PROPAGATION OF AUSTRALIAN NATIVE GRASSES

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The climate and soils of much of the inland region of Australia make maintenance of grassland to European standards prohibitively expensive. Maintenance conscious planners have therefore welcomed the growing public acceptance of landscapes with the yellow, red and brown tints that are characteristic of many Australian grasslands. Native grasses are now being considered for use in a variety of landscape situations. but particularly on low-wear sites such as roadside verges and medians, nature trails and dryland reserves. It is expected that the adaptation to drought and low fertility soils of native grasses will greatly improve their establishment and stability on such areas in comparison with most exotic grasses (6,7).

Basic investigation into techniques of native grass establishment was required before these could be considered as a substitute for exotic grasses. Methods have been developed for propagation from seed of four native grasses: the warm-season grasses, *Themeda australis* (Kangaroo grass), and *Bothriochloa macra* (Redleg grass), and the cool-season grasses, *Stipa begeniculata* (Tall Spear grass) and *Danthonia* spp. (short Wallaby grasses).

SEED GERMINATION AND SEEDLING ESTABLISHMENT

Seed. Freshly harvested seed of all four species is dormant due to the presence of germination inhibitors in the husks and/or the seed itself (2). This dormancy was overcome by normal storage for either 4 months for *Bothriochloa* and *Danthonia* or 6-11 months for *Themada* and *Stipa*. However, storage at higher temperatures, such as in an uncontrolled glasshouse during summer, resulted in loss of dormancy of all species after only 1-2 months.

Some modification of the seed material was necessary for mechanical sowing to allow the seed to flow freely and evenly through the sowing machine. Husks should be removed from *Danthonia* seeds whereas only the awns and hairs need be removed from *Themeda*, *Bothriochloa* and *Stipa*. Removal of the husks from these latter species results in excessive damage to the seed.

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GERMINATION

The two most important factors affecting germination are temperature and moisture (3,4).

Laboratory and field tests have shown that seeds of *Themeda* and *Bothriochloa* will not germinate until the daily maximum soil temperature is about 25°C. The greatest field germination of both species was recorded in November at Canberra.

On the other hand germination of *Stipa* and *Danthonia* seeds was less affected by temperature and, in the field, optimum seed germination of both species was recorded in March and April.

Seed germination of all four species was decreased by increasing moisture stress. *Stipa* was least affected while seed germination of *Themeda* was markedly reduced by even mild moisture stresses. This indicates a need for mulching and/or irrigation during the establishment phase.

FIELD ESTABLISHMENT FROM SEED

Small scale seed sowings have been made to determine the effects on establishment of seeding rates, fertilizer rates and herbicides (5). Preliminary results indicate that suitable seedling rates are 20-50 Kg/ha and 100 Kg/ha for *Stipa*. These rates are equivalent to 1000 germinable seeds/m^2 which is an average sowing rate of exotic grasses such as rye.

In general, the application of up to 150 Kg/ha of N:P:K (10-4-6) fertilizer had little effect on the number of established seedlings or their survival over the first summer.

Application of a paper or straw mulch at the rate of 3,200 Kg/ha increased the number of established seedlings of all species and while bitumen (12,000 l/ha) had the same effect on *Danthonia* and *Themeda* it markedly reduced the establishment of *Bothriochloa* and *Stipa*. The beneficial effect of the mulching was due to improved soil moisture retention on the mulched plots.

After six months under mulches there was little or no difference between plant survival under paper and straw mulches and no mulching. With the exception of *Stipa*, survival under the bitumen was lower than under any of the other treatments.

The application of either Diuron (4 Kg/ha or DCPA (6 Kg/ha) controlled weeds during establishment periods. DCPA was toxic to *Danthonia* and *Stipa* but had no effect on the emergence of *Themeda* and *Bothriochloa* seedlings. Diuron was toxic to seedlings of the four native grasses. However the application of activated carbon as a band or a seed pellet overcame the toxic effects of both herbicides.

One major problem remains, however, with seed propagation. This is the difficulty in obtaining sufficient quantities of viable seed for wide-scale sowing, as all the species mentioned above produce only low quantities of seed which are difficult to harvest by commercial methods.

Vegetative propagation is practiced on a number of exotic grasses where seeding techniques are not satisfactory. Such grasses are usually stoloniferous and include couch grasses (*Cynodon dactylon*), buffalo grass (*Stenotaphrum secondatum*), Kikuyu grass (*Pennisetum clandestinum*), bent grass (*Agrostis canina* and *A. gigantea*) and marram grass (*Ammophila arenaria*). Bunch grasses, such as *Eragrostis curvula* (Love grass) where rootstocks can be easily divided into sections, are also suitable for vegetative propagation. It was felt that the same procedures could be used for native grasses, particularly *Themeda australis*, as an alternative and complementary method to seed propagation.

Themeda australis is a tufted perennial grass with an erect growth habit and with chunky seed heads on flowering stalks of approximately 1 metre high (Fig. 1). It is widely distributed throughout most of Australia from tropical regions to Tasmania. The species shows considerable variation in form and colour with season and ecotype. In the A.C.T. the leaves are usually green in spring and summer, purple-green in autumn and red-brown in winter. It is a summer grass that is frost susceptible (1). Some winter growth has been observed in mild seasons.

Figure 1. *Themeda australis*.

Themeda australis is palatable to stock in early summer but it rapidly disappears under continual grazing, especially by sheep. With fertilizer treatment it is outgrown and eliminated by exotic pasture and weed species. It is most commonly seen on non-grazed areas such as roadside verges and railway reserves, where it regenerates quite vigorously if undisturbed.

VEGETATIVE PROPAGATION

Research has been conducted to develop a practical technique for establishment of *Themeda australis* with vegetative propagules. The trials compared the survival, growth, and development of various sized propagules and compared hand planting and mechanical planting techniques.

Stock plants were obtained from local grasslands. The plants were mattocked from the site with at least 50% of the root system intact. Lifting and replanting was carried out in September and replanting was within 2 days of lifting.

For the hand-planted trial the plants were divided into the following four size classes of tussock basal area; 45 mm^2, 70 mm^2, 95 mm^2, 190 mm^2.These classes were further divided into two sub-classes of tussock height growth removed to 100 mm, and tussock left intact.

The planting area was a typical Canberra clay-loam which was rotary hoed before planting. No fertilizer was applied and the only irrigation was a watering directly after planting.

In the hand-planted trial the size classes were arranged in randomized plots, with 10 plants per plot at 0.5 metre centres. There were three replications, that is, a total of 24 plots.

For the machine-planted trial propagules were of one size only, 70 mm^2 with tussock height clipped to 100 mm. Planting was at 0.5 metre centres, using an un-modified Smallford vegetable and nursery stock planter, in a single block of 1000 plants.

Weed control was achieved by manual means. The hand-planted trial required more weeding, particularly where survival was poor, than the machine planted trial. Hand planting required three weedings for the first year, compared to two weedings for machine planting.

Results of observations for two years are shown in Table 1 for the hand planted trial and in Table 2 for the machine planted trial.

Significant increases in survival and in flower stems per plant are obvious in plants with tussock cut back at planting. However, this same treatment appears to lead to a smaller plant after two years.

The larger propagules clearly had the highest survival rate and resulted in larger plants after two years. However the smaller-sized classes actually grew at a faster rate than the larger sizes and produced more flower stems per plant, particularly where the tussock had been cut back.

Machine planting resulted in almost identical survival, and

Table 1. Survival and growth responses of a range of sizes of vegetative propagules of *Themeda australis* planted by hand in September 1974.

Sizes Square (mm)	Treatment	Sept. 1975 Percent Survival	Sept. 1976 Percent Survival	Sept. 1976 Plant Size Square (mm)	Jan. 1975 Percent Plants Producing Flower Stalks	Jan. 1975 Mean Flower Stalks Per Plant	Jan. 1976 Percent Plants Producing Flower Stalks	Jan. 1976 Mean Flower Stalks Per Plant
47	Tops intact	25.0	27.6*	194	2.5	2.0	83.3	16.1
47	Tops removed	50.0	52.5	188	40.0	2.4	80.9	32.2
70	Tops intact	52.5	50.0	186	14.3	2.2	85.0	14.8
70	Tops removed	57.5	60.0	193	43.5	4.1	100	31.4
94	Tops intact	32.5	37.5	240	2.5	3.0	92.9	10.3
94	Tops removed	72.5	72.5	191	75.9	5.4	100	27.5
188	Tops intact	55.0	62.5	260	54.5	6.6	66.6	7.7
188	Tops removed	77.5	82.5	210	45.2	5.7	83.3	21.7

* Plants that appeared to be dead rejuvenated the following year.

Table 2. Survival and growth responses of machine-planted vegetative propagules of *Themeda australis*. Propagules were 70 mm^2 and were planted September 1974.

September 1975 Percent Survival	September 1976 Percent Survival	January 1975 Percent of plants producing flower stalks	January 1975 Mean flower stalk per plant	January 1976 Percent of plants producing flower stalks	January 1976 Mean flower stalk per plant	September 1976 Mean plant size square (mm)
61.0	61.8*	64.2	3.5	91.6	23.3	163.4

* Plants that appeared to be dead rejuvenated the following year.

similar growth and development as the equivalent hand planted propagules.

These results, although preliminary, do indicate that *Themeda australis* can be successfully propagated by vegetative means. In particular it would seem that the slight advantage in survival by using larger propagules would be outweighed by the ease of planting and the increased material available by using smaller propagules. Also the greater vigor and greater seed production from the smaller propagules after two years suggests that these are more likely to eventually produce better establishment.

Clearly, cutting back the tussock is a beneficial treatment with all size classes and machine planting seems to be a feasible method of establishment on a larger area.

While vegetative propagation appears satisfactory for small to medium size areas, or areas where immediate cover is essential, it seems unlikely that the technique could compare favorably with seed as a means of establishment on a wide scale.

Further research is required before this technique of vegetative propagation could be widely recommended. Seedling regeneration has commenced within the planted pots and this should be observed as a potential means of enrichment of an area with *Themeda australis*. Chemical weed control is being investigated as a management tool, as well as routine mowing. As use of Themeda increases no doubt other areas of investigation will become apparent.

CONCLUSIONS

It may be concluded that both the vegetative propagation of tussock grass as *Themeda australis* and the sowing of seed of a range of native grasses have potential for wide-scale application in landscaping. Some problems remain of which the non-availability of native grass seed on the commercial market is one of the more important. So too is the long term management of native grasslands when they are established for amenity purposes, especially in relation to mowing regimes. Some research is in progress on this aspect.

The ready acceptance of indigenous trees and shrubs by Australian landscapers should be extended to native grasses once these problems are overcome.

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