

Germination Behavior and Initial Growth Performance of Eight Multipurpose Tree Species

SHIULI MAHMUD¹, A.T.M. RAFIQU HOQUE AND MOHAMMED MOHIUDDIN

Institute of Forestry and Environmental Sciences, Chittagong University, Chittagong, Bangladesh

¹Corresponding author's e-mail rafiqcu@yahoo.com

ABSTRACT

The study was conducted in the nursery of the Institute of Forestry and Environmental Sciences and Chittagong University hills to determine the germination behavior and initial growth performance of eight multi-purpose tree species. Germination of *Leucaena leucocephala* was found highest (80%) followed by *Acacia auriculiformis* (68%) and *A. tortilis* was the lowest (8%). *Sesbania sesban* showed maximum height (127.17 cm in the nursery and 403.8 cm in the field level) followed by *L. leucocephala* (336.13 cm in the field), *Senna siamea* respectively. *Dalbergia sissoo* (7.23 cm) in the nursery and *Acacia nilotica* (53.81 cm) in the field was found to show the poorest growth performance. In the planting site *L. leucocephala* showed maximum (100%) survival, followed by *S. sesban* (97%) and *S. siamea* (96.67%). The results also revealed that *S. sesban* and *L. leucocephala* are the best performing species and these species will be most suitable for plantations in the hilly regions of Chittagong.

Key Words: Nursery; Germination; Growth; Multi-purpose tree species

INTRODUCTION

Despite a very low per capita consumption of wood (fuelwood 0.06 m³ and timber 0.018 m³) the supply from the forest is inadequate and far beyond the demand in Bangladesh (Bhuiyan, 1993). There remains a wide gap between the supply and demand of forest products. The existing forest of the country is unable to meet the current demand of forest products for its people due to overexploitation of resources, destruction of forests, shortage of quality seed supply and planting stocks, increased cost of raising plantation and shortage of sufficient research and technical know how. To increase the productivity of the Plantations Bangladesh Forest Department, Bangladesh Forest Research Institute and Institute of Forestry and Environmental Sciences, Chittagong University had taken initiatives to introduce fast growing multi-purpose tree species for plantations. Farmers widely prefer fast growing multipurpose trees for their plantation programs. Legumes are found to get popularity because of its fast growth, nitrogen-fixing and coppicing behavior and ability to adapt in wide range of environments. The demands of the fast growing multipurpose trees in plantation programs are immense. The aim of this study was to provide an insight onto the comparative growth performance of *Acacia nilotica*, *Acacia auriculiformis*, *Acacia tortilis*, *Senna siamea*, *Dalbergia sissoo*, *Sesbania sesban* and *Prosopis juliflora* including the germination behavior and their initial growth performance in the out planting site.

MATERIALS AND METHODS

The seeds of the experiment were obtained from the New Forest project, U.S.A. Forest topsoil was collected, air-

dried and sieved through to remove gravel and plant parts. A total of 1200 polybags were filled with the sieved soils. Mature uniform seeds of the species were sown and three replicate plots containing 50 polybags were set for the experiment. Two seeds of each species were sown on each polybags. Pretreatments were given to the seeds according to the standard nursery procedures (Zabala, 1991). As soon as the germination starts, seedlings were counted daily for one month. Germination of the seedlings was measured in every fifteen days interval for at least three months. When the seedlings attained planting height they were transplanted to the field. The planting hole was dug thoroughly and soil was loosened properly. Randomized block design was followed in arranging the experiment. All the seedlings in the field were measured and weeded monthly till for seven months. Germination percent, germination energy % and germination period were calculated following the Zabala (1991). Duncan Multiple Range Tests (DMRT) was used to compare the mean values of all the treatments following Zaman *et al.* (1982).

RESULTS AND DISCUSSION

Germination percent, germination energy % and germination period. Germination percent, germination energy % and germination period of eight MPTS in the nursery during the experiment is presented in Table I. *L. leucocephala* showed the highest (80%) germination percent followed by *Acacia auroculiformis* (68%) after 30 days and *Acacia tortilis* showed the lowest (8%). The germination was completed within 8 days for *S. sesban* followed by *L. leucocephala* (18 days); whereas, *A. tortilis* requires the longest germination period (29 days) followed by *Acacia auriculiformis* (26 days). Germination energy

(%) after 10 days interval is highest in *P. juliflora* (20%) followed by *L. leucocephala*, (17%) and lowest in *D. sissoo* (4%). Germination energy (%) of *L. leucocephala* was highest (26%) followed by *P. juliflora* (18%) and *A. nilotica* (15%) and lowest in *A. tortilis* (2%). But during the last 10 days, germination energy% is highest in *L. leucocephala* (26%) followed by *A. nilotica* (19%) and *P. juliflora* (18%) and lowest in *A. tortilis* (3%). Data also revealed that germination started most early in case of *S. sesban* and *P. juliflora* (2 days) and ends most lately in case of *A. auriculiformis* (32 days). Aggregate comparative results of the studied eight MPTS in single publication are not available but species-specific information found in different literature. Wiersum and Ramlan (1982) found that germination of *A. auriculiformis* starts in about 6 days where in the present study found it in 4 days of seed sowing. *A. auriculiformis* was reported germinate 40-100% after 6-15 days JØker (2000a); whereas, the germination rate for *D. sissoo* is 60-80% (JØker, 2002) and the germination percent of *A. tortilis* is reported as 77-98% (JØker, 2000b). *L. leucocephala* seed germination is commonly reported 50-98% (Von Carlowitz, 1986; Daguma *et al.*, 1988). Scarified seed of *L. leucocephala* germinates 6-10 days after sowing where unscarified seed germinates 6-60 days after sowing (Dijkman, 1950; Von Carlowitz, 1986). Drake (1993a) reported germination of *P. juliflora* after pretreatment is usually 75-95%. Fresh seeds of *S. siamea* germinate 50-

90% without pretreatment in 4-6 weeks (Rocas, 2002).

Growth rate at the nursery stage. The height of the seedlings at the nursery stage for eight MPTS is shown in Table II. *S. sesban* attained best initial growth rate while *D. sissoo* has shown the poorest height growth. In a comparative study of *S. siamea* and *L. Leucocephala*, Fayemilihin and Kang (1988) found 3.4 and 5.3 cm, respectively after 2 weeks of planting, 5.6 and 9.9 cm after 4 weeks, 11.4 and 28.9 cm after 6 weeks and 28.9 and 60 cm at the nursery stage. In Zaire, a trial with 1x1 m spacing of different species showed height growth of 0.9 m for *Acacia auriculiformis* in 7 months of planting with a spacing of 1.9 x 2.0 m in India. Aswathanarawyana and Mahadevappa (1996) reported 39.7 and 73.8 cm growth at the nursery stage. *A. nilotica* was found to grow up to 59.6 cm in 120 days by Kumar and Gupta (1990). Tote and Khatri (1997) attained 2.8 cm height in 3 weeks after planting in *D. sissoo*, *A. nilotica*, *L. Leucocephala* and *P. juliflora* in a trial test in India attained height up to 0.77m (NFTA Network Trials, 1988). The same report revealed that *S. siamea* and *L. leucocephala* grew up to 2 and 0.32 m, respectively in 5 months. Turnbull (1986) reported that seedlings of *A. auriculiformis* reach 15-30 cm in height in the nursery in about 3 months. Better results also recorded for *L. leucocephala* by Matin and Rashid (2000) where the height growth ranges from 80 to 100 cm. In comparison to the fast growing *Albizia* species, similar observations among the species were also found during height growth (Matin & Khan, 1999). Similar fast growing tendency in height growth of *A. procera* (52.7 cm), *A. falcaterria* (64.2 cm) and *A. chinensis* (73.11 cm) were also reported by Nandy (1999). According to Ruiz and Febles (1989), study of seeds of *L. leucocephala*, sown in April, May, and June had the best heights (125, 137, 120 cm). The causes of differences in initial height growth among the species may be their own genetic quality and variation of their growth behavior.

Growth performance of the seedlings in the field. At the field level outstanding growth rate of *S. sesban* followed by *L. leucocephala* were found (Table III). *A. tortilis* has shown the poorest growth rate of all the species. For the first four months, *S. sesban*, *L. leucocephala* and *P. juliflora* have shown good growth rate. During the last three months, *S. sesban* attained maximum height growth, which was followed by *L. leucocephala* and *S. siamea*. In Srilanka, *A. auriculiformis* was reported to grow up to 6.7 m in one and a half year and 5 m after 2 year in U.S.A. with 1 x 1 m spacing. Osho and Ajonina (1999) got about 16.63 m height in case of *S. siamea* after 14 years. *L. leucocephala* attained a height of 3.3 m after 2 years in U.S.A. at the field level.

Survival, collar dia. and branching ability of species. Survival rate of *L. leucocephala* (100%) found highest followed by *S. siamea* and *S. sesban* (97%) and lowest in *A. tortilis* (77%). According to the Osho and Ajonina (1999), *A. auriculiformis*, *A. nilotica*, *L. leucocephala* and *P. juliflora* showed survival of 84, 100, 98 and 92% in a 6 months old plantation. Again *S. siamea* and *L. leucocephala*

Table I. Germination percent, germination energy % and germination period of eight MPTS.

Name of the species	Germination (%)	Germination Energy (%)			Time required to reach the highest germination		
		10	20	30	Starts	Ends	Germination
		Days	Days	Days	Days	Days	period (days)
<i>L. leucocephala</i>	80a	17	26	27	4	22	18
<i>A. nilotica</i>	56b	8	15	19	3	27	24
<i>S. siamea</i>	41c	11	13	14	4	27	23
<i>A. auriculiformis</i>	68b	2	12	23	6	32	26
<i>A. tortilis</i>	8b	2	2	3	3	32	29
<i>D. sissoo</i>	15d	4	5	4	3	25	22
<i>S. sesban</i>	11d	4	4	4	2	10	8
<i>P. juliflora</i>	55b	20	18	18	2	22	20

Means followed by the same letter(s) are not significantly different at p<0.05, Duncsn's Multiple Range Test (DMRT).

Table II. 3months old seedling heights (at the nursery stage) of the eight MPTS (cm).

Species	15days	30days	Age (Days)			
			45 days	60 days	75 days	90 days
<i>L. leucocephala</i>	8 c	8 cd	9 c	13 c	15 c	22 bc
<i>A. nilotica</i>	11 b	13 b	15 b	19 b	22 b	27b
<i>S. siamea</i>	5 e	5 e	6 cd	6 e	7 d	8 de
<i>A. auriculiformis</i>	4 e	5 e	6 cd	8 d	9 d	10 de
<i>A. tortilis</i>	5 e	6 ed	9 c	15 c	17 cd	16 cd
<i>D. sissoo</i>	2 f	2 f	4 d	5 e	6 d	7 e
<i>S. sesban</i>	18 a	24 a	45 a	73 a	92 a	127 a
<i>P. juliflora</i>	7 d	9 c	14 b	19 b	22 b	28 b

*Means followed by the same letter(s) are not significantly different at p<0.05, Duncan's Multiple Range Test (DMRT).

Table III. Growth performance of the seedlings of the eight MPTS in the field

Species	Initial	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th
	Month	Month	Month	Month	Month	Month	Month	Month
<i>L.</i>	35b	62b	77b	101b	134b	150b	231b	336ab
<i>leucocephala</i>								
<i>A. nilotica</i>	32b	40cd	41cd	41c	45c	46c	50d	54d
<i>S. siamea</i>	11d	15e	25c	57c	84c	96c	178bc	251bc
<i>A. auriculiformis</i>	11d	20e	27c	51c	78c	82c	147bcd	186cd
<i>A. tortilis</i>	18c	21e	28c	35c	48c	49c	88cd	103d
<i>D. sissoo</i>	10d	26dc	38c	60c	77c	86c	102cd	115d
<i>S. sesban</i>	151a	184a	198a	256a	293a	302a	350a	404a
<i>P. juliflora</i>	36b	55bc	60bc	70bc	73c	75c	81cd	85d

*Means followed by the same letter(s) are not significantly different at $p < 0.05$, Duncan's Multiple Range Test (DMRT).

Table IV. Survival, Collar dia and dranching ability of MPTS.

Species	Survival (%)	Diameter (cm)	Branches
<i>L. leucocephala</i>	100a	1.80b	5d
<i>A. nilotica</i>	87c	0.57c	7c
<i>S. siamea</i>	97a	2.81a	10ab
<i>A. auriculiformis</i>	90bc	1.65b	11ab
<i>A. tortilis</i>	77d	0.47c	5d
<i>D. sissoo</i>	93b	0.92c	5d
<i>S. sesban</i>	97a	3.32a	22a
<i>P. juliflora</i>	80d	0.63c	5d

*Means followed by the same letter(s) are not significantly different at $p < 0.05$, Duncan's Multiple Range Test (DMRT).

showed survival up to 86 and 100% in a 5 months old plantation in Philippines. In a hybrid of *L. leucocephala* survival was reported to be 60 and 98% after 3 months and 8 months of planting. The same report revealed that *D. sissoo* survival was 81% after 8 months of planting. From the study, it was found that highest diameter at the age of seven months was attained by *S. sesban* (3 cm) followed by *S. siamea* (2.8 cm). The lowest rate of diameter growth was found in *A. tortilis* (0.47 cm). At seven months, *S. sesban* (22) had maximum branches; whereas, *P. juliflora* (5) had the lowest. D.B.H. growth up to 3.2 cm and 2.3 cm respectively after 2 years of planting was recorded in Hawaii and U.S.A. (NFTA Network Trials, 1988). *S. siamea* attained 18.25 cm D.B.H. in 1 year 2 months. *A. auriculiformis* and *L. leucocephala* showed D.B.H. growth up to 10.9 and 15.8 cm after 18 months of planting in Sri Lanka.

CONCLUSIONS AND RECOMMENDATIONS

Many exotic species are well adapted to our environment. Present investigation supports the statement again. *L. leucocephala* and *P. juliflora* have shown maximum germination. Though, *S. sesban* showed a poor germination but have shown outstanding growth rate both in the nursery and in the field level. At nursery stage, *L. leucocephala* have shown good growth performance too. But in the field, it was *L. leucocephala* and *S. siamea* to follow the *S. sesban* followed by *L. leucocephala*, which

have been found to show the out planting performance along with highest survival and best collar diameter growth. So, *S. sesban* and *L. leucocephala* are the most suitable for large-scale plantations in the soils of same nature (Chittagong University) of Bangladesh. It must be mentioned that *P. juliflora* has shown good germination rate as well as good growth performances on the nursery stage. But in the field, it did not show good growth rate. It might be caused due to the soil type. If we use drier soils, we might get better results in this species too, as it is well adapted to the drier soils, we might get better results in this species too, as it is well adapted to the drier regions. This species might show good growth performances on the drier North-Bengal region of Bangladesh.

Acknowledgement. Cordial thanks to Mr. Md. Shah Newaz, Assistant Professor, Institute of Forestry and Environmental Sciences, Chittagong University, Chittagong for his encouragement, constructive criticism and invaluable suggestions and inspiration throughout the period of study. Heartfelt gratitude to Dr. M. Kamal Hossain, Professor and Director of the same institute for his kind comments and final reviewing of the manuscripts without which it cannot be finalized for the submission in the journal.

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(Received 12 December 2004; Accepted 24 May 2005)