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The key ingredients in the successful broad-scale sowing of native grasses

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Abstract

Whilst many successful projects have been completed to revegetate with native grasses, mostly these have been undertaken on a scale of less than 0.5 ha. Often the work has involved the use of grasses grown in nurseries being transplanted into the field and being closely maintained until fully established. Direct seeding of native grasses has not been widely practiced for a number of reasons, including seed availability and price. Additional to these two concerns there also remains a lack of confidence that direct seeding of native grasses can be successfully accomplished for areas larger 0.5 ha and that the costs of attempting to do so would be beyond the capacity of most individuals or authorities.

Recent developments by a number of groups are starting to provide confidence and results are being obtained that should encourage people keen to take advantage of the beneficial attributes of the native grasses. Emerging positive results with the use of cover crops to protect seedlings of wallaby grass and weeping grass, improved knowledge of seedling herbicide tolerances, more knowledge of likely seedling problems with pests and the use of seed pelletising have introduced greater degrees of confidence in successful results. At the same time, the expectations of consumers of a rapid coverage and of no additional work after the date of sowing need to be moderated. Recent successes will be elaborated and all have combined the new technology with a realistic expectation of the requirements post-sowing.

Keywords:
Native grasses, sowing, field sowing

Introduction

Revegetation with understorey species is gaining prominence as revegetation practitioners come to understand that revegetation does not only mean "plant trees" if the aim is to provide a biodiverse ecosystem with a large species richness. In many cases trees are only the climax species and would not represent one hundredth of the total number of plants in a given area of a natural environment (Prober et al. 2002 a & b). Restoring the full range of native vegetation onto degraded sites is a desired outcome of much restoration work and increasingly this includes the use of native grasses as part of the understorey.

Authors discussing the rehabilitation after mining and the provision of grasses for low-use amenity conditions have recommended the use of native grasses for their ecological and adaptive advantages (Wilson, 1996). Native grasses provide much of the herbage for grazing animals through very large areas of Australia and their reintroduction is often recommended for this purpose (Lodge and Groves, 1991; Robinson et al. 1993; Jones, 1996). Another revegetation goal, being the provision of perennial groundcover to mitigate the build-up of dryland salinity, has stressed the beneficial effects of using native grasses (Johnston et al. 1999). Thus there is considerable academic and practitioner interest in including native grasses in the mix of species to be introduced (or in many cases reintroduced) to the target site.

Despite this considerable interest there has been very little area that has been rehabilitated using native grasses. The main limiting factors have often been the availability of a reliable supply of high quality seed (Waters et al. 1997). The next most common limiting factor has been the lack of confidence by applicators in the satisfactory outcome of revegetating with native grass seed. This lack of confidence has often been the result of unsatisfactory attempts to establish native grasses from seed. For this reason many revegetation projects completed to date have utilised tubestock of native grasses individually planted, often accompanied by a mulch layer to suppress weeds. This is an extremely expensive method and usually cannot be carried out on a much broader basis than 0.5 ha at any one time.

The volume of high quality seed reaching the market is now increasing rapidly and is sufficient to meet most revegetation needs. This seed is usually tested for purity and germination and hence practitioners can have knowledge of the quality of the seed and its ability to germinate if provided with the correct conditions. The question of confidence in obtaining desired results in field conditions remains the sticking point for many practitioners.

This paper considers some recent changes that are improving success in the field. Included in these are developments in seed technology, the use of cover crops and importantly a changing expectation in consumers of the time scales that are appropriate for successful revegetation with native grasses.

Changing soil preparation considerations

The attitude has often been along the lines that "since native grasses are native, they should be able to establish on whatever soil we provide under whatever conditions they encounter". This has often led to sowing being carried out onto tightly compacted soils or onto areas without any prior weed control or in inappropriate times of year, or worse still, all of those combined.

There is growing realisation that whilst these plants are extremely tough and hardy when established, they will not germinate and establish except under suitable conditions. Especially important in defining what are suitable conditions is knowledge of the desired soil conditions.

Soil preparation

Many soils in our agricultural landscapes have been artificially compacted by grazing by hard-footed animals or cultivation that has reduced soil organic matter. In our degraded landscapes heavy machinery may have travelled over the soils and/or they may have been devoid of vegetation for some years and be extremely low in organic matter. As a result many of the soil to be revegetated have very high bulk density, low rates of infiltration and are crusted, providing a challenging environment for the germinating seed. Disturbance in some fashion is necessary to provide suitable microsites, or ecological niches, for germination in such soils (Cole and Chivers, 2005). Without such disturbance the chance of a successful establishment from seed is extremely low. Applicators should think of the conditions that they would provide for tube stock plants and attempt to replicate that for native grass seeds. In this fashion, tubestock would not be planted into compacted soil or without some form of soil amendment to improve organic content and porosity. Practitioners should think along similar lines when considering the soil preparation requirements for sowing seed of native grasses.

Weed control.

The control of annual and perennial weeds of all kinds also forms part of the soil preparation process as competition from exotic weed seeds will substantially hinder both the germination and establishment of native grass seedlings. The control of weeds prior to sowing the natives should commence early enough to reduce the weed seed burden of the soil. This does not necessarily mean spraying or cultivating for an indefinite period prior to sowing the grass seeds as strategic timing of weed control operations can permit the germination and growth of the weeds, but prevent those plants from producing viable seed. For the success of any sowing program some consideration must be given to moderating competition from other plant species. Where site fertility is low, especially low nitrogen (N), minimal disturbance other than that associated with sowing may be needed to suppress weed species. At higher N or on high rainfall sites considerable effort may be needed to break annual cycles of nutrient release that favour annual species (Prober et al. 2002a). Selective herbicide options may need to be included, as could selectively mowing off the seedheads of the weedy plants as they ripen.

Soil fertility.

Native grasses tend to be more competitive in low N fertility soils (Prober et al.2002a). Hence, establishment of native grasses on low-quality soils has generally been successful. Similarly, sites that have had one or two seasons of weed control prior to sowing have always given better results than where control has been just prior to sowing.

Seed sowing.
The means of sowing of the native grasses has often been over-emphasised as early attempts of encountered problems with seeding and it was considered a "show-stopper". Over the last two to three years several changes have occurred, firstly seed with fewer stems and so on is now available, secondly, more equipment is available for hire or loan that is capable of sowing fluffy or chaffy seeds, and thirdly, new seed treatments are available that permit easy sowing of chaffy seeds (more on that below).

Timing of sowing.
Field establishment studies have shown the importance of soil moisture in achieving good emergence and establishment. This emphasises the need to sow only when periods of high soil moisture are guaranteed for some weeks after sowing.

Generally for the cool season grasses our experience is that they require a period of constant moisture for three weeks after sowing to see a high emergence rate. Our experience is that for the slower establishing grasses such as wallaby and weeping grass, that a very large "patience pill" be taken when sowing as they take quite some time to become significant plants.

For the warm season grasses they are well adapted to more intermittent rainfall and a wet-dry cycle. For example it is felt that the best way to establish Curly Mitchell grass (*Astrebla lappacea*) is to watch the weather forecasts and to sow when the temperature is high and immediately before a substantial rain front (Waters, 2003).

Sowing depth.
For virtually all species sown so far, the best results have occurred where the seed is placed in the soil to a depth that permits soil moisture to remain around the seed for some weeks after sowing. Usually this means a depth of 10 to 15 mm below the soil surface, but it may be deeper on the self-mulching soils.

Use of Cover Crops
Some field work by Toll (2005) suggests that for *Austrodanthonia* at least there is a capacity to protect the seedlings through the use of a cover crop such as a common cereal. The cereal crop seems to act to control spreading weeds and to provide some shelter for the emerging seedlings. In the work of Toll, *Austrodanthonia caespitosa* and *Microlaena stipoides* were sown along with common cereals in unirrigated conditions in autumn 2004 at Echuca. Those seeds sown within the rows of cereal established poorly and had very few numbers at the end of the experimental period. In contrast, weeping grass sown between the rows of cereals established well and was in substantial numbers by the harvest time for the cereal (Figure 1). Similar results were obtained for wallaby grass (Figure 2).

Figure 1. The average number of weeping grass (*Microlaena stipoides*) plants growing at the end of the season under varying rates of cover crop when sown within and between crop rows. (Plots were 1 sq.m.)

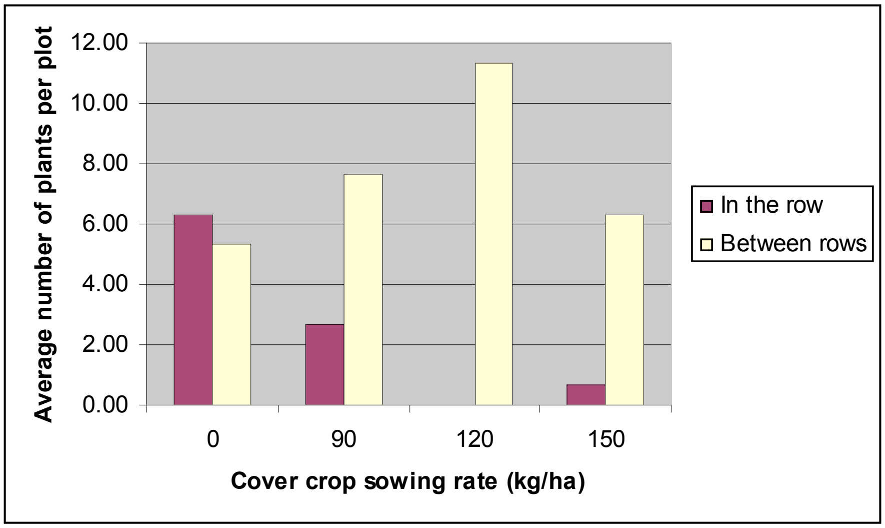
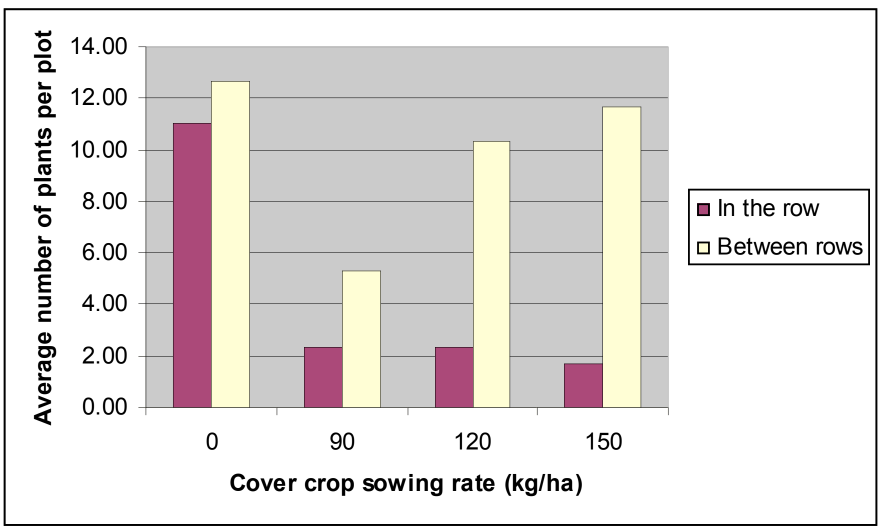


Figure 2. The average number of wallaby grass (*Austrodanthonia caespitosa*) plants growing at the end of the season under varying rates of cover crop when sown within and between crop rows. (Plots were 1 sq.m.)



Significant differences were found in each grass type for sowing between the rows (weeping grass at $P \leq 0.01$, wallaby grass at $P \leq 0.1$) but not for the rate of cover crop sowing. There were no significant interactions.

The competition for moisture between the cereal crop and the emerging seedlings seemed to be the limiting factor at other sites, where moisture through the growing season was very limited. These sites had very low establishment rates for both of the native grasses. The approach of using cover crops is probably going to be best served by using lower rates of cover crop to reduce the moisture competition.

The general rules are now quite well understood.
Prepare the soil so that many niches or microsites are available for the seed.

Sow high quality seed of known germination standards.
Control weeds prior to sowing and ideally for some seasons prior to sowing.
Sow at a time when rainfall or soil moisture conditions are predictable (and usually high)
Sow the seed below the soil surface or at least have it roughed into the top of the soil.
Sow with a cover crop to help control weeds, retain soil and provide a short term vegetative cover.

Changing seed technology
Of very recent times some technologies previously applied to vegetable seeds and to some exotic grasses (Anon, 2006) to pelletise the seed of native grasses. The ensuing product is much larger than the original seed and substantially heavier. It is able to be sown through conventional equipment, thus eliminating one of the limitations to the use of these grasses on a broad-scale basis.

The seeds retain the fluffy appendages and simply wrap it up with an inert binder to create a pellet. This procedure has led to increased germination rates both in the laboratory and in the field.

Future developments in the area of seed pelletising are likely to include a range of additives that will also aid the establishment of the grasses. Inclusions such as insecticides to prevent predation by red-legged earth mites, fungicides to control seedling diseases and beneficial fungi to promote growth are being assessed for their effect on establishment. Experience with exotic grasses suggests that these additives will greatly benefit the establishment rate of the sown grass.

Changing consumer attitude
Potential users of native grass seeds are becoming more aware of the need to accept that these grasses are no different to many of the exotic grasses in either their sowing requirements or the care required to have them fully established. The earlier attitude of “they will grow anywhere” still occurs but is less prevalent.

We are finding more understanding from our clients and more preparedness to undertake the works required to properly prepare the soil, to control the weeds and to allow sowing at the correct time of year. This is providing far higher success rates for our projects.

Conclusion

The desire by many people, from a broad range of perspectives, to establish native grasses on a broader scale is now able to be achieved. This has not always been the case and poor results have occurred in the past due to low quality seeds and a scant understanding of the requirements for a successful result.

Experience of the last few years has provided solutions to many of the reasons for previous failures and greater confidence can be felt by practitioners for sowing of large areas with native grass seed.

Part of the improvement also comes with a realisation from consumers that they need to be patient and to hold a view of the long-term when commencing projects that include these grasses.

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