Decision Making
for Insect Management
in Grain Crops

Pest Management in Canola

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Contents

Decision Making for Insect Management in Grain Crops

Key canola pests

<table>
<tr><th>Pest group</th><th>Emergence</th><th>Vegetative</th><th>Flowering – Grain fill</th></tr>
<tr><td>Earth mites</td><td style="background:#FFC000"></td><td></td><td></td></tr>
<tr><td>Lucerne flea</td><td style="background:#FFC000"></td><td></td><td></td></tr>
<tr><td>Caterpillars (cutworms, loopers)</td><td style="background:#FFC000"></td><td></td><td></td></tr>
<tr><td>Beetles (weevils, false wireworms)</td><td style="background:#FFC000"></td><td></td><td></td></tr>
<tr><td>Slugs</td><td style="background:#FFC000"></td><td></td><td></td></tr>
<tr><td>Earwigs, millipedes, slaters</td><td style="background:#FFC000"></td><td></td><td></td></tr>
<tr><td>Snails</td><td style="background:#FFC000"></td><td style="background:#FFC000"></td><td style="background:#FFC000"></td></tr>
<tr><td>Aphids</td><td></td><td></td><td style="background:#FFC000"></td></tr>
<tr><td>Diamondback moth</td><td></td><td></td><td style="background:#FFC000"></td></tr>
<tr><td>Native budworm</td><td></td><td></td><td style="background:#FFC000"></td></tr>
<tr><td>Rutherglen bug</td><td style="background:#FFC000"></td><td></td><td style="background:#FFC000"></td></tr>
</table>

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Canola establishment

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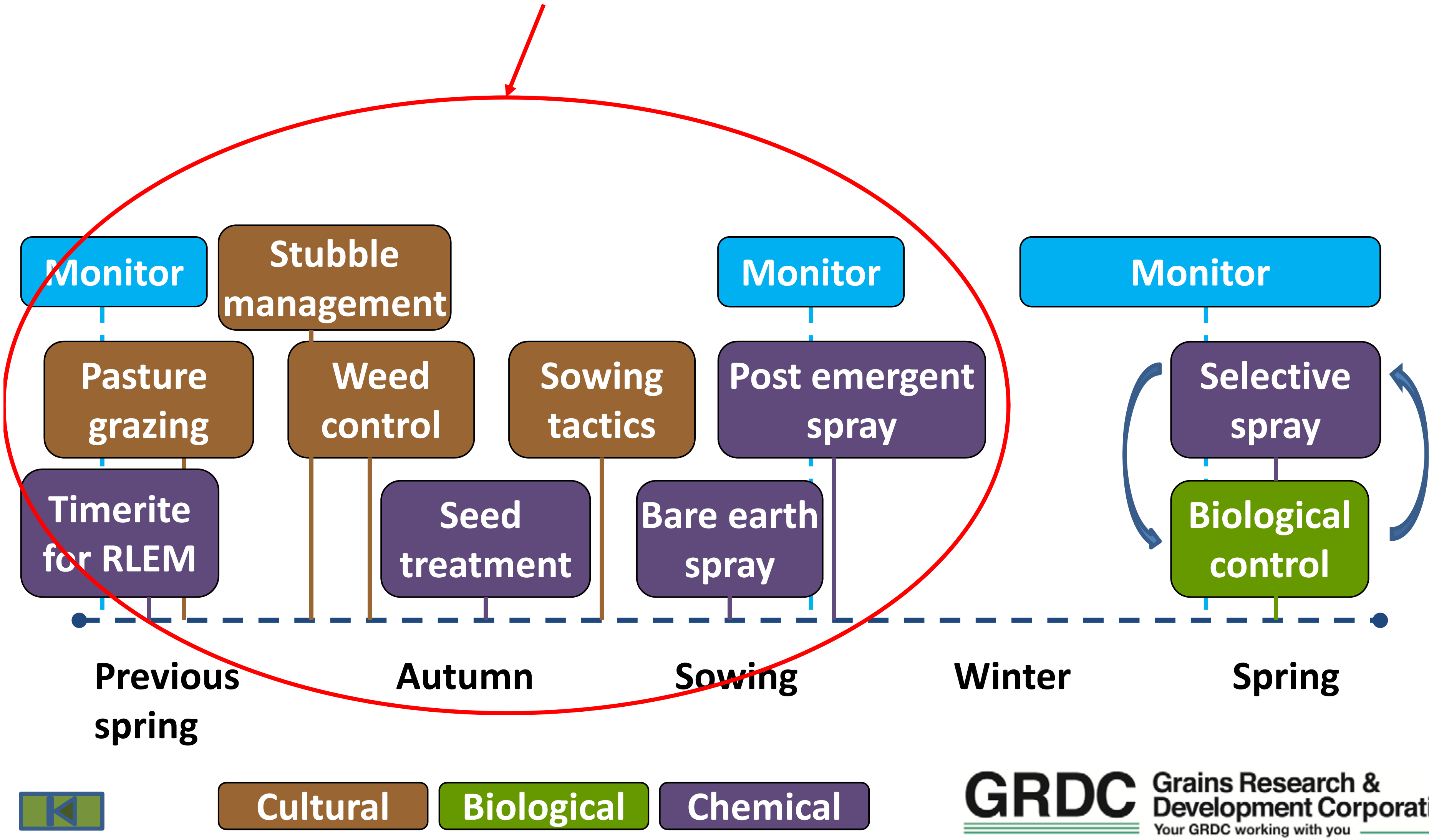
Decision timeline

Decision Making for Insect Management in Grain Crops

Planning ahead gives you more options



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Decision timeline

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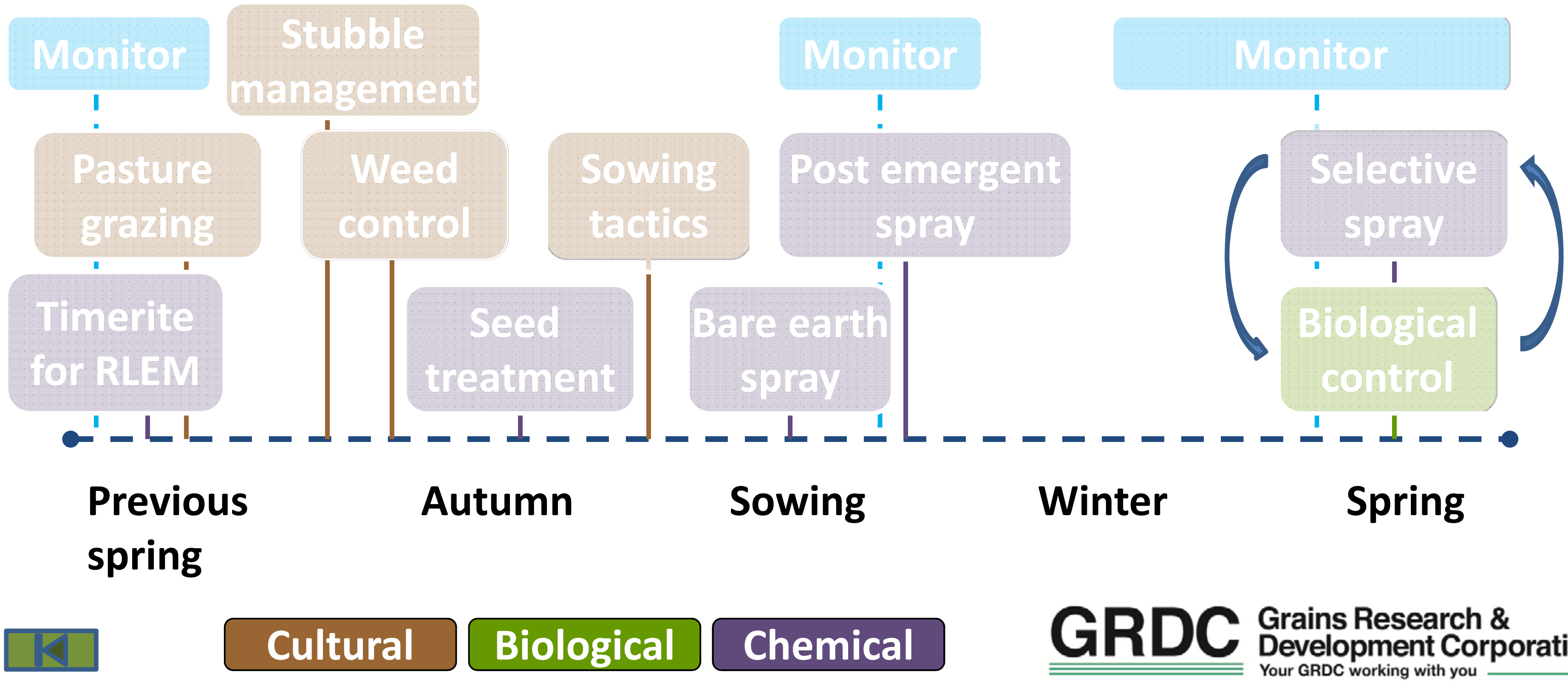
What are the risks?

Mites, lucerne flea, Slugs, snails, earwigs, millipedes, slaters

Aphids
Diamondback moth
Native budworm



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Canola Aphids

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Canola aphids

Cabbage aphid

- Greyish colonies on growing tips
- Thick powdery wax covering

Turnip aphid

- Yellow/green colonies on growing tips
- Finer wax covering
- More common in drier years

Green peach aphid

- Sparse colonies on the underside of lower leaves
- Important vector of BWY Virus

Aphid damage

Direct feeding – high populations

- Sucking, removal of nutrients
  – wilting, flower abortion, reduced pod set
- Impact on the crop depends on:
  – timing (early vs late)
  – severity (intensity and duration)
  – plant stress (compensation, aphid growth)

Virus spread – few individuals needed

- Beet Western Yellows Virus spread by green peach aphid

Cabbage aphid colony on the main raceme

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Risk factors

- *Brassica* green bridge (virus)
- Weather
- Low beneficial activity
- 'Hard' chemistry (any pest)

Mitigating factors

- Weather
- Beneficials

Lacewings

Hoverflies

Nabids

Ladybirds

Parasitoids

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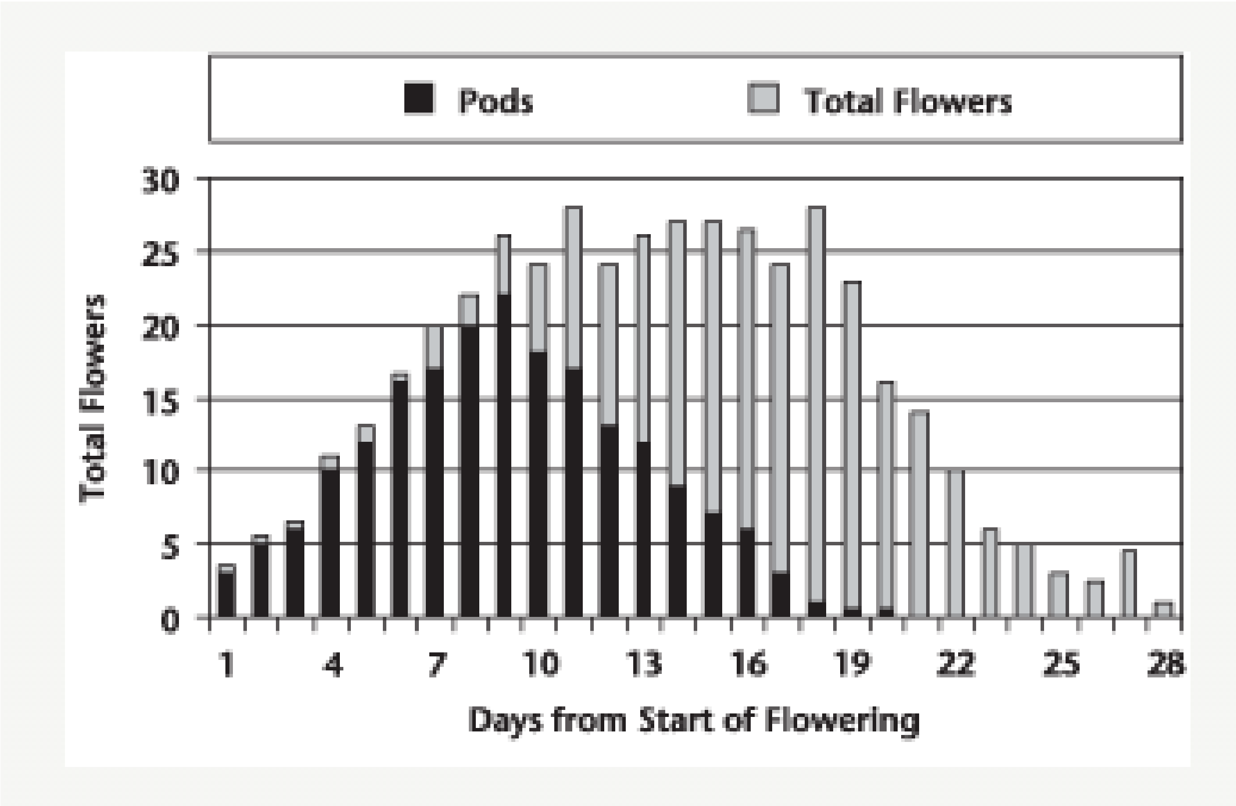
Yield impact / thresholds

- Estimating infestation – plants/stems
- Crop stage & stress
- Predicted weather
- Potential for compensation?

Few demonstrated examples of yield loss in Australian literature

- Thresholds: 10-50% infestation + limited compensation capacity

Crop physiology knowledge needed



Source: Canola Council of Canada. Canola Grower's Manual. Chapter 3: Growth Stages.

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Simulated aphid damage trial. Allora, 2013.

Treatment	Yield (t/ha)
Control	2.07 a
10% of terminals removed	1.93 a
50% of terminal removed	1.98 a
90% of terminal removed	2.01 a

Treatments followed by the same letter are not significantly different ($P < 0.05$).

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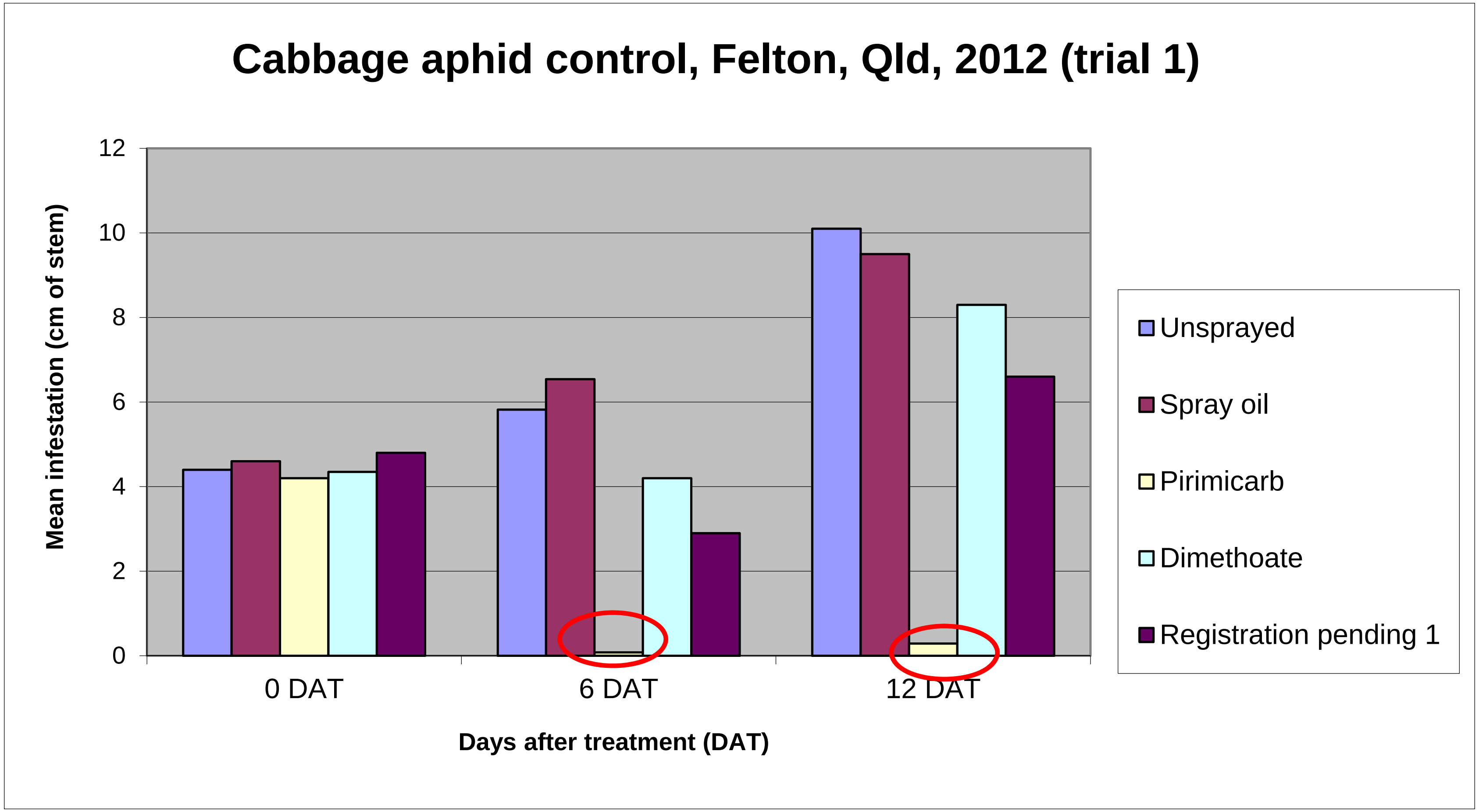
Insecticides for aphids



N.B. dimethoate is not registered for control of aphids in canola

Best bet table – options for management and control

Spring	Monitor <u>trends</u> in aphid and beneficial populations in crops over time. Use thresholds to guide spray decisions, considering crop stage (% flowering) and moisture stress. High risk where • Infestation rapidly increasing during early flowering to bud formation • Forecast is for warm and dry conditions to continue • Low/no parasitism and beneficial activity (note: this can also happen if SPs/OPs are used to control DBM/native budworm). If spraying: • Consider border sprays with a selective aphicide (pirimicarb) to prevent/delay build-up and retain beneficials • Use soft products (pirimicarb or petroleum spray oils) to retain beneficials • Rotate insecticide MOAs to reduce resistance selection in green peach aphid.

Green peach aphid: Insecticide options

Managing GPA in canola and pulses

- Possible resistance to imidacloprid?
- Implement resistance management strategies, such as rotating chemicals, avoid 'insurance sprays' and apply chemicals only after monitoring and correctly identifying pest species
- Report chemical control failures; don't necessarily assume application issue (includes imidacloprid!)
- Reduce the availability of alternative plant hosts and consider border sprays
- Consider role of beneficials; ds over time

Economics of spraying

Expected yield x price

Crop Value per ha	Control costs per hectare (chemical + application)						
	$10	$15	$20	$25	$30	$35	$40
$500	2 (%)	3	4	5	6	7	8
$750	1.3	2	2.7	3.3	4	4.7	5.3
$1000	1	1.5	2	2.5	3	3.5	4
$1250	0.8	1.2	1.6	2	2	2.8	3.2
$1500	0.7	1	1.3	1.7	2	2.3	2.7
$2000	0.5	0.8	1	1.3	1.5	1.8	2
$2500	0.4	0.6	0.8	1	1.2	1.4	1.6

Table values: % future yield loss before spraying is economically justified

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Diamondback moth (DBM)

Risk assessment, control and insecticide resistance management

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Diamondback Moth (DBM)

- Periodic outbreaks in spring
  - every 3-4 years in SA and NSW, Victoria
- Larvae feed on leaves, buds, flowers and pods
  - defoliation, reduced seed number & size
- In green-bridge years can attack establishing canola



Risk Factors for DBM

Decision Making for Insect Management in Grain Crops

High risk	Reduced risk	Low risk
• High summer rainfall creates *Brassica* green bridge • Warm and dry weather July through spring • No major rainfalls • Broad-spectrum sprays killing beneficials	• Significant heavy rainfall (>10mm) dislodges and drowns larvae • High beneficial activity	• Cool, moist conditions late winter through spring • Epizootics of fungal disease (e.g. *Zoophthora radicans*)

Lincoln weed
Perennial DBM host

Diadegma semiclausum
Key DBM parasitoid

DBM larva infected by
Z. radicans

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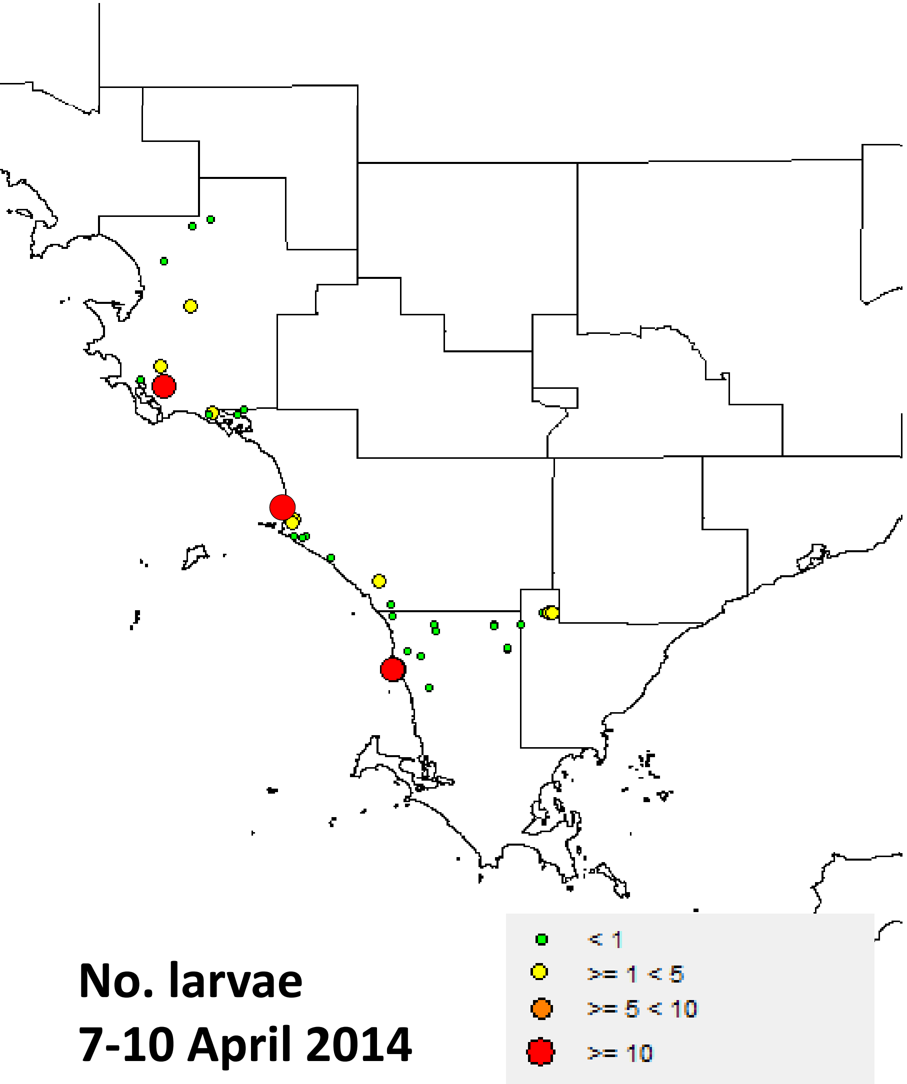
DBM over-summer on non-crop *Brassicas*

Results: Field sampling on Eyre Peninsula, March-April 2014

Source: K. Perry, 2014

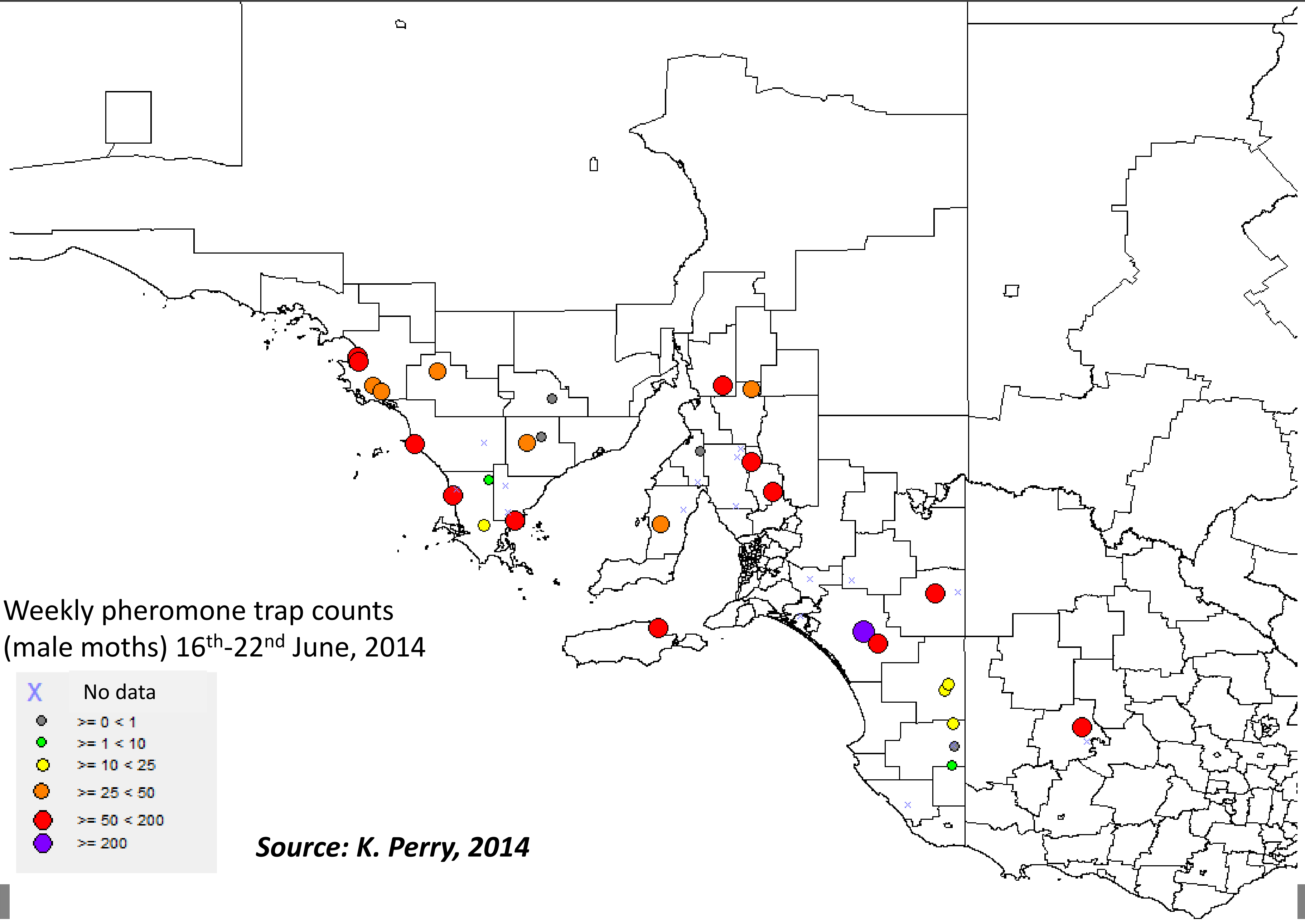
Sea rocket
Cakile maritima

Lincoln weed
Diplotaxis sp.



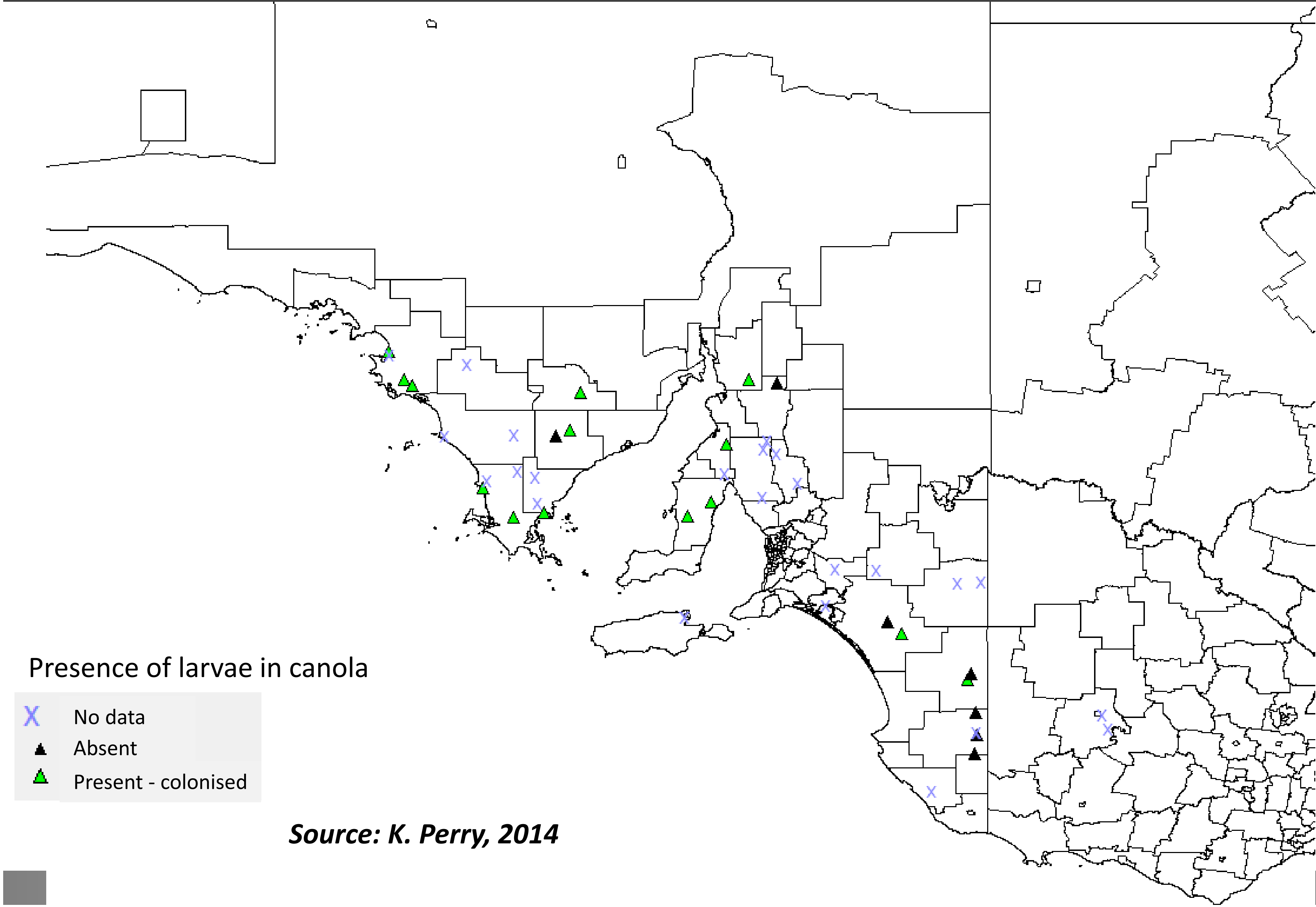
No. larvae
7-10 April 2014

… high moth activity in canola, early 2014



Source: K. Perry, 2014

… early colonisation of canola (larvae) in 2014



Source: K. Perry, 2014

Weather effects on DBM

- Develop quickly in warm weather; slower in cool weather
  E.g. at **15^{O}C**, lifecycle takes approx **47** days,
  at **28^{O}C**, lifecycle takes approx **14** days
  - **DBM Development Calculator reduces "guess" work (available on AUSVEG website - google "Diamondback Moth development calculator")**
- Rainfall causes direct losses and can induce disease outbreaks
- Drought conditions mobilize nitrogenous compounds in plants, which stimulate DBM growth and development

Zoophthora infected larvae and adult

tion

DBM Spray Thresholds Guidelines

Decision Making for Insect Management in Grain Crops

- Crop stage and plant moisture status is key
- Minimum of 5 sets of 10 sweeps
- Calculate larvae per 10 sweeps

Crop stage	Moisture stressed?	Spray threshold (grubs/10 sweeps)
Pre-flowering	Yes	> 30
	No	> 50
Majority in flower	Yes	< 100-200
	No	> 100-200

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DBM Insecticidal Control Challenges

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- Overlapping generations
- Larvae distributed throughout canopy
- Spray penetration – often poor
- Rapidly evolves insecticide resistance
  - R to SPs, OPs & carbamates
- Product selection, good coverage critical for good control

RESISTANCE: Widespread to SPs, OPs and carbamates

% Mortality at Discriminating Dose (the dose that kills 99.9% of susceptible DBM), 2008-2011

DBM Strain	SP Alpha-cyper-methrin	OP Diazinon	Group 6 Affirm	Group 5 Success Neo	Group 28 Coragen
Wanilla 2008	35				
Eyre Pen. 2009	10		95		
Mt. Hope 2009	13		100		
Tammin WA 2009	15		100		
Meckering WA 2009	7		100		
Albany WA 2009	18		100		
Mt. Hope 2010	6	84	96		
Wudinna 2011	19	83	98		
Neridup/Condinup (7) WA 2011	7-30	46-80	86-99		

Source: G. Baker and K. Powis (SARDI)

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SP's ineffective

Source: G. Baker and K. Powis (SARDI)

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Diazinon R lower than SP's

Source: G. Baker and K. Powis (SARDI)

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NS Affirm R detected prior to 2011

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But significant shift in R to Affirm detected in WA in 2011

Source: G. Baker and K. Powis (SARDI)

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Nundroo 2013	20	43	23		12.5
Mallala 2013	10	28	50	80	50
Victor Harbour 2013	25	14	93	97	98
York WA 2013	8	10	68	98	95
Meg's, Lincoln weed Mar 14	33		63	70	25
Pt Kenny, Lincoln weed Mar 14	20		70	67	67
Calca, Lincoln weed Mar 14	25		57	80	48
Point Drummond, volunteer canola Mar 14	6		89	80	83
Picnic Beach, sea rocket Mar 14	41		80	66	40
Walker's Bch, sea rocket Mar14	40		80	75	60

Source: G. Baker and K. Powis (SARDI)

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SP & OP R higher than 2008-11

Source: G. Baker and K. Powis (SARDI)

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[illegible]ker’s Bch, sea rocket Mar14	40		80	75	60

Affirm R widely detectable

Source: G. Baker and K. Powis (SARDI)

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Success Neo R also widely detectable

Source: G. Baker and K. Powis (SARDI)

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Group 28 R also widely detectable

Source: G. Baker and K. Powis (SARDI)

DBM Control and Insecticide Resistance Management

Highest Resistance Factor values (at LC_{50}) recorded for each insecticide:

Insecticide	Year of 1st registration	Veges	Canola
Diazinon	1960's	-	45.4
B. t. kurstaki	early 1970's	3.7	-
ά-cypermethrin	~1980	43.8	600
Ema. benzoate	1998	30.7	17
Spinosad/Spinetoram	1999	4.6	2.6
Indoxacarb	2000	12.0	-
Chlorantraniliprole	2009	55.2	51

Source: G. Baker and K. Powis (SARDI)

DBM Insecticidal Options in Canola

Decision Making for Insect Management in Grain Crops

MOA Group	Product (Chemical name)	DBM Efficacy	Toxicity to Beneficials And Bees	Current Resistance Risk
5	Success Neo® (Spinetoram)	Good	Moderate	Low
6	Affirm® (Emamectin benzoate)	Good	Moderate	Higher
11	Dipel®, etc. (Bacillus thuringiensis)	Good where: 1) applied at 100L/ha, 2) larvae up to 5-8mm	Nil	Low

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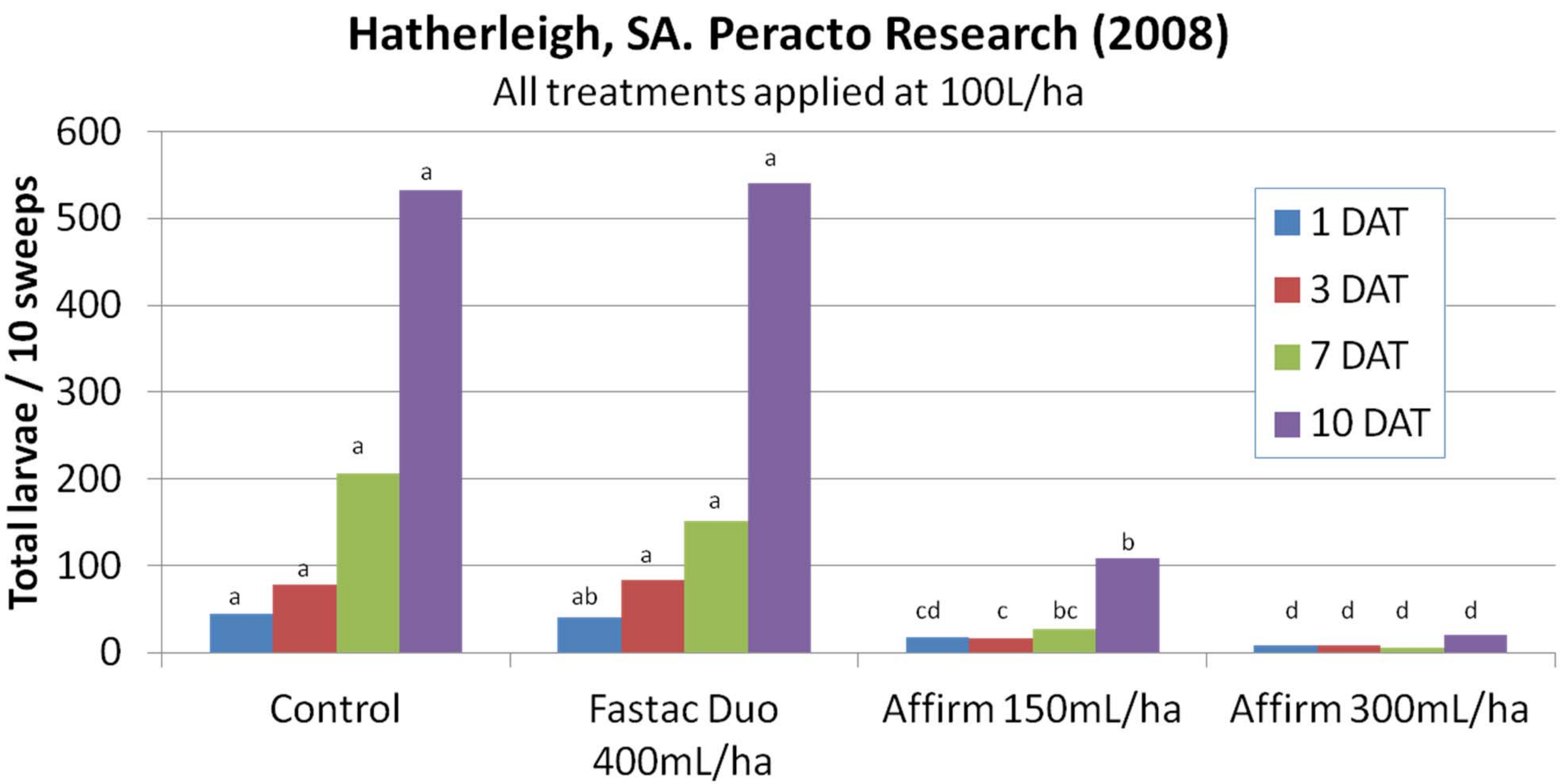
22A/15	Test product (Indoxacarb/ Novaluron mixture)	Good	Moderate	Low

oration

DBM Insecticide Efficacy

Decision Making for Insect Management in Grain Crops



Source: G. Baker (SARDI)

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DBM Insecticidal Efficacy – 2013 trial

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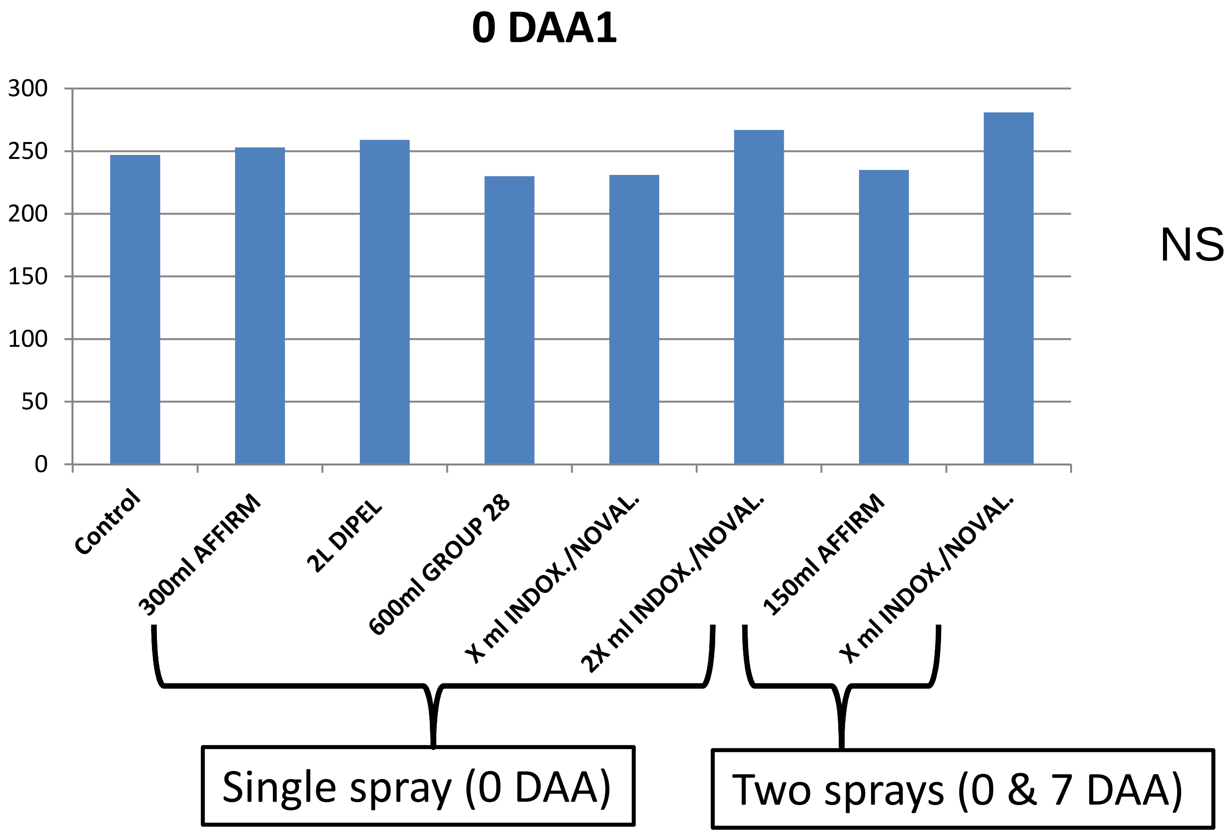
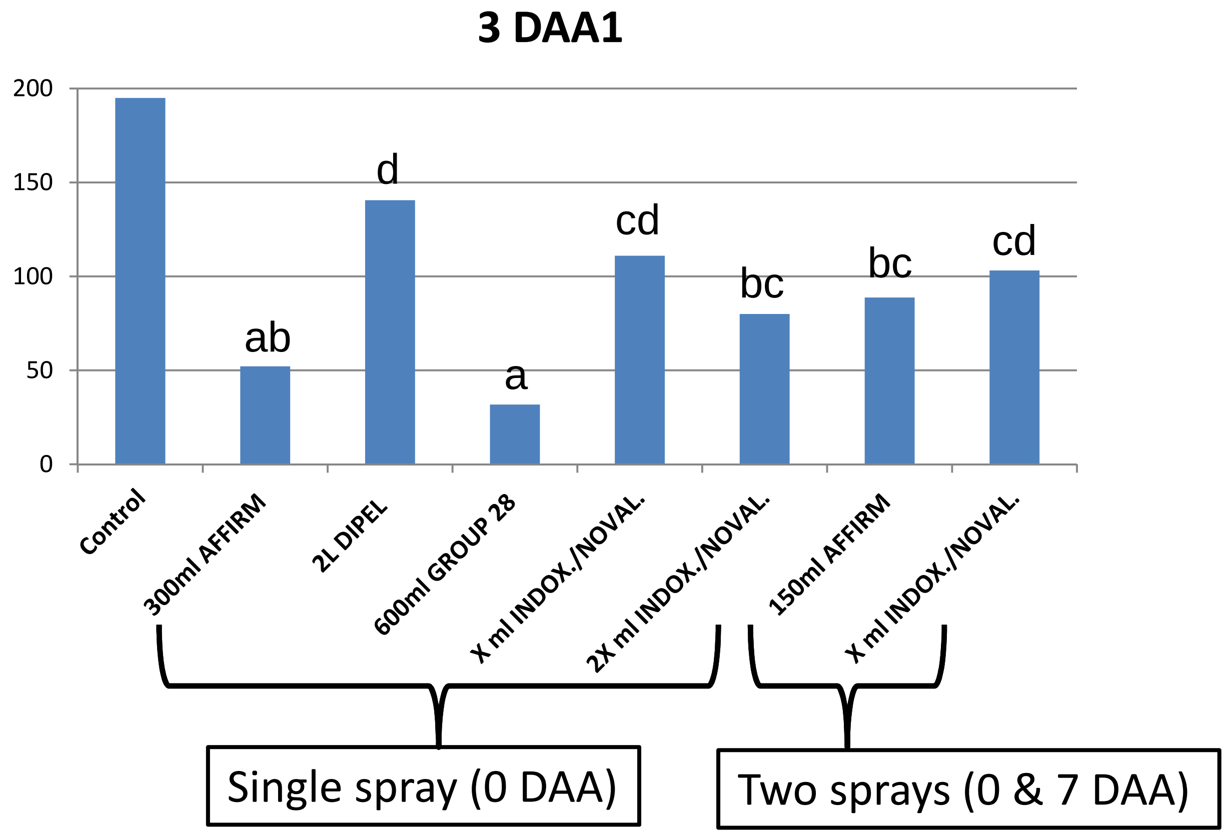


NSD pre-treat

Source: G. Baker (SARDI)

DBM Insecticidal Efficacy – 2013 trial



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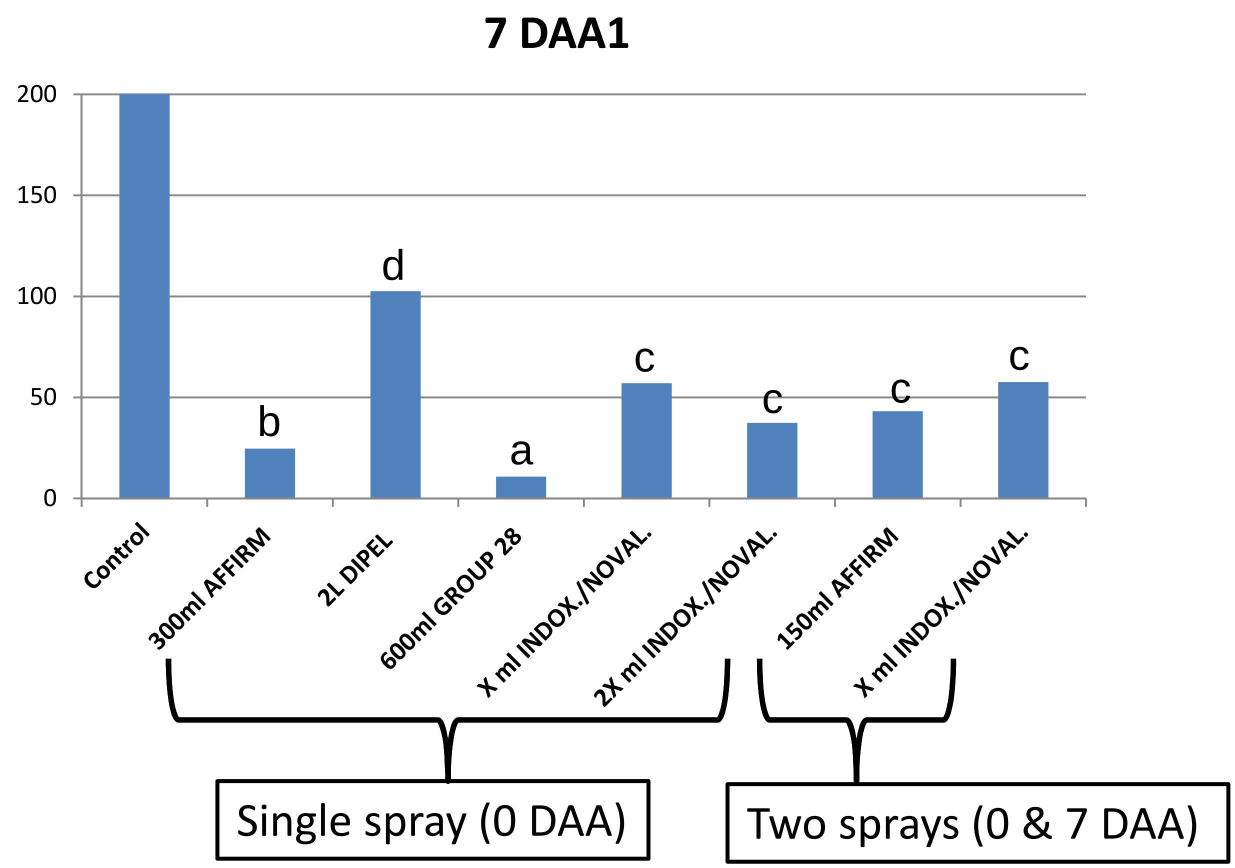
DBM Insecticidal Efficacy – 2013 trial



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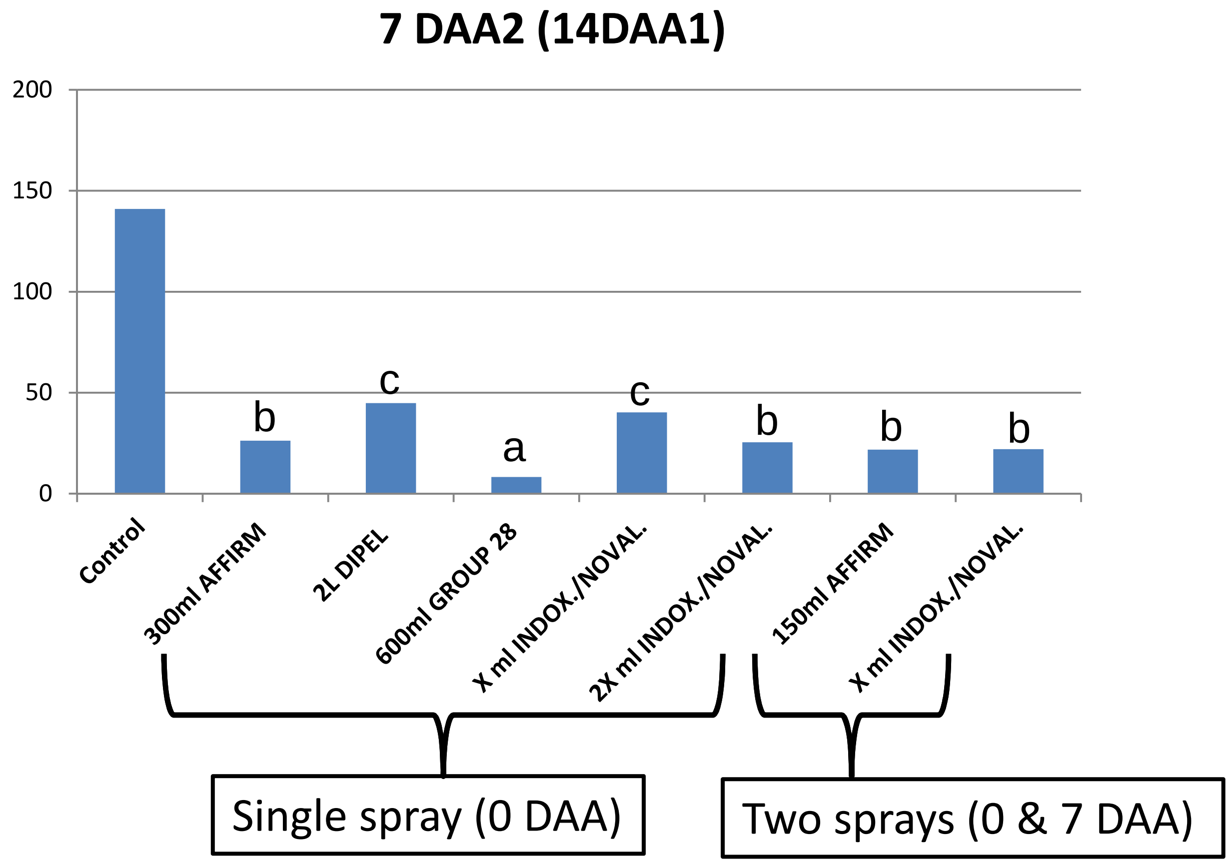
DBM Insecticidal Efficacy – 2013 trial



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Potential New DBM Management Tactic

- Attract and Kill
  - Magnet ™ (Prof Peter Gregg UNE)
    - Moth food attractant + insecticide (eg. spinetoram)
    - Developed for *Helicoverpa* control in Nth pulses
    - Trials underway for DBM control in canola
  - Advantages
    - Less insecticide a.i. / ha
    - Potentially less disruptive to natural enemies
    - Assist with resistance management

Decision Making for Insect Management in Grain Crops

DBM Management - Key Messages

- Manage *Brassica* green bridge
- Frequently monitor DBM numbers and risk of exceeding thresholds
- If spraying:
  - Bt (<8mm larvae)
  - New chemistry
  - Rotate MOA across seasons
  - Avoid SPs and chlorpyrifos

DBM Control and Insecticide Resistance Management

Spray Coverage Trials

Impacted doses on undersides of leaves and mid to lower canopy (0-0.2µl cm^{-2}) inadequate for good DBM control.

Best doses on upper plant parts ~0.4µl cm^{-2}.

Insecticide	Potter Tower applied LC_{99} dose*	Maximum field dose*
α-cypermethrin	0.032	0.2
Diazinon	0.53	2.8
Ema. benzoate	0.00077	0.0255

*µg ai cm^{-2}

UWA-led project to investigate spray coverage/spray drift.

Native budworm

Native budworm in canola

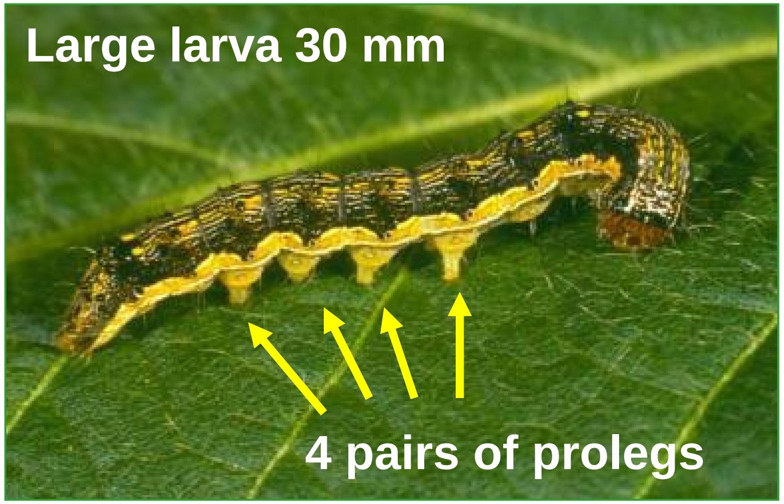
- Sweep net from flowering/podding until late maturity
- Dynamic thresholds based larvae per 10 sweeps
- SPs may impact DBM/aphids
- *Bt* or NPV for small larvae (< 7-8mm)

Mature native budworm larva burrowing into a canola pod

Native budworm life stages

Helicoverpa punctigera

Eggs: fresh, brown ring, about to hatch **Only 0.6 mm diameter**



Helicoverpa size categories			
Very small	Small	Medium	Large
1-3 mm	4-7 mm	8-23 mm	24-30+ mm

90 % of damage caused by these larvae

Decision Making for Insect Management in Grain Crops

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Monitoring budworm

Decision Making for Insect Management in Grain Crops

Early warning – moth activity

– Pheromone traps

In-crop monitoring

– Sweep net

Dynamic thresholds for native budworm

	K – grain loss kg/larva/ha	**P –** grain price $/tonne	**C –** cost of control $/ha	**ET –** larvae per 10 sweeps
Field peas	**50**	350	10	**0.6**
Lentils	**60**	435	10	**0.4**
Faba bean	**90**	335	10	**0.3**
Chickpeas - desi	**30**	275	10	**1.2**
Canola	**6**	580	10	**2.9**
Lupins	**7**	300	10	**4.8**

ET = (C x 1000) / (K x P)

**Developed in Western Australia:* Source: DAFWA

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Rutherglen bug (RGB)

- Highly sporadic
  - weather dependent
- Suck sap from leaves, stems, flowers, pods
  - wilting, reduced seed yield/oil quality
- Highly mobile
  - long distance migration
- Multiple life-stages

Risk factors for RGB

High risk	Reduced risk	Low risk
• Moisture stressed plants **Autumn** • Weeds drying off in/near crops • Warm conditions in late summer/autumn **Spring** • Hot/dry spring and early summer • Long distance migration into cropping areas	• Plants not moisture stressed (autumn & spring) • High egg parasitoid activity (e.g. *Telenomus* sp.) 	**Autumn** • Later germinating crops (after nymphs disappear) **Spring** • Cool/wet conditions • No long distance migration (best monitored locally)

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RGB – best bet IPM strategy

Summer/autumn	Spring
• Remove summer weeds near crops > 4 weeks before sowing • Insecticide seed treatment • Monitor during establishment (along with other pests) • Spot spray as needed	• Monitor from flowering to windrowing • Thresholds – 10 adults or 20 nymphs per plant (consider moisture stress) • Registrations limited to SP/OPs - may flare aphids/DBM/native budworm • Spot spray crop/ nearby weeds as needed • Monitor for re-invasion

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Insecticide options in canola

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Insecticide options - spring canola

MOA		Green peach aphid	Cabbage, turnip aphids	DBM	Native budworm	Rutherglen Bug	Beneficial toxicity
11	*Bt*			<8mm	<8mm		Very Low
	Petroleum spray oils		(s)	Mix *Bt*	(s)		Very Low
	NPV				? <7mm ?		Very Low
1A	Pirimicarb	R					Very Low
6	Emamectin						Mod
4C	Sulfoxaflor						
5	Spinetoram						Mod
1A	Methomyl			R?	WA		High
1B	OPs	R		R			High
3A	Pyrethroids	R		R			Very High

R = resistance (s) = suppression

Registered

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Key messages

- **Planning ahead** gives you more options
- **Assessing risk** (establishment pests, aphids/DBM) helps decide which management approach to take
- **Manage resistance** in DBM by rotating MOAs across seasons
- Avoid using hard chemistries (SPs/OPs) in spring canola
  - Resistance management
  - Aphid flares

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Supporting research organisations

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NSW Government
Department of Primary Industries

cesar

SARDI
South Australian Research and Development Institute

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