Decision Making
for Insect Management
in Grain Crops

Integrated Pest Management pilot workshop for advisors

Winter Pulses - South

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Key pests of winter pulses

Chickpeas, faba beans, lupins, field peas, lentils

Pest	Emergence	Vegetative	Flowering	Podding - Grainfill
Mites				
Lucerne flea				
Weevils				
Snails				
Aphids				
Helicoverpa				
Pea Weevil (peas)				
Etiella (field pea, lentils)				

Will focus on these pests

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Viruses & Pulses

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Management requires an integrated approach

Viruses are

- aphid-vectored
- Some are seed-borne

Cowpea aphid on volunteer vetch (photo K. Perry)

Increased risk if:

- High rainfall (> 500 mm/year)
- Irrigation region
- Clover/medic pastures and other hosts nearby
- Green bridge (weeds and volunteers)

Aphid virus transmission

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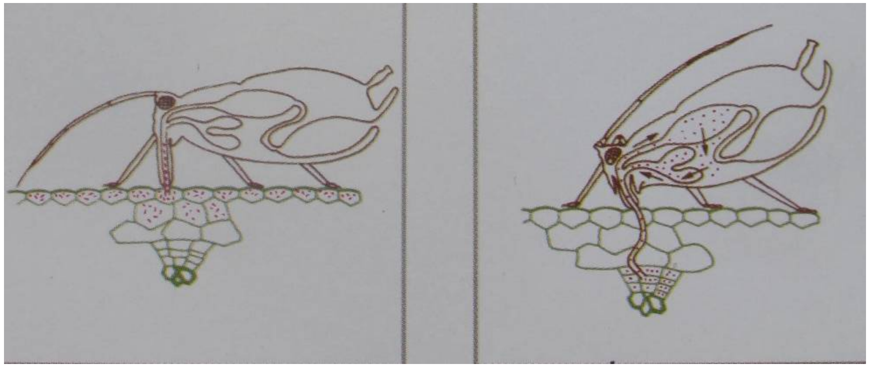
Non-Persistent (N-P) vs. Persistent (P)

CMV
AMV
BYMV



BLV
BWYV

(image: D Persley, DAFF Qld)

Need only very short feeding times

Need feed for several hours to acquire virus

Insecticides not usually fast enough to reduce transmission

Insecticides may reduce virus transmission

- Monitoring and aphid thresholds do not apply to aphids carrying virus

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Assessing risk: aphids and virus transmission

GREEN PEACH APHID (*Myzus persicae*) | PEA APHID (*Acyrthosiphon pisum*) | COWPEA APHID (*Aphis craccivora*) | BLUEGREEN APHID (*Acyrthosiphon kondoi*)

Transmission of viruses by different aphid species

Aphid species	Cucumber mosaic virus (non-persistent)	Pea seed-borne mosaic virus (non-persistent)	Beet western yellows virus (persistent)
Green peach aphid	✓	✓	✓
Pea aphid	✓	✓	
Cowpea aphid	✓	✓	✓
Bluegreen aphid	✓		

Ex GRDC factsheet "Aphids and viruses in pulse crops"

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Managing aphids and virus impact

Minimise sources of virus (green bridge, weeds)

Sow

- virus-free seed
- resistant cultivars
- Into standing stubble
- Higher seeding rate

Control

- Seed dressing where risk of persistent virus

Virus-infected plants scattered through a chickpea crop

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Flowering to grain fill

Helicoverpa

Aphids

Pea weevil

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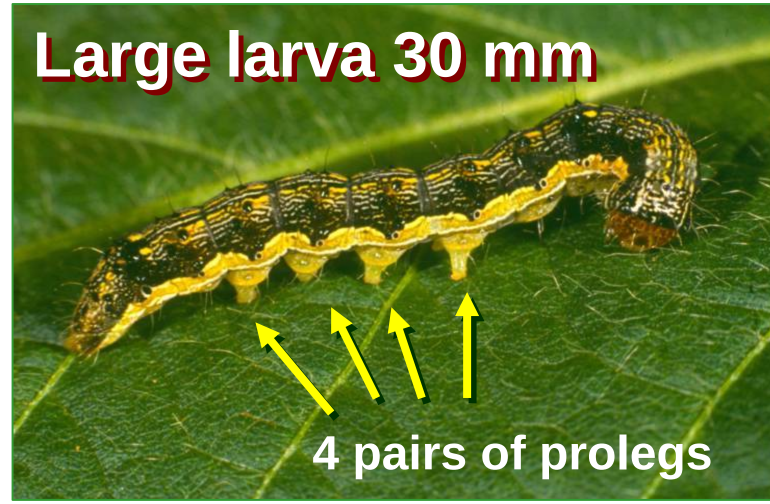
Helicoverpa lifestages

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

80% of damage caused by these larvae

Large larvae showing the distinguishing dark and pale hairs behind their heads.

Monitoring helicoverpa

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Early warning – moth activity

- Pheromone traps (*H. armigera* and *H. punctigera*)
- Emergence model for *H. armigera* (**http://cottassist.cottoncrc.org.au/DIET/about.aspx**)

In-crop monitoring***

- Sweep net
- Beatsheet

***use the method appropriate to the threshold

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Managing helicoverpa

- Assess risk (local and inland sources)
- Determine monitoring strategy
- Monitor when crop is susceptible
  - record population over time (survival)
  - assess natural enemy activity (predators, parasitoids) use economic threshold to guide decision
- **Softest option first**
- Assess post treatment
- Where *H. armigera* present, consider pupae-busting

Helicoverpa Thresholds

	Grain loss/ha (kg) per larva		Threshold
	WA (per 10 sweeps)	Qld (per m^2)	SA/Vic (per 10 sweeps)
Chickpea (desi)	30	20	5
Chickpea (kabuli)			2-3
Lupins	7		
Faba beans	90		2-3 4-8/m^2 (beat)
Field peas	50		5
Lentils	60		

Thresholds developed by DAFWA (sweep net)
* DAFF Qld threshold (helicoverpa collectively, beatsheet)

Economic thresholds

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$$Yield\ loss\ (\$/ha) = \frac{number\ helicoverpa\ larvae\ per\ m^2 \times 2.0* \times chickpea\ price\ (\$/t)}{100}$$

* 2.0 g grain per larva

Beatsheet ready reckoner

	Value of yield loss ($/ha)				
Chickpea price ($/t)	1 larva/m²	2 larva/m²	3 larva/m²	4 larva/m²	5 larva/m²
200	4	8	12	16	20
300	6	12	18	24	30
400	8	16	24	32	40
500	10	20	30	40	50
600	12	24	36	48	60

Sweep net ready-reckoner table

Control is warranted if the cost of control is less than the value of the yield loss predicted.

	Value of yield loss ($/ha)				
Chickpea price ($/t)	1 larva/10 sweeps	2 larva/10 sweeps	3 larva/10 sweeps	4 larva/10 sweeps	5 larva/10 sweeps
200	6	12	18	24	30
300	9	18	27	36	45
400	12	24	36	48	60
500	15	30	45	60	75
600	18	36	54	72	90

Value of yield loss = (cost of control x 1000)/ (30 x chickpea price)
based on DAFWA estimate of potential yield loss 30 kg/ha per larva/10 sweeps

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Helicoverpa in chickpea – threshold calculator

Helicoverpa is the only major insect pest of chickpea. Research has shown that the impact of one helicoverpa larvae (per square metre) completing development on the crop is a resultant loss of 2 grams of grain. This figure is used in estimating the potential yield loss and subsequently the economic threshold. The following calculator can be used to identify potential yield loss and provide an appropriate suggestion for action.

Helicoverpa threshold in chickpea

Steps in determining if control is warranted:

1. Sample the crop and record the number of small (S), medium (M), and large (L) larvae in each sample (e.g. 5 beatsheet samples of metre row).
2. Average the number of each size of larvae and enter into the relevant box
3. Enter the crop's row spacing and click the calculate button from mean larval density
4. Add your estimate of the cost of control (including application) and expected crop value to calculate potential yield loss and break-even economic threshold. (If you have a preferred cost:benefit, enter it to get a revised economic threshold).
5. You can then request a suggestion for action based on crop stage and selected threshold.

Number of larvae		
Very small (1-3 mm) = 1^{st} instar	0	*Note: due to high mortality and low damage rates, very small larvae are not included when calculating larval densities*
Small (4-7 mm) = 2^{nd} instar	0	*Note: Final density assumes a 30% mortality rate of these larvae*
Medium (8-23 mm) = 3^{rd} or 4^{th} instar	0	
Large (24-30+ mm) = 5^{th} or 6^{th} instar	0	
Row spacing (m)	1	
Mean larval density (per m^2) after factoring in likely mortality:		0.00
		Calculate

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Do receival standards for defective grain make yield thresholds irrelevant?

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Faba bean as an example

Cost of control ($/ha)	Grain price ($/t)		
	300	400	500
15	0.6	0.4	0.3
20	0.7	0.6	0.4
25	0.9	0.7	0.6
30	1.1	0.8	0.7
35	1.3	1.0	0.8
40	1.5	1.1	0.9

Based on DAFWA yield loss estimate of 90 kg/ha per larva per 10 sweeps.

Faba beans Canning grade	**2% Max by weight,** includes 1% Max by weight Poor Colour
Faba beans #1 grade	6% Max by weight includes 3% Max by weight Poor Colour **3% Max by weight total of all other Defects**
Faba beans #2 grade	**10% Max by weight**, includes 7% Max by weight Poor Colour
Faba beans #3 grade	**20% Max by weight** of which 7% Max by weight bin burnt, caked, heat damaged, sprouted

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Other considerations

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Egg and early instar mortality high

Hot weather – small larvae burrow

Soft options – NPV, Bt?

Target small – medium larvae

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Aphids – direct damage

	Threshold
Chickpea	None
Lupins	Treat at appearance of clusters on flowering plants (NSW)
Faba beans	10% plants heavily infested (Vic)
Field pea	None. Assess % plants infested.
Lentil	

Southern region – 'Best Bet' IPM strategy for winter pulse pests

	Aphid vectors and virus source	Aphids – direct damage (not virus) Cowpea; Green peach; Blue-green; Pea aphid	Pea weevil
Post harvest, pre-sowing	Control green bridge (in fallows) Sow virus-free seed. Sowing into standing stubble may reduce aphid landing.	Remove green bridge (aphid hosts) to minimise build up during autumn and spring. Sowing into standing stubble may reduce aphid landing and delay aphid build up in crops.	
Establishment - Vegetative	Assess risk of aphid outbreak High risk when: • warm, mild conditions, • abundant weed hosts, • nearby sources e.g. clover/medic Aim to close canopy and minimse gaps; outcompete infected plants (source of virus).	Control in-crop weeds to minimise sources of aphids. Conserve beneficial insects that will suppress small aphid populations and reduce the likelihood of outbreaks. High nitrogen may make the crop more attractive to aphids.	
Flowering - maturity	Conserve and monitor beneficials that suppress aphids.	Conserve and monitor beneficials that suppress aphids.	Use temperature model to predict timing of movement.

Additional information

Slides in this section cover specific issues that are relevant to only some regions.

Chickpea virus outbreak 2012

Etiella in lentils

Pea weevil management

Chickpea virus outbreak 2012

NSW and Qld

- BWYV implicated – suspect canola a source (turnip weed, marshallow and Shepherd's purse also hosts).
- Another virus group identified (phasey bean)
- Aphids likely vectors

Virus in chickpea

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Edgeroi chickpea crop (11km NW of Edgeroi) with ~50% symptomatic plants throughout block 2012. (M. Sharman, DAFF)

Virus symptoms in chickpeas showing reddening 2011 (M. Sharman, DAFF)

- Losses are often difficult to estimate but can be 100% if infections are early in the cropping cycle and at high incidence
- if infection is very late in the season then those plants may still have produced some pods but it is likely the seed quality would be poor as the plants would have shut down (died) prematurely.

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Etiella in lentils

- Larvae remain enclosed within pods until close to maturity
  - Damage levels not known until harvest
  - Not exposed to chemical sprays
- Sprays must target adult moths before egg lay
- Therefore require early warning system
- Very low tolerance for damaged lentil grain

http://www.graintrade.org.au/commodity_standards

Early warning system – *Etiella*

Etiella degree-day model

- **Forecasts timing of initial moth flight**
- **Uses daily max/min temperatures**
- **Date when the model reaches 351 D-days is the date to start monitoring for moth flights**

- Download the model from the SARDI website www.sardi.sa.gov.au
- Input max/min temperatures from www.bom.gov.au/climate/data
- **PestFacts newsletter provides model D-day outputs during spring**

Etiella flight model output

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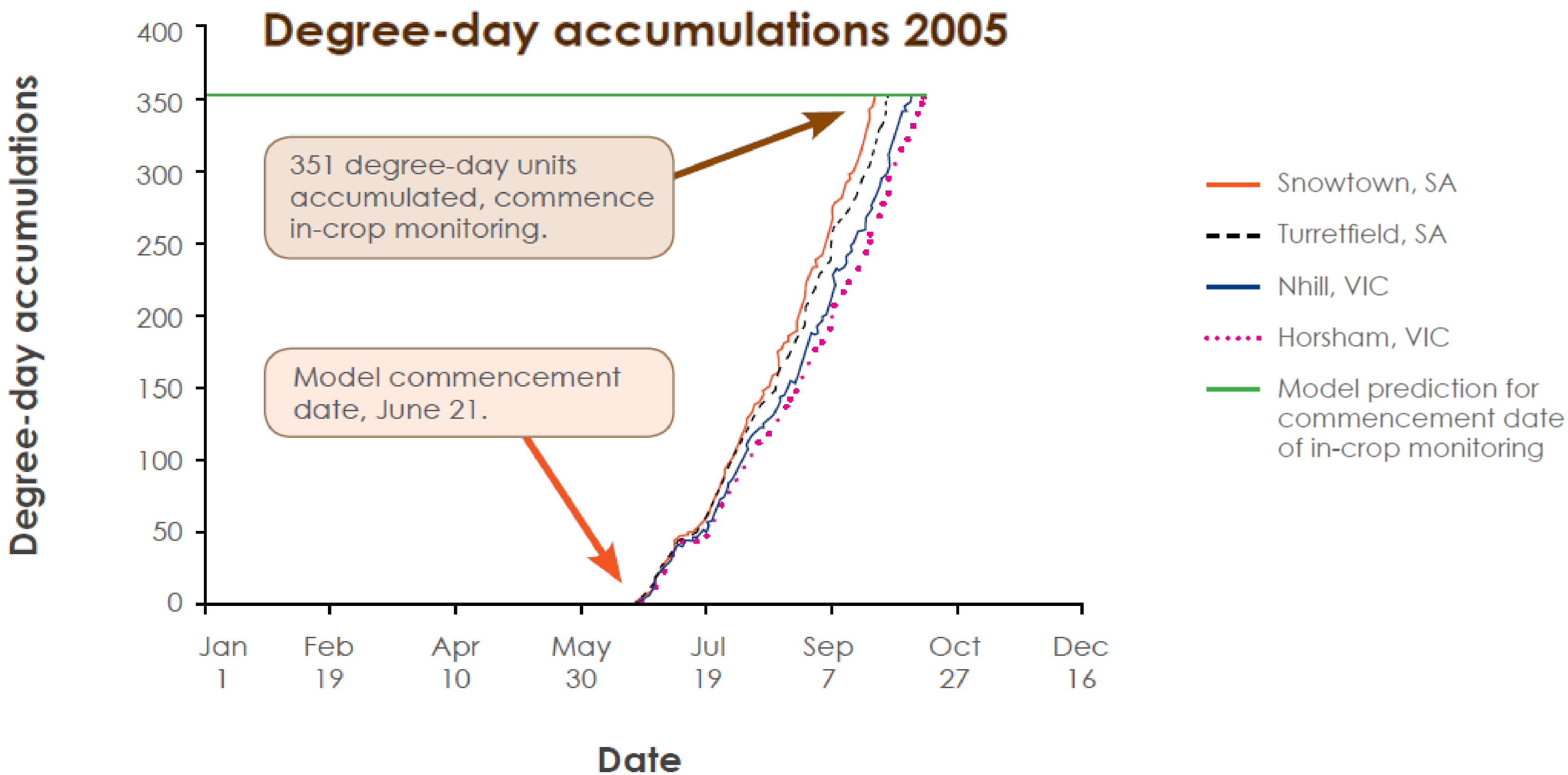

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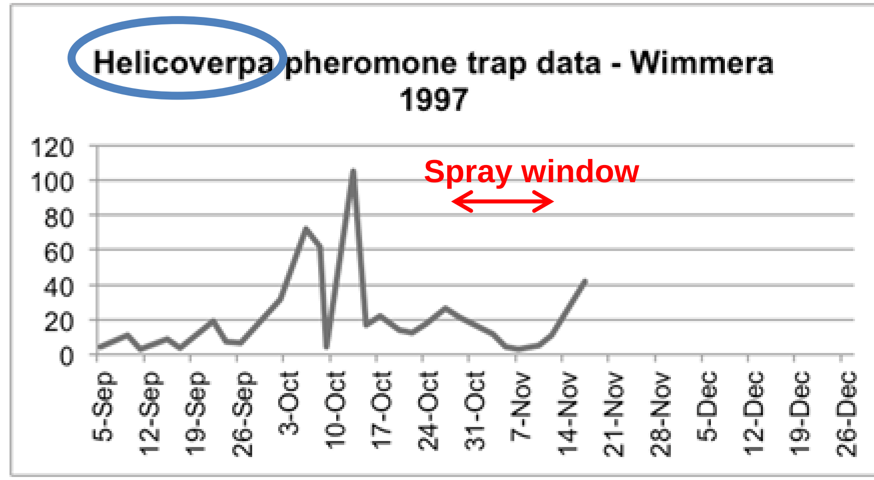
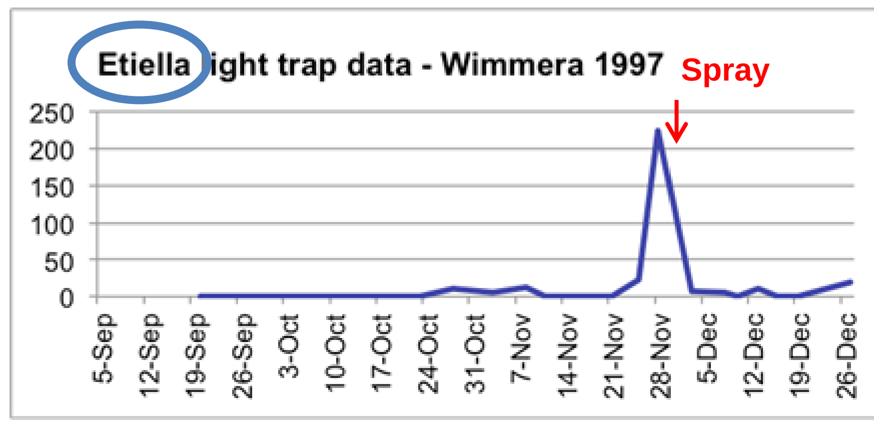
Can we control *Helicoverpa* and *Etiella* with one spray?

- Not in all years.
  e.g. Wimmera 1997.

- However in some years YES.

- Requires close monitoring and use of the *Etiella* model.





Adapted from M. Miles, H. Brier, Lentil Focus Proceedings 2002

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Pea Weevil (PW): a southern Pulse IPM case study

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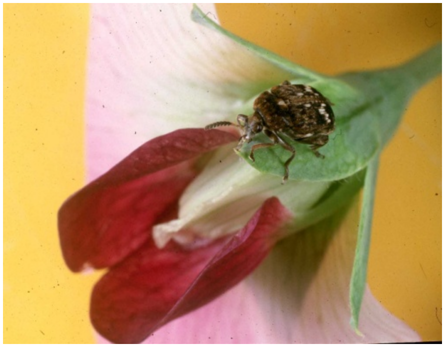
- 1980s - emerged as major pest
  - no effective natural enemies
  - no cultural controls
  - insecticidal control difficult
    - Timing must prevent egglaying
- 1986-1992: coordinated research on PW biology/ecology across 3 States
  - objective to generate new knowledge to improve management



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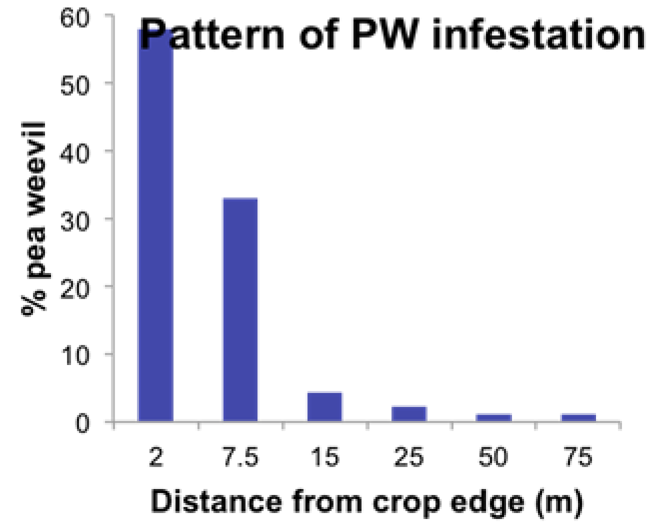
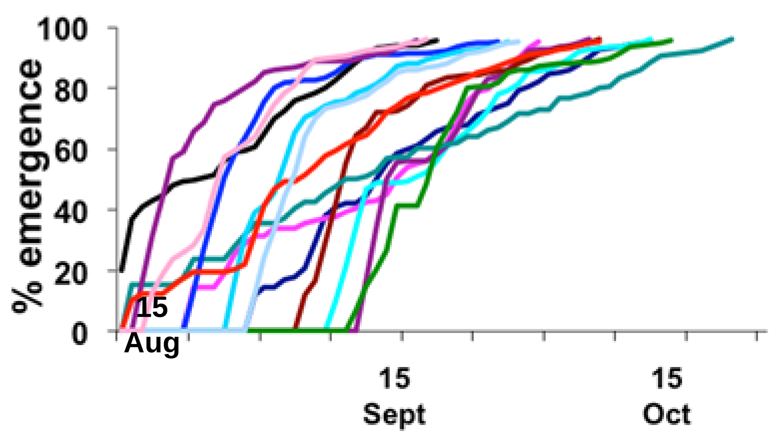
Pea Weevil: the key R&D findings

- PW invasion of pea crops
  - Occurs from crop edge, PW infestation remains highly skewed
  - Timing of invasion (start date & duration) is temperature dependent
    - Predictive models were developed
- Rate of Pea Weevil Development
  - Rate of ovarian development
  - Egg to adult: Pea crop consistently harvestable 3-4 weeks before first PW adults develop



Estimated timing of PW invasion, SA, 1986-2002



Pea Weevil - The IPM Strategy

- Optimised Insecticidal Control
  - Border spraying (outer 40 m, < 1/3 of average crop area)
  - Accurate timing guidelines:
    - date for 1st spray
    - need for 2nd spray (and date if required)
  - Marked reduction in grain infestation levels and spray costs
- Early Harvest followed by grazing
  - Yield losses minimized, and
  - Prevents PW dispersal and carryover within the district