Crop establishment pests
Contents

• IPM options for crop establishment pests
• Management of earth mites and lucerne flea
• Millipedes, earwigs & slaters
• False wireworms and beetles
• Mandalotus weevils
• “Best Bet” example
• Take home messages
Why look at crop establishment?

- Crop establishment is the most susceptible growth stage of plant development to pests & can also be the challenging period for applying IPM.
- Canola, medics and clovers are generally more susceptible to insect attack compared with cereals, grasses and pulses.
Key crop establishment pests

- > 40 invertebrate species threaten seedling establishment in crops and pastures
- Control tactics for these species presently relies heavily on the application of pesticides

<table>
<thead>
<tr>
<th>Pest group</th>
<th>Example species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth mites</td>
<td>redlegged earth mite, blue oat mite</td>
</tr>
<tr>
<td>Lucerne flea</td>
<td>lucerne flea</td>
</tr>
<tr>
<td>Slugs, snails</td>
<td>grey field slug, black keeled slug; white and conical snails</td>
</tr>
<tr>
<td>Beetles &amp; weevils</td>
<td>false wireworm, pasture cockchafers, mandalotus weevil</td>
</tr>
<tr>
<td>Caterpillars</td>
<td>common cutworm, pasture webworm</td>
</tr>
<tr>
<td>Other</td>
<td>earwigs, millipedes, slaters</td>
</tr>
</tbody>
</table>
What are the IPM options for crop establishment?

- Cultural ✔
- Biological ?
- Chemical ✔ ....can we be more strategic?

Key principles:
- Paddock histories and managing pre-season risk
- Pest ID
- Cultural techniques
- Strategic use of pesticides
- Decisions underpinned by monitoring
Paddock histories and managing pre-season risk
Risk profiles for crop establishment

Example: Earth mites and lucerne flea

<table>
<thead>
<tr>
<th>High risk</th>
<th>Reduced risk</th>
<th>Low risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Forecast for dry or cool, wet conditions that slow crop growth</td>
<td>• Thin/sparse pasture in the previous spring</td>
<td>• Following a cereal or pulse</td>
</tr>
<tr>
<td>• Pasture going into crop</td>
<td>• Low weeds in paddocks and along fence-lines</td>
<td>• paddock with low weeds</td>
</tr>
<tr>
<td>• Susceptible crop being planted (canola, pasture, lucerne)</td>
<td>• Higher sowing rate used</td>
<td>• Sandy soils (lucerne flea only)</td>
</tr>
<tr>
<td></td>
<td>• Optimal plant growing conditions during establishment</td>
<td></td>
</tr>
</tbody>
</table>

Full Risk profile table in printed resources
Make use of paddock histories

... helps with crop selection to reduce pest populations and negate the need for chemicals

- ‘Resident’ pests are more predictable with paddock history information (e.g. mites, LF, slugs, snails, cockchafers, false wireworm)
- ‘Transient’ pests (mobile across large distances) more difficult to predict (e.g. aphids, caterpillars)
- Records of paddock histories and soil type are particularly useful when planning to sow susceptible crops, such as canola
Example

Pre-season planning & crop selection

Number of mites in canola following 2 years of various crops

- Be careful following pastures, unless mite populations were controlled in the previous spring

Micic et al. 2012. GRDC WA Updates
Management of earth mites and lucerne flea
Beneficials / Natural enemies

Effectiveness
- Pastures
- Native predator complex suppress spring RLEM peak (James 1995)
- Anystis (RLEM) and Spiny snout (LF) mites most effective
  - 80% (RLEM) and 60% (LF) control (Michael 1995)
  - 93% LF in autumn with >25/m2 (Ireson 2006)
- But effectiveness is patchy!!

From James 1995
Pre-season control of RLEM

- Reduces the carry-over of pest eggs (>95%)
- Timing of spray is critical
- Freely available tool

Timerite®

Initiation of egg hatch:
- <20°C & >10 mm rain

Termination of diapause:
- Summer conditions for 30-40 days

http://www.wool.com/Grow_Timerite.htm
Timerite for RLEM (cont.)

- Residual chemicals needed to target later emerging eggs
- Timerite provides excellent control of RLEM, in autumn
- Not applicable to other mites and lucerne flea

% increase in canola seedlings in Autumn

Adapted from AWI Ltd: Timerite© Information Package (sourced from Bayer)
Tolerance to insecticides

Insecticide response curve: RLEM vs LF

Tolerance to insecticides

Insecticide response curve: comparison of mites

### Cesar Chemical Testing (Tolerance)

<table>
<thead>
<tr>
<th>Chemical</th>
<th>RLEM*</th>
<th>BOM*</th>
<th>Bal.</th>
<th>Bry.</th>
<th>LF*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omethoate (e.g. LeMat)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Dimethoate (e.g. Dimethoate)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Chlorpyrifos (e.g. Lorsban)</td>
<td>☐</td>
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<td>Phosmet (e.g. Imidan)</td>
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<tr>
<td>Bifenthrin (e.g. Talstar)</td>
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<td>☐</td>
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<tr>
<td>Alpha-cypermethrin (e.g. Fastac)</td>
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<tr>
<td>Lambda-cyhalothrin (e.g. Karate)</td>
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<tr>
<td>Gamma-cyhalothrin (e.g. Trojan)</td>
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<tr>
<td>Esfenvalerate (e.g. Sumi Alpha)</td>
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<tr>
<td>Methidathion (e.g. Suprathion)</td>
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<td>☐</td>
<td>☐</td>
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<tr>
<td>Imidacloprid (e.g. Gaucho)**</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<td>?</td>
</tr>
</tbody>
</table>

* Other pesticide products are registered

** Tested as seed dressing only
Tolerance to insecticides
chemical testing

Research with unregistered chemicals does not constitute a recommendation for that particular pest species. Chemicals have been largely tested against g a.i./L rather than at recommended application rates. All pesticide applications must accord with the currently registered label for that particular pesticide, crop, pest and region.
Latest on controlling *Balaustium* mites

- The majority of chemical treatments have limited impact
Insecticide resistance in RLEM

• RLEM have been controlled using chemicals for > 50 years in Australia
• In 2006, chemical control failures experienced at 1 location
• 4 separate applications over a period of 3 weeks
• Paddock history: repeated applications of synthetic pyrethroids > 5 years
Insecticide resistance in RLEM

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Population</th>
<th>LC50 value</th>
<th>Resistance ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bifenthrin</td>
<td>Control</td>
<td>0.03</td>
<td></td>
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<tr>
<td></td>
<td>WA</td>
<td>6881.97</td>
<td>243,027</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>WA (Gen 2)</td>
<td>7122.17</td>
<td>268,694</td>
</tr>
<tr>
<td>Alpha-cypermethrin</td>
<td>Control</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td></td>
<td>WA</td>
<td>942.81</td>
<td>59,353</td>
</tr>
<tr>
<td>Omethoate</td>
<td>Control</td>
<td>0.10</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>WA</td>
<td>.26</td>
<td></td>
</tr>
</tbody>
</table>

- Resistance also found to be heritable
- Resistance located > 20 properties in WA (>900 km apart)
- Movement is known between WA & east coast
- Implications: need for careful management of insecticides

Adapted from Umina 2007. *Pestic. Sci*
Current status of field resistance

- 26 paddocks (from 15 properties) identified with resistance between 2007-10
- Another 23 paddocks detected since 2011
Decision timeline for earth mites & lucerne flea

- Pasture grazing
- Crop selection
- Seed treatments
- Bare earth treatments
- Early sowing*
- Post emergent treatments**
- Timerite for RLEM
- Monitoring

* Also consider other sowing tactics (eg. increased seed density)
** Consider spot spraying for lucerne flea
‘Best Bet’ example: Earth mites and lucerne flea

<table>
<thead>
<tr>
<th>Pre-season (previous spring/summer)</th>
<th>Pre-sowing</th>
<th>Emergence</th>
<th>Crop establishment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess risk</td>
<td>If high risk:</td>
<td>• Monitor susceptible crops through to establishment (direct visual searches)</td>
<td>• As the crop grows, it becomes less susceptible unless growth is slowed by dry or cool, wet conditions</td>
</tr>
<tr>
<td>High risk when:</td>
<td>• Use seed dressing on susceptible crops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• History of high mite pressure</td>
<td>• Plan to monitor more frequently until crop establishment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Pasture going into crop</td>
<td>• Use higher sowing rate to compensate for seedling loss</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Susceptible crop being planted (eg. canola, pasture)</td>
<td>• Consider scheduling a post-emergent insecticide treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Seasonal forecast is for dry or cool, wet conditions that slow crop growth.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If risk is high:</td>
<td>If low risk:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Ensure accurate ID</td>
<td>• Avoid seed dressings (esp. cereals/pulses) &amp; plan to monitor until crop establishment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Use Timerite (RLEM)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>• Heavily graze pastures in early-mid spring</td>
<td></td>
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</tr>
</tbody>
</table>

**Best Bet** example: Earth mites and lucerne flea

**Full ‘Best Bet’ table in printed resources**
Millipedes, earwigs & slaters
Increasing pest prevalence

• Earwigs, millipedes and slaters have increased in pest status over the last 4-5 years in SE Australia

Total pest reports received from PestFacts subscribers from SA, Vic and NSW since 2006

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earwigs</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>5</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Millipedes</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>7</td>
<td>8</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Slaters</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>8</td>
</tr>
</tbody>
</table>

• This increase has been linked to stubble retention, no-till farming practices and improvements in soil organic matter, which have provided a more favourable habitat

• Damage has been reported mainly in the medium and high rainfall zones, including Wimmera and Western Districts in Victoria
European earwigs

Lifecycle/description
- Adults 20 mm long
- Communal
- Easily confused with beneficial earwigs

Damage
- Adults and nymphs attack canola, lupins, cereals
- Associated with heavier soils, stubble
- Irregular chewing of leaves, cotyledons, stems (similar to slug damage)
- Can also chew through seed pods; and occasionally are a grain contaminant
- Nocturnal feeders (inspect at night)
# Earwigs: the good & the bad

<table>
<thead>
<tr>
<th><strong>Forficula auricularia</strong></th>
<th><strong>Gonolabis michaelseni</strong></th>
<th><strong>Labidura truncata</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EUROPEAN EARWIGS</strong></td>
<td><strong>NATIVE EARWIG</strong></td>
<td><strong>COMMON BROWN EARWIG</strong></td>
</tr>
<tr>
<td><strong>PEST</strong></td>
<td><strong>BENEFICIAL</strong></td>
<td><strong>BENEFICIAL</strong></td>
</tr>
<tr>
<td>• 12 – 24 mm long</td>
<td>• Lighter fore body, darker abdomen</td>
<td>• 35 mm long</td>
</tr>
<tr>
<td>• Uniform, dark colour body</td>
<td>• Legs &amp; pincers similar colour to other parts of the body</td>
<td>• Dull brown with straw coloured markings</td>
</tr>
<tr>
<td>• Legs &amp; pincers lighter than the body</td>
<td></td>
<td>• Orange triangle on the back</td>
</tr>
</tbody>
</table>
European earwigs - management

- **Cultural** – removing the shelter
  - Stubble burn
  - Weed control
  - Cultivation
  - Grazing pastures to <1.5 t/ha in Spring

- **Biological**
  - Carabid beetles
  - Birds & lizards

- **Chemical:**
  - Nothing registered in broadacre crops
  - Some chemicals registered in horticulture (carbaryl, chlorpyrifos)
  - Seed dressings may give some control
Black Portuguese millipedes

Lifecycle/description
- Active in autumn and spring
- 2 years to sexual maturity
- Easily distinguishable from native species

Damage
- Mainly organic matter feeder, attacks canola and cereals
- Associated with black organic soils (although damage has occurred on lighter soils)
- Foliar grazing, cotyledons/leaves (relatively rare)
- Nocturnal feeders
- Large numbers? Damage?
Slaters/ Pill bugs

Lifecycle/description

• Crustations related to crabs and lobsters; terrestrial but moisture dependent
• Stubble provides a cool, moist habitat; crumbly clay soil surfaces aid their survival
• Feed on decaying vegetable and animal matter
• The flood bug (*Australiodillo bifrons*) slater species can swarm
• Prevention is best

Damage

• Cereals, canola and lentils
• Chew base or tips of seedlings
Managing trash feeders: thinking ahead

Risk is increased in:
• Canola
• Heavy organic soils that retain moisture
• Stubble retention / high loads
• Wetter weather patterns
• Poor germination / slow plant growth
• High populations last spring

To reduce losses:
• Understand the culprit!
• Monitor prior to sowing (traps)
• Manage / burn stubbles (timing!)
• Sow other crops (not canola)
• Rapid establishment
  – High vigour varieties
  – Higher seeding rates
• Few registered insecticides
  – Difficult to control with SPs and OPs
  – Fipronil and imidacloprid some seed registrations (see Fact Sheet)
  – Methiocarb baits offer some control in horticulture
False wireworms and beetles
F WW and (adult) beetles species

<table>
<thead>
<tr>
<th>‘Smaller’ false wireworms and beetles</th>
<th>Size range</th>
<th>Larval colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bronzed field beetle larvae Adelium brevicorne</td>
<td>9-12 mm</td>
<td>Shiny grey</td>
</tr>
<tr>
<td>Grey false wireworm Isopteron aversum</td>
<td>10-12 mm</td>
<td>Grey green flattened</td>
</tr>
<tr>
<td>Vegetable beetle Gonocephalum elderi</td>
<td>10 mm</td>
<td>Brown</td>
</tr>
</tbody>
</table>

| ‘Larger’ false wireworms and beetles            |            |                         |
| Eastern false wireworm Pterohelaeus spp.       | 50 mm      | Light brown             |
| Southern false wireworm Gonocephalum misellum  | 20 mm      | Cream brown             |
Bronzed field beetle (BFB)

Lifecycle/description

• Native species, soil dwelling
• Common in and on fine textured soils high in organic matter
• Favoured by stubble retention, trash (shelter/breeding)
• Adult beetle lay eggs in late Feb/March

Damage

• >5 adults/m2 under carpet squares pre-sowing
• Larvae ringbark seedling & sever the hypocotyl of young seedlings
• Adults feed on decaying organic matter
Bronzed field beetle

Cultural control
Remove plant residues / trash by late February (before eggs are laid)

Reducing harvest contamination
• Preventing/controlling the autumn population
• Avoid leaving windrows on the ground too long
• Harvest in the hottest part of the day
Vegetable beetle

Lifecycle/description

• Larvae 10 mm (brown) rarely seen above the soil surface
• Adults 8 mm long, flattened, usually dull grey, but sometimes brown / black. Often with soil on their backs
• One generation per year

Damage

• Adults may attack emerging canola
• Larvae damage cereals
  o hollow out seeds
  o attack roots or ringbark seedling at or below the soil surface
Managing false wireworm/beetles

**Cultural**

1. **Crop choice**
   - Sow less susceptible crops, e.g. cereals or pulses

2. **Seedbed preparation**
   - Remove crop residue in Feb
   - Monitor adult activity before sowing canola (carpet square or baits)

3. **Sowing**
   - Compaction - good soil/seed contact
   - Early seeding date
   - (if risk) - higher seeding rates

**Insecticides**

- Seed dressings have limited benefit for these pests
Mandalotus weevils
Mandalotus weevils (multiple spp.)

• Largest Australian weevil genus
  – 152 described species
• Endemic, mainly SE Australia
• Taxonomy not defined

Adults

• 3-5 mm long, flightless, dull grey-brown
• Attack seedlings of canola, cereals, pulses in autumn
• Mainly lighter soils
Damage - worst in canola

- Adults chew stems, leaves, cotyledons, ringbark/lop young seedlings
- Often first noticed 1 week after emergence
- Damage occurs rapidly - intervene immediately

Usually patchy (SA mallee 2013)

Damage in lentils, 2010

Typical ring-barking of canola seedlings
Crop damage

Sometimes large areas (Ardrossan SA 2009)

Canola destroyed at Bowhill, SA, 2003
Crop damage - # reports

Crop damage reports in SA, Vic and NSW 2006-2012 (Perry, Umina)
Mandalotus distribution

Crop damage reported across SE Aust. 1997-2013, colour coded by species (Perry, Umina)
Identification

• Over 10 species, only 2 currently identified, some undescribed
• 3-5mm, resemble clod of dirt, often rows of thick paddle-shaped hairs on the back
Identification

Species appear to have geographic associations

M. puncticollis (common in Vic)
M. crawfordi (common in SA mallee)
Monitoring and assessing risk

- Paddock history (areas of paddocks with previous problems, little insecticide use)
- Soil type/region – lighter calcareous
- Hard to find. Check under weeds and grasses from early April – best after rainfall
Biology - lifecycle

- Sexual reproduction, one generation per year
- **Critical period is May/June** (peak adult emergence)

<table>
<thead>
<tr>
<th>Adults</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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<tr>
<td>Eggs</td>
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<td>Larvae</td>
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<td>Pupae</td>
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</tbody>
</table>

- Life stage present
- Crop damage

`soil surface`
Biology - over-summering

Adults ‘hibernate’ deep in the soil over summer

<table>
<thead>
<tr>
<th>Soil depth (cm)</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar*</th>
<th>Apr*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3</td>
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<td></td>
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<td>3-6</td>
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<td>6-9</td>
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<td>9-12</td>
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<td>12-16</td>
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<td>16-20</td>
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<td>20-25</td>
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<td>25-30</td>
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■ = life stage present  ■ = life stage absent  □ = no sampling

Presence of adults in the soil profile (Perry, DeGraaf)
Management

• Difficult – not practical during non-crop period (adults hibernate well below ground)

• Current best bet: Chemical control in high risk areas (see next slides)
  - Region/soil type
  - Paddock history
  - Canola not sown before!

• Monitor carefully at 1 week after emergence, check until 4 leaf stage
Chemical control - seed treatments

No products have good activity

Recapture = 56%
Mean n = 40

Means of 4 groups of weevils ± SE. LH bar = site 1, RH bar = site 2

* $\chi^2$ p < 0.05 within site
Chemical control – bare earth sprays

No products have good activity

Recapture = 55%
Mean n = 40

Means of 4 groups of weevils ± SE.
LH bar = site 1, RH bar = site 2
* $\chi^2$ p < 0.05 within site
Establishment pests ‘Best Bet’ IPM strategy
Take home messages

• Crops most **vulnerable** at establishment, esp. canola and medics
• Planning **pre-season** is important (time constraints to monitor sufficiently at establishment period)
• We have the ability to foresee many establishment pest issues before they happen... as they are **‘residents’**
• **Monitoring & Pest ID** are vital (eg. mites, weevils, scarabs)
• **Early planting, stubble management, increasing sowing density** and **seedbed rolling** are common cultural strategies
• **Beneficial species** often only play a support role at crop establishment (difference b/w crops & pastures)