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Field performances of certain selected species in hilly region of high rain fall zone
in Uttara Kannada district, Western Ghats southern - India.

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ABSTRACT

An attempt was made to assess the field performance of 16 species in Uttara Kannada district of the Western Ghats part of Karnataka, India. Survival percent, collar diameter, height and volume was measured during 1985 and 1989. Mean annual increment of collar diameter, height and volume was computed and a rank was developed using these observed and measured parameters. Rank-sum was computed using these individual ranks and based on the highest rank of a species, recommendations were made for suitability for plantations.

Acrocarpus fraxinifolius, a softwood species, was found fast growing with high survival percent, followed by *Tectona grandis* and *Lagerstroemia microcarpa*. Species such as *Dalbergia sissoo*, *Spondias acuminate* and *Sterculia guttata* were found not performing well with low percent survival and growth parameters. Rank-sum method was found useful to assess the performance of species for suitability in afforestation/planting programmes.

Key Words: Field performance, Uttara Kannada, Western Ghats, Rank-sum method, seedling survival.

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Introduction

Large scale afforestation programme has been taken up in recent years by several countries all over the world including India aiming at halting environmental degradation, maintaining vegetation cover over the land area, checking soil erosion, flood and meeting biomass demands such as wood for industries, fuel and fodder. Though plantation activity in India is almost 100 years old, initially, importance was given to species having industrial and commercial values (Tiwari 1989). Search for fast growing species began with the oil crisis of 1970's and subsequent shortage of fuelwood and biomass for subsistence and industrial uses (Negi *et al* 1988). In this respect many researchers studied the forest productivity as a source of energy and chemical feed stock (Satoo and Medgwick 1982). To meet the growing demands of biomass and energy, raising plantation of fast growing species was thought as best alternative. Identification of suitable species to serve various end uses was attempted by conducting field trials. Many exotic species, that are fast growing, were planted to meet fuelwood and industrial pulpwood demands, were introduced in India. About 100 species were tried so far (MOEF 1999).

Use of indigenous species was advocated for afforestation/planting of degraded lands by many people (Singh, 1981; Singh and Khanduja, 1984; Negi *et. al.*, 1985; Maithani *et. al.*, 1988; Jain and Shanker, 1977; Dogra, 1989; Varmah, 1977; Deb, 1978; Ghate 1990). In western Maharashtra 38 indigenous species of fuelwood characters have been described (Ghate *et. al.*, 1990). Similarly Negi *et. al.*, (1985) have listed indigenous species of various importance in Gharwal Himalayas. Khanduja (1987) offers many species of shrubs of fuelwood importance because of their sclerophyllous nature that makes them better candidates for fuelwood. Though such list of species could be had from almost every part of the forest rich and species rich Indian regions, very little information is available on their field performance under different agro-climatic zones and more particularly their suitability to large-scale plantations. Further, the seedling survivorship, biomass accumulation and other growth parameters are scanty to include indigenous species for afforestation/plantation programmes.

In the Western Ghats part of India people are dependent on forests and use a variety of plant species for meeting their diverse needs (Prasad and Hegde 1986). Use of forest by the local people and extraction of timber by the state forest department over the century led to degradation

of forest in this region. Forest Department took lead to undertake vast stretches of Teak, Eucalyptus, Casuarina and Acacia plantations. Most of these plantations were dominated by one or two species predisposing these plantations to pest and disease attacks. One such incidence was pink disease of Eucalyptus in Uttara Kannada district, Karnataka. In order to circumvent this situation identification of alternative species to supplement the dominant species or replace them is imminently necessary. An attempt is made in this paper to assess the field performance of some species in the high rain fall zone of the Uttara Kannada district in Western Ghats and based on the results inclusion of some of these species in the afforestation programme is discussed.

Material and Methods

Study location: This study was conducted in newly planted area of the forest department located in Sirsi division of Kanara Circle, Uttara Kannada district (latitude, $30^{\circ} 55'$ to $15^{\circ} 31' N$; longitude $74^{\circ} 9'$ to $75^{\circ} 10' E$). The study area is situated towards western side of Sirsi town. The soil is red loam with an annual rainfall of 2500 mm. June to October is rainy period, November to February is winter period and January to May is summer period.

Methods

Pit planting at the spacing of 2 x 2m was done in the month of June 1985. Seedlings were provided a dose of DAP (Di-Ammonium Phosphate) soon after planting. Protection was provided by cattle-proof trench and barbed wire fence. Saucer shaped pit was dug for each plant during September-October to break soil capillary, to conserve moisture and also to facilitate infiltration of rainwater. Such operations were continued in the second and third year.

Of the total 27 species planted, only 16 species had more than 15 individuals. All these individuals were marked, tagged and monitored for survival and growth. Observations were made with respect to in seedling survival, collar diameter, height in the initial year and final year. Such observation was started in the month of October 1985 and continued up to May 1989. Performance of gap planting seedlings was ignored. Volume of the tree was calculated multiplying the basal area with height using collar diameter and height. Ranks for each species was given based on the survival rate, mean annual increment in collar diameter, height and volume individually. Later, the ranks given to each species over all the four parameters were

summed to get a rank-sum for the species. Rank-sum values were used for making recommendations of the species suitable for plantation purposes.

Results and Discussions

Table 1 provides the names of the species number of individuals in each species and survival percentage. After 4 years 100% survival of seedlings was observed in 2 species (*Eugenia jambolana* and *Acrocarpus fraxinifolius*), more than 90% survival was observed in 9 species, more than 70% survival was observed in *Bombax malbaricum*. Less than 50% survival observed in 3 species viz. *Artocarpus hirsutus* (34%), *Artocarpus integrifolia* (7.69%) and *Sterculia guttata* (7.4%). Species that have poor survival are shade loving so seedlings require dense crown cover for survival and growth. So, their poor survival could be attributed to openness of the area. Species that have shown better survival are hardy and drought resistant. So, they manage to survive in such conditions. Better survival of several indigenous species in the study locality (i.e. Uttara Kannada district) has been reported by Yogananda et al (1997). *Casuarina equisetifolia* showed less survival percent (75%) than the 11 species that were tested here (Yogananda et al., 1997). Considering the local use and their NTFP values species that have performed better could be considered for planting in the afforestation programme and also in the promotion of diversity.

Collar diameter and height are two simple parameters that provide enough information about the performance and productivity. Table 2 provides details of the field performance of 16 species. After 4 years of growth it was observed that collar diameter ranged from 2.2 (*Dalbergia sissoo*) to 6.37cm (*Lagerstroemia microcarpa*). Average height ranged from 120.25 (*Spondias accuminata*) to 373 cm (*Grevillia robusta*). Volume of wood produced after 4 years ranged from 698.83 (*Spondias accuminata*) to 10,663.37cm³ (*Acrocarpus fraxinifolius*).

Mean annual increment (MAI) of biomass was high for *Acrocarpus fraxinifolius* (2,625 cm³/year) followed by *Lagerstroemia microcarpa* (1,806 cm³/year) and was low in *Spondias accuminata* (160.75 cm³/year). Exotics species are rated highly for their ability to thrive under adverse conditions and to provide appreciable biomass (Reddy and Sugur, 1992). In a study Reddy and Sugur (1992) in the same area have reported the MAI for *Acacia auriculiformis* as

2430 cm³/year. But in our study *Acrocarpus* had more MAI than *A auriculiformis*. However, a study conducted in a semi-arid tract near Bangalore, MAI of *Acacia auriculiformis* was very high with 8.6 kg/plant/year (Swaminath, 1988). Biomass production in *Eucalyptus hybrid*, which is most commonly used in afforestation/plantation programmes, was lower (Swaminath, 1988) with a yield of 5.8 kg per tree per year. The biomass accumulation is comparable to any other exotic species in first 5 species (Table 3). Rank-sum ranged from 13 (*Spondias acuminata*) to 62 (*Acrocarpus fraxinifolius*) indicating high variability in performance among the species studied. Rank-sum values indicate that *Accrocorpus*, *Lagerstroemia* and *Tectona* have very good survival rates and growth parameters. It is evident from the field performance of these species that instead of considering plantations of single species there should be a mixture of many species to promote diversity and to meet the diverse needs of the local people. However, fast growing species may be raised as mono or poly-culture plantations depending on the demand.

Apart from recommendation of species for plantation purposes, this study indicates the suitability of rank-sum method to assess the field performance of species. This method could be used with many quantitative or qualitative variables for making necessary recommendations.

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Table 1: List of species and their survival percent in the field in Uttara Kannada District.

Sl. no	Species	Common Name	Number of individuals observed in 1985	Survival % in 1989
1	<i>Acrocarpus fraxinifolius</i>	Red cedar	50	100.00
2	<i>Artocarpus hirsutus</i>	Aini	50	34.00
3	<i>Artocarpus integrifolia</i>	Jack fruit	39	7.69
4	<i>Bombax malabaricum</i>	Silk cotton tree	50	72.00
5	<i>Dalbergia latifolia</i>	Indian rose wood	26	92.30
6	<i>Dalbergia sissoo</i>	Sissoo	48	93.75
7	<i>Eugenia jambolana</i>	Jamun	50	100.00
8	<i>Gmelina arborea</i>	Malay bush beach	49	93.87
9	<i>Grevilia robusta</i>	Silver oak	50	90.00
10	<i>Lagerstroemia microcarpa</i>	Ben teak	25	92.00
11	<i>Pterocarpus marsupium</i>	Indian kino tree	49	97.95
12	<i>Spondias accuminata</i>	Hog-plum	22	90.90
13	<i>Sterculia guttata</i>		27	7.40
14	<i>Tectona grandis</i>	Teak	50	94.00
15	<i>Terminalia tomentosa</i>		50	98.00
16	<i>Terminalia bellerica</i>	Belleric myrobalon	50	88.00

Table 2: Growth performances of species in Utaraa Kannada District.

Sl. No.	Species	Collar diameter (cm)		Height in cm		Average volume in cm ³	
		Average ± SD	1989	Average ± SD	1989	1985	1989
1	<i>Acrocarpus fraxinifolius</i>	1.54 ± 0.45	6.24 ± 2.68	86.98 ± 20.01	332.66 ± 137.69	162.03	10663.37
2	<i>Artocarpus hirsutus</i>	1.23 ± 0.31	3.26 ± 1.20	50.24 ± 20.64	192.12 ± 85.67	59.70	1545.32
3	<i>Artocarpus integrifolia</i>	1.0 ± 0.33	3.6 ± 1.76	40.26 ± 18.87	203.33 ± 87.36	31.62	2069.61
4	<i>Bombax malabaricum</i>	1.99 ± 0.59	5.66 ± 1.78	101.58 ± 20.71	248.16 ± 87.77	315.98	5918.08
5	<i>Dalbergia latifolia</i>	0.84 ± 0.31	4.65 ± 0.99	45.54 ± 23.81	244.46 ± 48.79	25.24	4162.22
6	<i>Dalbergia sissoo</i>	0.88 ± 0.31	2.2 ± 1.03	82.77 ± 35.82	140.42 ± 88.05	50.34	1139.54
7	<i>Eugenia jambolana</i>	0.97 ± 0.26	4.53 ± 1.35	56.72 ± 11.7	215.46 ± 57.22	41.92	3426.23
8	<i>Gmelina arborea</i>	2.21 ± 0.78	5.09 ± 1.90	127.98 ± 43.18	193.58 ± 76.62	490.99	3937.88
9	<i>Grevilla robusta</i>	1.55 ± 0.45	5.28 ± 1.66	102.3 ± 29.83	373.0 ± 109.91	193.05	7922.49
10	<i>Lagerstroemia microcarpa</i>	1.55 ± 0.39	6.37 ± 1.22	55.96 ± 16.86	235.63 ± 57.14	105.61	7345.18
11	<i>Pterocarpus marsipium</i>	1.7 ± 0.54	4.94 ± 1.7	85.71 ± 27.16	249.33 ± 82.05	194.5	4779.41
12	<i>Spondias accuminata</i>	1.24 ± 0.46	2.72 ± 1.09	46.22 ± 14.27	120.25 ± 44.29	55.82	698.83
13	<i>Sterculia guttata</i>	1.28 ± 0.29	3.35 ± 2.19	49.11 ± 11.58	132.5 ± 67.17	63.20	1168.42
14	<i>Tecoma grandis</i>	1.67 ± 0.43	5.38 ± 1.42	50.36 ± 19.8	232.32 ± 71.86	110.32	5281.63
15	<i>Terminalia tomentosa</i>	1.32 ± 0.42	4.76 ± 1.36	50.6 ± 15.4	133.12 ± 52.71	617.17	2369.21
16	<i>Terminalia bellerica</i>	1.1 ± 0.26	2.95 ± 1.59	50.48 ± 15.88	133.18 ± 56.22	47.98	1099.26

Table 3: Rank-sum of species using survival rate, mean annual increment of collar diameter, height and volume.

Species Name	Collar diameter	Height	Volume (cm ³ /year)	Survival %	Rank Sum
<i>Acrocarpus fraxinifolius</i>	1.18	61.42	2625.33	100	62
<i>Lagerstroemia microcarpa</i>	1.21	44.92	1809.89	92	50
<i>Tectona grandis</i>	0.95	45.49	1292.83	94	50
<i>Grevilia robusta</i>	0.93	67.67	1932.36	90	49
<i>Dalbergia latifolia</i>	0.95	49.73	1034.25	92.3	47
<i>Pterocarpus marsupium</i>	0.81	40.90	1146.23	97.95	43
<i>Eugenia jambolana</i>	0.89	39.68	846.08	100	42
<i>Bombax malabaricum</i>	0.92	36.64	1400.53	72	36
<i>Terminalia tomentosa</i>	0.86	20.63	438.01	98	33
<i>Gmelina arborea</i>	0.72	16.4	861.72	93.8	29
<i>Artocarpus integrifolia</i>	0.65	40.76	509.50	7.69	25
<i>Artocarpus hirsutus</i>	0.51	35.47	371.40	34	19
<i>Sterculia guttata</i>	0.52	20.84	276.30	7.4	16
<i>Terminalia bellerica</i>	0.46	20.67	262.82	88	15
<i>Dalbergia sissoo</i>	0.33	14.41	272.30	93.75	15
<i>Spondias accuminata</i>	0.37	18.50	160.75	90.9	13