Journal of Coastal Research	12	4	1006–1008	Fort Lauderdale, Florida	Fall 1996

Direct Seeding of Native Trees and Shrubs in Coastal Environments

Phil Barron and Greg Dalton

Primary Industries (SA)
P.O. Box 752
Murray Bridge, South Australia, 5253, Australia

ABSTRACT

BARRON, P. and DALTON, G., 1996. Direct seeding of native trees and shrubs in coastal environments. *Journal of Coastal Research,* 12(4), 1006–1008. Fort Lauderdale (Florida), ISSN 0749-0208.

Direct seeded trees and shrubs are difficult to establish in semi-arid coastal environments due to the poor moisture holding sandy or calcareous soils and the exposure to extreme winds. This trial assessed different weed control strategies, in terms of width of the spray band and length of the weed control period, to determine the effect of moisture conservation and protection from winds on the establishment of *Acacia sophorae* and *Eucalyptus diversifolia.* The trial was carried out during a much drier than average period, which resulted in very poor establishment of *Eucalyptus diversifolia.* However it was found that *Acacia sophorae* were more drought tolerant than *Eucalyptus diversifolia* and significantly more plants were established when weed control was maintained throughout the first summer. There was no long term benefit for *Acacia sophorae* from a two metre wide weed control strip over a one metre wide strip.

ADDITIONAL INDEX WORDS: *Spray band, coastal trees, semi-arid coastal environment, wind erosion, sand dunes.*

INTRODUCTION

Establishment of trees and shrubs in coastal environments is difficult, because exposure to extreme sand-laden winds damages or kills seedlings. Also, poor moisture-holding sandy or calcareous soils limit the moisture available to seedlings. At the Coorong, South Australia, the winds often exceed 50 km/h, especially in summer. Drifting dry sand can be expected in winds exceeding 20 km/h, which occur four to five days per month from September through March (SA NATIONAL PARKS AND WILDLIFE SERVICE, 1989). The aim of this trial was to improve the reliability of establishing direct seeded native trees and shrubs in a coastal environment, by modifying moisture availability and wind exposure.

METHODS

Trial Site

The trial was located in coastal sand dunes, approximately 100 m from the Coorong, South Australia and 2.5 km from the Southern Ocean (139°17′ E, 35°47′ S). The soil is a uniform sand of greater than two metres deep. The average annual rainfall for Meningie, the nearest historical climatic recording station, is 469 mm (BUREAU OF METEOROLOGY, ADELAIDE).

Treatments

Exposure and soil moisture are both affected by weed control. For example, longer term and wider weed control should conserve more moisture and leave the seedlings more exposed than shorter term and narrower weed control. The optimum period and width of weed control were determined to give the best combination of moisture conservation and wind protection for seedling establishment.

The treatments factorially combined:

(1) Period of Weed Control

Single weed kill. One spray just before sowing, with 1.08 kg ha^{-1} a.i. of glyphosate to determine if a single spray gives sufficient moisture conservation, with wind protection benefits of soil cover from weeds growing later in the season.

Repeat weed kill. Initial spray as above, plus follow-up spray when weeds regenerate (*i.e.* usually 10 to 20 weeks after initial spray), with 1.08 kg ha^{-1} a.i. of glyphosate and the seedlings shielded from spray drift to determine if the growth benefit from a longer period of weed control exceeds the growth reduction due to extra exposure. This is considered to be the control plot for weed control, as this is a normal procedure for weed control in direct seeding (DALTON, 1993).

(2) Width of weed control

Two metre wide strip. A standard width of weed control used to maximise moisture conservation for seedling planting and direct seeding (DALTON, 1993; KNIGHT *et al.,* 1992; CONSTANTINI, 1989). This is considered to be the control plot for weed control, as this is the normal procedure for direct seeding (DALTON, 1993).

One metre wide strip. A narrower width of weed control to reduce exposure of the plants to coastal winds and sand blasting to determine if reduced exposure and moisture conservation give better results for direct seeding establishment than that provided by a 2 m wide band.

94265 received 13 December 1994; accepted in revision 12 November 1995.

Indicator species were *Acacia sophorae* and *Eucalyptus diversifolia* used separately, as indicators for species with large and small seeds respectively. They are indigenous to the site.

The trial was designed as a split-split plot with twelve replicates for an ANOVA to be carried out on the data. Period of weed control was assigned to main-plots, width of weed control to sub-plots, and indicator species to sub-sub-plots. Sub-sub plots (10 × 4 m) gave at least 2 m of weed cover between weed control areas. Sub-plots were 8 m wide, main-plots were 16 m wide, and replicates were 32 m wide.

Seeding Details

A Rodden III direct seeding machine (Primary Industries, SA), sowed seeds in rows of narrow trenches (approximately 15 cm wide × 2.5 cm deep) (DALTON, 1993). Bitumen mulch (Shell AMC OO®) at 0.3 L m^{-2} was sprayed over the trench to stop the seeds from blowing away. The *Acacia sophorae* had a seed viability of 24 plants/g and were direct seeded at 1 g/m. The *Eucalyptus diversifolia* had a seed viability of 55 plants/g and were direct seeded at 0.65 g/m.

The initial weed spray was implemented on the 26.06.1991, with the direct seeding occurring on the 16.07.1991. The repeat spray treatments were implemented on the 11.11.1991. Plant numbers were counted on the 11.11.1991 (pre-summer), to assess germination rates, and again on the 31.03.1992 (post-summer), to assess the post-summer survival of the germinated seedlings.

All operations were delayed by at least six weeks from the optimum time, due to late seasonal opening rains.

RESULTS AND DISCUSSION

In 1991, 352 mm of rain fell at Meningie but only 60.6 mm in September–November, 55.4 mm below average for these months (BUREAU OF METEOROLOGY, ADELAIDE). The drier than average conditions prevailed through summer as well. Only 21 mm of rain fell in December, 1991–February, 1992 (average, 59 mm). The much drier than normal conditions, in conjunction with the deep and sandy free draining soil, created harsh, dry conditions when the plants were establishing.

Wind data for the period of the trial, from a weather station with a similar aspect to the Southern Ocean, was only available from Robe, located over 150 km from the site and not considered to have much relevance to the trial. However, the data showed that Robe received 28 more days with winds over 20 km/h than the average of 76 from September, 1991 to the end of March, 1992 (BUREAU OF METEOROLOGY, MELBOURNE).

Eucalyptus diversifolia

A total of only 22 *Eucalyptus diversifolia* were recorded in the pre-summer assessment for the whole trial (0.46 plants/10 m), giving a heterogeneous variance and making analysis of variance inapplicable. This total is only 0.001% of the viable seed sown, when 2–5% establishment could normally be expected for *Eucalyptus* species (DALTON, 1993). Only one plant was left by the post-summer assessment, probably because of the prevailing dry climatic conditions.

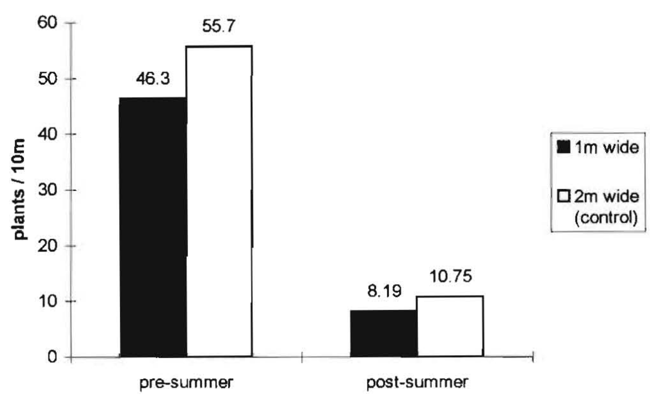

Figure 1. The effect of width of weed control on the numbers of *Acacia sophorae* before and after the first summer. The pre-summer LSD @ 5% = 9.2, F value = 0.047, standard deviation = 15.4 and the coefficient of variation = 30.2%. The post-summer LSD @ 5% = 4.3, F value = 0.221, standard deviation = 5.66 and the coefficient of variation = 59.7%.

Acacia sophorae

A grand mean for the trial of 51 plants/10 m of *Acacia sophorae* was recorded in the pre-summer assessment. This suggests this species is more drought resistant than *Eucalyptus diversifolia,* possibly because of larger seeds and more endosperm enabling them to establish more quickly. However, the drier spring/summer period still has a large impact on the *Acacia sophorae,* with the pre-summer grand mean of 51 plants/10 m decreasing to 9.5 plants/10 m by the post-summer assessment (a drop of 81%). This means that the average percentage survival of viable seeds sown over the whole trial was 4%. The best treatment after summer (see below) yielded a 6% survival of viable seeds. This is a satisfactory result according to CLEMENS (1980) and CURTIS (1991). Their general recommendations for the minimum percentage survival of viable acacia seed in direct seeding is 5%.

The pre-summer assessment showed that a 2 m wide weed control band was 18% significantly better than the 1 m wide band, with an F value of 0.047 (Figure 1). Therefore, the advantages of reduced weed competition just outweigh the effect of reduced exposure before the onset of the first summer in this coastal environment. The difference in weed control width may have been exaggerated because the trial was conducted in such a dry period. There were no significant interactions between weed control lengths and widths. There was no significant difference between a single or repeat spray before the first summer because the repeat spray treatment had been implemented only just before the pre-summer assessment, and could not have had an effect.

The post-summer assessment indicated that a repeat spray was significantly beneficial in improving the establishment of *Acacia sophorae,* with an F value of 0.003 (Figure 2). Therefore, a single weed spray does not adequately control weeds over a long enough period to conserve enough moisture in this environment.

There was no longer any significant difference between the different weed control widths after the first summer, indi-

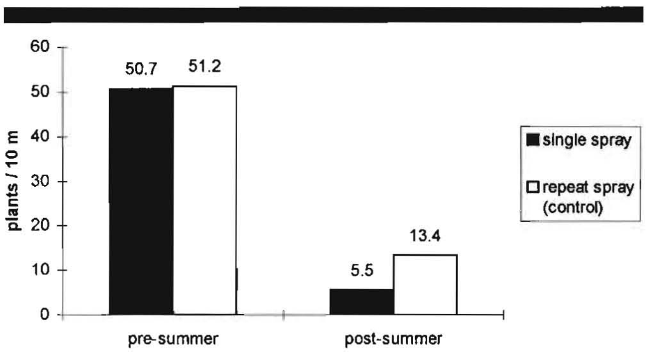

Figure 2. The effect of the period of weed control period on the number of *Acacia sophorae* before and after the first summer. The pre-summer LSD @ 5% = 12.65, F value = 0.927, standard deviation = 14.1 and the coefficient of variation = 27.6%. The post-summer LSD @ 5% = 4.34, F value = 0.003, standard deviation = 3.67 and the coefficient of variation = 38.8%.

cating that, providing there was a follow-up spray, the 2 m wide weed control band (reduced weed competition) has no long-term advantage over the 1 m wide band (reduced exposure). This may mean that the 2 m wide band was leaving the plants too exposed, and/or the 1 m wide band was conserving enough moisture. These results indicate that, with a repeat spray, a 1 m wide weed control band would be satisfactory for long-term plant establishment, and that herbicide costs can be halved.

This is supported by MILLER and DALTON (1992), who found that, providing there was long term weed control, a 1 m wide band gave satisfactory results on a severely exposed ridge receiving an annual rainfall of about 420 mm near Callington, South Australia. However, KNIGHT *et al.* (1993) found that a 2 m wide band was significantly better than a 1 m wide band in the riverland of South Australia. However, the riverland is more arid than the Coorong area and probably requires greater moisture conservation. There is also less exposure to strong winds over 20 km/h (BUREAU OF METEOROLOGY, ADELAIDE).

Because *E. diversifolia* is more sensitive to the drier conditions than *Acacia sophorae* we could assume that, in a year that is closer to the average spring climatic conditions, wider weed control (*i.e.* 2 m) may assume more importance for fine seeded species. Also, the best treatment for large seeded species (*i.e.* a repeat spray) would also benefit fine seeded species.

ACKNOWLEDGEMENTS

The trial site was on a property 10 km SSE of Meningie, South Australia, owned by David Hope.

LITERATURE CITED

S.A. NATIONAL PARKS AND WILDLIFE SERVICE, 1989. *Draft Management Plan for the Coorong National Park.* Adelaide, South Australia: SANPWS.

CLEMENS, J., 1980. Direct seeding of native woody plants. *Landscape Australia,* 4 (80), 279–284.

CONSTANTINI, A., 1989. Definition of planting zone for weed management during the establishment of *Araucaria cunninghamii* plantations. *Forest Ecology & Management,* 29, 15–27.

CURTIS, D., 1991. *Direct seeding on the northern tablelands of NSW.* Greening Australia, Sydney, NSW.

DALTON, G.S., 1993. *Direct seeding of trees and shrubs: A manual for Australian conditions.* Adelaide, South Australia: Primary Industries (SA).

KNIGHT, A.; DALTON, G.S., and MILLER, L.R., 1992. Arid zone direct seeding. *State Flora, Primary Industries (SA) Research Trial HT20.* Unpublished report.

MILLER, L.R. and DALTON, G.S., 1992. Oxyfluorfen for weed control when direct-seeding with native plants. *State Flora, Primary Industries (SA) Research Trial HT15.* Unpublished report.