capability of tree species (Gikloo *et al.*, 2012) [5]. The impacts of raised climatic CO<sub>2</sub> on tree coverings are showed by changes in photosynthesis. Investigations of both deciduous and evergreen species have appeared raised CO<sub>2</sub> prompts expanded photosynthesis and diminished stomatal conductance (Calfapietra *et al.*, 2005) [3]. Past research on diurnal elements on various tree species have uncovered evening decreases in photosynthesis, even under perpetual light conditions when some different pressure happens (Muraoka *et al.*, 2000) [9]. This evening decay is frequently credited to stomatal conclusion or potentially photograph inhibitory harm. The present examination plans to demonstrate an eco-physiological conduct of trees in no man's land condition and its effect on carbon sequestration.

### Materials and Methods

#### Experimental location and climate

The exploratory zone, the Anna University Regional Zone, Coimbatore is situated near Somayampalayam, Coimbatore in the surroundings of Western Ghats in Tamil Nadu. This area gets a yearly normal precipitation of 500-600mm and mean yearly temperature of 33.4 °C (least of 28 °C and limit of 37 °C). The soil type of the trial area is red sandy earth with the pH and EC of 7.26-7.41 and 0.34 dS m<sup>-1</sup>, respectively.

### Materials

The tree species selected for the investigation of eco-physiological traits are *Pongamia pinnata*.

*Thespesia populnea*, *Terminalia catappa*, *Albizia saman*, *Holoptelea integrifolia*, *Azadirachta indica*, *Melia azedarach*, *Peltophorum pterocarpum*, *Limonia acidissima*, *Albizia lebbeck*, *Spathodea campanulata*, *cassia siamea*, *Adenanthera pavonina*, *Swietenia macrophylla*, *Ficus religiosa* and *Mailnkara hexandra* king and were planted with a spacing of 1m x 1m.

### Biometric traits

The biometric attributes like, height and basal diameter were evaluated for all the sixteen tree species.

### Eco-physiological attributes

The eco-physiological characters were estimated utilizing a compact photosynthesis framework (PPS, model LC pro + Photosynthesis framework CO<sub>2</sub> gas analyzer, UK) to evaluate the transpiration, photosynthesis and stomatal conductance of focused tree species. The estimations were made on completely developed leaves (5-6 leaves from the bud) at twenty sixth month and thirtieth months in the wake of planting. The eco-physiological estimations viz., transpiration rate, stomatal conductance and photosynthetic rate were estimated on a bright day between 10.00 AM to 12.00.

### Statistical analysis

The data obtained were subjected for statistical analysis to evaluate the possible relationship between the different parameters and analysis of variance employing statistical methods described by Panse and Sukhatme (1985).

### Results and Analysis

The outcomes got from the present experiment just as applicable talk have been outlined under the accompanying heads:

#### Biometric Evaluation of Afforested Plantation

In biometric evaluation, the maximum height was observed in *Spathodea campanulata* with 6.26m followed by *Cassia siamea* with 5.64 m and the minimum height was recorded in *Ficus religiosa* and *Peltophorum pterocarpum* with 1.79m and 1.29m after 31 months of the plantation. An almost a similar pattern was observed in the basal diameter also. The highest basal diameter was observed in *Spathodea campanulata* with 51.49mm followed by *Peltophorum pterocarpum* and *Cassia siamea* with 50.70mm and 45.43mm respectively. However the lowest basal diameter was observed in *Melia azedarach*, *Holoptelea integrifolia*, *Swietenia macrophylla* and *Limonia acidissima* due to the severe edaphic and Climatic Stress. Goel and Singh (2008)<sup>[6]</sup> stated that under the sodic condition the *Dalbergia sissoo* species recorded maximum height of 5.35m in 5 years and thus proven to be suitable for the wasteland. However, Kumar (2011)<sup>[7]</sup> and Babu (2012)<sup>[1]</sup> observed that highest diameter increment was recorded in the order of *Dalbergia sissoo*, *Bambusa vulgaris* var. *vulgaris*, *Swietenia macrophylla*,

*Tectona grandis* and *Gmelina arborea*. Prasath et al. (2016)<sup>[10]</sup> reported that *Dalbergia sissoo* and *Tectona grandis* species recorded the maximum diameter of 6.82 cm and 5.15 cm in 3 years. In the present study, it was observed that *Holoptelea integrifolia*, *Swietenia macrophylla* and *Limonia acidissima* have recorded lowest diameters after 31 months after plantation, hence they are not suitable for Miyawaki method of afforestation. (Table 1).

**Table 1:** Biometric evaluation of thirty one month old trees planted at The Anna University Regional Zone, Coimbatore

Name of the tree species	Height (m)	Basal diameter (mm)
<i>Pongamia pinnata</i>	2.97	35.68
<i>Thespesia populnea</i>	3.75	37.65
<i>Terminalia catappa</i>	2.88	42.13
<i>Albizia saman</i>	4.00	38.50
<i>Holoptelea integrifolia</i>	3.70	23.46
<i>Azadirachta indica</i>	2.61	32.66
<i>Melia azedarach</i>	3.74	25.43
<i>Peltophorum pterocarpum</i>	1.29	50.70
<i>Limonia acidissima</i>	3.42	19.87
<i>Albizia lebbeck</i>	4.11	29.37
<i>Spathodea campanulata</i>	6.26	51.49
<i>Cassia siamea</i>	5.64	45.43
<i>Adenanthera pavonina</i>	1.83	27.95
<i>Swietenia macrophylla</i>	4.51	21.22
<i>Ficus religiosa</i>	1.71	27.00
<i>Mailnkara hexandra</i>	3.29	26.43
SEd	0.08	0.6583
C.D.(P=0.05)	0.1633	1.3444

#### Eco-physiological traits

The eco-physiological behavior like photosynthetic rate (A), transpiration rate (E) and stomatal conductance (Gs) was studied with the planted sixteen tree species during January and September. During January, the *Cassia siamea*, *Adenanthera pavonina* and *Spathodea campanulata* showed lowest transpiration rate and photosynthetic rate of 0.15  $\mu\text{mol. M}^{-2} \text{s}^{-1}$ , 0.29, 0.41 and 0.66, 0.59, 0.32  $\mu\text{mol. M}^{-2} \text{s}^{-1}$  respectively (Fig 1). Nevertheless, the *Cassia siamea* and *Spathodea campanulata* showed maximum growth height and basal diameter but in *Adenanthera pavonina* moderate height and basal diameter were observed. The tree species with highest growth height and basal diameter showed the lowest transpiration rate and photosynthetic rate. The *Albizia saman* exhibited the highest transpiration and photosynthetic rate of 0.17 and 7.99  $\mu\text{mol. M}^{-2} \text{s}^{-1}$  but observed highest growth height and moderate basal diameter. Other species like *Pongamia pinnata*, *Peltophorum pterocarpum*, *Melia azedarach* and *Azadirachta indica* showed highest photosynthetic rates and transpiration rates however showed moderate to lowest height and basal diameter. The *Albizia saman* and *Peltophorum pterocarpum* showed maximum stomatal conductance of 0.04  $\mu\text{mol. M}^{-2} \text{s}^{-1}$  and photosynthetic rate of 7.99 and 7.68  $\mu\text{mol. M}^{-2} \text{s}^{-1}$  respectively (Table 2).

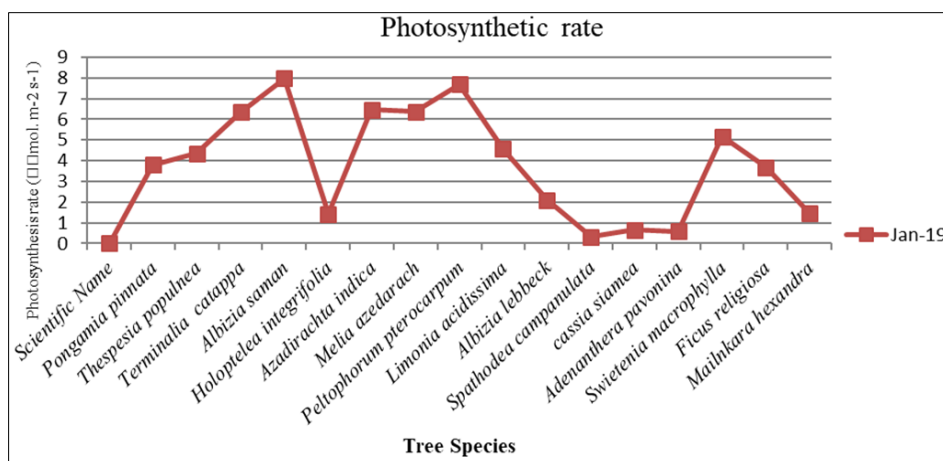
**Table 2:** Eco physiological behavior of thirty months old trees planted at the Anna University Regional Zone, Coimbatore

Name of the tree species	Transpiration rate (E)	Stomatal conductance (Gs)	Photosynthetic rate (A)
<i>Pongamia pinnata</i>	1.07	0.04	3.79
<i>Thespesia populnea</i>	0.85	0.03	4.36
<i>Terminalia catappa</i>	0.96	0.03	6.34
<i>Albizia saman</i>	1.17	0.04	7.99
<i>Holoptelea integrifolia</i>	0.39	0.01	1.42
<i>Azadirachta indica</i>	0.72	0.02	6.46
<i>Melia azedarach</i>	0.69	0.02	6.38

<i>Peltophorum pterocarpum</i>	1.01	0.04	7.68
<i>Limonia acidissima</i>	0.56	0.02	4.57
<i>Albizia lebbek</i>	0.51	0.01	2.09
<i>Spathodea campanulata</i>	0.41	0.01	0.32
<i>Cassia siamea</i>	0.15	0.04	0.66
<i>Adenanthera pavonina</i>	0.29	0.01	0.59
<i>Swietenia macrophylla</i>	0.41	0.01	5.18
<i>Ficus religiosa</i>	0.54	0.02	3.67
<i>Mailnkara hexandra</i>	0.24	0.03	1.46
SEd	0.02		0.08
C.D.(P=0.05)	0.03		0.17

Balasubramanian *et al.* (2009) [2] recorded a high photosynthetic and high transpiration rate under waterlogged conditions in Eucalyptus clones. However, the low performing clones showed a lower growth, high photosynthetic and high transpiration rate but the higher performing clones exhibited lower photosynthetic and lower respiration rate. Availability of water to plant and the ability of a plant to regulate water potential under climatic change condition will help to adapt species (Rouhi *et al.*, 2007 and

Souza *et al.*, 2004) [11, 12]. The plant's physiological character, such as transpiration is an important factor in changing environmental condition (Campose *et al.*, 2011) [4]. Earlier studies of Kumar (2011) [7] and Babu (2012) [1] have confirmed that *Tectona grandis* and *Gmelina arborea's* transpirational behavior was lower than that of *Dalbergia sissoo* and *Bambusa vulgaris var. vulgaris* during 1st year and 2nd year, respectively.



**Fig 1:** Photosynthesis rate ( $\mu\text{mol. m}^{-2} \text{s}^{-1}$ ) behavior of thirty month old trees planted at Anna University Regional Zone, Coimbatore.

## Conclusion

The *Spathodea campanulata*, *Peltophorum pterocarpum*, *Cassia siamea* and *Terminalia catappa* exhibited their suitability for Miyawaki afforestation even though they exhibited mixed biometric traits and eco-physiological activities. However, *Limonia acidissima*, *Swietenia macrophylla*, *Holoptelea integrifolia* and *Mailnkara hexandra* exhibited highest stomatal conductance and eco-physiological activities but lowest biometric traits, resulted in their non-suitability for Miyawaki afforestation.

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