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Standardization of nursery techniques in *Simarouba gluaca* : bio-diesel species

R. L. CHAVAN[1] AND B. V. TEMBHURNE[2]

[1]College of Forestry, Sirsi-581 401, UAS, Dharwad - 580 005, Karnataka, India
[2]Dept. of Genetics and Plant Breeding, College of Agriculture, UAS, Raichur - 584 104, India
E-mail: rajuchavanuasr@gmail.com

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Abstract: A Nursery experiment was conducted with an aim to select suitable substrata for seed germination and container for quality seedlings production during 2011 at the Main Agricultural Research Station, Raichur farm of University of Agricultural Sciences, Raichur. Silvicultural parameters of *Simarouba seedlings viz.*, shoot length, root length, collar diameter, fresh weight, dry matter production and numbers of leaves were maximum in poly bag of size 25 x 18 cm and raised bed. Vigour index and quality index were also significantly higher in poly bag of size 25 x 18 cm and raised bed. Raised bed substrata revealed best performance in respect to germination and other growth parameters. Seed germination percentage, imbibition period and energy period was found higher in raised nursery bed followed by root trainer and flat bed. Among substratas, raised bed method has significantly higher scope in ensuring seed germination and poly bag of size 25 x 18 cm suitable for quality seedling production availability for commercial nursery.

Key words: Nursery bed, Seed germination**,** *Simarouba glauca*, Substrata

Introduction

Simarouba glauca DC. Lakshmi Taru, is an important paradise tree species growing in the forests of Central and South America. National Bureau of Plant Genetic Resources first introduced it in 1960s in the Research Station at Amravathi, Maharashtra. This was brought to the University of Agricultural Sciences, Bangalore in 1986 (Joshi and Hiremath, 2000) and systematic Research and Developmental activities began from 2005 onwards in Northeren Dry Zone of Karnataka. Due to ever diminishing sources of fats and oils, there is the growing need for the search of new sources of oil as well as exploiting sources that are currently unexploited in order to supplement the existing ones. *Simarouba glauca*, a very rapid growing tree found growing in a varying range of climatic condition is a promising tree and has the potential to become a new source of oil.

However, there are less privileged geographical regions in North Eastern Dry Zone of Karnataka, which receive low and erratic rainfall that cannot support good vegetation. Cultivation of traditional crops adopting recommended packages is very much uneconomical and often disastrous to agriculturists in these regions. Several measures are suggested for mitigating this problem. Since agriculture is not sustainable, the farmers want to take Simarouba plantation on the bunds as well as the block plantation on farm lands. Among them, recommending a low cost input technology for cultivating Simarouba that can grow well even with erratic and low rainfall, still giving assured returns is of great significance (Devaranavadgi *et al.,* 2005). *Simarouba* cultivation in marginal/ wastelands generates employment to thousands of farmers, artisans, carpenters, pharmacists and others at village level. In this context, cultivation of *S. glauca* a multipurpose tree that can grow well under a wide range of hostile ecological conditions, offers a great hope. The success of a plantation program largely depends on production of quality seedlings without increasing costs. Hence, interest in producing quality seedlings by application of improved and modern nursery technique has increased in recent years (Gera and Ginwal, 2002). Since various containers and substrata are plays a very significant role during the process of seed germination. In the scanty information on seed germination and quality seedling production, hence these efforts were made to assess effect of substrata on seedling growth performance and survival in *S. gluaca.*

Material and methods

The study was carried out in plantations established at the Main Agricultural Research station, University of Agricultural Sciences, Raichur situated in the Northeastern Dry Zone of Karnataka between 16° 342 N and 77° 362 E longitude with an altitude of 389 meters above the mean sea level and an average rainfall of 660 mm. Climate at the experimental site is typically semi arid, characterized by exceptionally hot dry summer, sub-humid monsoon and cold dry winters. Mature seeds of seven years old trees of *Simarouba* (An average height 5.3 m and girth 82 cm) were collected during April 2011 from ten selected trees located in the UAS, Campus Raichur. About 10 kg fruits were peeled, washed in running water and then these seeds were raised in six sets of substrata

A total of 800 poly pots and four root-trainers were filled with the sieved potting media. In substratum, soil mixtures used were red soil, sand and Farm Yard Manure in the ratio of 2:1:1. Three types of containers *viz.,* T_0: Root-trainer; T_1: Poly bag of size 25 x 18 cm (10 x 7 inch); T_2: Poly bag of size 12 x 15 cm (5 x 6 inch) and traditional nursery beds *viz.,* T_3: Raised bed, T_4: Sunken bed and T_5: Flat bed with the same potting media was used to compare the *Simarouba* seedling growth. The most common type Hiko pots with 20-25 cavities each having volume of 150 cm^3 was used. The root trainers were placed on a root trainer stand in such a way that the drainage hole is exposed above the ground, which facilitates free flow of air. The experiment consisted of five substrata laid out in a completely randomized block design with four replications. The seeds were sown directly in the nursery beds with dimension of 5 x 1.2 m at line spacing of 10 x 15 cm with four hundred seeds and covered with thin layer of sand and Farm Yard Manure. Adequate care by watering, weeding and prophylactic spraying was undertaken like conventional nursery practices and frequent observations were taken from the time of seed sowing up to the transplanting of seedlings.

The effects of seed sowing in different containers were assessed periodically through counting germination and initial growth performance of the seedlings. At the age of four months, ten dominant seedlings from each treatment were randomly selected and uprooted very carefully to estimate the seedling biomass. The seedlings were measured for shoot length, collar diameter, root length and total oven dry weight (leaf, shoot and root components). Leaf, shoot, root and nodules were oven dried at 70°C for 48 hours until the constant weight is obtained. The germination and growth data were analyzed statistically by using computer software package SPSS for determining the morphological growth variation. Germination energy was calculated using the formula of Djavanshir and Pourbeik (1976). Vigour Index was calculated according to Abdul-Baki and Anderson (1973). The Quality Index (QI) of the seedlings was computed as developed by Dickson *et al.* (1960).

Results and discussion

Perusal of Table 1 showing effect of various treatments on the growth of *Simarouba* reveals significant differences among all the recorded parameters. The mean total length of the seedlings was significantly highest in T_1 (24.33 cm) and T_3 (24.05 cm) having significantly higher seedling length only than T_0, T_5 and T_4 treatments. Considering the collar diameter and number of leaves of the seedlings, T_1 recorded highest collar diameter (4.41 mm) and number of leaves (34.80) followed by T_3, T_5 and significantly different from T_2 and T_4 treatments.

The Table 2 shows comparative weights (dry and fresh) of different parts including total seedling biomass in different substrata. The oven dry weights of seedling components (shoot and root) of different treatments were statistically analyzed. Mean shoot dry weight (2.92 g), root dry weight (1.8 g) and total dry weight (4.72 g) of the seedlings were highest in T_1 treatment but significantly different from all other treatments. However, considering the seedling dry weight, T_3 (4.07 g) and T_5 (4.03 g) were attained the on par with each other. Vigour index of seedling attained the highest value in T_5 (1803) and T_3 (1774) treatments and the lowest value for T_2 (551) treatment (Table 1). Similarly, T_1 (5.95) attained the maximum seedlings quality index and minimum in T_0 (4.79) and T_4 (4.74) treatments. But, T_1 (5.10) followed by T_2 (5.12) and T_5 (5.10) treatments were on par with each other for seedling quality index (Table 2). In the present study, the seedling morphometric parameters were superior in T_1 and T_3 treatments.

Significant differences were observed for all the growth parameters among seedlings grown in T_1, T_3 and T_5. It is revealed that the size of the container has influence on all the characters, *e.g.* size, root length, shoot height, shoot collar diameter, number

Table 1. Growth performance of *Simarouba glauca* seedlings in juvenile at nursery stage

Substrata / Treatments	Germination (%)	Shoot length (cm)	Root length (cm)	Total seedling length (cm)	Collar diameter (mm)	Number of leafs /seedling	Vigour index
T_0	90.50	9.69	5.32	15.01	3.19	27.00	1358
T_1	41.25	16.95	7.37	24.33	4.41	34.80	1004
T_2	29.50	12.30	6.37	18.67	4.04	29.40	551
T_3	95.00	16.58	7.48	24.05	4.19	33.00	1774
T_4	42.00	14.25	6.76	21.01	3.93	27.30	882
T_5	78.00	15.68	7.43	23.11	4.13	29.40	1803
Mean	62.71	14.24	6.79	21.03	3.98	30.15	1229
S.Em.±	0.78	0.32	0.20	0.43	0.11	1.13	41.41
C.D. (0.05)	2.34	0.95	0.60	1.29	0.35	3.41	58.56
C.D. (0.01)	3.24	1.31	0.83	1.79	0.48	4.71	124.83
CV (%)	2.48	4.43	5.85	4.08	5.75	7.50	172.57

T_0= Root trainer, T_1= Poly pot (25 x 18 cm), T_2= Poly pot (12 x 15 cm), T_3= Raised bed, T_4= Sunken bed and T_5= Flat bed

Table 2. Influence of different substrata for seedling biomass production in *Simarouba glauca* at four months after transplanting

Substrata / Treatments	Shoot fresh wt (g)	Root fresh wt (g)	Total seedling fresh wt (g)	Shoot dry wt (g)	Root dry wt (g)	Total seedling dry wt (g)	Quality index
T_0	8.51	5.99	14.50	2.11	1.50	3.61	4.79
T_1	10.70	6.39	17.09	2.92	1.80	4.72	5.95
T_2	9.75	5.25	15.00	2.54	1.31	3.85	5.12
T_3	10.32	5.56	15.88	2.68	1.39	4.07	5.10
T_4	9.35	5.71	15.06	2.29	1.43	3.71	4.74
T_5	9.60	6.15	15.75	2.50	1.54	4.03	5.10
Mean	9.71	5.84	15.55	2.51	1.49	4.00	5.13
S.Em.±	0.31	0.39	0.43	0.08	0.10	0.13	0.17
C.D. (0.05)	0.92	1.16	1.30	0.23	0.31	0.38	0.52
C.D. (0.01)	1.27	1.61	1.80	0.32	0.43	0.53	0.72
CV (%)	6.30	13.20	5.55	6.22	13.80	6.36	6.74

T_0= Root trainer, T_1= Poly pot (25 x 18 cm), T_2= Poly pot (12 x 15 cm), T_3= Raised bed, T_4= Sunken bed and T_5= Flat bed of leaves, root and shoot fresh weights, root and shoot dry weights, and quality index and vigour index throughout the growth period of the seedlings. The increased root lengths of container grown seedlings perform better on adverse sites than do bare root seedlings and they survive better under drought conditions. Milks *et al.* (1989) reported that plants growing in small containers have growth problems due to poor aeration or low water holding capacity of the growing medium. Aeration porosity is considered to be the most important physical property of any growing medium (Brag and Chambers, 1988). The container of 10 x 7 inch size and raised bed recorded superiority over 5 x 6 inch size polythene containers and then other nursery bed and the seedlings grown in the root trainer for the above growth parameters of the seedlings. The seedlings raised in root trainers showed poor performance for height, collar diameter and the biomass parameters for *S. glauca* in comparison to other treatments. This may be due to the limited space available to the root system in root trainers (Gera and Ginwal, 2002). Seedlings can better be compared on the basis of quality parameters, rather than on actual values on height or collar diameter. Seedling quality specifications have traditionally been based on certain morphological characters such as vigor index and some other quality index features (Cleary *et al.,* 1978). Several Researchers found suitable container size for particular species such as 30 x 20 cm for Cocoa (Keshavachandran and Nair, 1985), 26 x 12.6 cm for *Azadirachta indica* A. Juss (Bharathi, 1999) and poly bag size of 25 x 15 cm for *Albizia lebbeck* (L.) Benth. (Natarajan, 1999).

However, the treatments when compared on the basis of seedling quality parameters in different containers, 25 x 18 cm size container is the best in order to obtain vigorous seedlings capable of surviving under stress in nursery condition. Growth performance of seedlings increased with the increase of poly bag sizes in comparison to nursery bed and root trainers. Longer containers have significant influence on the survival, height and vigor index under nursery conditions. The present study provided information that differences in seedlings growth were significant throughout the treatments. The seedlings raised in root trainers showed poor performance in comparison to other treatments. For quality seedlings, poly bag of 25 x 18 cm size produce the best seedlings followed by nursery bed and 12 x 15 cm size treatments. The treatment T_1 may be recommended to raise the quality seedlings for large scale plantations in short time due to its lower cost involvement. However, for successful afforestation and reforestation programs and maximum survival of seedlings in the field, the bigger size poly bags as well as the quality seedlings are essential in field planting. So, after keeping cost factors in consideration polybags of bigger sizes (25 x 18 cm) may be preferred for producing large and vigour seedlings.

Germination of seeds is a critical step in afforestation by both natural and artificial means, *S. glauca* attained 95 per cent germination within 26 days germination period in T_3 treatment followed by T_0 (90.50%) treatment (Hiremath *et al.,* 2002). T_0 and T_3 treatments took longer time (energy period 11 days) and showed highest germination percent (95%) was high in comparison to other treatments (Table 1 & Fig.1). While, T_0 and

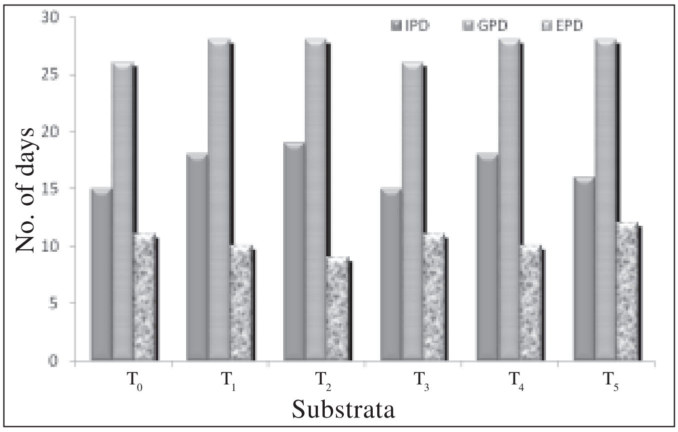

Fig. 1 Effect of different substrata on seeds imbibitions, germination and energy periods in *Simarouba glauca*

IPD- imbibitions days
GPD- germination period days
EPD- energy periods
T_0= Root trainer
T_1= Poly pot (25 x 18 cm)
T_2= Poly pot (12 x 15 cm)
T_3= Raised bed
T_4= Sunken bed
T_5= Flat bed

T_3 treatments were took early time for initial germination (imbibitions 15 days) and end germination within 26 days period among treatments (Joshi and Hiremath, 2000). The effect of different containers on mean daily germination percent was highest at the 22nd day after sowing in T_0 and T_3 treatments. The possible reason for better germination could be that seeds prefer well drained soils (without water logging condition). The cumulative germination per cent in T_0 and T_3 treatments rises sharply from the 15th to 26th days and remains constant upto 26th day (Fig. 1). The findings of the present study also get support from Rath (1987) confined that seeds germination better in raised bed than other substrata. The cumulative germination percent remains on par with T_1 (41.25 %) and T_4 (42.0 %) treatments and was lowest in T_2 (29.50 %) treatment. The results are in consonance with that of Jabbar *et al.* (2010) opined seed germination higher in nursery bed than poly pot in *Albizia procera* (Roxb.) Benth.

Based on the results of the present experiment, it may be recommended that seedlings hypothetical to be grown in 25 x 18 cm size containers, in order to obtain vigorous seedlings capable of surviving in plantation area. But, recently Government is discouraging the use of polybags for raising seedlings because of non degradable and act as hazards to edaphic factors. Hence, root trainers are becoming popular as they can be reused for several years and very light to transport. The results are quite encouraging and uses of raised bed is suitable for seed germination and poly bags of 25 x 18 cm in size for quality seedling production, and also help in conservation of such important biodiesel species.

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