INFLUENCE OF DIFFERENT SOIL MIXTURES ON NURSERY GROWTH OF SOME ARID ZONE TREE SPECIES

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Introduction

Arid region is predominantly occupied by sandy soils which have very low water holding capacity and poor fertility. Such soil when used for raising nursery plants of the tree species of arid region, fails to support good seedling growth. Further, the sandy soil lacks aggregation because of which the container soil gets dispersed at the time of planting, leaving the seedling naked, planting of which results in poor survival. Therefore, to produce healthy seedling stock and to impart aggregation, use of suitable nursery soil mixture is of paramount importance. Pond sediment available from water tanks is often used for mixing with the nursery sand. Based on the preliminary studies conducted at Central Arid Zone Research Institute, Jodhpur, Mann and Muthana (1984) reported the suitability of mixture containing sand, FYM and tank silt in 1:1:1 ratio, for healthy seedling growth. However, systematic experiments need to be undertaken by taking FYM, tank silt and sand and also inorganic fertilizers in varying proportions and their combinations to indentify the most suitable mixture for healthy growth of the seedlings of different species. This may vary from species to species as well. Delwaulle (1977) found the mixture, compost : sand : soil in ratio of 1 : 1 : 2, the best for raising nursery stock of *Eucalyptus camaldulensis* in Nigeria. For the nursery plants of broadleaved species in Fiji, a soil mixture of forest soil : sand in ratio of 4 : 1 was found most ideal (Evans, 1983).

Experimental results pertaining to Acacias in arid zone have been reported by Gupta *et al.* (1991). The present study was undertaken to findout the influence of varying rates of pond sediment, FYM and fertilizer mixing on seedling growth of *Prosopis cineraria* and *Albizia lebbek*, both planted under rained conditions, and *Dalbergia sissoo* which is an important species of IGNP command area in Western Rajasthan.

Materials and Methods

The study was conducted at the Arid Forest Research Institute, Jodhpur in the year 1989. The treatments, in factorial combinations, were comprised of mixing with sand the different rates of pond sediment (tank silt), Farm Yard Manure (FYM), nitrogen and phosphorus Relevant properties of sand, tank silt and FYM are given in Table 1. The treatments were comprised of mixing 0, 10, 15 and 20 per cent tank silt; 0, 2, 4 and 6 per cent FYM and 0, 20 and 40 ppm N (as urea), making 48 mixtures in factorial combinations. Another set of 48

mixtures was comprised of three rates of P_2O_5, 0, 15 and 30 ppm (in the form of single superphosphate) and four levels of each of tank silt and FYM as above. Sand, tank silt and FYM were weighed and mixed in different proportions to prepare different mixtures. Urea and single superphosphate were dissolved in water in specified quantity and mixed to get different mixtures. The mixtures were thoroughly mixed and filled in polythene bags of size 27×11 cm. Each treatment (mixture) had 30 bags in three replications in completely randomised design. Afer watering, seeds of *Dalbergia sissoo*, *Prosopis cineraria* and *Albizia lebbek* were sown on 18-4-1989. Only one seedling per bag was retained after germination. The nursery was watered everyday during the experimental period. The data on seedling height recorded after 120 days are presented and discussed in the subsequent section.

Table 1

Properties of the tank silt and sand used in the nursery

	Tank silt	Sand
pH	7.90	8.87
EC_2 (dSm^{-1})	2.11	0.23
Available N (kg ha^{-1})	310	87
Available P_2O_5 (kg ha^{-1})	75.2	4.5
Clay (%)	12	7
Silt (%)	45	4
Sand (%)	43	89

The FYM used contains 1.60 per cent nitrogen and 0.27 per cent phosphorus.

Results and Discussion

Effect of Tank Silt : Influence of mixing tank silt was significant on the seedling height of all the three species. The average effects (presented in Table 2 to 4) indicate that mixing 10 per cent tank silt increased the height of *Dalbergia sissoo* by 20 per cent (higher proportion of tank silt was not further beneficial). On average, 15 per cent tank silt increased the height of *Albizia lebbek* by 25 per cent; increased the height of *Prosopis cineraria* only marginally. Data on the influence of mixing tank silt alone are given in Table 5. Mixing of 10 per cent tank silt alone increased the seedling height of *Prosopis cineraria* from 30 to 41 cm. Higher proportion of clay soil was not beneficial for the former two species but the seedling height of *Dalbergia sissoo* increased to 53 cm (a net increase of 90 per cent) when rate of tank silt mixing was enhanced to 15 per cent.

Effect of FYM : Average effect of mixing Farm Yard Manure (FYM) was significant on seedling growth of *Prosopis cineraria* and *Albizia lebbek* but not on *Dalbergia sissoo* (Tables 2 to 4). On average, mixing 4 per cent FYM increased the seedling height of *Albizia lebbek* by 25% and of *Prosopis cineraria* by 15 per cent. Interestingly, when only FYM was mixed, significant plant response was observed at 2% FYM. The higher rate of FYM mixing did not cause further growth of seedlings (Table 5). With the mixing of 2% FYM alone, seedling height increased from 30 to 45 cm in *Prosopis cineraria*, 20 to 30 cm in *Albizia lebbek* and 28 to 38 cm in *Dalbergia sissoo*.

Table 2

Interaction effect of tank silt, FYM, nitrogen and phosphorus on seedling height (cm) of Dalbergia sissoo

	C_0	C_{10}	C_{15}	C_{20}	Mean	C.D. (5%)
N_0	33	46	47	48	44	Silt : 3.0
N_{20}	40	48	47	48	46	N : NS
N_{40}	43	48	45	48	46	Silt × N : NS
Mean	39	47	46	48		
	M_0	M_2	M_4	M_6	Mean	
N_0	42	43	46	46	44	FYM : NS
N_{20}	44	47	45	47	46	FYM : N : NS
N_{40}	46	43	49	47	46	
Mean	44	44	47	46		
	M_0	M_2	M_4	M_6	Mean	
C_0	37	39	43	40	40	FYM × Silt : 6.6
C_{10}	45	50	48	48	48	
C_{15}	48	41	48	48	46	
C_{20}	46	46	51	49	48	
Mean	44	44	47	46		
	C_0	C_{10}	C_{15}	C_{20}	Mean	
P_0	42	45	47	48	45	
P_{15}	44	46	42	51	46	P : NS
P_{30}	41	46	45	45	44	P × Silt : NS
Mean	42	45	45	48		
	M_0	M_2	M_4	M_6	Mean	
P_0	44	45	44	48	45	FYM × P : 5.7
P_{15}	46	48	45	45	46	
P_{30}	45	46	47	39	44	
Mean	45	46	46	44	—	

C_0, C_{10}, C_{15}, C_{20} : 0, 10, 15 & 20% tank silt
N_0, N_{20}, N_{40} : 0, 20 and 40 ppm Nitrogen
M_0, M_2, M_4, M_6 : 0, 2, 4 & 6% FYM
P_0, P_{15}, P_{30} : 0, 15 and 30% Phosphorus
NS : Not Significant
CD : Critical Difference

Table 3

Interaction effect of tank silt, FYM, nitrogen and phosphorus on seedling height (cm) of Albizia lebbek

	C_0	C_{10}	C_{15}	C_{20}	Mean	C.D. 5%
N_0	28	31	35	36	32	Silt : 2.9
N_{20}	33	32	39	37	34	N : 2.5
N_{40}	33	38	37	39	37	Silt × N : NS
Mean	30	34	37	37		
	M_0	M_2	M_4	M_6	Mean	
N_0	28	33	36	32	32	FYM : 2.9
N_{20}	30	33	35	39	34	FYM × N : NS
N_{40}	33	37	40	36	36	
Mean	30	34	37	36		
	M_0	M_2	M_4	M_6	Mean	
C_0	24	31	33	32	30	FYM
C_{10}	30	34	35	35	34	Silt × : NS
C_{15}	32	34	40	42	37	
C_{20}	35	38	42	34	37	
Mean	30	34	38	36	—	
	C_0	C_{10}	C_{15}	C_{20}	Mean	
P_0	30	34	35	33	33	P : NS
P_{15}	31	35	34	36	34	Silt × P : NS
P_{30}	33	36	31	33	34	
Mean	32	35	33	34		
	M_0	M_2	M_4	M_6	Mean	
P_0	30	32	35	35	33	FYM × P : 4.2
P_{15}	32	34	35	33	34	
P_{30}	31	36	37	31	34	
Mean	31	34	36	33		

C_0, C_{10}, C_{15}, C_{20} : 0, 10, 15 and 20% tank silt
N_0, N_{20}, N_{40} : 0, 20 and 40 ppm Nitrogen
M_0, M_2, M_4, M_6 : 0, 2, 4 and 6% FYM
P_0, P_{15}, P_{30} : 0, 15 and 30% Phosphorus
NS : Not Significant
CD : Critical Difference

Table 4

Interaction of tank silt, FYM, nitrogen and phosphorus on seedling height (cm) of Prosopis cineraria

	C_0	C_{10}	C_{15}	C_{20}	Mean	C D. (5%)
N_0	36	39	32	37	36	Silt 1.8
N_{20}	37	36	36	38	37	N : NS
N_{40}	38	37	33	42	38	Silt × N 3.1
Mean	37	38	34	39		
	M_0	M_2	M_4	M_6	Mean	
N_0	35	38	39	32	36	FYM : 1 8
N_{20}	37	38	39	36	37	FYM × N : 3.1
N_{40}	34	36	41	40	38	
Mean	35	37	40	36		
	M_0	M_2	M_4	M_6	Mean	
C_0	31	43	42	32	37	Silt × FYM : 3.6
C_{10}	38	37	40	36	38	
C_{15}	35	32	34	35	34	
C_{20}	37	37	43	41	39	
Mean	35	37	40	36	37	
	C_0	C_{10}	C_{15}	C_{20}	Mean	
P_0	38	36	37	39	37	P NS
P_{15}	35	39	32	39	36	Silt × P : 3 1
P_{30}	39	39	33	38	37	
Mean	37	38	33	39	37	
	M_0	M_2	M_4	M_6	Mean	
P_0	35	36	37	39	37	FYM × P : 3 1
P_{15}	34	37	38	36	36	
P_{30}	36	40	39	35	37	
Mean	35	38	38	36		

C_0, C_{10}, C_{15}, C_{20} : 0, 10, 15 and 20% tank silt
N_0, N_{20}, N_{40} : 0, 20 and 40 ppm Nitrogen
M_0, M_2, M_4, M_6 : 0, 2, 4 and 6% FYM
P_0, P_{15}, P_{30} : 0, 15 and 30% Phosphorus
NS : Not Significant
CD : Critical Difference

Table 5

Growth of nursery seedlings as affected by mixing different rates of nitrogen, tank silt and FYM

Tank Silt (%)	FYM (%)	*Prosopis cineraria*			*Albizia lebbek*			*Dalbergia sissoo*		
		Nitrogen levels (ppm)								
		0	20	40	0	20	40	0	20	40
0	0	30	32	30	20	24	28	28	37	46
	2	45	44	41	30	30	33	38	45	34
	4	44	43	37	32	34	33	37	43	49
	6	25	28	42	28	32	36	38	37	44
10	0	41	39	35	29	27	34	41	45	49
	2	37	40	34	31	29	42	50	51	49
	4	46	33	40	29	32	44	45	45	48
	6	34	34	41	35	38	33	49	51	46
15	0	36	36	33	31	33	31	53	49	42
	2	36	32	28	33	34	35	39	43	41
	4	28	35	39	36	36	50	45	44	52
	6	30	41	33	38	53	34	49	51	44
20	0	35	34	36	33	35	37	45	46	47
	2	33	37	42	36	39	39	44	49	45
	4	38	43	47	47	39	40	55	50	48
	6	40	40	43	29	33	41	47	48	52
C.D. 5% (N × FYM × Silt)		N S			10.1			6.2		

Effect of Nitrogen : Average effect of nitrogen addition was significant on seedling growth of *Albizia lebbek* and not on the growth of other two species (Tables 2 to 4) When 40 ppm nitrogen alone was added (data in Table 5), the seedling height increased from 20 to 28 cm in *Albizia lebbek* and 28 to 46 cm in *Dalbergia sissoo.* However, *Prosopis cineraria* did not respond to application of nitrogen alone.

Effect of Phosphorus : None of the species in the nursery experiment responded to the application of phosphorus (Tables 2 to 4 and 6).

Interaction Effects : The mean effects of combined applications of tank silt and FYM, tank silt and nitrogen, tank silt and phosphorus and FYM and phosphorus, on seedling growth of different tree species are given in Tables 2 to 4. In *Dalbergia sissoo,*

Table 6

Growth of nursery seedlings as affected by mixing different rates of phosphorus, tank silt and FYM

Tank Silt (%)	FYM (%)	*Prosopis cineraria*			*Albizia lebbek*			*Dalbergia sissoo*		
		Phosphorus levels (ppm)								
		0	20	40	0	20	40	0	20	40
0	0	34	33	36	26	29	31	40	45	38
	2	39	41	41	33	34	39	40	46	42
	4	35	31	40	32	31	32	39	40	39
	6	42	35	40	31	31	31	47	46	43
10	0	37	39	40	32	28	31	50	44	45
	2	34	39	42	32	36	36	44	50	52
	4	38	44	37	35	40	40	46	49	48
	6	35	34	35	36	34	36	38	41	38
15	0	32	27	31	29	30	26	42	38	51
	2	34	32	32	31	33	34	41	47	43
	4	40	36	34	39	35	38	46	39	47
	6	34	33	35	42	37	38	60	43	41
20	0	38	38	37	33	41	37	44	56	47
	2	38	37	44	33	34	37	54	50	48
	4	36	41	43	32	36	40	45	50	54
	6	45	41	29	32	31	19	48	48	32
C.D. 5% (Silt × FYM × P)		6.2			10.1			NS		

mixing of tank silt alone played a paramount role and the 10 per cent of it improved the seedling growth from 33 to 46 cm (Table 2). Coupling 2 per cent FYM with 10 per cent tank silt further increased the growth significantly. Thus mixing 10 per cent tank silt + 2 per cent FYM with sand formed the best mixture for nursery seedlings of *Dalbergia sissoo*.

In *Albizia lebbek* combined application of FYM, tank silt and nitrogen significantly influenced the seedling growth (Table 5). Mixing 10 per cent tank silt + 4 per cent FYM + 40 ppm N increased the seedling growth from 20 to 44 cm. Mohan *et al.* (1990) also reported significant response of *A. lebbek* to finer texture and nitrogen application. Equally effective was the treatment 20 per cent tank silt + 4 per cent FYM.

Seedling growth of *Prosopis cineraria* was significantly influenced by various combinations of tank silt, FYM, nitrogen and phosphorus. However, mixing of only 2% FYM increased the seedling height by 50 per cent (Table 5). Mixing of 10 per cent tank silt was also effective which may be preferred for its additional advantage of promoting aggregation and keeping the potting mixture intact with seedlings.

It is concluded from the study that to produce healthy nursery seedlings for tree planting in arid zones, 10 per cent tank silt + 2 per cent FYM should be mixed with sand for *Dalbergia sissoo*, 10 per cent tank silt + 4 per cent FYM and 40 ppm nitrogen for *Albizia lebbek* and only 10 per cent tank silt for *Prosopis cineraria*.

SUMMARY

Arid regions of Rajasthan are predominantly occupied by sandy soil. The nursery stock raised on such soil is poor and often results in heavy mortality when out planted. Therefore, a nursery experiment was conducted by mixing different levels of tank silt (0, 5, 10 and 20%), farm yard manure (0, 2, 4 and 6%), nitrogen (0, 10, 20 and 40 ppm as urea) and phosphorus (0, 15 and 30 ppm P_2O_5 as single superphosphate) to findout the suitable mixture for producing healthy seedlings of some arid zone tree species. The study indicated significant influence of mixing tank silt and FYM, with sand, on the seedling growth of *Dalbergia sissoo*, *Albizia lebbek* and *Prosopis cineraria*. Response to nitrogen application was shown only by *Albizia lebbek*. None of the species responded to phosphate application. The potting mixture producing the best healthy seedlings in this study were, 10 per cent tank silt + 2 per cent FYM for *Dalbergia sissoo*, 10 per cent tank silt + 4 per cent FYM + 40 ppm nitrogen for *Albizia lebbek* and 10 per cent tank silt for *Prosopis cineraria*. Use of tank silt improved the aggregation and the mixture remained intact with the seedling when polythene bag was removed.

विभिन्न मृदा मिश्रणों का कतिपय शुष्क प्रदेश की वृक्ष जातियों की रोपणी में होनी वृद्धि पर प्रभाव

जी०एन० गुप्त

सारांश

राजस्थान के शुष्क क्षेत्रों में प्रधानत: रेतीली मृदा पाई जाती है। ऐसी मृदाओं में उगाए गए रोपणी के पौधे कम जान होते हैं और क्षेत्र में रोपे जाने पर बड़ी संख्या में मर जाते हैं। अत: एक रोपणी परीक्षण विभिन्न स्तरों में तालाब की साद (0, 5, 10 और 20%), गोबर की खाद (0, 2, 4 और 6%) नाइट्रोजन (0, 10, 20 और 40 भाग प्रति दस लाख भाग में मिले, यूरिया के रूप में) और फास्फोरस (0, 15 और 30 भाग प्रति दस लाख भाग में मिलाकर, P_2O_5 अकेला सुपरफास्फेट) मिलाकर कतिपय शुष्क क्षेत्र वृक्ष जातियों के स्वस्थ पौधे उगाने के लिए उपयुक्त मिश्रण मालूम करने के लिए किया गया। अध्ययन से डलबर्गिया सिस्सू, एल्बिजिया लेब्बेक और

प्रोसोपिस सिनेरेरिया के पौधों की वृद्धि पर रेत में तालाब की साद और गोबर की सड़ाई खाद मिलाने पर सार्थक प्रभाव होने का संकेत मिलता है। नाइट्रोजन देने का प्रतिचार केवल एल्बिजिया लेब्बेक में हुआ। किसी भी वृक्ष जाति में फास्फेट देने का प्रतिचार नहीं हुआ। गमलों के जिन मिश्रणों से इस अध्ययन में सबसे स्वस्थ पौधे बने वे 10% तालाब की साद +4% गोबर की सड़ाई खाद +40 भाग प्रति दस लाख भाग में मिली नाइट्रोजन एल्बिजिया लेब्बेक के लिए, 10% तालाब की साद प्रोसोपिस सिनेरेरिया के लिए रहे। तालाब की साद उपयोग करने पर मिट्टी जमना सुधरा और पोलिथीन की थैली हटा देने पर भी मिश्रण यथापूर्व बना रहा।

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