Systems Approach to Reliable Direct Sowing of Native plants: Implications for the Revegetation of Mined and Agricultural Landscapes

by Geoff Woodall

Native Plant Agronomist:
Part-time research Fellow, University of WA
Part time sandalwood farmer.
• Revegetation of cleared agricultural land for pure landcare benefit has been hard to sell.

• David Pannell looked at the scale of revegetation required and could not see farmers investing in non commercial treatments at the scale that is required: “it would cripple the economics of their farm”.

![Image of a person surrounded by vegetation]
• My focus has been on plants that can be commercial drivers for revegetation.

• Commercial drivers include food, fibre, forage, sandalwood.

• The work on commercial species has direct relevance and benefits for biodiversity revegetation
Direct seeding

- Often the cheapest way to establish native plants in agricultural and mined landscapes is via direct field sowing of seed.
- It often delivers vegetation with structural and species diversity, both of which are difficult to achieve with the planting of nursery raised seedlings.
- It does have limitations
Main direct seeding R&D&E

- Equipment design
- Moisture Management
- Sowing Depth, Seedling Morphology and Spacing
- Seed pre-treatments
- Weed Control
- Pest Control
- Seedling nutrition
Equipment design

1998-2003

• No control over seed placement
• Unstable soil environment
• Poor seed use efficiency

2002-2004
Version 1 and 2 of modified Egadd seeder

• improved control over seed placement
• More stable soil environment
• major improvement in seed use efficiency
• One line per pass
• One sowing depth
• Large reduction in required HP
Equipment design

2004-2005 Version 1 of Commercial native vegetation seeder (CommVeg seeder)

• 1-3 lines per pass
• Improved tillage
• Version 1 of floating seeder arm
• Large reduction in required HP

2005-2014

Version 2 and 3 of Commercial native vegetation seeder (CommVeg seeder)

• Adjustable row spacing
• Spot placement of seed
• Improved seeder arms
• Improved construction
• Option to sow different groups of seeds within a single line
• Tractor (tilt and lift) and battery operated hydraulics
• Large reduction in required HP
• Improved construction (frame, components, hydraulics, seed delivery...
Standard CommVeg approach
CommVeg sowing fodder shrubs on the top of mounds (2010)
minimum tillage approach on **shallow clays soils**: knife point, followed by floating seeder arm
Adoption of new and retro fitted direct seeding machinery within agricultural district of WA

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Approximate scale of revegetation 2011-2014</th>
<th>Equipment description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corporate 1</td>
<td>2000ha+</td>
<td>CommVeg machine and retro fitted machinery</td>
</tr>
<tr>
<td>Corporate 2</td>
<td>2000ha+</td>
<td>retro fitted machinery</td>
</tr>
<tr>
<td>NRM group 1</td>
<td>100ha+</td>
<td>retro fitted machinery</td>
</tr>
<tr>
<td>Contractor 1</td>
<td>140ha</td>
<td>CommVeg machine</td>
</tr>
<tr>
<td>Contractor 2</td>
<td>300ha</td>
<td>CommVeg machine</td>
</tr>
<tr>
<td>NRM group 2</td>
<td>600ha</td>
<td>CommVeg machine</td>
</tr>
<tr>
<td>Contractor 3</td>
<td>250ha</td>
<td>partial retro fitted machinery + new machine</td>
</tr>
</tbody>
</table>
2014 Esperance sandplain reveg using a retrofitted Kimseed seeder, 150ha,
Great machine if you know what you are doing

BUT

How do you teach others how to operate these machines
Training operators has been challenging because:

- Different machinery configurations are required for different landscapes, soils, species etc.
- Small adjustments make a very large difference to outcomes
New practitioners take a long time to understand that complete establishment systems are required for repeatable success not just a fancy new machine!

Developments such as new equipment, seed coating, smoke water, nutritional supplements are useless unless they are part of an agronomic package
Key components of an overall establishment strategy

- Vertebrate and insect pest strategy
- Sowing niche strategy
- Nutritional strategy
- Timing of operations strategy
- Sowing depth strategy
- Strategy for seed treatments
- Mixing and blending strategy
- Moisture management strategy
Sowing depth strategy: key components

Species or mix
soil texture
time of sowing
soil moisture
Seed Preparation

Most (95%?) WA species can be sown through off the shelf agricultural cog driven seed distributors, though some species require some preparation.

Most practitioners and seed merchants fail to prepare the seed of some species correctly.
New Weed Control strategies

Wireweed (*Polygonum aviculare*) control
Cheaper tillage

2009  1 tractor in service
2014  3 tractors in service

A general progression towards minimum tillage has meant that less HP is required
Moisture management strategy

Choosing an appropriate water harvesting site prep is important.
Moisture management strategy
Moisture management strategy

Uneven soil moisture along scalp lines
– Bonnie Rock June 2012
Moisture management strategy

Direct sown lines after water harvesting and precision sowing – Bonnie Rock WA 2012

Note uniform moisture along sown line
Case study: Greening Australia and Alcoa farms

**Key characteristics**
- Dry deep grey sand
- Unstable and non wetting in parts
- High rainfall
- Low fertility
- Vertebrate pests

Planting of nursery raised seedlings is standard industry practice

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site difficulty index</td>
<td>8</td>
<td>10= extremely difficult to establish</td>
</tr>
<tr>
<td>Suitability index</td>
<td>9</td>
<td>10= proposed vegetation highly suitable for site</td>
</tr>
<tr>
<td>Establishment window</td>
<td>narrow</td>
<td></td>
</tr>
</tbody>
</table>
Key aspect of establishment package

- Timing (Early season establishment)
- Kangaroo and Rabbit control
- Seed mix and rates
- Sowing mixes and species grouping
- Seed treatments
- Supplementary nutrition
- Insect control post sowing and at beginning of summer
- Seed placement
- Soil stability
- Water harvesting, uniform infiltration
- Seed and seedling combo
Final coarse sowing mix, species grouping and seed treatments

Image: Dale Miles / Bayden Smith, |Greening Australia
Summary:
Complete establishment systems are required for success.
In isolation, innovations such as sowing at an optimal depth, nutrient addition or insecticide application are unlikely to improve the reliability and uniformity of direct seeding.
Real improvements in direct seedling are only likely to eventuate when individual components are compiled into an establishment system.
Parts of a system may be species specific.
Summary:
Implications for the Revegetation of Mined and Agricultural Landscapes

Mining Industry
• Very poor adoption of systems by mining industry
• Mining companies with agricultural land are starting to see benefits of adoption
• Adoption likely to occur in the future as systems are fundamentally cheaper to implement and potentially more reliable
Summary:
Implications for the Revegetation of Mined and Agricultural Landscapes

Agricultural and Urban Landscape
• Large scale adoption
• Multiple groups/contractors using part or full system(s)
• Several problems with adoption, mostly related to training, communicating what’s important and what’s not, and attention to detail, practitioner turnover
• Further adoption likely to occur in the future as systems are fundamentally cheaper to implement and potentially more reliable
• Continuous improvement of systems for a variety of landscapes, soils and vegetation types