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Screening of Tree Species for Dendro Biomass Utility through Biometric Characterization

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ABSTRACT

Preliminary evaluation was carried out to select the fuelwood tree species based on biometric attributes *viz.,* shoot length, basal diameter and volume index under field conditions. This study involved fifteen tree species *viz., Acacia auriculiformis, Acrocarpus fraxinifolius, Cassia siamea*, TNAU Casuarina MTP 2, *Casuarina junghuhniana, Chukrasia tabularis, Dalbergia sissoo, Eucalyptus camaldulensis, Gliricidia sepium, Khaya senegalensis, Leucaena leucocephala, Melia dubia, Populus deltoides, Prosopis juliflora* and Thornless Prosopis which was carried out at Forest College and Research Institute, Mettupalayam. *Dalbergia sissoo, Eucalyptus camaldulensis, Casuarina junghuhniana* and *Cassia siamea* proved superior in shoot length consistently over a period of 6MAP. Considering all the growth periods, three species *viz., Cassia siamea, Casuarina junghuhniana and Eucalyptus camaldulensis* have registered best growth potential in basal diameter. Volume index was significantly high in *Eucalyptus camaldulensis, Casuarina junghuhniana, Cassia siamea* and *Dalbergia sissoo*.

Introduction

Fossil fuel, a non-renewable resource, highly utilized for energy generation is quite challenging option for ecological balance and environmental stability nowadays. To address this issue, choosing woody biomass based power generation provides indirect benefits which may be climatic or protective. Wood fuel provides 40% of today's global renewable energy supply as much as solar, hydro-electric and wind power combined. In India, biomass fuel is highly utilized by the rural people accounting for over 80 percent of total energy consumed. In 2011, the total annual consumption of fuelwood for the country is estimated to be 216.42 million tones out of which 58.75 million tones comes from forests. Bioenergy is expected to play an important role in future energy systems due to nature of renewable energy source that could be sustainably developed in the future and it is CO_2 neutral. It provides a safe and secure energy supply that could have efficient economic potential while considering fossil fuels (Tonn, 2002). So, preliminary evaluation of fifteen fuelwood tree species is a supporting and a step forward process to identify the amenable source for biomass-based power generation. Selection of fast growing tree species with short rotation is the main objective of this study for the continuous supply of raw materials to the bioenergy based industries.

Materials and Methods

Field experiment

The experiment was conducted under field conditions in Randomized Block Deign (RBD) and biometric attributes *viz.*, shoot length, basal diameter and volume index were recorded. The species under evaluation are *Acacia auriculiformis*, *Acrocarpus fraxinifolius*, *Cassia siamea*, TNAU Casuarina MTP 2, *Casuarina junghuhniana*, *Chukrasia tabularis*, *Dalbergia sissoo*, *Eucalyptus camaldulensis*, *Gliricidia sepium*, *Khaya senegalensis*, *Leucaena leucocephala*, *Melia dubia*, *Populus deltoides*, *Prosopis juliflora* and Thornless Prosopis. The biometric observations were recorded at 0.5 MAP, 2 MAP, 4 MAP and 6 MAP at twenty-five seedlings per replication. The data collected from various growth periods were analyzed for mean, variance and standard error were worked out using the method described by Panse and Sukhatme (1978). The significance test was carried out by referring to the standard 'F' table of Snedecor (1961).

Results and Discussion

Shoot length

Significant variations were found among different species for shoot length. At 2 Months after Planting (MAP), shoot length ranged from 27.21 cm (*Gliricidia sepium*) to 227.91 cm (*Eucalyptus camaldulensis*). Three species *viz.*, *Eucalyptus camaldulensis* (227.91 cm), *Casuarina junghuhniana* (223.49 cm) and *Dalbergia sissoo* (139.52 cm) recorded significantly higher shoot length compared to general mean (98.93 cm).

At 4 MAP, shoot length ranged from 58.09 cm (*Gliricidia sepium*) to 238.31 cm (*Casuarina junghuhniana*). At this stage, the following three species *viz.*, *Casuarina junghuhniana* (238.31 cm), *Eucalyptus camaldulensis* (235.82 cm) and *Dalbergia sissoo* (199.75 cm) recorded significantly higher shoot length compared to grand mean (134.36 cm). At 6 MAP, it ranged between 86.89 cm (*Chukrasia tabularis*) and 291.01 (*Eucalyptus camaldulens*). Among 15 species *Eucalyptus camaldulensis* (291.01), *Dalbergia sissoo* (278.12 cm), *Casuarina junghuhniana* (277.45 cm) and *Cassia siamea* (231.73 cm) were proved superior compared to grand mean (177.15 cm) (Table 1).

Basal diameter

Basal diameter differed significantly among the evaluated species at four growth periods. At 2 MAP, basal diameter ranged between 2.15 cm (*Eucalyptus camaldulensis*) and 0.76 cm (Thornless Prosopis). Three species *Eucalyptus camaldulensis* (2.15 cm), *Cassia siamea* (1.89 cm) and *Casuarina junghuhniana* (1.74 cm) recorded significantly higher value than the grand mean (1.24 cm). At 4 MAP, basal diameter ranged between 2.78 cm (d*Eucalyptus camaldulensis*) and 0.93 cm (Thornless Prosopis). Compared to mean basal diameter (1.68 cm), five species *viz.*, *Eucalyptus camaldulensis* (2.78 cm), *Cassia siamea* (2.58 cm), *Casuarina junghuhniana* (2.43 cm), *Acrocarpus fraxinifolius* (2.08 cm) and *Dalbergia sissoo* (1.98 cm) registered significantly higher.

At 6 MAP, significantly higher value for basal diameter was recorded by five species which includes *Cassia siamea* (3.16 cm), *Eucalyptus camaldulensis* (3.14 cm), *Casuarina junghuhniana* (2.88 cm), *Dalbergia sissoo* (2.72 cm) and *Acrocarpus fraxinifolius* (2.51 cm) compared to grand mean (2.13 cm) (Table 2).

Table.1 Shoot length of various species at different growth periods

Treatments / species	Shoot length (cm)			
	0.5 MAP	**2 MAP**	**4 MAP**	**6 MAP**
Acacia auriculiformis	38.05	78.45	132.98	143.34
Acrocarpus fraxinifolius	28.36	58.25	126.01	145.02
Cassia siamea	25.85	91.95	161.43	231.73*
TNAU Casuarina MTP 2	86.68*	105.75	130.21	185.88
Casuarina junghuhniana	125.46*	223.49*	238.31*	277.45*
Chukrasia tabularis	47.79	66.43	83.43	86.89
Dalbergia sissoo	36.65	139.52*	199.75*	278.12*
Eucalyptus camaldulensis	119.51*	227.91*	235.82*	291.01*
Gliricidia sepium	12.76	27.21	58.09	120.02
Khaya senegalensis	38.65	47.40	69.62	110.16
Leucaena leucocephala	84.03*	107.88	141.91	192.91
Melia dubia	23.84	62.53	116.50	171.63
Populus deltoides	12.08	46.79	94.25	169.08
Prosopis juliflora	94.30*	89.24	112.57	138.62
Thornless Prosopis	108.76*	111.22	114.58	115.45
Mean	**58.85**	**98.93**	**134.36**	**177.15**
SEd	2.79	10.06	19.67	21.08
CD (0.05)	5.64	20.30	39.70	42.54

*Significant at 5 % level.

Table.2 Basal diameter of various species at different growth periods

Treatments / species	Basal diameter (cm)			
	0.5 MAP	**2 MAP**	**4 MAP**	**6 MAP**
Acacia auriculiformis	0.35	1.04	1.19	1.80
Acrocarpus fraxinifolius	0.34	1.39	2.08*	2.51*
Cassia siamea	0.53	1.89*	2.58*	3.16*
TNAU Casuarina MTP 2	0.67	1.04	1.45	1.83
Casuarina junghuhniana	0.78*	1.74*	2.43*	2.88*
Chukrasia tabularis	0.26	0.80	0.99	1.30
Dalbergia sissoo	0.27	1.34	1.98*	2.72*
Eucalyptus camaldulensis	0.83*	2.15*	2.78*	3.14*
Gliricidia sepium	0.90*	1.34	1.68	2.14
Khaya senegalensis	0.52	1.09	1.53	2.26
Leucaena leucocephala	0.48	0.95	1.40	1.71
Melia dubia	0.46	1.26	1.70	2.05
Populus deltoides	0.79*	0.83	1.25	1.93
Prosopis juliflora	0.62	1.02	1.27	1.48
Thornless Prosopis	0.67	0.76	0.93	0.99
Mean	**0.56**	**1.24**	**1.68**	**2.13**
SEd	0.04	0.11	0.14	0.18
CD (0.05)	0.08	0.23	0.28	0.37

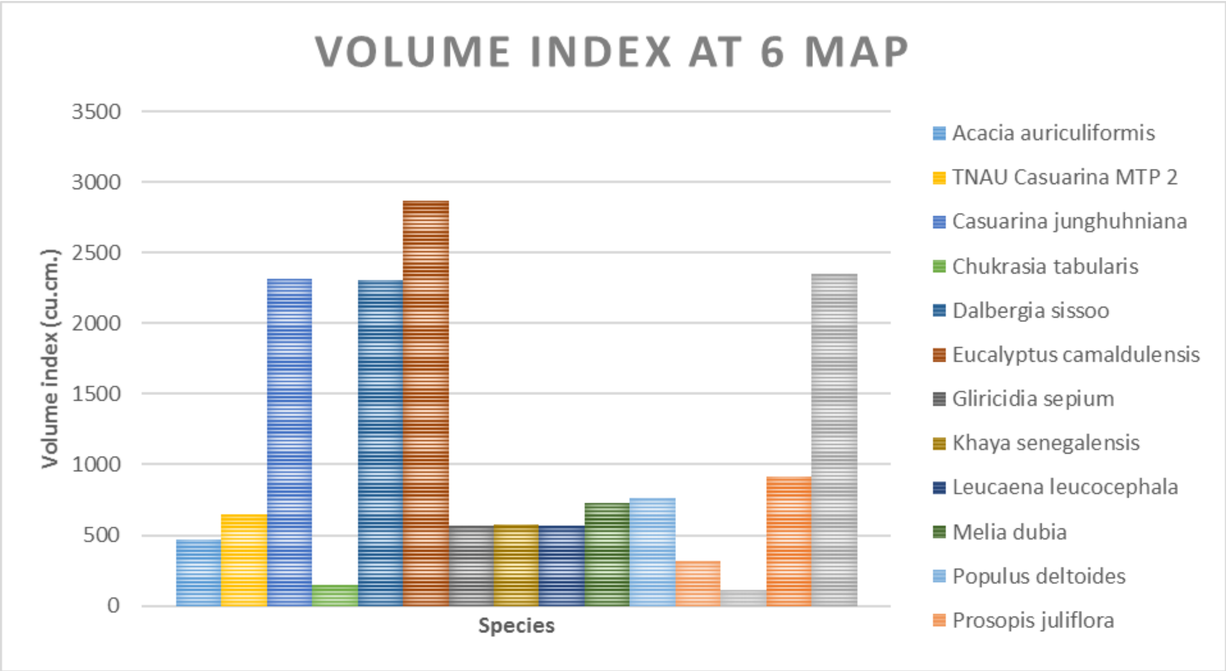
*Significant at 5 % level.

Table.3 Volume index of various species at different observation periods

Treatments / species	Volume index (cm^3)			
	0.5 MAP	**2 MAP**	**4 MAP**	**6 MAP**
Acacia auriculiformis	4.75	85.43	190.05	469.02
Acrocarpus fraxinifolius	3.27	115.28	549.16	916.06
Cassia siamea	7.25	327.87*	1091.46*	2353.72*
TNAU Casuarina MTP 2	38.71*	132.06	326.35	643.64
Casuarina junghuhniana	76.87*	682.75*	1424.85*	2318.06*
Chukrasia tabularis	3.27	42.40	81.71	147.69
Dalbergia sissoo	2.72	276.58	860.98*	2305.53*
Eucalyptus camaldulensis	81.86*	1052.62*	1838.42*	2865.34*
Gliricidia sepium	11.13	49.49	162.18	564.09
Khaya senegalensis	10.38*	56.63	165.25	573.71
Leucaena leucocephala	19.67	99.13	286.73	564.55
Melia dubia	5.22	116.60	355.99	728.95
Populus deltoides	7.58	34.93	146.26	765.37
Prosopis juliflora	36.76*	94.80	184.84	313.51
Thornless prosopis	48.33*	63.84	99.10	113.21
Mean	**23.85**	**215.36**	**517.56**	**1042.83**
SEd	3.00	50.24	176.71	320.02
CD (0.05)	6.05	101.42	356.69	645.97

*Significant at 5 % level.

Fig.1 Volume index of different tree species at 6 MAP



Volume index

The species differed significantly due to volume over four growth periods. At 2 MAP, *Eucalyptus camaldulensis* (1052.62 cm^3) followed by *Casuarina junghuhniana* (682.75 cm^3) and *Cassia siamea* (327.87 cm^3) registered significantly higher volume compared to the general mean (215.36 cm^3). At 4 MAP, *Eucalyptus camaldulensis* (1838.42 cm^3), *Casuarina junghuhniana* (1424.85 cm^3) and *Cassia siamea* (1091.46 cm^3) followed by *Dalbergia sissoo* (860.98 cm^3) showed significant variations compared to the general mean (517.56 cm^3).

At 6 MAP, *Eucalyptus camaldulensis* (2865.34 cm^3), *Cassia siamea* (2353.72 cm^3), *Casuarina junghuhniana* (2318.06 cm^3) and *Dalbergia sissoo* (2305.53 cm^3) had proved significantly higher compared to the general mean (1042.83 cm^3).

Considering volume at all growth periods, *Eucalyptus camaldulensis* had the effective volume growth attribute followed by *Cassia siamea, Casuarina junghuhniana* and *Dalbergia sissoo* consistently proved superior (Table 3).

Biomass species for energy production should be resistant to browsing preferably a nitrogen fixer with good coppicing ability (Harris *et al.,* 2011). These besides the species intended for energy production should be fast growing and should produce wood of calorific value. Such species need to survive under adverse abiotic conditions; perennial deep root plants or able to tolerant of poor soil, low rainfall and generally required low management inputs. Tree species with the potential of producing larger volumes of straight branches and trunks are recorded as important fuel sources for the local population (Pasiecznik *et al.,* 2000). Woody biomass species used in common agro forestry systems with multipurpose utility can also play a vital role in energy conversion. The vital factors for trees as an energy source are biomass growth rate, calorific value, suitability of species to local climate, the competition of land for other uses and extend of local expertise (Coote, 2005).

Taking these factors into consideration 15 species of fast growing nature with coppicing ability and few of them with nitrogen fixing capacity was incorporated in the evaluation program. The evaluation of species has been done under field conditions for a period of six months.

Under field conditions, among 15 species studied *viz*., *Dalbergia sissoo, Eucalyptus camaldulensis*, *Casuarina jhunghuhniana* and *Cassia siamea* were proved superior in shoot length increment in different growth periods. The highest shoot length observed in *Eucalyptus camaldulensis* (291.01 cm) followed by *Dalbergia sissoo* (278.12 cm) from 0.5 MAP to 6 months after planting among the selected species. This was in line with Schubert and Whitesell (1985) findings where a total of 30 tree species, including 15 *Eucalyptus* species, were evaluated for higher biomass production. They found that *Eucalyptus saligna*, *E. grandis*, *E. urophylla and E. robusta* consistently outperformed the other species in height, diameter, and survival.

Considering basal diameter in the current study, three species *viz., Cassia siamea, Casuarina junghuhniana* and *Eucalyptus camaldulensis* had best growth potential followed by *Dalbergia sissoo* and *Acrocarpus fraxinifolius*. The results of this parameter was related with analysis of morphological attributes of 10 tree species by Lamers *et al.,* (2006) for determination of their suitability at 0.5 MAP, 7 MAP and 19 MAP where the mean stem diameter of *P. nigra* increased consistently at different observation periods which thereby attest the finding of current study. By considering volume index *viz.*, *Eucalyptus camaldulensis*, *Casuarina junghuhniana* and *cassia siamea* showed significant variations among the selected species.

The study was conducted to screen fifteen tree species for fuel wood utility based on the growth attributes *viz.*, shoot length, basal diameter and volume Index. The species *viz.*, Acacia *auriculiformis*, *Acrocarpus fraxinifolius*, *Cassia siamea*, TNAU Casuarina MTP 2, *Casuarina junghuhniana*, *Chukrasia tabularis*, *Dalbergia sissoo*, *Eucalyptus camaldulensis*, *Gliricidia sepium*, *Khaya senegalensis*, *Leucaena leucocephala*, *Melia dubia*, *Populus deltoides*, *Prosopis juliflora* and Thornless Prosopis are evaluated under field conditons. Among the species evaluated, *Eucalyptus camaldulensis*, *Casuarina junghuhniana*, *Cassia siamea* and *Dalbergia sissoo* showed higher performance in the growth attributes viz., Shoot length, Basal diameter and Volume index comparing all other species under study.

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References

Christopher, B.F., J.E. Campbell and D.B. Lobell. 2007. Biomass energy: the scale of the potential resource. Trends in Ecology and Evolution, 23(2).

Coote, H.C. 2005. The economics of forest plantations and on-farm planting as a rural income-generating activity in the UK and Sri Lanka. In: Proceedings of the international conference on the issues for sustainable use of biomass resources for energy. Held August 2005 at Colombo Sri Lanka.

Hall, D.O., F. Rosillo-Calle, R.H. Williams and J. Woods. 1993. Biomass for energy - Supply prospects. In: Renewable energy - Sources of fuels and electricity. Johansson, T.B., H. Kelly, A.K.N. Reddy and R.H. Williams (Eds.). Island Press, Washington D.C., U.S.A.

Harris, P.J.C, J.E. Wright and E.J. Trenchard. 2011. Potential for rainfed woody biomass production for energy conversion in drought and salinity affected areas of Northern India. J. Sci. Ind. Res., 70: 572-582.

Lamers, J.P.A., A. Khamzina and M. Worbes. 2006. The analysis of physiological and morphological attributes of ten tree species for early determination of their suitability to afforest degraded landscapes in the Aral Sea Basin of Uzbekistan. Forest Ecology and Environment, 221: 249-259.

Manavalan, A. 1990. Seedling vigour and bioproductivity in woody biomass species. Ph.D. Thesis, Madurai Kamaraj University, Madurai.

Panse, V.G. and P.V. Sukhatme. 1978. Statistical methods for agricultural workers. ICAR Publication, New Delhi

Pasiecznik, N.M., P. Felker, P.J.C. Harris, L.N. Harsh, G. Cruz, J.C. Tewari, K. Cadoret and L.J. Maldonado. 2000. The *Prosopis juliflora - Prosopis pallida* complex: A Monograph. Coventry: HDRA.

Ravindranath, N.H. and D.H. Oakley Hall. 1995. Biomass, energy and environment - A developing country perspective from India. Oxford University Press, Oxford.

Schubert, T.H and C.D. Whitesell. 1985. Species trail for biomass plantations in Hawaii: a first appraisal. United States Dept. of Agriculture. p. 176.

Sinha, C.S., P.V. Ramana and V. Joshi. 1994. Rural energy planning in India: Designing effective intervention strategies. Energy Policy, 22(5): 112-115.

Snedecor, G. 1961. Statistical methods. Ed. 5. Iowa State Univ. Press, Ames. Iowa. p. 534

Tonn B.E. (2002). Distant futures and the environment. Futures 34: 117-132.

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