Decision Making
for Integrated Pest Management
in Grain Crops

Sorghum pest management

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The suite of potential pests

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

The focus of the discussion

	Impact on the crop
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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

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Monitoring and Management

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The basics:

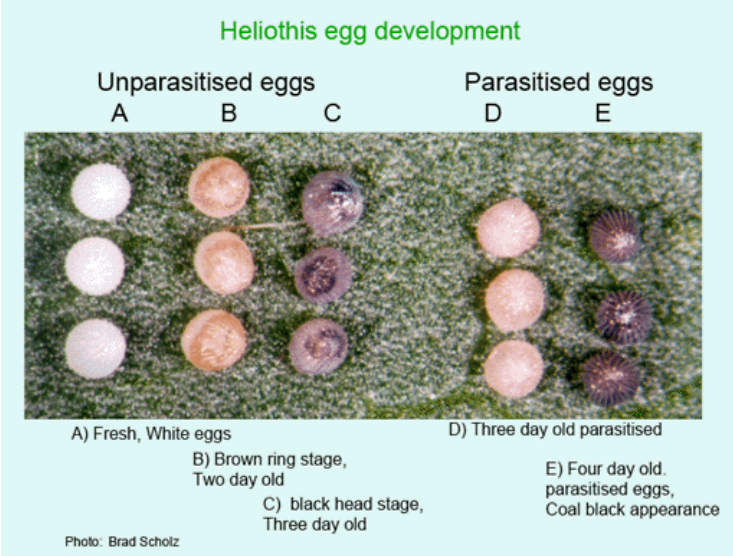
80% of eggs laid prior to flowering

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, 4th instar and older feed on developing seed
- Egg density not a good measure of potential larval density
  - Parasitisim by *Trichogramma*, predation by *Orius*, cannabalism of early instars



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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

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Making decisions to control

Threshold

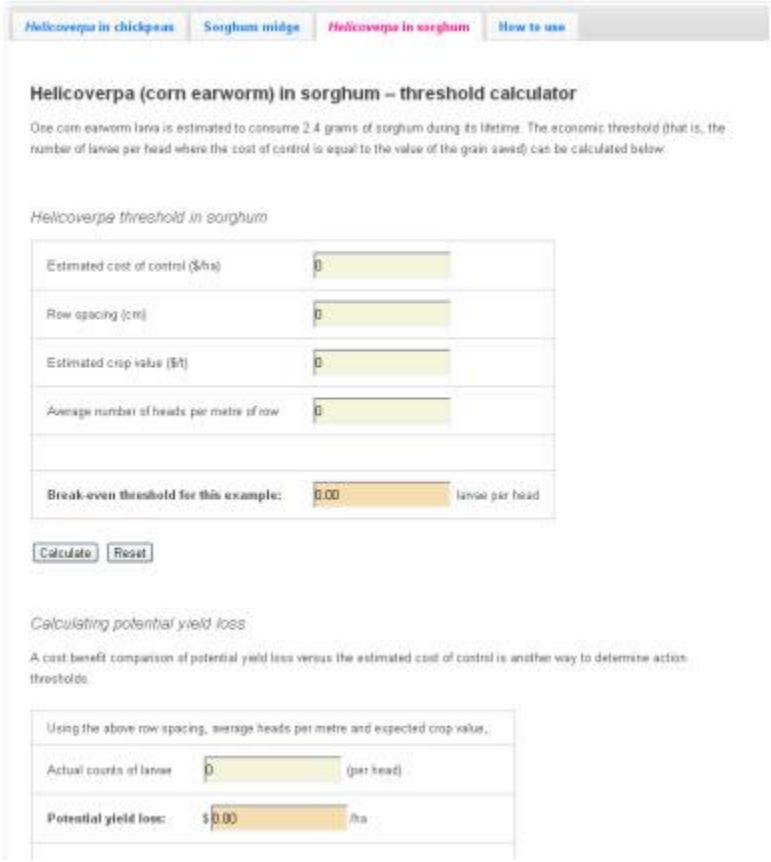
Based on a yield loss of 24 kg/ha yield loss per larva per m row.

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



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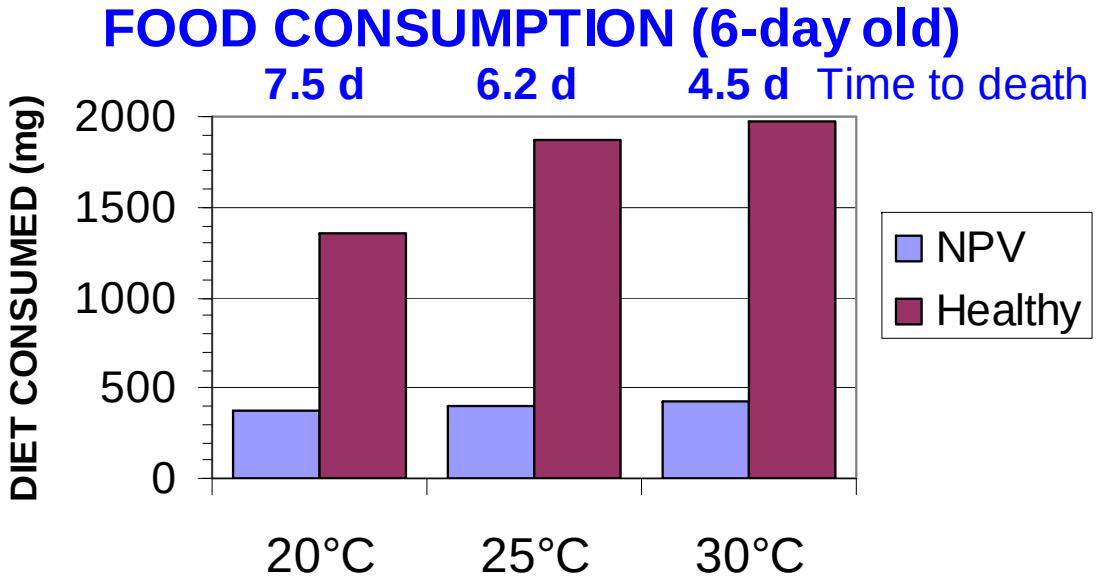
Getting the best out of NPV

- NPV has greatest efficacy against larvae up to 4th 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)



Getting the best out of NPV

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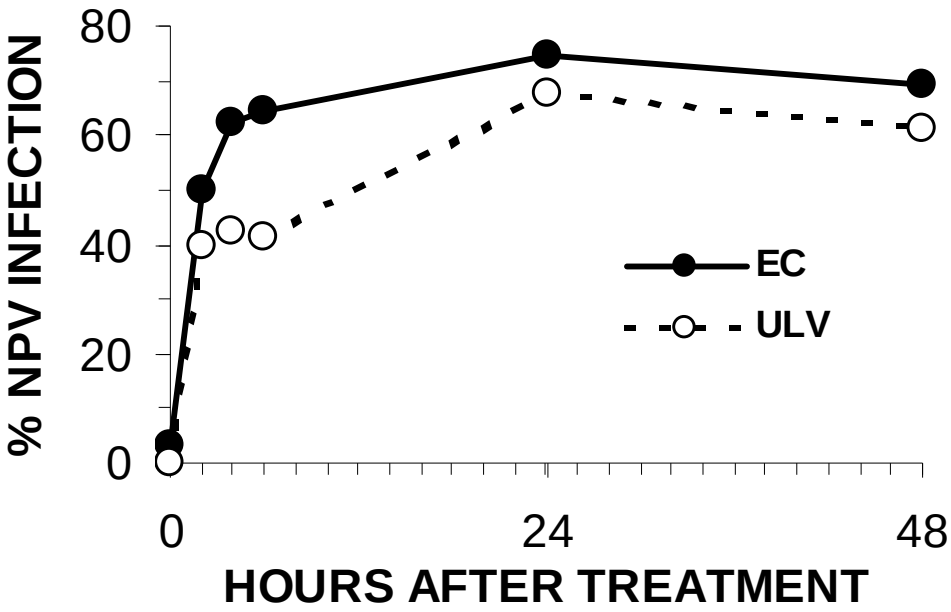
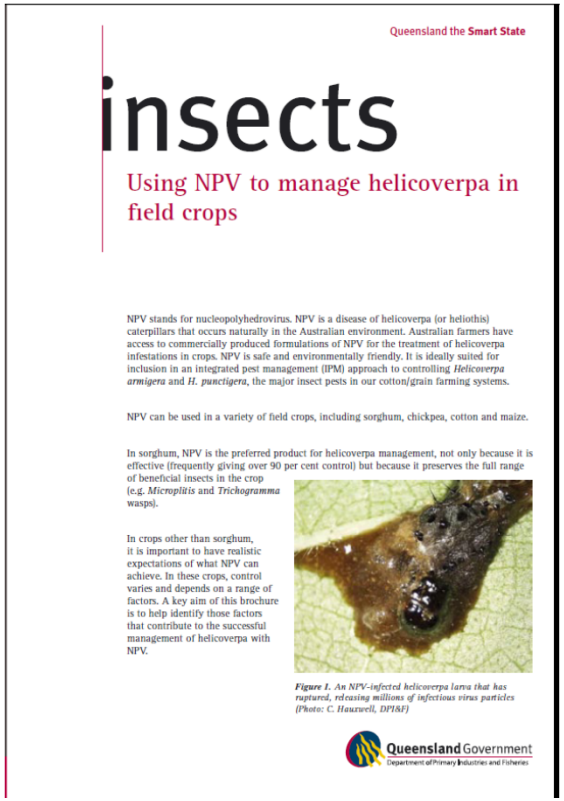
Acquisition is rapid (max uptake within 1 hour)

- focus on achieving optimal coverage





Queensland the Smart State

insects

Using NPV to manage helicoverpa in field crops

NPV stands for nucleopolyhedrovirus. NPV is a disease of helicoverpa (or heliothis) caterpillars that occurs naturally in the Australian environment. Australian farmers have access to commercially produced formulations of NPV for the treatment of helicoverpa infestations in crops. NPV is safe and environmentally friendly. It is ideally suited for inclusion in an integrated pest management (IPM) approach to controlling *Helicoverpa armigera* and *H. punctigera*, the major insect pests in our cotton/grain farming systems.

NPV can be used in a variety of field crops, including sorghum, chickpea, cotton and maize.

In sorghum, NPV is the preferred product for helicoverpa management, not only because it is effective (frequently giving over 90 per cent control) but because it preserves the full range of beneficial insects in the crop (e.g. *Microplitis* and *Trichogramma* wasps).

In crops other than sorghum, it is important to have realistic expectations of what NPV can achieve. In these crops, control varies and depends on a range of factors. A key aim of this brochure is to help identify those factors that contribute to the successful management of helicoverpa with NPV.

Figure 1. *An NPV-infected helicoverpa larva that has ruptured, releasing millions of infectious virus particles (Photo: C. Hauxwell, DPI&F)*

Queensland Government
Department of Primary Industries and Fisheries

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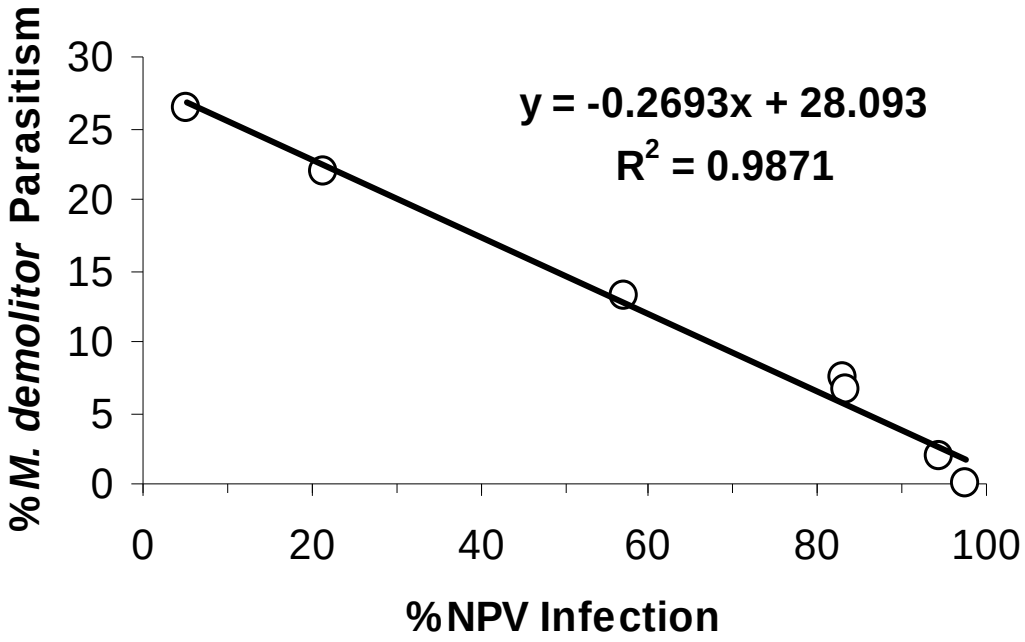
NPV has no impact on beneficials – but timing important to preserve *Microplitis* (needs a 3 day advantage to complete development)

- 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)



Microplitis larva inside helicoverpa larva

Yellow anthers

Brown anthers

But, better to go early than late

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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 busting consideration.

Midge basics

Midge populations driven by

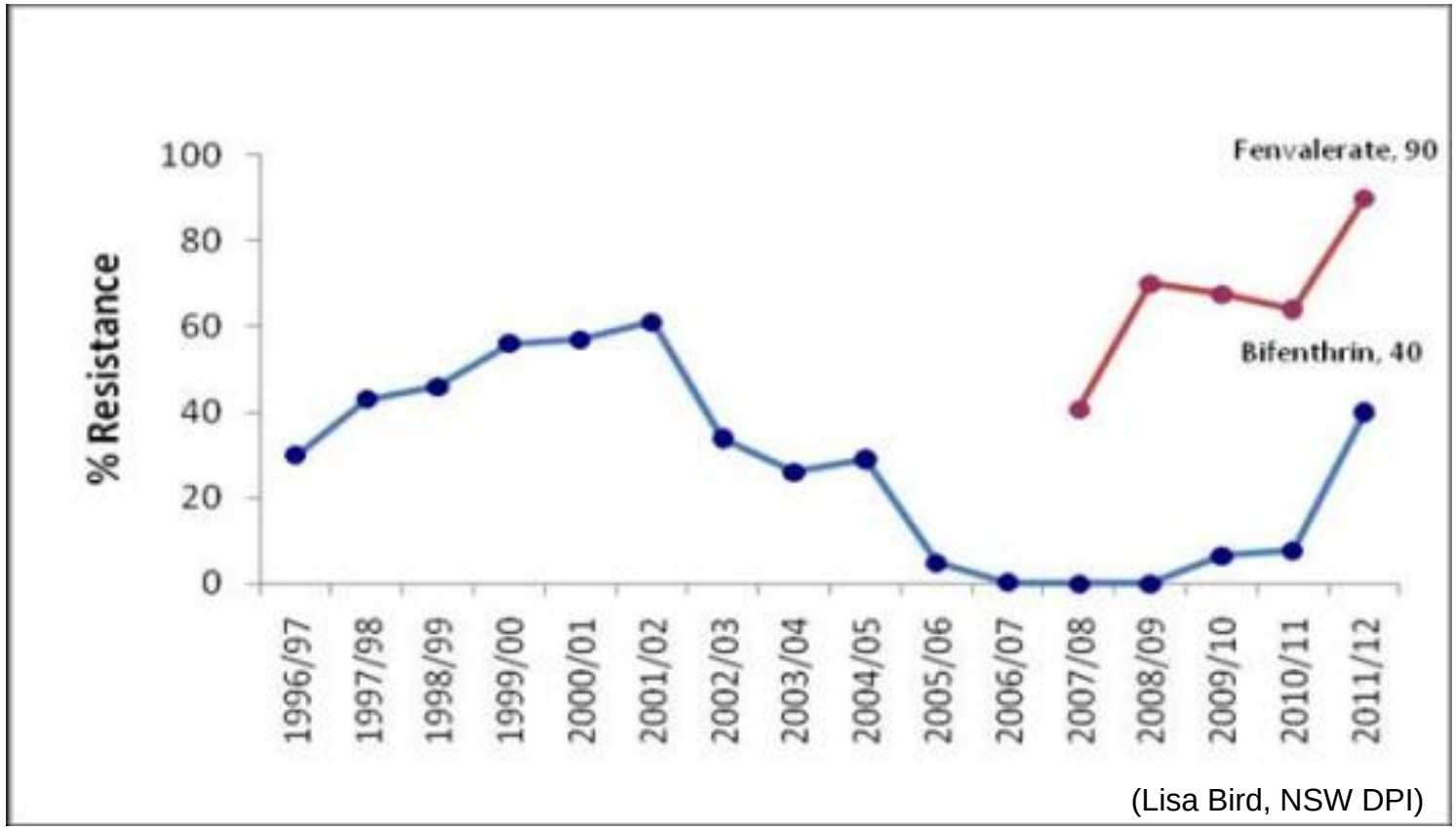
- Johnson grass – first generation in this host
- Successive generations in a local area – successive plantings and low MR varieties
  - 10 x increase in population each generation

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

Multipest considerations



(Lisa Bird, NSW DPI)

SP resistance in *Helicoverpa armigera* increased in 2011/12 season

Why?

- midge spraying in sorghum?
- sp use in chickpea?

Management and control

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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.

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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

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Trial work to date:
Characterised damage – dry and irrigated

Provisional threshold
- Need field validation of provisional threshold

Insecticide evaluation

Anthesis	Milky dough	Soft dough	Hard dough
Check for RGB Control warranted if >20-25 bugs/head		Control warranted if >30-50 bugs/head	No impact on yield or quality post physiological maturity

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Characterising damage

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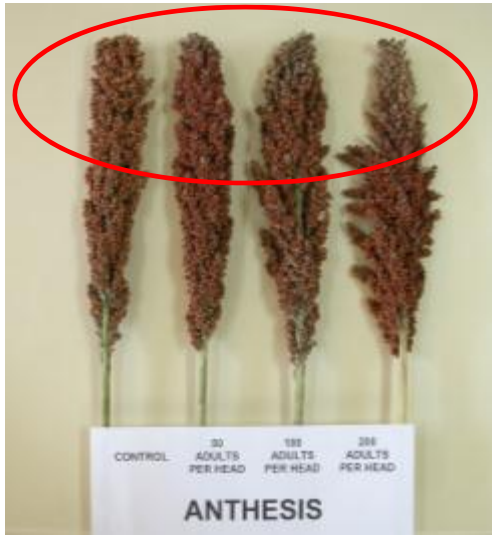

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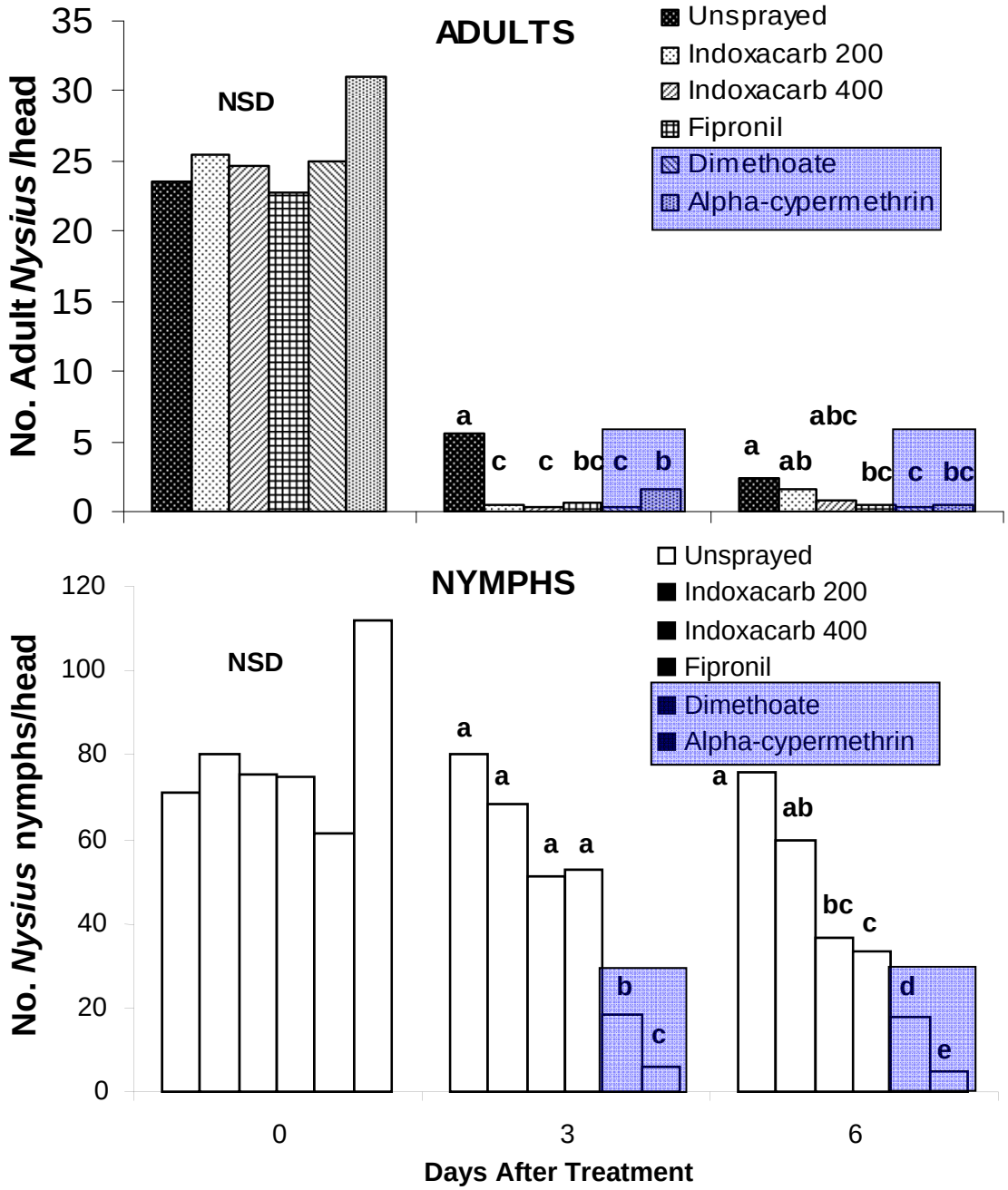
ADULTS
No. Adult Nysius /head
35
30
25
20
15
10
5
0
NSD
a
c
c
bc
c
b
a
ab
abc
bc
c
bc
Unsprayed
Indoxacarb 200
Indoxacarb 400
Fipronil
Dimethoate
Alpha-cypermethrin
NYMPHS
No. Nysius nymphs/head
120
100
80
60
40
20
0
NSD
a
a
a
a
b
c
a
ab
bc
c
d
e
0
3
6
Days After Treatment

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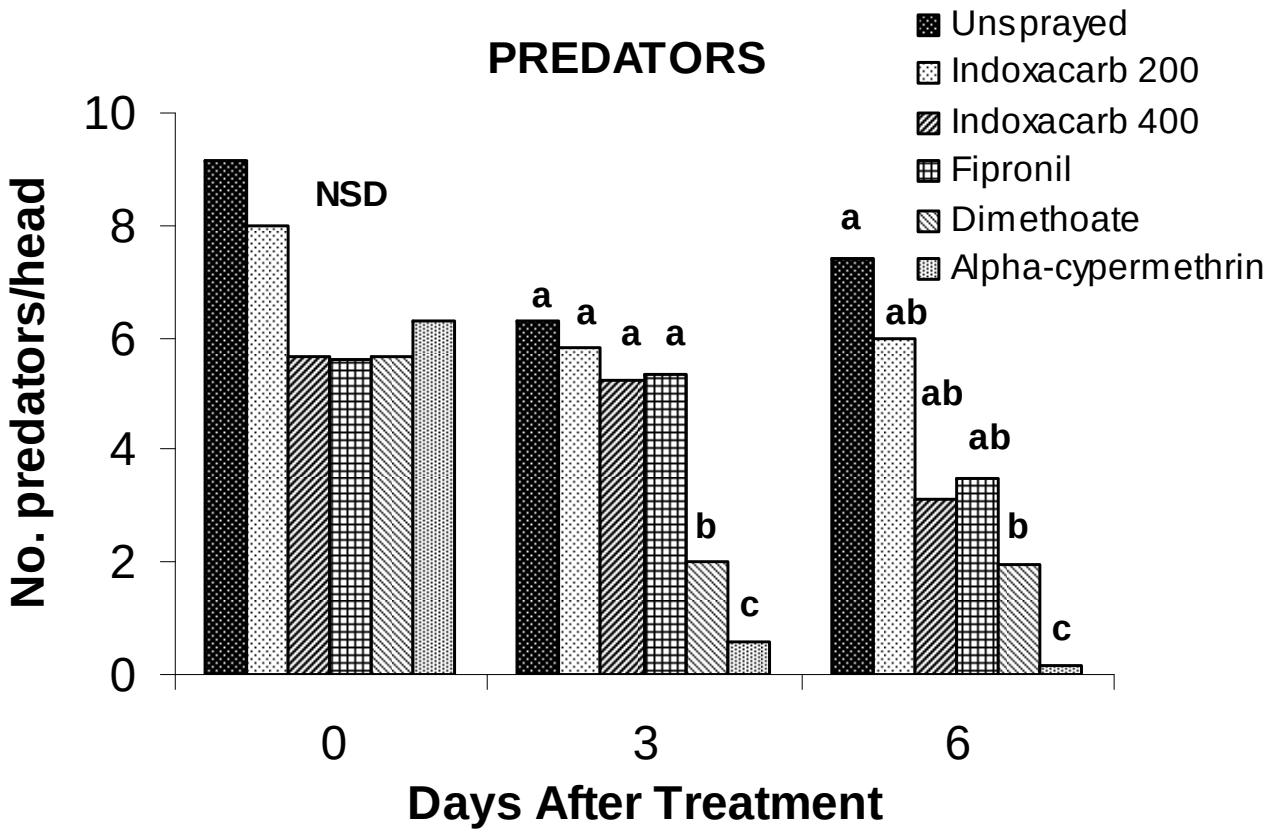
RGB in sorghum insecticide evaluation – impact on predators (mainly spiders)



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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

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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

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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

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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

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