Sorghum pest management
The suite of potential pests

<table>
<thead>
<tr>
<th>Pest</th>
<th>Impact on the crop</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Helicoverpa armigera</em></td>
<td>Larvae feed on filling grain = Yield and quality</td>
</tr>
<tr>
<td>Sorghum midge</td>
<td>Prevent seed set = Yield</td>
</tr>
<tr>
<td>Corn aphid</td>
<td>Honeydew contamination = No impact on yield</td>
</tr>
<tr>
<td>Rutherglen bug</td>
<td>Adults and nymphs feed on setting and developing grain = Yield and quality</td>
</tr>
<tr>
<td>Sorghum head caterpillar</td>
<td>Larvae feed on filling grain = Yield</td>
</tr>
<tr>
<td>Yellow Peach moth</td>
<td>Larvae feed on filling grain = Yield</td>
</tr>
<tr>
<td>Armyworm</td>
<td>Feed on vegetative plants = no impact on yield</td>
</tr>
<tr>
<td>Establishment pests</td>
<td>Adults and larvae feed on seed, seedlings = reduced plant stand or retarded seedling development</td>
</tr>
<tr>
<td>Cutworm, FWW, crickets, black field earwigs, cockroaches</td>
<td></td>
</tr>
<tr>
<td>Locusts</td>
<td>In plague years = defoliation, feeding on developing and maturing grain = Yield and growth.</td>
</tr>
</tbody>
</table>
The focus of the discussion

<table>
<thead>
<tr>
<th>Species</th>
<th>Impact on the crop</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Helicoverpa armigera</em></td>
<td>Larvae feed on filling grain = Yield and quality</td>
</tr>
<tr>
<td>Sorghum midge</td>
<td>Prevent seed set = Yield</td>
</tr>
<tr>
<td>Rutherglen bug</td>
<td>Adults and nymphs feed on setting and developing grain = Yield and quality</td>
</tr>
<tr>
<td>Sorghum head caterpillar</td>
<td>Larvae feed on filling grain = Yield</td>
</tr>
<tr>
<td>Yellow Peach moth</td>
<td>Larvae feed on filling grain = Yield</td>
</tr>
<tr>
<td>Corn aphid</td>
<td>Honeydew contamination = No impact on yield</td>
</tr>
<tr>
<td>Armyworm</td>
<td>Feed on vegetative plants = no impact on yield</td>
</tr>
<tr>
<td>Establishment pests</td>
<td>Adults and larvae feed on seed, seedlings = reduced plant stand or retarded seedling development</td>
</tr>
<tr>
<td>Cutworm, FWW, crickets, black field earwigs, cockroaches</td>
<td>In plague years = defoliation, feeding on developing and maturing grain = Yield and growth.</td>
</tr>
</tbody>
</table>
**Helicoverpa armigera** – corn earworm

Only *H. armigera* in sorghum – no *H. punctigera*

**major driver of local populations = pest pressure**
- Chickpeas - Control in chickpeas, and pupae busting play a role in managing local populations
- Infestation of vegetative sorghum – control these populations?

**Sorghum is a sink for *H. armigera* in the system**
- Egg and larval parasitism, predation can be significant
Monitoring and Management

The basics:
80% of eggs laid prior to flowering
   Uniform crop flowering = uniform larval age
   Also impacts on sorghum midge management
   (what influences uniformity of flowering, and can this be managed?)

- Early instars feed on pollen, 4\textsuperscript{th} instar and older feed on developing seed
- Egg density not a good measure of potential larval density
  - Parasitism by *Trichogramma*, predation by *Orius*, cannibalism of early instars
Managing Helicoverpa in sorghum

How do you monitor?
Visual, beat heads, spin heads

What do you record, and why?

Monitoring and control decisions
- getting the timing right
- the contribution of beneficial insects
- thresholds
- control options and considerations
Making decisions to control

Threshold
Based on a yield loss of 24 kg/ha yield loss per larva per m row.
On-line calculator now available
  – there is compensation (applies to midge too) = larger seed beside seed that doesn’t fill
  – Damage post physiological maturity cannot be compensated for.

Influences on product choice
• Larval density and age
  – Crop uniformity and larval age spread
Getting the best out of NPV

- NPV has greatest efficacy against larvae up to 4\textsuperscript{th} instar (<13 mm)
- Low volume (<10 L/ha + Optimol®)
  - coverage remains an issue – ingestion active
- Influence of cool weather on efficacy or speed of kill
  - 12 degree threshold for larval activity/feeding

**FOOD CONSUMPTION (6-day old)**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>NPV 7.5 d</th>
<th>Healthy 6.2 d</th>
<th>Healthy 4.5 d</th>
<th>Time to death</th>
</tr>
</thead>
<tbody>
<tr>
<td>20°C</td>
<td>500</td>
<td>1500</td>
<td>2000</td>
<td>7.5 d</td>
</tr>
<tr>
<td>25°C</td>
<td>1000</td>
<td>2000</td>
<td>2500</td>
<td>6.2 d</td>
</tr>
<tr>
<td>30°C</td>
<td>1500</td>
<td>2500</td>
<td>3000</td>
<td>4.5 d</td>
</tr>
</tbody>
</table>
Getting the best out of NPV

Acquisition is rapid (max uptake within 1 hour)
- focus on achieving optimal coverage

Using NPV to manage helicoverpa in field crops

**Graph:**
- **EC** (solid line)
- **ULV** (dashed line)

**Axes:**
- X-axis: HOURS AFTER TREATMENT
- Y-axis: % NPV INFECTION
NPV has no impact on beneficials – but timing important to preserve *Microplitis* (needs a 3 day advantage to complete development)
- Beneficial activity more important where a single application may not give a high level of control
- Benefits for other crops in the system
= Apply NPV 3 days post flowering (50% of heads with brown anthers)

But, better to go early than late

*Microplitis* larva inside helicoverpa larva

**Yellow anthers**

**Brown anthers**
Summary

• Crop uniformity makes control decisions simpler re. timing and product selection
• Sorghum potentially a sink for Helicoverpa and a source of parasitoids in the system
• Late crops, with larvae present past mid March, potentially harbour diapausing larvae – pupae bursting consideration.
Midge basics

Midge populations driven by
• Johnson grass – first generation in this host
• Successive generations in a local area – successive plantings and low MR varieties
  – 10 x increase in population each generation

Midge Resistance
• Physical resistance to placement of egg in the floret
• Allowed increased flexibility in terms of planting time
• Where spraying still required
  – SP use will impact on *H. armigera* resistance

• Extreme midge pressure will put strain on the resistance
SP resistance in *Helicoverpa armigera* increased in 2011/12 season

**Why?**
- midge spraying in sorghum?
- sp use in chickpea?
Management and control

Threshold

• Based on midge numbers – early morning monitoring
• Incorporates compensation, MR, insecticide residual
• On-line calculator available – (www.thebeatsheet.com.au)

Sorghum midge parasitoids
Contribute to overall population suppression – not midge control.
Strategy for managing sorghum

- Control alternate hosts in spring i.e. Johnson grass

- Plant early (prior to mid November)
  - Avoid high midge pressure
    - Reduce likelihood of spraying
    - Maintain efficacy of MR

- Manage the crop for uniform flowering
  - 3 week spread will result in midge from early heads attacking late heads in the same crop

- Highest possible MR for later plantings
  - Midge pressure increases as the season progresses
Rutherglen bug

Trial work to date:
Characterised damage – dry and irrigated

Provisional threshold
• Need field validation of provisional threshold

Insecticide evaluation

<table>
<thead>
<tr>
<th>Anthesis</th>
<th>Milky dough</th>
<th>Soft dough</th>
<th>Hard dough</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check for RGB</td>
<td>Control warranted if &gt;20-25 bugs/head</td>
<td>Control warranted if &gt;30-50 bugs/head</td>
<td>No impact on yield or quality post physiological maturity</td>
</tr>
</tbody>
</table>
Characterising damage
RGB in sorghum insecticide evaluation – impact on predators (mainly spiders)

<table>
<thead>
<tr>
<th></th>
<th>Days After Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsprayed</td>
<td></td>
</tr>
<tr>
<td>Indoxacarb 200</td>
<td></td>
</tr>
<tr>
<td>Indoxacarb 400</td>
<td></td>
</tr>
<tr>
<td>Fipronil</td>
<td></td>
</tr>
<tr>
<td>Dimethoate</td>
<td></td>
</tr>
<tr>
<td>Alpha-cypermethrin</td>
<td></td>
</tr>
</tbody>
</table>

PREDATORS

No. predators/head

Days After Treatment

GRDC Grains Research & Development Corporation
Decision Making for Integrated Pest Management in Grain Crops

NSD

0

6

10

a

b

ab

ab

ab

ab
Diagnosing causes of yield loss in sorghum at the end of the season

Sterility?
Midge?
Rutherglen bug?
Corn earworm?
Mice?
Birds?

Discussion
How often are you faced with this sort of situation?
And how do you go about identifying what has happened?
Look at the pattern of yield loss

**Sterility**
- Large areas of head devoid of grain
- No evidence of shriveled grain in glumes
- Uniformity in where the poor seed set is in heads across the field
- High temperatures during flowering
- Persistent rain during flowering

**Sorghum midge**
- Grain fails to develop – nothing in the glumes
- Squashed grain exudes pink fluid (midge pupa)
- Empty pupal cases visible (>2wks post flowering)
- No grain or frass on the ground
Diagnosing causes of yield loss in sorghum

Rutherglen bug
- Grain fails to develop – nothing in the glumes (looks like midge damage)
- Small shrivelled grain that fails to develop further
- Spotting on maturing grain (feeding punctures + fungi/bacteria)
- Damage to the endosperm (developing seed)
- No grain or frass on the ground

Corn earworm
- Preflowering damage (grazing)
- Chewed and partly consumed grain
- Empty glumes – but open
- Grain or frass on the ground and in leaf axils
Other sorghum pests

Sorghum head caterpillar
- No thresholds
- Beneficials likely to control small infestations (<10/m row)
- Webbing characteristic
- Monitor along with helicoverpa

Yellow peach moth
- Threshold ~ 0.4x helicoverpa threshold
- No webbing
- Monitor along with helicoverpa