

WATERCOURSE REVEGETATION - JUST A WALK IN THE PARK!

Jim Burston¹ and Wayne Brown²

ABSTRACT:

The art of revegetation is generally poorly understood by river managers. All too often, revegetation is done using the outdated, expensive, labour intensive technique of tubestock planting. If we are to revegetate the vast lengths of watercourse across Australia, then a new approach is needed. The answer is direct seeding. The technique was first used more than 100 years ago. It is now the primary method of broad-acre revegetation in South Australia. Its application to watercourses is limited only by the conservative approach of river managers.

1.0 INTRODUCTION

Ask river engineers or river managers about grade control and other erosion control structures, and they are more than likely to tell you that the main function of such structures is to provide an opportunity for vegetation to re-establish (Ian Drummond and Associates 1993). It is generally accepted among most river managers that vegetation is the best long term approach for erosion control. For smaller watercourses, erosion problems can be addressed directly through revegetation and natural regeneration, without the use of any structural works. In South Australia, this refers to watercourses of magnitude 5th order or lower (as defined by the Strahler method, from 1:50,000 map sheets, see Good & Burston, this volume).

Unfortunately, the method by which most people revegetate watercourses is decidedly primitive. Since the mid 1980s there have been great advances made in broad-acre revegetation. They appear to have passed by most of our river managers, who are well versed in the geomorphological and engineering aspects of the business, yet in a time warp when it comes to revegetation. We all hear talk of the great benefits of riparian revegetation, but in south-eastern Australia, little appears to be happening "on the ground". This is surprising, given how easy it is to revegetate watercourses.

It is disappointing to find that the use of willows (*Salix* spp) is still being promoted, both in Australia (Ian Drummond and Associates 1993, p. 57-58) and

in New Zealand (Collier *et al.* 1995). This is despite the fact that the willows have created major management problems for some river managers in south-eastern Australia. Some authors have made the suggestion that once willows have stabilised the site, the landholder can then remove them (eg. Standing Committee on Rivers and Waterways VIC., 1991). Such a suggestion demonstrates a failure to understand the character of landholders. Furthermore, we believe that it reflects a lack of knowledge of the growth potential of native plants and the efficacy of direct seeding and natural regeneration.

Where revegetation is occurring, it is usually done using an outdated technique - tubestock (Ian Drummond and Associates 1993). This expensive, labour intensive form of revegetation is arguably one of the major factors constraining the rate of watercourse revegetation. Ian Drummond and Associates (1993, p58) quote a figure of \$11,200 per km of watercourse (figure includes materials, labour and planting - for both banks). This has surely to be a printing error!! Any funding application to the National Landcare Program, quoting such a figure for revegetation, would be rejected in an instant. If we are to seriously address the issue of revegetating our watercourses, then there will have to be a quantum leap in the rate and extent of revegetation. The solution (developed more than 100 years ago - R. Jamieson pers comm) has been used for broad-acre revegetation for nearly a decade. The solution is direct seeding.

2.0 DIRECT SEEDING IN SOUTH AUSTRALIA

South Australia undoubtedly leads the nation in broad-acre revegetation of agricultural lands. This is due, in part, to the extension programs run by the Department of Environment and Natural Resources (then Department of Environment and Planning - see Prescott and Bishop 1990), Primary Industries (SA) (the then Department of Agriculture), Trees for Life and Greening Australia (SA Inc.). As a result there has been a major shift in the attitudes of landholders toward broad-acre revegetation.

¹ Mount Lofty Ranges Catchment Program, Department of Environment and Natural Resources (Water Resources Group), 2/85 Mt. Barker Rd, STIRLING S.A. 5152 Phone: (08) 339 7111 Fax: (08) 339 7112

² Mount Lofty Ranges Catchment Program Primary Industries (SA)

5c Cameron Road, Mt Barker SA 5152 Phone: (08) 391 7500 Fax: (08) 391 7524

Revegetation is now taken for granted as a major component within Primary Industries (SA) Property Management Planning programs. The success of direct seeding in South Australia is due to the fact that it is farmer-driven. The basic direct seeding machinery has changed little since the mid 1980s, but it was not until 1989 that Primary Industries (SA) and Greening Australia (SA Inc.) adopted an extension programme to take direct seeding to landholders. In 1995, more than 200 linear kilometres of direct seeding (equivalent to 50 km of watercourse - both banks) was undertaken in the Mount Lofty Ranges alone.

A comparison with revegetation activities in other states is intriguing. It is ironic that community groups in NSW and Qld can apply for tree planting grants under the One Billion Trees program, yet at the same time, large tracts of native scrub are still being cleared. In South Australia, broad-acre clearance of native vegetation has been effectively prohibited since 1985 with the introduction of the Native Vegetation Management Act. Because broad-acre clearing is still permitted in these states, landholders (and peak farming bodies) in these states have not seriously entertained the notion of broad-acre revegetation and therefore direct seeding. Watercourse revegetation will not take off until there is a fundamental shift in the attitudes of both landholders and government agencies.

3.0 DIRECT SEEDING: THE BASIC STEPS.

The factors for success in direct seeding are:

- site preparation,
- time of sowing,
- seed viability / species selection, and
- maintenance of the site.

The broad principles of direct seeding have been the topic of a number of books (Dalton 1993, Venning 1988), a national conference (Greening Australia Ltd 1990) and other extension material

3.1 Site Preparation

Undoubtedly the most important factor in a successful revegetation program is weed control (both herbaceous and woody). The vast majority of revegetation projects fail due to poor weed control. Good weed control starts with understanding the weed spectrum at your revegetation site. Depending upon the weed spectrum (eg. couch, kikuyu, phalaris, cocksfoot, gorse, blackberry) weed control may need to be initiated up to 24 months prior to sowing. This is particularly important if the weed spectrum includes aggressive summer growing plants. Good weed control means a complete kill of all weeds. Weed control ensures adequate soil

moisture for plants to grow through the summer months. The experience from hundreds of revegetation sites across South Australia is that unless weed control is excellent, direct seeding will fail. In fact, if you don't control your weeds, don't bother with direct seeding.

Control of most herbaceous weeds is generally achieved through the application of a knockdown herbicide (eg. glyphosate 360g/L, @ 1-2 L per Ha). For best results, two applications should be used: the first application at one - two months prior to sowing, followed by a second application one week prior to sowing. Some broadleaf weeds (eg. strawberry clover, prickly lettuce, wire-weed), can be controlled with herbicides such as MCPA®, DiCamba®, Ally®. Extreme care should be taken to ensure that no herbicide enters the water body.

Some practitioners (R. Bird, pers comm) have encouraged the use of residual herbicides to achieve satisfactory weed control. However, unless the soils to which these herbicides are applied have a high clay content, there is a risk of herbicide leaching into the zone where the seeds have been laid.

For best growth, it is desirable to remove weed competition for a distance of 1.5m from the seedlings. This will ensure the seedlings have access to sufficient soil moisture and nutrients. Good weed control will render fertiliser application unnecessary.

Weed control with herbicides generally takes the form of blanket, strip or spot spraying. When revegetating watercourses, it is desirable to allow weeds to grow to a height of approximately 150 mm prior to spraying. As the weeds die, they will form a mulch and protect the soil from erosion (but not necessarily flood events). Sowing in Spring will also lessen the chance of the site being damaged by a major flood event (ie risk management). On steeper slopes, or where access may be difficult, strip or spot spraying are appropriate.

There are two other methods of weed control - grading and cultivation. Both techniques have serious pitfalls - they physically remove the seed bank that is stored in the top few centimetres of the soil profile, exposing the site to erosion in heavy rainfall events, and may change the weed spectrum. Many hard-coated seeds can survive in the soil for many years (eg seeds of *Acacia* spp - up to 120 years). Any potential for natural regeneration from the seed bank to compliment the direct seeding is lost if site preparation involves grading or cultivation.

3.2 Seed Treatment / Seed Viability / Seeding Rates

Many individuals tend to be obsessed with seeding rates and have devised all sorts of formulae to determine the "correct" seeding rate. It is the view that much of this concern is unwarranted. The most important factor is to ensure that there is an adequate floristic (ie wattles, banksias, bottle-brushes, gum trees, tea-trees, etc) and structural diversity (ie. trees, shrubs, grasses) within the seed mix. The approach to revegetation in South Australia has been to encourage and develop the seed collecting skills of landholders. Germination tests are unnecessary if emphasis is placed on collecting fertile seed - which is an easy task. You don't need a Ph.D to collect native seed.

Most hard-coated seeds (eg. *Acacia* spp) will require some form of treatment (ie. scarification) prior to sowing. The easiest method is to place the seeds in very hot water for a short length of time, for further details see Bonney (no date). This can be done a few days prior to sowing.

3.2 Sow At The Right Time

Sowing should be timed to coincide with optimal soil moisture and soil temperature. In southern Australia, where sites receive rainfall of >450 mm pa., the optimal time is Spring (ie. August - October, depending upon average annual rainfall). In fact, direct seeding is arguably more successful in years of slightly below average annual rainfall - due to less opportunity for weed growth.

3.3 Methods of Direct Seeding

The depth to which seeds are sown will have a major bearing on the success of direct seeding. It is important that seed has good contact with the soil. Ideal burial depth can vary according to the amount of light required by the seed. A general rule of thumb is to sow seed at a depth that is twice its diameter (Dalton 1993).

Most direct seeding is done using machines that resemble up-market "1080" rabbit bait layers. But this is central to the widespread adoption of direct seeding in South Australia - a simple, "farmer friendly" technology.

All direct seeding machinery currently used in South Australia perform the following tasks:

- removal of soil and trash (ie generally the top 1-2 cm of the soil profile),
- preparation of a level seedbed for sowing with standard (or modified) agricultural seedling implements,

- ensuring that germination takes place in mineral soil,
- pressing the seed into the soil in order to minimise predation by ants (Dalton 1993).

Where access is limited, machines can be attached to 4WD motorbikes. Where access can only be achieved on foot, hand direct seeding is the answer. The procedures for hand direct seeding are outlined in Figure 1 below.

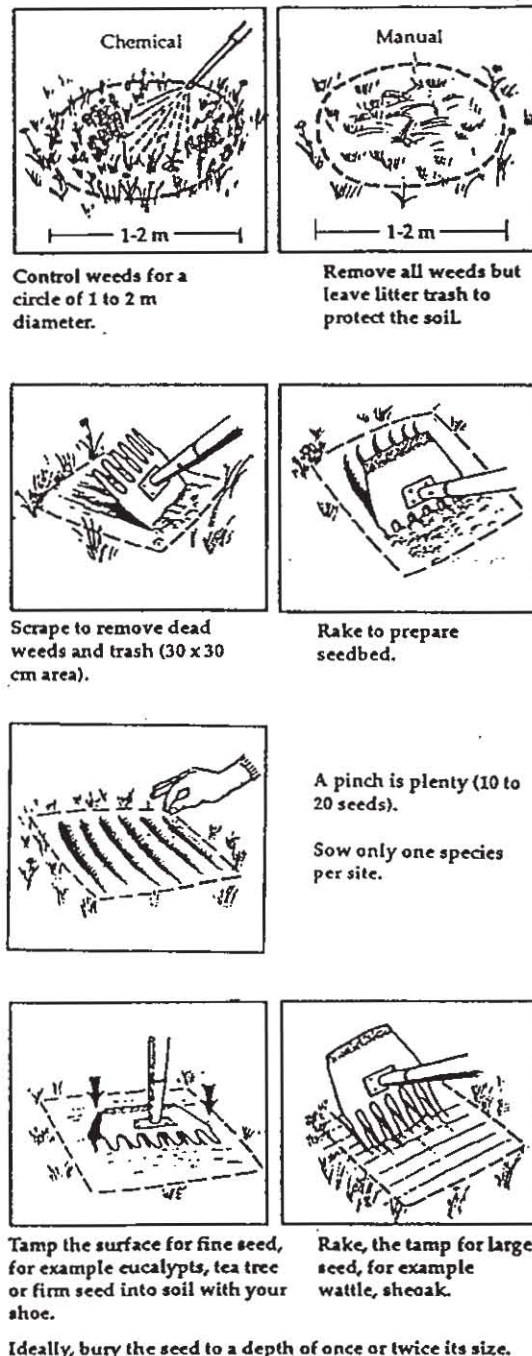


Figure 1. Hand direct seeding of native plants (source: Primary Industries (SA) Fact Sheet 7/95)

In the agricultural regions of South Australia, there are only two soil types which present problems for direct seeding:

- alkaline black cracking clays (these sites were originally native grasslands), and
- deep non-wetting sands in low rainfall areas (ie. less than 350 mm pa.).

In the last two years, the success rate of direct seeding onto non-wetting sands has been dramatically improved with the use of wetting agents at the time of sowing, seed treatment prior to sowing and advances in seeding machinery. Successful germination on cracking clay has been achieved, but most seedlings die as the soil cracks upon drying.

3.4 Use Of Local Species

For the last decade there has been a concerted effort in the field of revegetation toward the planting of indigenous species. The reasons are many, including:

- maintaining landscape character,
- conserving biodiversity,
- avoiding genetic pollution of remnant vegetation, and
- longevity of local species.

South Australia is littered with sites that have been planted with "exotic" native species (ie Australian species that are not indigenous to that area). Unsurprisingly, most of these sites have failed in the longer term (ie 15-20 years) and now require a second revegetation effort. Species selection can vary within a few hundred metres, owing to a change in aspect, soil type, geology or any number of other factors. Thus, species lists have to be very site specific.

In South Australia, several landholders (including one of the authors) have planted river oak (*Casuarina cunninghamiana*) along their watercourses. We do not recommend this species because it appears to have a habit similar to willows - roots protruding into the channel, thereby reducing its capacity. This is of particular concern on the smaller watercourses (ie. < 4th order).

3.5 Maintenance

Young seedlings are vulnerable to defoliation from insects such as red-legged-earth-mite and lucerne flea. In some circumstances, it may be necessary to add an insecticide (eg. Le Mat ®) to the herbicide solution. It is essential that extreme caution be used in the use of insecticides near watercourses, regardless of the concentration.

It is highly desirable to provide young plants the opportunity to grow through a second summer in a weed-free environment. This can be achieved by spraying the site with a knockdown herbicide, at a reduced rate (ie. glyphosate 360g/L @ 0.5 L per Ha), during late winter (ie. late July - early August). This approach may cause minor tip burning to some species, but it is quite safe. At this time, the young native plants are relatively dormant as compared to introduced grasses and broadleaf weeds. Most native plants will be physically shielded from the herbicide by the growth of herbaceous weeds.

Some individuals are concerned that direct seeding can create a situation of "too many seedlings", and express a desire to "thin-out" the site. Over time, Nature will ensure self-thinning, leaving only the strongest individuals.

4.0 WHAT ARE THE ADVANTAGES OF DIRECT SEEDING?

- Plant density: an average germination, using a seed mix of 1 kg per Ha, will deliver approximately 4,000 - 6,000 seedlings per Ha (Dalton 1994, M Campbell pers comm). Compare this to tubestock, using a 3m x 3m spacing, which produces less than 1,000 seedlings per Ha.
- Cost: Site preparation and fencing costs are the same for either technique. However, direct seeding will require approximately 1 kg of seed mix (approximate price of \$170 per kg), whereas tube stock at 50c per seedling (@ 1,000 per Ha) will cost \$500.
- Species diversity: Most sites in South Australia are sowing, on average 20-25 species and at some sites the range is 35-45. Such plant species diversity is just not feasible using tubestock plantings.
- Randomness: most tubestock planting tends to be done on a rigid adherence to a 3m x 3m format. This leads to the appearance of a geometric pattern, like a pine (*Pinus* spp) plantation, at odds with the ebb and flow of the natural landscape. Direct seeding allows a more random pattern.
- Growth rates: Many first-time direct seeders are disappointed with the early results as compared to tubestock planting. Although direct seeded seedlings "appear" to grow slower, experience in South Australia indicates that by Year 2, the height of these seedlings surpasses that of tubestock. In the ensuing years the difference in performance widens. Refer to Plates 1 & 2.
- Time: for the average site, one hectare (= 3 linear km of sowing) of direct seeding will take

approximately 20 minutes. How long would it take you to plant 1000 trees?

5.0 CONCLUSION

River engineers build erosion control structures mindful of the fact that vegetation is a vital tool in attaining a stable watercourse. However, the revegetation component is the weak link in the chain. Most revegetation is undertaken using an out-dated technology - tubestock planting. There has been nearly a decade of using direct seeding for broad-acre revegetation. The technique is dependant upon good weed control, sowing at the right time and using viable seed. Most importantly, the method is cheap and farmer friendly.

6.0 REFERENCES

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Plate 1: Revegetation of 3rd order watercourse, September 1990.



Plate 2: The same site as in Plate 1, five years later, October 1995.