Enemies of pasture establishment and legume regeneration

Dr Belinda Hackney
Enemies-establishment

• Preparation
  Clean up phase - weeds to be aware of

• Soil conditions
  Physical
  Chemical

• Species selection

• Rhizobia

• Sowing
  Timing
  Technique
  Depth
  Rate

• Post sowing management
Preparation – clean up phase

What is the weed seed level in a pasture?

Table 3.1 Germinated seed found after three years of either continuous grazing or where hay was cut each spring in an old (degraded) phalaris pasture in southern NSW.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Phalaris</th>
<th>Sub clover</th>
<th>Annual grasses</th>
<th>Broadleaf weed</th>
<th>Other legume</th>
<th>Toadrush</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous grazing</td>
<td>158</td>
<td>3660</td>
<td>5859</td>
<td>1020</td>
<td>895</td>
<td>3263</td>
</tr>
<tr>
<td>Spring hay cut</td>
<td>0</td>
<td>1450</td>
<td>668</td>
<td>419</td>
<td>215</td>
<td>215</td>
</tr>
</tbody>
</table>

Source: Bowcher 2002
Preparation – how many seeds do you sow?

- Sowing rates compared to weed seed bank are low
  - Sub clover sown at 4 kg/ha
    - \(330,000 \text{ seeds/kg} \times 4 \text{ kg/ha} = 1,320,000 \text{ seeds/ha}\)
    - \(= 132 \text{ seeds/m}^2\)

- Phalaris sown at 3 kg/ha
  - \(650,000 \text{ seeds/kg} \times 3 \text{ kg/ha} = 195 \text{ seeds/m}^2\)

- BLW seedbank in previous slide 420-1020 seeds/m\(^2\) and annual grasses 670-5900 seeds/m\(^2\)
Weeds to be aware of:

Sorrel

Bent grass

Vulpia
Preparation – weeds to be aware of:

**Sorrel**

Perennial

Indicator of acidity

Needs a minimum two year control phase, preferably three

Spread by seed and root material

Lime – useful in increasing competitive ability of favourable species and for legume nodulation – more later

*No options to remove out of newly sown pasture containing legumes – so clean up BEFORE sowing*
Preparation – weeds to be aware of:

**Bent grass**
- Perennial
- Needs a minimum two year control phase, preferably three
  - Control – best results achieved when sprayed as first seed heads emerging

*No options to remove out of newly sown pasture containing grasses – so clean up BEFORE sowing*
Preparation – weeds to be aware of:

Vulpia

- Annual – up to 2,850,000 seeds/kg (Dowling and Nicol 1993)...........cocksfoot has 1 300 000 seeds/kg

- Residual seedbank ~1% if total control achieved over 12 months (Jones et al. 1992)

  From this low level – can be back at original density in two years

- High density pasture sowing (25 kg/ha sub + 20 kg/ha RG) reduced vulpia seed production by 80% (Leys et al. 1992) - what rate do you sow at?

Minimum two year control phase
Soil physical

Soil depth and texture
Determine WHC – all important
Soil physical

Soil structure
Sowing method
Establishment/emergence
Soil chemical

Nutrient availability – very important, but not the only consideration

P, S and Mo

Starter fertiliser containing N for sowing

Seeds only have sufficient N to supply seedling for 7-10 days
Acidity

Important question – *How acid is the soil and does it get better or worse with depth?*

Conventional thinking and recommendation

Surface acidity – correct it

Deeper acidity – liming unlikely to be economic….choose tolerant plants

*BUT ……….*
Soil chemical

Acidity

Before we consider the ‘BUT’……..

Acidity measured on a ‘log’ scale

Means a 1 unit change in pH is actually a 10 fold difference in acidity

- pH of 4 is ten times more acidic than pH 5
- pH of 4 is one-hundred times more acidic than pH of 6

What does this mean?
Soil chemical

Perennial grass
  Some species or varieties within species are more acid tolerant
    *In general*: coxksfoot > phalaris
      Advanced AT phalaris > Australian phalaris

Legumes
  Some species more tolerant than others
    Yellow serradella > French serradella > subclover > lucerne
So in acid soils or soils acid to depth, you can choose acid tolerant grass/legume combinations……

**BUT**………

*That’s only part of the answer/problem*

*For legumes, there is more to consider*
## Soil chemical conditions and rhizobia

<table>
<thead>
<tr>
<th>Rhizobia species</th>
<th>Group-Host legume</th>
<th>pH 4.5</th>
<th>pH 5.0</th>
<th>pH 5.5</th>
<th>pH 6.0</th>
<th>pH 7.0</th>
<th>pH 8.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhizobium l. bv. trifolii</td>
<td>C-Clovers</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Sinorhizobium spp.</td>
<td>AM, AL - medics</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Mesorhizobium spp.</td>
<td>Bis - Biserrula</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Bradyrhizobium spp.</td>
<td>G,S-Serradella</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Rhizobium l. bv. viciae</td>
<td>E,F - Vetch</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
</tbody>
</table>

Source: Ron Yates, DAFWA

- **Dark Green**: 60-90 % efficiency
- **Orange**: 25-60 % efficiency
- **Red**: <25 % efficiency
Soil chemical and rhizobia

Most rhizobia activity in top 20 cm soil with majority in the top 10 cm

A relatively small change in pH via liming may induce significant change in nodulation and nitrogen fixation

A legume with its associated rhizobia is only using N, not fixing it

A grass without nitrogen can’t perform at its best
Soil chemical and rhizobia
Sowing - timing

Annual legumes – scarified seed sowing
  Adapted to autumn sowing
Perennial legumes – autumn or spring
Perennial grasses – autumn or spring

Decision of when depends on what you choose in terms of annual/perennial combinations and seasonal conditions
Sowing - timing

Be careful of sowing when temperatures are very low – i.e. late autumn-winter

- Emergence – Moot et al. (2000)
Sowing - timing

- Input costs are the same!
Sowing - technique

Increasing seed-soil contact usually gives better results

Source: Dowling et al. (1971)
Sowing - technique

Experiments at Berridale – mid 2000’s in Stipa pasture

Treatments
• Broadcast
• Broadcast plus knockdown
• Direct drill
• Direct drill plus knockdown

Results
• Only treatment giving moderately acceptable results was Direct drill plus knockdown

On Reflection
• Higher sowing rates need investigation
Sowing - depth

Most pasture seed quite small:
Subclover – 330 000 seeds/kg
Balansa clover – 1 500 000 seeds/kg
Lucerne – 500 000 seeds/kg
Cocksfoot – 1 300 000 seeds/kg
Phalaris – 650 000 seeds/kg

Sowing depths > 1 cm can result in significant reduction in emergence
Table 3.1 Germinated seed found after three years of either continuous grazing or where hay was cut each spring in an old (degraded) phalaris pasture in southern NSW.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Phalaris</th>
<th>Sub clover</th>
<th>Annual grasses</th>
<th>Broadleaf weed</th>
<th>Other legume</th>
<th>Toadrush</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous grazing</td>
<td>158</td>
<td>3660</td>
<td>5859</td>
<td>1020</td>
<td>895</td>
<td>3263</td>
</tr>
<tr>
<td>Spring hay cut</td>
<td>0</td>
<td>1450</td>
<td>668</td>
<td>419</td>
<td>215</td>
<td>215</td>
</tr>
</tbody>
</table>
Sowing - rate

Sowing rates compared to weed seed bank are low

• Sub clover sown at 4 kg/ha – NSW Standard
  
  \[
  330,000 \text{ seeds/kg} \times 4\text{kg/ha} = 1,320,000 \text{ seeds/ha} \\
  = 132 \text{ seeds/m}^2
  \]

• Are these rates high enough – remember seed is the ‘cheap’ part of the sowing operation

• As a comparison – standard WA sowing rate in 8 -10 kg/ha for subclover

• BLW seedbank in previous slide 420-1020 seeds/m² and annual grasses 670-5900 seeds/m²
Sowing – balance between species

Some things to keep in mind:
1. Pastures will tend to run to grass dominance over time
2. A common problem is lack of sufficient legume in pasture……………do we start out with enough legume when sowing a pasture???
3. Has something gone amiss in preparation to disadvantage legume?
   Acidity-rhizobia interactions
   Weeds
   Species/variety selection
Post sowing management

Remember:
1. Good preparation will prevent a lot of post sowing problems
2. Don’t cut corners in preparation – commit to a proper clean up period
3. Two years *absolute* weed control should be minimum – three would be preferred
4. In the year of sowing, treat the pasture like a crop
5. Don’t forget about fertiliser in years following sowing
6. Use a range of strategies for weed control – livestock are useful (despite what croppers say!)
Managing regeneration of annual legumes

This is one of the most reported issues in medium and high rainfall regions in mixed perennial-annual pastures.

In considering management of the problem, it is useful to think about where annual legumes we use evolved and why they are successful in their native range.
Managing regeneration of annual legumes

Where do most agricultural annual legumes come from?

- Most annual legumes we use come from the Mediterranean or Mediterranean-like regions of the world
- Characteristics of Mediterranean environment
  - Winter-wet, summer dry
  - Hot summer, mild to cool winters
  - Little herbage/litter cover on ‘pasture’ areas in summer autumn
  - Dominated by annual lifecycle pasture species

What does this mean for annual legumes?

In their native range in autumn, annual legumes will have **space**, **light** and **seed soil contact**
Managing regeneration of annual legumes

What do we often see in our pasture over summer autumn?
   Standing dry residue and ground litter cover
   Temperate cool season growing perennial grasses which can have moderate to high density in the pasture

What does this mean?
   Lack of light, space and/or seed-soil contact for legumes trying to regenerate
   Perennial grasses recommence growth with opening autumn rain and dry soil out quicker than germinating legumes can extend their root system
   Can result in very poor legume presence in pastures
Managing regeneration of annual legumes

So what can you do?

Reduce litter cover and standing residue over summer and early autumn – not necessarily all paddocks every year

Don’t always graze/spell a given paddock at the same time of year, every year

What about when you have paddocks with no legumes left and you want to resow

Are you sure there is no legume left
Start with the highest potential paddock first
Commit to a proper clean up phase
Don’t try to save money by reducing sowing rates of legumes
Get advice – think about alternative deep-rooted annual legumes and alternative establishment options
Species