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Effect of nursery mixtures on nutrient content and quality parameters of seedlings of different tree species

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ABSTRACT

The study was conducted in nursery at Regional Agricultural Research Station, Bijapur during January 2007. The results indicated that, the nitrogen and potassium content in seedling of tree species were influenced significantly due to different nursery mixtures, but phosphorus content was not significantly influenced. The N content (2.80%) was highest in black soil : vermicompost : black sand (1:1:1) closely followed by black soil : vermicompost : black sand (2:1:1) (2.63%), but potassium content (1.26%) was highest in black soil : vermicompost : black sand (2:1:1), closely followed by black soil : vermicompost : black sand (1:1:1) (1.25%) were at par with each other. Among tree species, *Gliricidia sepium* registered higher N and K content in their seedlings (2.64% and 1.23%, respectively). With regards to seedling quality, seedling vigour index of black soil : vermicompost : black sand (2:1:1) and shoot : root ratio of red soil : FYM : white sand (2:1:1) were highest at all growth stages. However, interaction effect was found to be non significant.

Key words : Black sand, Seedling vigour index, Shoot : Root ratio, Vermicompost

INTRODUCTION

The concept of plantation forestry and also growing trees in agroforestry models in the semi-arid tracts of north Karnataka is gaining popularity. It requires successful production of healthy and vigorous seedlings in nursery at low cost using locally available resources. The nursery mixture influences the quality of seedlings to a greater extent. Seedlings raised in good media can ensure better establishment and growth when planted in the main field. The nursery mixture should have enough nutrients, good water holding capacity and drainage to ensure the growth of better seedlings (Noble, 1993). Normally the nursery mixture used for raising container stock involves red soil : FYM : white sand (2:1:1). But the availability and the cost of red soil and white sand has increased the cost of nursery mixtures, particularly in the dry tract of black soils. Hence, the locally available black soil and black sand could be used as an alternative. Further the possibility of using vermicompost as an alternative to FYM also needs to be evaluated. Hence, different nursery mixtures were tested to identify optimum and economic nursery mixture to produce seedlings of important tree species of the tract with better quality. The state forest department is engaged in raising the seedlings and using it for planting in community land besides supplying to farmers on demand. But for raising seedlings, traditionally red earth, white sand and FYM are always used in 2:1:1 proportion. These nursery mixture components are expensive in black soil areas of north Karnataka.

The studies have made it possible to identify alternate nursery mixtures which are based on the use of black soil and black sand. The economic conditions of farmers of dryland tracts are very poor. Hence, they cannot afford to spend more on production cost of planting stock in general and nursery mixture in particular. If technology is given to raise the seedlings with locally available material at a low cost, the afforestation of these degraded lands will be possible. Hence, keeping these points in view the present investigation was under taken to study the effect of different nursery mixture on silvicultural parameters of different tree species.

MATERIALS AND METHODS

The nursery experiment was conducted during January 2007 at Regional Agricultural Research Station, Bijapur farm of University of Agricultural Sciences, Dharwad, Karnataka. The experiment was laid out with Randomized Block Design with factorial concept with three replications consisted of 30 treatment combinations, comprising five nursery mixture *viz.,* N_1 – Red soil : FYM : White sand (2:1:1), N_2 – Black soil : FYM : Black sand (1:1:1), N_3 – Black soil : FYM : Black sand (2:1:1), N_4 – Black soil : Vermicompost : Black sand (1:1:1) and N_5 – Black soil : Vermicompost : Black sand (2:1:1) and six tree species *viz.,* T_1 – *Acacia nilotica*, T_2 – *Albizia lebbeck*, T_3 – *Dalbergia sissoo*, T_4 – *Gliricidia sepium*, T_5 – *Inga dulce* and T_6 – *Azadirachta indica*. In all five different nursery mixtures (weight basis) were prepared as per treatment and evaluated six tree species of local importance. The required inputs like red soil, white

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sand, black soil, black sand, farmyard manure and vermicompost were procured for preparation of various nursery mixtures to be tested. The physical and chemical properties of different nursery mixtures are presented in Table 1. The filling of nursery mixture was taken up on 02-01-2007 and 03-01-2007. The sowing of seeds was done on 04-01-2007 in polybags of size 9" x 6". The seedlings were watered twice a day upto 150 days. After that watering was done once in a day for 20 days and for last 30 days on alternative days. The seedlings were shifted from shade to partial shade at 150 days and partial shade to open conditions from 170-200 days for hardening the seedlings. In each treatment combinations 150 seedlings were raised for study purpose. The hand weeding was done twice to remove the weeds emerged in the polythene bags at 50 and 100 days prior to recording the observations. In between two hand weeding and application of Captan (2 g liter^{-1} of water) was taken up to encourage healthy growth of seedlings and prevent the damping off disease. The observations on nutrient content (NPK) at 200 days, shoot : root ratio and seedling vigour index were recorded at 50, 100, 150 and 200 days after planting. The shoot : root ratio was worked out by using the following formula and expressed in pure number.

$$\text{Shoot : root ratio} = \frac{\text{Shoot length (cm)}}{\text{Root length (cm)}}$$

The seedling vigour index was computed by following Abdul Baki and Anderson (1973) and expressed as a whole number.

Seedling vigour index = Germination percentage x seedling length in centimeter

Seedling length = plant height + root length)

RESULTS AND DISCUSSION

The results obtained from the present investigation are presented in Table 1, 2 and 3.

Nutrient content in seedlings :

The nutrient uptake by seedlings will influence the growth of seedlings and there by their performance in the fields. The nitrogen and potassium content in seedlings of different tree species significantly varied under the influence of nursery mixtures, but not significant with phosphorus content (Table 2).

The nitrogen content (2.80%) was highest in black soil : vermicompost : black sand (1:1:1) closely followed by black soil : vermicompost : black sand (2:1:1) (2.63%) and black soil : FYM : black sand (2:1:1) (2.50%). The better nitrogen content may be due to vermicompost which contains higher nitrogen than FYM. The traditional nursery mixture of red soil : FYM : white sand (2:1:1) could record the lowest nitrogen content (2.16%). The trends suggest that black soil can replace red soil as a component of nursery mixture and vermicompost can replace FYM, but if the cost of vermicompost is to be considered, FYM may be better option with black soil + black sand. Similar results were obtained by Devaranavadgi and Sajjan (1997) when neem seedlings were raised by black soil based

Table 1 : Physical and chemical properties of different nursery mixtures

Sr. No.	Type of nursery mixture	Physical properties			Chemical properties				
		Bulk density (g/cc)	Infiltration rate (cm/hr)	MWHC (%)	pH	EC dm^2/S	Nutrient composition (%)		
							N	P_2O_5	K_2O
1.	Nursery mixture-I Red soil : FYM : White sand (2:1:1)	1.80	10	35	7.20	0.39	0.070	0.031	0.084
2.	Nursery mixture-II Black soil: FYM : Black sand (1:1:1)	1.15	7.5	55	7.40	0.22	0.093	0.041	0.112
3.	Nursery mixture – III Black soil: FYM : Black sand (2:1:1)	1.20	6.2	48	7.45	0.24	0.070	0.031	0.084
4.	Nursery mixture – IV Black soil: Vermicompost : Black sand (1:1:1)	1.35	7.0	42	7.40	0.25	0.093	0.041	0.112
5.	Nursery mixture – V Black soil : Vermicompost : Black sand (2:1:1)	1.30	5.0	45	7.50	0.23	0.070	0.031	0.084
	Method of analysis employed	Black (1965)	Black (1965)	Piper (1968)	Jackson (1967)	Jackson (1967)	Jackson (1967)	Jackson (1967)	Black (1965)

MWHC – Maximum Water Holding Capacity

Table 2 : Nitrogen, phosphorus and potassium content at 200 days in seedlings of different tree species as influenced by different nursery mixtures

Treatments	Nitrogen (%)	Phosphorus (%)	Potassium (%)
Nursery mixtures (N)			
N_1 – Red soil : FYM : White sand (2:1:1)	2.16	0.95	1.05
N_2 – Black soil : FYM : Black sand (1:1:1)	2.26	0.97	1.17
N_3 – Black soil : FYM Black sand (2:1:1)	2.50	1.06	1.20
N_4 – Black soil : Vermicompost : Black sand (1:1:1)	2.80	1.20	1.25
N_5 – Black soil : Vermicompost : Black sand (2:1:1)	2.63	1.13	1.26
S.E.±	0.023	0.101	0.009
C.D. (P=0.05)	0.064	NS	0.026
Tree species (T)			
T_1 – *Acacia nilotica*	2.58	1.13	1.19
T_2 – *Albizia lebbeck*	2.43	0.97	1.16
T_3 – *Dalbergia sissoo*	2.31	0.99	1.15
T_4 – *Gliricidia sepium*	2.64	1.22	1.23
T_5 – *Inga dulce*	2.44	1.03	1.19
T_6 – *Azadirachta indica*	2.42	1.03	1.20
S.E.±	0.025	0.110	0.010
C.D. (P=0.05)	0.070	NS	0.029
Interaction (NXT)			
S.E.±	0.083	0.214	0.088
C.D. (P=0.05)	NS	NS	NS
CV (%)	13.84	16.36	13.32
Nursery mixtures (N)			

NS = Non significant

nursery mixtures. Among the tree species highest nitrogen content were recorded in case of *Gliricidia sepium* (2.64%) and *Acacia nilotica* (2.58%). It may be due to the superior nitrogen fixing ability of these species compared to others. Similar observations were made by Biradar *et al.* (2001).

The phosphorus content in seedlings of different tree species were significantly not influenced by nursery mixtures. However numerically higher phosphorus content (1.20%) was in the order of black soil : vermicompost : black sand (1:1:1), black soil : vermicompost : black sand (2:1:1) (1.13%) and black soil : FYM : black sand (2:1:1) (1.06%). It may be attributed to available phosphorus in the different nursery mixtures. Similar findings were recorded by Anonymous (2006). Among the tree species *Gliricidia sepium* (1.22%) and *Acacia nilotica* (1.13%) recorded superior phosphorus content than others. It might be due to their inherent capacity to utilize available phosphorus. The findings are in conformity with that of Biradar *et al.* (2001).

The potassium content (1.26%) was higher in nursery mixture of black soil : vermicompost : black sand (2:1:1), closely followed by black soil : vermicompost : black sand (1:1:1) (1.25%) were at par with each other and black soil : FYM : black sand (2:1:1) (1.20%). It was minimum with traditional nursery mixture of red soil : FYM : white sand (2:1:1) (1.05%). The reasons may be attributed to higher potassium content in black soils than red soil. The results are in conformity with the findings of Anon. (2006). Among the tree species potassium content was highest in *Gliricidia sepium* (1.23%) followed by *Azadirachta indica* (1.20%) and it was lowest in *Dalbergia sissoo* (1.15%). The reasons for this variation may be attributed to the inherent capacity of tree species to utilize potassium available in the media. Similar findings were recorded by Biradar *et al.* (2001).

The interaction effects with respect to nitrogen, phosphorus and potassium content in seedlings were found to be non significant.

Seedling quality parameters :

The seedling vigour index (SVI) and shoot : root ratio are the most important seedling quality parameter which decides the quality of planting stock produced in nursery. The SVI and shoot : root ratio were significantly influenced by nursery mixtures, but interaction effects found to be non significant (Table 3).

The seedling vigour index of black soil : vermicompost : black sand (2:1:1) was highest at all the stages of growth (50 days – 3116.61, 100 days – 4572.39, 150 days – 5530.95 and 200 days – 6356.24). The next best in the order were black soil : vermicompost : black sand (1:1:1) and red soil : FYM : white sand (2:1:1). The poor SVI was recorded by black soil : FYM : black sand (1:1:1). The SVI is not only influenced by seedling length but also germination per cent. Similar trends were reported by Biradar *et al.* (2001). Among different tree species, similar to earlier parameters the SVI at all growth stages was highest in *Gliricidia sepium* (50 days – 3100.44, 100 days – 4665.47, 150 days – 5657.80 and 200 days – 6452.66). The next best in the order were *Acacia nilotica* and *Dalbergia sissoo*. It was minimum with *Albizia lebbeck*. The findings of Saravanan (1991) and Sudhakar *et al.* (1995) are in line with present investigations. The seedling vigour index is the ideal quality parameter of planting stock. Because it not only indicated the performance in nursery but also indicates the survival and early growth in field.

Table 3 : Seedling vigour index (SVI) and shoot : root ratio of different tree species as influenced by different nursery mixtures

Treatments	50 days	100 days	150 days	200 days	50 days	100 days	150 days	200 days
Nursery mixtures (N)								
N_1 – Red soil : FYM : White sand (2:1:1)	2494.33	3680.12	4449.04	5069.72	1.55	2.03	1.97	2.02
N_2 – Black soil : FYM : Black sand (1:1:1)	1520.57	2236.75	2758.90	3122.28	1.32	1.75	1.75	1.79
N_3 – Black soil : FYM : Black sand (2:1:1)	2154.26	3209.91	3937.79	4475.79	1.37	1.93	1.92	1.94
N_4 – Black soil : Vermicompost : Black sand (1:1:1)	2862.78	4324.91	5329.96	6062.36	1.30	1.82	1.89	1.93
N_5 – Black soil : Vermicompost : Black sand (2:1:1)	3116.61	4572.39	5530.95	6356.24	1.42	1.87	1.82	1.86
S.E.±	50.83	97.78	175.95	102.27	0.042	0.057	0.043	0.056
C.D. (P=0.05)	143.78	282.23	497.67	289.36	0.119	0.158	0.122	0.152
Tree species (T)								
T_1 – *Acacia nilotica*	2561.61	3834.55	4653.18	5314.39	1.33	1.86	1.83	1.87
T_2 – *Albizia lebbeck*	2158.27	3172.82	3872.68	4408.14	1.53	1.92	1.94	1.98
T_3 – *Dalbergia sissoo*	2425.56	3634.94	4434.63	5050.79	1.30	1.83	1.84	1.89
T_4 – *Gliricidia sepium*	3100.44	4665.47	5657.80	6452.66	1.39	1.94	1.92	1.94
T_5 – *Inga dulce*	2335.30	3412.24	4416.15	4721.78	1.49	1.89	1.89	1.93
T_6 – *Azadirachta indica*	1844.62	2674.37	3347.98	3800.77	1.37	1.77	1.81	1.85
S.E.±	55.69	109.31	192.75	112.03	0.046	0.038	0.029	0.031
C.D. (P=0.05)	157.51	309.17	545.17	316.88	0.130	0.114	0.078	0.084
Interaction (NXT)								
S.E.±	352.19	691.33	630.19	540.24	0.216	0.218	1.228	1.326
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	18.84	12.61	18.12	14.50	16.54	17.54	17.22	14.85

NS = Non significant

The shoot : root ratio of red soil : FYM : white sand (2:1:1) at all the stages (50 days – 1.55, 100 days – 2.03, 150 days – 1.97 and 200 days – 2.02) was superior over others. The next best in the order were black soil : FYM : black sand (2:1:1) and black soil : vermicompost : black sand (2:1:1), where as it was lowest in black soil : FYM : black sand (1:1:1). The trends indicate that higher sand proportion will lead to poor moisture holding capacity resulting in the lower shoot : root ratio. However in general a shoot : root ratio of 1.5 to 2.00 is accepted as optimum (Noble, 1993). According to Natarajan (1999) the potting mixture of red soil : sand : compost (2:1:1) ratio recorded better seedling quality parameters like seedling vigour index, leaf area, number of branches and shoot : root ratio. Among the tree species the highest shoot : root ratio was found in *Albizia lebbeck* and *Gliricidia sepium* (50 days – 1.53 and 1.39, 100 days – 1.92 and 1.94, 150 days – 1.94 and 1.92 and 200 days – 1.98 and 1.94, respectively). The next best in the order was *Albizia lebbeck* and *Inga dulce*. The lowest shoot : root ratio at 200 days was found in *Azadirachta indica* (1.85). The shoot : root ratio of individual species is not only controlled by its genetic potential but the media where it grows. Similar trends of superior shoot : root ratio of *Pongamia pinnata* due to nursery mixture over others was noticed by Anon. (2006).

Interaction effect between nursery mixtures and tree species on seedling quality parameters was found to be non-significant at all growth stages.

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