IDENTIFICATION OF FAST GROWING SALT TOLERANT TREE SPECIES

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SUMMARY

Enormous areas of previously productive agricultural and forestry land have been rendered unsuitable for traditional farming purposes due to salinity, sodicity and waterlogging in the irrigated plains of the province of Punjab and Sindh. These were the major food, fuelwood and timber producing areas in the plains. Pakistan has acute wood deficits and firewood is still the principal source of fuel for heating and cooking. There is an urgent need to reforest such areas and other waste lands with salt tolerant, fast-growing trees.

In order to identify salt tolerant tree species which could be grown in such areas, seeds of 26 salt tolerant species were procured from CSIRO Australia, plants raised in the nursery and then outplanted in the field trial during Sepgember, 1990. Three years survival and growth data have been analysed and better performing salt tolerant species have been identified.

INTRODUCTION

Salinity, sodicity, waterlogging and combinations of these have rendered enormous areas of previously productive agricultural land around the world marginal or unsuitable for traditional farming pursuits. In Pakistan, 4.2 M ha (25% of irrigated land) is saline and saline-sodic to some extent. 2.1 M ha (pre-monsoon) and 4.3 M ha (post-monsoon) has ground-water depth less than 1.5 m, i.e. these areas are poorly drained and subject to waterlogging. In addition, considerable areas of land have sodic soil. The states most affected by these conditions are Punjab and Sindh.

Pakitan has acute wood deficits. There is an urgent need to increase the rate of afforestation. Since most of Pakistan is situated in the semi-arid subtropical zone there is reliance on irrigated agriculture and forestry to supply food, fuelwood and timber needs. Increasingly, farmers are planting windbreaks or blocks of fast growing trees such as *Eucalyptus camaldulensis* and the local babul *Acacia nilotica*. Firewood is still the principal source of fuel for cooking and heating. Whilst much of the plantation forest area is in the northern hilly tracts, considerable area of State-owned and private irrigated forests have been developed in plains of the Punjab and Sindh provinces. Considerable areas in these forests have been rendered unproductive by salinity and waterlogging and there is an urgent need to reforest such areas as well as wastelands with salt tolerant, fast growing trees.

Engineering management options for such areas are costly. There is already evidence in Pakistan and other countries that local amelioration of saline and sodic sites by correct vegetation management (the 'biosaline approach') is technically possible. Afforestation of salt-affected soils offers the possibility of both utilizing and ameliorating these degraded lands. For this purpose identification of fast-growing and multipurpose salt tolerant species is imperative. In collaboration with CSIRO Australia, under ACIAR Project 8633, seed of a number of Australian woody species was obtained through the courtesy of Dr. Nico Marcar with the main objective to identify better performing tree germplasm and establishment techniques for these soil conditions. Performance of these species is discussed in this paper.

Griffith (1945) reported that *Acacia nilotica* and *P.cineraria* appeared to be more promising on alkali (Kallar) soils in Punjab (India). Sheikh (1974) conducted experiment on saline soils of Shorkot and found 92, 77 and 66 percent survival of *E.camaldulensis, E.robusta* and *E.microtheca*.

Malik and Sheikh (1983) planted *E.camaldulensis, P.euphratica, M.azedarch and Salix tetrasperma* in Azakhel with 8.2 to 10.0 soil pH. *E.camaldulensis* gave maximum survival followed by*P.euphratica*. In another study, *E.camaldulensis, T.aphylla* and *E.tereticornis* gave 95, 91 and 80 percent survival and turned out to be most useful species out of a long list of 12 tested. Ahmad et al. (1984) conducted a study with the application of saline waterin the fiel and showed that *E.camaldulensis* and *Laptochloa fusca* could be grown in the high saline conditions and low sodium content. Chaturvedi (1985) tested relative productivity of 2 years old plantations of different species on alkali soils in Uttar Pradesh (India). *P.juliflora* followed by *A.nilotica* and Eucalyptus hybrid showed much better performance than the other species.

Jain et al. (1985) studied that *P.juliflora*

and *T.articulata* were most tolerant with 87% survival even at highest salinity leve. *A.tortilis* and *E.camaldulensis* showed medium tolerance while *Azadirachta indica* and *Albizzia lebbek* were most sensitive. Singh and Yadav (1985 a,b) revealed that *Casuarina equisetifolia* was most tolerant to soil salinity and was able to survive even at ECe 32.5 ds/m.

In Sindh, *Prosopis juliflora, Leucaena leucocephala, Casuarina equisetifolia* and *Pithecolobium dulce* gave more than 65% survival on soils with pH ranging from 8.4 to 8.6 (Anon, 1986). Singh et al. (1986) indicated greater tolerance of *P.juliflora* than *A.nilotica* to sodic as well as saline conditions. Bodla (1988) studied the salt areas in Punjab and stated that *Acacia nilotica* and *Prosopis juliflora* could tolerate moderate salinity.

MATERIALS AND METHODS

Seed of 26 salt tolerant Australian woody species was received from CSIRO Australia during January - March, 1990. Seeds were pre-treated as per their requirements and plants raised in polythene containers of 10x20 cm size in March, 1990 in research nursery of Punjab Forestry Research Institute, Faisalabad. When the plants were six months old, these were outplanted in the field in Shorkot plantation (150 Km south of Faisalabad) during September, 1990. Only 21 species could be planted out due to less number of plants available for other five species. Two local species namely *Terminalia arjuna* and *Tamarix aphylla* were also included in the study for comparison with Australian species. Experimental design used was randomised complete block with 5-tree row plots having five plants in each row. There were three replications/blocks. Total area of the experiment was 0.6 ha. Planting was done at 2x2 m spacing in holes 23 cm deep. Method of irrigation was flow system in trenches of 0.3 m depth and 0.3 m width. Irrigation was provided twice a month during 'kharif' season only (April to September).

Soil texture of the experimental site is generally loam. pH value in the upper 30 cm depth varies from 8.0 to 9.5 whereas throughout the depth upto 120 cm it varied from 7.8 to 9.6. Generally it varied from 8.0 to 8.5. Total soluble salts % varied from 0.3 to 2.9 at various points in the experimental area upto 60 cm depth, and it was higher in the upper 30 cm depth as compared to lower zone from 30 to 60 cm depth.

RESULTS AND DISCUSSION

Survival, height growth and DBH data collected during February, 1994, when the trial was 40 months old, has been compiled and summarised in Table-1.

Considering overall performance regarding survival, height and diameter growth the following species can be rated as very good in order of priority:

1. *E. camaldulensis* (14847)
2. *E. camaldulenis* (15441)
3. *C. cunninghamiana*
4. *E. rudis*
5. *C. glauca*
6. *E. microtheca*
7. *C. obesa* (15796)
8. *A. salicina*
9. *C. equisetifolia*
10. *T. aphylla*
11. *A. auriculiformis*
12. *C. obesa* (14100)

Table 1: Showing Survival, Height and DBH after 40 months of Outplanting.

Treatment	Name of species	Survival %age	Height (m) at the time of Outplanting	After 40 months	DBH (cm)	Remarks
T_1	*Acacia ampliceps*	15	0.40	3.9	6.1	Partly damaged
T_2	*A.auriculiformis*	59	0.46	4.8	3.6	
T_3	*A.salicina*	74	0.46	5.3	5.6	
T_4	*A.saligna*	37	0.46	4.7	3.6	Partly damaged
T_5	*A.sclerosperma*	4	0.36	2.2	1.8	Partly damaged
T_6	*A.victoriae*	7	0.32	2.2	2.0	Partly damaged
T_7	*Eucalyptus microtheca*	93	0.59	6.8	6.6	
T_8	*E.camaldulensis* (15441)	89	1.01	11.2	10.9	
T_{10}	*E.rudis*	78	0.54	8.7	8.4	
T_{11}	*E.occidentalis*	41	0.57	7.8	7.6	
T_{12}	*Melaleuca leucadendra*	Zero	0.73	-	-	Partly damaged
T_{13}	*M.bracteata*	89	0.36	3.8	3.3	
T_{14}	*M.halmaturorum*	56	0.30	2.3	2.0	
T_{15}	*Casuarinaobesa* (15796)	89	0.44	5.3	5.8	
T_{16}	*C.glauca*	89	0.76	6.1	6.4	
T_{17}	*C.cunninghamiana*	100	0.81	7.0	6.9	
T_{18}	*C.equisetifolia*	67	0.42	4.3	5.1	
T_{19}	*C.obesa* (14100)	70	0.15	3.9	3.8	
T_{20}	*Sesbania formosa*	Zero	0.15	-	-	Partly damaged
T_{21}	*Melaleuca lanceolata*	22	0.30	2.6	2.3	
T_{22}	*Terminalia arjuna*	37	0.39	4.0	3.6	Partly damaged
T_{23}	*Tamarix aphylla*	100	0.52	4.5	5.1	

The species can be divided into three classes on the basis of their survival as under:

70% or above	40 to 69 %	Below 40%
1.C.cunninghamiana	*1.C.equisetifolia*	*1.A.saligna*
2.T.aphylla	*2.A.auriculiformis*	*2.T.arjuna*
3.E.camaldulensis (14847)	*3.M.halmaturorum*	*3.M.lanceolata*
4.E.microtheca	*4.E.occidentalis*	*4.A.ampliceps*
5.E.camaldulensis (15441)		
6.C.glauca		
7.C.obesa (15796)		
8.M.bracteata		
9.E.rudis		
10.a.salicina		
11.C.obesa		

On the basis of height growth the three classes can be as under:

5m or above	3.5 to 4.9 m	Below 3.5 m
1. *E. camaldulensis*(15441)	1. *A. auriculiformis*	1. *M. lanceolata*
2. *E. camaldulensis*(14847)	2. *A. saligna*	2. *M. halmaturorum*
3. *E. rudis*	3. *T. aphylla*	
4. *E. occidentalis*	4. *C. equisetifolia*	
5. *C. cunninghamiana*	5. *T. arjuna*	
6. *E. microtheca*	6. *A. ampliceps*	
7. *C. glauca*	7. *C. obesa*	
8. *A. salicina*	8. *M. bracteata*	
9. *C. obesa*		

6 cm or above	3.5 to 5.9 cm	Below 3.5 cm
1. *E. camaldulensis*(15441)	1. *C. obesa* (15796)	1. *M. bracteata*
2. *E. camaldulensis*(14847)	2. *A. salicina*	2. *M. lanceolata*
3. *E. rudis*	3. *C. equisetifolia*	3. *M. halmaturorum*
4. *E. occidentalis*	4. *T. aphylla*	
5. *C. cunninghamiana*	5. *C. obesa* (14100)	
6. *E. microtheca*	6. *A. auriculiformis*	
7. *C. glauca*	7. *A. saligna*	
8. *A. ampliceps*	8. *T. arjuna*	

CONCLUSION

In saline areas having pH value upto 8.5 and T.S.C. % below 3.0 with flow irrigation facility, species like *E.camaldulensis, E.rudis, C.cunninghamiana, C.glauca, C.obesa, A.salicina* and *T.aphylla* can be used for afforestation to produce wood and forage.

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