

Full Length Research Paper

Performance of *Casuarina equisetifolia* provenances on a saline site in southern Pakistan

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Survival and growth of 16 provenances of *Casuarina equisetifolia* Forst were compared in a trial established on a saline site near Tandojam, southern Pakistan. The site is located at 25° 26' 0" N / 68° 32' 0" E at latitude of 14 m above sea level in Sindh Province, Pakistan. Survival up to 6 months varied from 56 to 78%. Height growth was generally slow. The performance of provenance 18118 was comparatively better than other provenances. The average fresh weight/plant was about 1 kg/plant.

Key words: Saline site, *Casuarina equisetifolia*, provenances.

INTRODUCTION

Casuarina equisetifolia Forst (beefwood, ironwood, Queensland swamp oak, whistling pine, she-oak) is a rapidly-growing tree which can attain a height of 25 m or more, slender when young but developing a bole to 2 m in girth, straight, somewhat buttressed and fluted at the base. It is native to Australasia, where it is found near the coast, mostly on sandy soils but able to grow well on other soils except under waterlogged conditions.

Casuarinas have become important for the rehabilitation of marginal lands, especially those that are salt affected, and in coastal environment protection (Midgley et al., 1983). They also provide a major source of fuel wood and other wood products. Poles from this species are typically used for house construction, mine props and electricity transmission lines. Interest in planting Casuarinas in desert areas and other arid lands as wind breaks and in wood lots has increased in the last two decades. Precise information on seed collection, handling, storage and viability which affect germination and subsequent growth is needed to fill an existing gap in the available knowledge on Casuarinas (El-Lakany et al., 1990). Over 100 years ago, casuarinas was introduced to Vietnam and India (Kondas, 1983; Chu and Kha, 1996), covering nearly 0.12 million ha in Vietnam (Chu and Kha, 1996; Midgley et al., 1996), 0.3 million ha in coastal areas

of southern China (Zhong and Bai, 1996), 0.8 million ha in India and 3500 ha in Sri Lanka (Midgley et al., 1996).

There is little information available on genotypic variation within *C. equisetifolia* in response to salinity. This study was conducted to evaluate the degree of variation amongst 16 accessions of *C. equisetifolia* in response to soil salinity and fertility.

METHODOLOGY

Site description

The study was conducted at Tandojam, southern Pakistan; the geographical coordinates of which are 25° 26' 0" North, 68° 32' 0" East. The soil was silty clay to clay loam with underground water-table at about two meters, the salt contents varied with a range of ECe between 0 to 30 cm depth (10.5 to 50.5 dS/m) in the upper layer, and 30 to 60cm depth (9.10 to 42.5 dS/m), pH (7.3 to 8.2) and sodium, potassium were dominant cations (Table 1). Rainfall is strongly monsoonal, generally less than 35 mm spread over the months of July and August. During the last decade, the rainfall was generally during alternate years. The areas have long hot summer and mild winter with minimum/maximum temperatures of 26/50°C and 12/30°C for summer and winter, respectively.

Method

Seedlings of *C. equisetifolia* of sixteen (16) provenances (Table 2) of exotic origin were planted in randomized complete block design

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Table 1. Physio-chemical analysis of experimental site at the time of transplantation.

Properties of soil		
Depth	0 -30 cm	30-60 cm
Texture class	Silty clay	Clay loam
Saturation (%)	36.9 - 48.0	38.0 - 55.5
EC _e (dS/m)	10.5 -50.5	9.10 – 42.5
pH	7.5 -8.2	7.3 – 8.0
Na (meq/L)	165.0 - 2890	152.2 - 1695
K (meq/L)	1.41 – 5.0	1.03 – 1.93
Ca+Mg (meq/L)	38.5 - 118	28.75 – 97.5
SAR	14.81 - 376	40.0 – 243.0

Table 2. Geographic localities of *C. equisetifolia* provenances.

CSIRO Seed-lot No.	Provenance name	Latitude	Longitude	Altitude (m)	No. of plants
18008	Darwin, NT, Australia	12° 25' S	130° 50' E	20	11
18267	Yanjing Forest Farm, Guandong, China	23° 00' N	113° 03' E	4	12
18268	Daodong State Forest Farm Hainan, China	19° 58' N	110° 59' E	10	20
18125	Maa' mora, Egypt	31° 20' N	30° 00' E	5	9
18270	Baravi, Viti Levu, Fiji	18° 11' S	177° 35' E	106	10
18121	Mariana Island, Guam	13° 20' N	144° 40' E	2	Na
1803	Kujang, Cuttack, Orissa State, India	20° 12' N	86 38' E	7	10
18118	South Arcot, Tamil Nadu, India	11° 42' N	79° 44' E	40	10
18134	Kenyatta Beach, Kenya	4° 00' N	39° 00' E	10	10
18244	Teluk Lakei, Bako National Park, Sarawak, Malaysia	1° 44' N	110° 30' E	30	4
18153	Ela Beach, Papua New Guinea	9° 05' S	147° 17' E	10	5
18287	Hambantota, Sri Lanka	8° 06' N	81° 07' E	16	Na
18298	Had Chao Mai, Trang, Thailand	7° 33' N	100° 37' E	2	21
18312	Efate Island, Vanuatu	17° 45' S	168° 18' E	30	4
18128	Non Nuoc, Quang Nam-Da Nang, Vietnam	16° 06' N	108° 21' E	2	8
18117	San Joes, Mindoro, Philippines	12° 25' N	121° 03' E	20	10

with four (4) replicates, 25 plants of each provenance at a distance of 2 × 2 m between rows and plants. Dead plants were replaced after 160 days of transplantation/transplanting. Periodical irrigation was applied during the early establishment. Fifty grams (50 g) of mixed fertilizer of single super phosphate and ammonium nitrate in the ratio of 1:3 was applied to each plant. Tree survival was recorded every month up to one year. Tree height was measured every six months up to three years. Above-ground green weight was recorded for each tree at the time of harvest.

RESULTS AND DISCUSSION

Survival of all the provenances of *C. equisetifolia* up to 6 months of transplantation varied from 56 to 78%. After replacement of dead plants with new seedlings, the survival increased with a range of 73 to 99% after 2 months of

replacement (Table 3). It shows that the species can survive in these conditions, but the survival percentage was very low at early stage. This may be due to hot and dry season which badly affect the survival of the species as mentioned by Phi Quang (1996). Among other dicot tree species, the poorest surviving species were melaleuca (*Melaleuca quinquenervia*), Australian pine (*C. equisetifolia*) and black olive (*Bucida buceras*) in Hurricane Charley, as reported by Mariana and Julie (2007).

Plant height recorded at the intervals of six months (Table 3, Figure 1) show that all provenances performed rather poorly. Such types of result are also reported by Zhong and Bai (1996). The performance of provenance No. 18118 was comparatively better than other provenances. Although plants established well, their growth

Table 3. Survival percentage of *Casuarina eqisetifolia* of sixteen (16) provenances at different time intervals.

Provenance No.	Survival percentage			After re-planting
	2 months	3 months	6 months	8 months
18117	85.0	72.0	59.0	95.0
18118	96.8	92.0	73.6	97.0
18121	94.0	92.0	78.4	93.0
18125	97.0	95.0	75.0	98.0
18128	92.0	87.0	78.0	98.0
18134	94.0	89.0	56.0	97.0
18153	93.0	93.0	72.0	96.0
18244	99.0	90.0	67.0	98.0
18267	89.0	80.0	59.0	97.0
18287	96.0	91.0	62.0	95.0
18298	93.6	88.8	59.2	98.0
18312	92.8	88.8	76.8	99.0
18013	95.0	89.0	67.0	94.0
18270	84.0	84.0	65.0	76.0
18268	92.0	74.0	58.0	73.0
18008	96.0	93.3	73.3	78.0

Table 4. Average height (cm) with standard deviation (SD) values for 16 provenances of *C. eqisetifolia* at different time intervals.

Provenance No.	Dec., 95		May, 96		Nov., 96		May, 97		Dec., 97		July, 98	
	8 months		1 year		1½ years		2 years		2½ years		3 years	
	Height	SD	Height	SD	Height	SD	Height	SD	Height	SD	Height	SD
18117	39.9	7.0	44.7	8.2	74.0	14.1	86.7	20.0	127.1	29.6	146.7	36.2
18118	50.2	2.9	56.4	3.8	85.2	5.8	127.4	37.0	183.1	53.0	211.5	61.3
18121	44.3	3.2	46.3	3.4	56.3	4.2	66.5	7.5	78.1	8.8	87.0	9.8
18125	53.0	4.3	57.1	4.6	62.8	5.1	79.8	18.6	96.0	22.4	113.0	26.3
18128	44.4	3.1	46.3	3.4	53.9	3.8	74.8	14.1	106.6	19.9	120.2	22.5
18134	52.3	5.5	54.3	5.7	57.9	6.1	70.0	10.4	83.0	12.5	94.0	14.0
18153	42.4	7.3	47.8	8.1	68.4	11.7	93.7	22.3	104.8	25.0	123.4	29.4
18244	31.9	1.9	36.3	2.3	50.9	3.1	72.1	20.5	104.7	29.7	128.0	36.4
18267	34.7	3.5	37.7	3.6	50.5	5.1	65.1	24.9	94.3	36.2	111.4	42.7
18287	41.6	1.9	43.9	2.3	55.2	2.6	78.3	18.1	109.5	25.4	118.0	27.4
18298	45.5	5.8	51.2	6.6	66.1	8.4	90.4	16.7	122.8	22.8	139.3	25.9
18312	26.1	2.7	29.8	3.1	37.8	4.0	55.8	22.5	73.3	29.7	91.9	37.1
18013	36.0	2.5	39.0	2.6	54.5	4.0	78.9	8.7	110.3	12.2	119.5	13.3
18270	42.3	3.5	46.0	3.9	58.9	5.0	70.3	10.9	84.0	13.0	96.4	14.9
18268	41.1	5.1	42.0	5.2	54.5	6.8	66.8	3.2	73.5	3.5	92.7	4.8
18008	31.0	6.1	34.0	6.7	43.4	8.5	60.0	16.3	71.0	19.3	79.2	21.5

was generally poor. Therefore, the trial was dismantled and plants were harvested. Fresh weight of all the trees was recorded. The average fresh weight/plant was about 1 kg/plant which meant the plant grain was about 1 kg weight in three years (Figure 2). by Mariana and Julie (2007).

Plant height recorded at the intervals of six months (Table 4, Figure 1) show that all provenances performed rather poorly. Such types of result are also reported by Zhong and Bai (1996). The performance of provenance No. 18118 was comparatively better than other provenances. Although plants established well, their growth

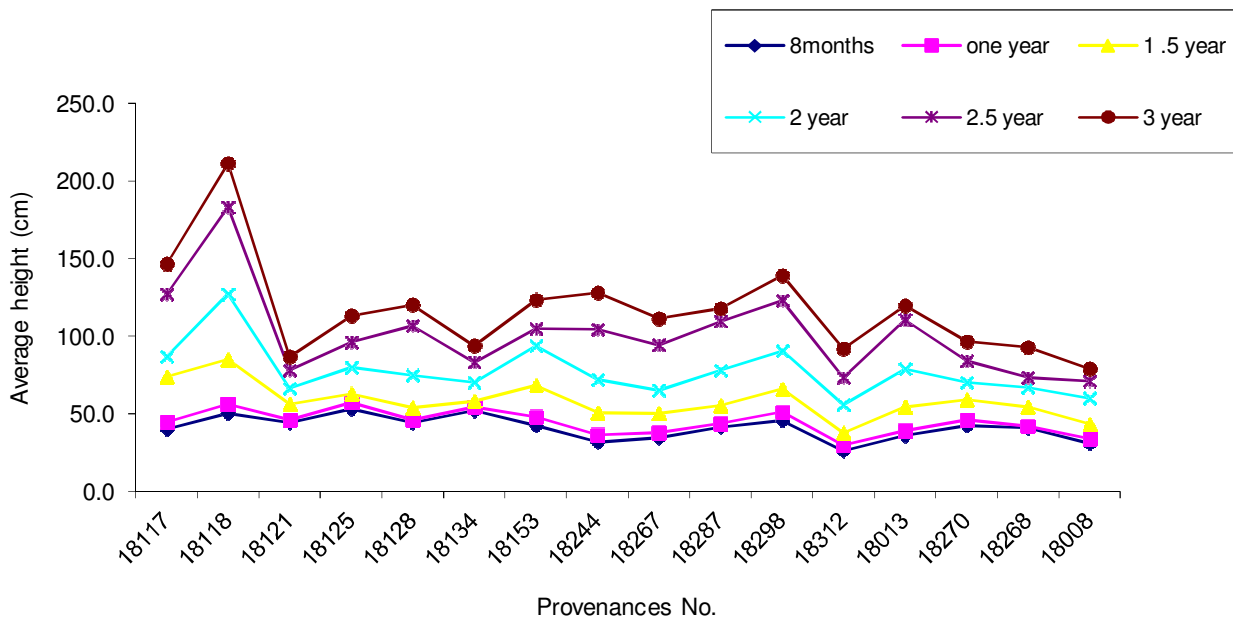


Figure 1. Average height of *Casuarina equisetifolia* of sixteen (16) provenances at different time intervals.

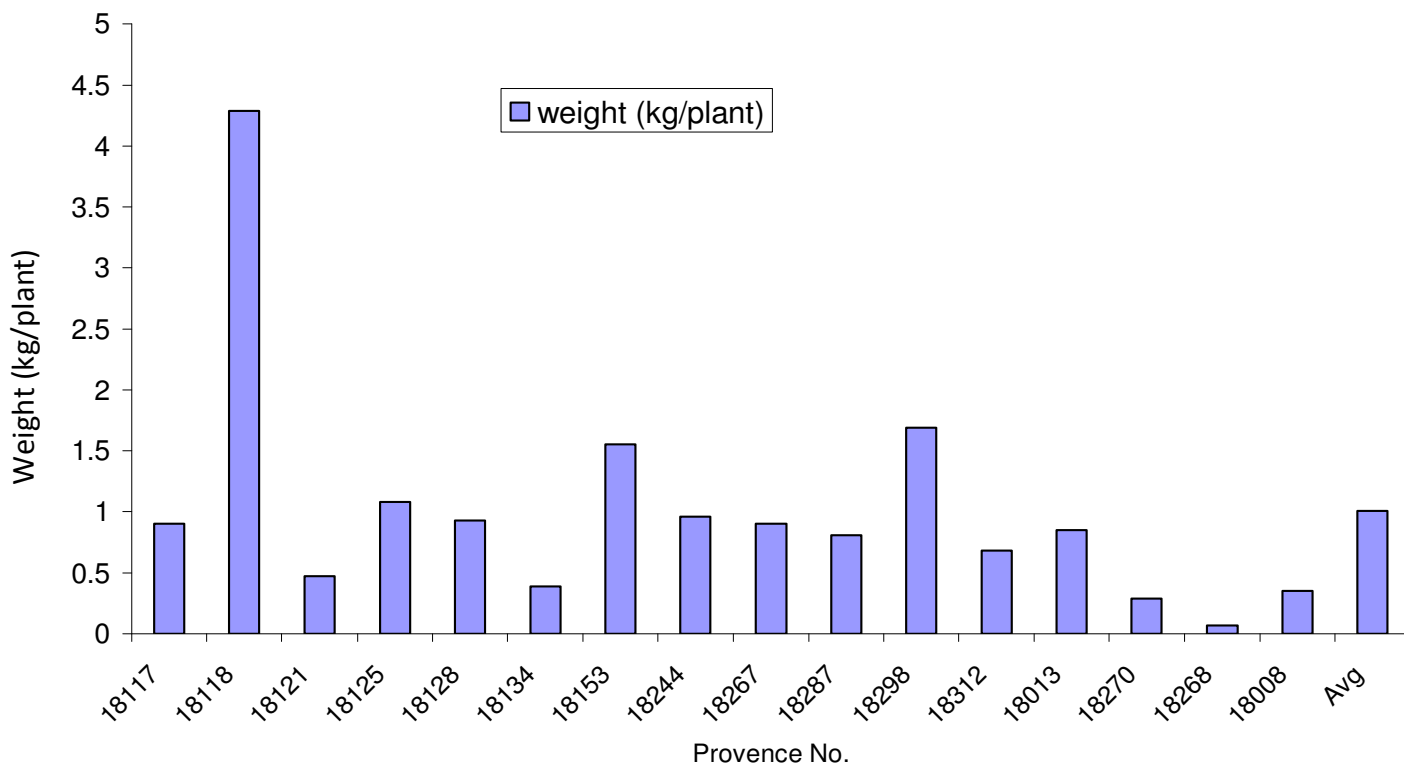


Figure 2. Average plant fresh weight (kg/plant) at the time of harvest after 3 years of transplantation.

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Conclusion

It was concluded from the study that due to hot and dry season, the survival of the species may be badly affected. The growth of the species/provenances of *C. equisetifolia*

tested depends upon the soil and climatic conditions of the site of plantations. In general, the species grow slowly. To confirm these facts, further studies is needed.

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