RESULTS OF EARLY SELECTION OF *ACACIA* AND *PROSOPIS* SPECIES/SEED SOURCES

S. Rehman, A. Hussain and S. Ameen*

Abstract

Survival and height growth data of a number of indigenous and exotic species and seed sources of *Acacia* and *Prosopis* in the nursery gave significant differences among sources indicating the possibilities of selection of best seed sources for afforestation in Pakistan. Further scope of improvement of these species is discussed.

Introduction

About 1200 *Acacia* and *Prosopis* species are widely distributed in Africa, Asia and Australia (FAO, 1983). In the plains of Pakistan, these are mainly confined to riverain areas of Indus. Small linear plantations are also found along canal banks, roadsides and around farmers fields in Sind and Punjab. There are four common *Acacia* (*Acacia nilotica, A. modesta, A. senegal, A. jacquemontii*) and two *Prosopis* (*P. cineraria* and *P. juliflora*) species in Pakistan. However, Khan (1958) enumerated 35 Acacia species in the country and among these *Acacia nilotica* is widely distributed in central and southern Pakistan. The tree does not grow well in the north due to frost.

Ali and Faruqui (1969) recognised four sub-species as a result of hybridization in *A. nilotica* complex. *Acacia arabica* syn. *A. nilotica*, commonly called Kikar and Babul, is an important species because its timber is used as pit prop and firewood. Root stumps are converted into charcoal while the bark is used in tanning industry. The leaves and pods are nutritious and fed to the cattle. More than 75% of the area in Pakistan is arid and so *Acacia nilotica* alongwith other species are important and adoptable to the arid and semi-arid regions. *Acacia senegal*, produces excellent gum with palatable fodder. *Prosopis* species are mainly used as firewood and grow under dry conditions with good soil binding characteristics.

Acacia nilotica and *Prosopis cineraria* have gained much importance in Pakistan in the recent past because of their better firewood and fodder characteristics specially in the arid areas. It would be, therefore, desirable to test the performance of different *Acacia* and *Prosopis* species and seed sources in the nursery for further field trials. No work on similar trials in Pakistan had been reported in the past. The information may later on be utilized to eliminate and evaluate species/seed sources under varying climatic and edaphic conditions. Results of species elimination trial may also reduce the cost of raising planting stock in different nurseries to some extent. It is with these objectives that the performance of 46 indigenous and exotic seed sources of *Acacia* and *Prosopis* are described in the following paragraphs.

*Pakistan Forest Institute, Peshawar.

Literature Review

Sayda and Faiz (1983) studied optimum period of maximum seed germination in six stratified and non-stratified indigenous species of *Acacia* in Sudan. The results indicated that germination of *A. nubica, A. nilotica, A. albida* and *A. seyal* was better than *A. spirocarpa* and *A. ehrenbergiana*. It was found that *A. nubica* and *A. nilotica* were most responsive to seed coat scarification because their germination response was remarkably greater in comparison with other species. Sheikh (1984) recommended that the seed of *A. nilotica* should be treated with cow-dung for 24 hours to hasten germination. The author reported the performance of two exotic *Acacia i.e. A. victoriae* (Australia) and *A. tortilis* (Sudan) and recommended these for afforestation in low rainfall areas of the country. Results of other workers (Gupta *et al* 1973) on germination, seedling behaviour and phytomass production of *A. albida, A. verek, A. tortilis* and *A. senegal* in the nursery showed that growth of *A. tortilis* was superior in all respects. Germination studies were also conducted on seven *Acacia* species (*A. aneura, A. catechu, A. cyanophlla, A. cyclops, A. modesta, A. nilotica* and *A. senegal*) at PFI using various pre-treatments. It was found that conc-sulphuric acid treatment for 5 minutes was best for *A. catechu* and *A. modesta* as compared with other treatments. Other species like *A. nilotica, A. senegal, A. aneura* and *A. cyclops* gave good response to boiling water treatment (Siddiqui, 1986).

Based upon aforementioned observations it seems that the effectiveness of seed pretreatment in various *Acacias* is different. The germination percentage may also vary between geographic regions as the latitudinal range lies between 24^{o}–32^{o} N with varying rainfall, soil pattern and temperature regimes in Pakistan.

Materials and Methods

Seed of 46 indigenous and exotic species/sources of *Acacia* and *Prosopis* (Table 1) were sown in March, 1984 in polythene tubes (Size 7.5x17.5 cm) using a mixture 2:1 of soil: sand. The geographic data of local seed sources of *Acacia* and *Prosopis* was recorded from Atlas of Pakistan (1985). The latitudinal range of Acacia lies between $24^{o}.13'$ to $33^{o}.46'$ N and that of *Prosopis* between $25^{o}.29'$ to $31^{o}.47'$ N. All exotic seed sources of *Acacia* and *Prosopis* were procured in 1983 through DANIDA/FAO Seed Centre Denmark, under International Board of Plant Genetic Resources (IBPGR) Programme. Fresh seed of local sources was also collected the same year and used in the trial. Every seed lot was pretreated with hot water for 5 minutes before sowing. There were 4 replications in RCB design with 300 seed/replication/ source. Watering was done alsmost daily upto three months and on each alternate day afterwards using rose-cane. No. fertilizer was given at the nursery stage. The survival percentage was recorded three months after sowing alongwith height-growth data (cm) of individual seedling.

Analysis of variance was carried out separately for *Acacia* and *Prosopis* species/seed sources. Arc-sine transformation was done for survival before analysis. LSD test was also worked out for both characters to find out the level of significance between mean of treatments.

Results and Discussion

Mean survival of 34 seed sources of six *Acacias (Acacia nilotica, A. tortilis, A. albida, A. aneura, A. cowleana* and *A. holosericea)* ranged from 7.9–64.9% (Table 1). Exotic Australian species, *Acacia holosericea* and *A. aneura*, were poor performers than *A. nilotica*. There was greater variability in *A. aneura* for survival and height growth as compared with other species. In a study conducted by Sheikh (1986), it was found that 4-year-old *Acacia tortilis* had better survival and growth than *A. aneura* at Daggar Kotli under an average annual rainfall of 250 mm. In the present study an Indian source of *A. nilotica* (Pune, Maharashtra) gave highest survival of 65%. The LSD test (Table 3) also confirmed that this source had outgrown significantly than all other species/sources. There were significant differences for survival and growth among *Acacia* seed sources (Table 2). Similar observations have been reported by Mathur *et al* (1984) who found that various provenances of *A. nilotica* had given significant differences in India. The pretreatment and germination studies on different species of *Acacias* at the Pakistan Forest Institute, Peshawar (1986) indicated that best results could be obtained by treating seed of *A. modesta* and *A. catechu* with conc. sulphuric acid for five minutes. Seed of *A. nilotica* and *A. sengegal, A. aneura* and *A. cyclops* may be treated with boiling water, to enhance germination. Mathur *et al* (1984) also found that treatment of *A. nilotica* with hot water for ten minutes gave distinctly better and quicker germination as compared to untreated seed. It seems that hot water seed treatment of *A. nilotica* for 5–10 minutes is very effective for better germination. Studies conducted at the Pakistan Forest Institute, Peshawar had also shown that the seed of *A. aneura, A. albida* and *A. victoriae* gave better germination with boiling water treatment (PFI; 1982). It is therefore, suggested that *Acacia* seeds should be pretreated with suitable agents before sowing to stimulate germination.

Exotic *Prosopis* species/sources exhibited less survival than indigenous sources except *P. chilensis*; while *Prospis tamarugo* gave poor survival and height. The later had been reported to perform better in Chile (FAO, 1981). However, a Chilean source, *Prosopis chilensis*, performed better than local sources. The height-growth was almost double as compared with indigenous sources of *Prosopis*. The overall survival and height growth of three *Prosopis* species (including 12 seed sources) ranged from 22.5–57.5% and 14.2–46.0 cms respectively. There were also significant differences between *Prosopis* sources (Table 2) both for survival (F=47.2) and height (F=19.4). The LSD test indicated that the Chilean source, *Prosopis chilensis*, gave maximum height growth as compared with all other *Acacia* and *Prosopis* sources. An Indian sources of *Prosopis* also gave maximum survival of 58% as compared with Chilean source which gave 50% survival (Table 3). It, therefore, seems that *Prosopis chilensis* showed better survival and height growth and out performed under Peshawar conditions in the nursery (Fig. 1). The test site is situated at $34^{o}.01'$ latitude; $71^{o}.34'$ longitude with an altitude of 400m. The average annual rainfull is 350 mm while the average annual temperature range is 51^{o}– 91^{o}F. The studies conducted in Sudan under IBPGR programme in 1984 also indicated that *Prosopis chilensis, Acacia nilotica* and *Acacia albida* were rated best for survival among large number of exotic and indigenous sources of *Acacia* and *Prosopis* (Sheikh *et al.* 1986). *A. albida* in the present study did not prove better than indigenous *Acacia nilotica*. Although few indigenous seed sources of *P. cineraria* from southern Pakistan gave somewhat better survival but the height growth was not desirable. *Acacia aneura, A. holosericea* and *A. cowleana* were found to give discouraging

results. The inclusion and testing of more seed sources of best species in the nursery may yield some encouraging results in the future.

Acknowledgement

The seed of the exotic species was provided by DANIDA/FAO; Forest Seed Centre for which the authors are grateful. The assistance offered by the staff of Forest Genetics Branch, PFI, in collection of seed is also appreciated.

TABLE 1

Geographic Origin and height growth data of *Acacia* and *Prosopis* seed sources tested at Peshawar

Exotic *Acacia*

S. No.	Source No./ Species	Location/ Origin	Lat. ° '	Long. ° '	Alt. (m)	Mean Survival %	Mean Height (cm)
I. *Acacia tortilis*							
1.	1066	Negev Arqva (Israel)	–	–	–	36.3	24.1
2.	1086	Jaypur (India)	–	–	–	20.6	28.6
II. *Acacia albida* (Senegal)							
3.	1043	Marina-Dakhar	–	–	–	48.0	21.2
4.	1044	Niakha Fall	–	–	–	47.9	24.6
III. *Acacia aneura* (Australia)							
5.	12791	Cobar, NSW	31 30 S	145 45 E	250	28.9	6.4
6.	12838	Kalgoorlie WA	30 45 S	121 30 E	0	9.8	5.6
7.	13267	Morven, QLD	26 25 S	146 55 E	440	23.8	3.6
8.	13480	WST George, QLD	27 53 S	148 43 E	210	26.5	3.5
9.	13481	Charlieville, QLD	26 25 S	146 17 E	300	14.4	3.1
10.	13489	Howitt, QLD	26 47 S	142 13 E	180	10.2	4.7
11.	13490	Eromang, QLD	26 22 S	143 9 E	180	14.6	5.1
12.	13716	Tanami Rd. NT	23 28 S	133 17 E	650	30.5	9.6
13.	13719	Vaughan. NT	22 12 S	130 55 E	600	29.2	8.6
14.	13720	Flood-out, NT	21 47 S	131 9 E	580	25.7	9.2
15.	13722	Gien Helen, NT	23 37 S	132 27 E	650	29.6	7.5
16.	14079	Jameson, WA	26 00 S	127 16 E	560	13.6	6.1
IV. *Acacia holosericea* (Australia)							
17.	13771	Vaughan Springs, NT	22 18 S	130 52 E	600	8.2	6.5
V. *Acacia cowleana* (Australia)							
18.	13774	Vaughan Springs, NT	22 18 S	130 52 E	600	7.9	4.2

VI. *Acacia nilotica* (India)

19.	1069	Etawah, UP	–	–	–	45.9	42.8
20.	1070	Pune, Maharashtra	–	–	–	35.5	42.9
21.	1071		–	–	–	37.2	43.9
22.	1080	Inand Pur, Indra Pradesh	–	–	–	13.8	31.9
23.	1081	Bil-wani, Manyana	–	–	–	36.4	40.9
24.	1082	Pune, Maharastra	–	–	–	64.9	43.4

Indigenous *Acacia*

VII. *Acacia nilotica*

25.	Ghazighat	30 06 N	70 53 E	–	48.0	44.4
26.	Attock	33 46 N	72 21 E	–	54.3	42.8
27.	D.I. Khan	31 50 N	70 54 E	173	47.1	43.6
28.	Patoki	31 02 N	73 51 E	196	51.3	44.3

VIII. *Acacia senegal*

29.	Tharparker	24 13 N	68 40 E	30	41.1	26.4
30.	Baberbund	24 50 N	67 27 E	36	52.9	21.5
31.	Gadani	25 06 N	66 43 E	25	38.5	24.3
32.	Dadu	26 43 N	67 40 E	–	39.1	21.2
33.	Islamkot	24 42 N	70 11 E	–	46.2	23.0
34.	Dhabeji	24 48 N	67 29 E	4	51.4	22.6

Exotic *Prosopis*

S. No.	Source No./ Species	Location/ Origin	Lat. ° '	Long. ° '	Alt. (m)	Mean Survival (cm)	Mean Heignt (cm)
I. *P. tamarugo* (Chile)							
1.	1018	Lattuayca, Iquique	–	–	–	27.9	14.2
II. *P. chilensis* (Chile)							
2.	1027	Rio pana, Combarbala	–	–	–	49.9	46.0
III. *P. cineraria*							
3.	1062	Khantar (Yemen)	–	–	–	36.5	30.4
4.	1088	Etawa, UP (India)	–	–	–	35.6	25.7
5.	1090	Barmer, Rajastan (India)	–	–	–	53.7	30.8
6.	1091	Thunjhuru, Rajastan (India)	–	–	–	57.5	33.7

Indigenous *Prosopis*

IV. *Prosopis cineraria*

7.	Darya Khan	31 47 N	72 07 E	–	52.2	21.9
8.	Mirpur Khas	28 11 N	68 44 E	–	47.7	21.3
9.	Saeed Abad	–	–	–	30.0	21.6
10.	Hyderabad	25 29 N	68 25 E	–	42.4	26.7
11.	Cholistan (Greater)	27 00 N	70 30 E	–	40.8	22.3
12	Cholistan (Lesser)	28 30 N	72 30 E	–	22.5	19.9

TABLE 2

F-Value of *Acacia* and *Prosopis* seed sources for survival and height.

	Species/sources	Df	Survival (%)	Height (cm)
(i)	*Acacia*	33	23.6*	66.9*
(ii)	*Prosopis*	11	47.2*	19.4*

*Significant at 1% level.

TABLE 3

LSD test for survival and height growth of *Acacia* and *Prosopis* species at nursery stage

Acacia species/sources = 34			
Sources/App.	Sourvival (%)		Av. height (cm)
1082 (India)	64.9	Chazi Ghat (Pak)	44.4
Attock (Pak)	54.3	Patoki (Pak)	44.3
Babarband (Pak)	52.9	1071 (India)	43.9
Dhabeji (Pak)	51.4	D. I. Khan (Pak)	43.6
Patoki (Pak)	51.3	1082 (India)	43.4
Ghazi Ghat (Pak)	48.9	1070 (India)	42.9
1043 (*Senegal*)	48.0	Attock (Pak)	42.8
1044 (*Senegal*)	47.9	1069 (India)	42.8
D. I. Khan (Pak)	47.1	1081 (India)	40.9
Islamkot (Pak)	46.2	1080 (India)	31.9
1069 (India)	45.9	1086 (India)	28.6
Tharparker (Pak)	41.1	Tharparker (Pak)	26.4
Dadu (Pak)	39.1	1044 (Senegal)	24.6

Sources/App.	Sourvival (%)	Av. height (cm)
Acacia species/sources = 34		
Gadani (Pak)	38.5	24.3
1071 (India)	37.2	1066 (Israel) 24.1
1081 (India)	36.4	Islamkot (Pak) 23.0
1066 (Israel)	36.3	Dhabeji (Pak) 22.6
1070 (India)	35.5	Babarband (Pak) 21.5
13716 (Australia)	30.5	1043 (Senegal) 21.2
13722 (Australia)	29.6	Dadu (Pak) 21.2
13719 (Australia)	29.2	13716 (Australia) 9.6
12791 (Australia)	28.9	13720 (Australia) 9.2
13480 (Australia)	26.5	13719 (Australia) 8.6
13720 (Australia)	25.7	13722 (Australia) 7.5
13267 (Australia)	23.8	13771 (Australia) 6.5
1086 (India)	20.6	12791 (Australia) 6.4
13490 (Australia)	14.6	14079 (Australia) 6.1
13481 (Australia)	14.4	12838 (Australia) 5.6
1080 (India)	13.8	13490 (Australia) 5.1
14079 (Australia)	13.6	13489 (Australia) 4.7
13489 (Australia)	10.2	13774 (Australia) 4.2
12838 (Australia)	9.8	13267 (Australia) 3.6
13771 (Australia)	8.2	13480 (Australia) 3.5
13774 (Australia)	7.9	13481 (Australia) 3.1
Prosopis species/sources = 12		
1091 (India)	57.5	1027 (Chile) 46.0
1090 (India)	53.7	1091 (India) 33.7
Darya Khan (Pak)	52.2	1090 (India) 30.8
1027 (Chile)	49.9	1062 (Yemen) 30.4
Mirpur Khas (Pak)	47.7	Hyderabad (Pak) 26.7
Hyderabad (Pak)	42.4	1088 (India) 25.7
Cholistan (Greater)(Pak)	40.8	Cholistan (Greater)(Pak) 22.3
1062 (Yemen)	36.5	Darya Khan (Pak) 21.9
1088 (India)	35.6	Saeedabad (Pak) 21.6
Saeedabad (Pak)	30.0	Mirpur Khas (Pak) 21.3
1018 (Chile)	27.9	Cholistan (Lesser) (Pak) 19.9
Cholistan (Lesser) (Pak)	22.5	1018 (Chile) 14.2

Fig. 1. Growth performance of an exotic species of Prosopis (*P. chilensis* Mol. Stuntz) at Peshawar

BIBLIOGRAPHY

Ali, S.I. and S.A. Faruqi. 1969. Hybridization in *Acacia nilotica* Complex. Pak. Jour. Bot. 1, 119–128.

Directorate Survey of Pakistan. 1985. Atlas of Pakistan. Map publication Section, Rawalpindi.

FAO, 1981. *Prosopis tamarugo* fodder tree for arid zones. Plant production and protection paper No. 25.

FAO, 1983. Handbook on seeds of dry-zone Acacias; a guide for collecting, extracting, cleaning and storing the seed and for treatment to promote germination of dry-zone Acacias. 92 p.

Gupta, P.K; S.K; Saxena and B.K. Dutta, 1973. Germination, seedling behaviour and phytomass of nine Acacias in the nursery stage. Ind. For. 99, 352–58.

Khan, A.H. 1958. Acacias in Pakistan. Govt. of Pak. Press, Karachi: p. 30.

Mathur, R.S; K.K. Sharma and M.S. Rawat. 1984. Germination behaviour of various provenances of *Acacia nilotica* spp. *indica*. Ind. For. 110, 435–49.

Pakistan Forest Institute, Peshawar. 1982. Annual Progress Report, Cyclostyled. p. 149.

Sayda and Faiz. 1983. Seed dormancy rhythm of some Sudanese Acacias. Sudan Silva. 25, 36–45.

Sheikh, M.I. 1984. Performance of exotic Acacias in Pakistan. Pak. Jour. For. 1, 55.

Sheikh, M. I; S.M. Khan and S.R. Khan. 1986. Arid zone afforestation – A report on study tour to Sudan. Pak. For. Inst., Peshawar; p. 50.

Sheikh, M.I. 1986. Deep planting means better survival and growth. Pak. Jour. For. 36; 145.

Siddiqui, K.M. 1986. Annual Progress Report of PL-480 Scheme. "National Research Program of Tree Improvement and Introduction". Pak. For. Inst., Peshawar p. 21.