Decision Making
for Integrated Pest Management
in Grain Crops

Sunflower, Maize and Chickpeas

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Establishment pests in sunflowers and maize

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Establishment pests

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Sunflower	Maize	Chickpeas
True and False wireworm	Wireworms and False wireworm	Aphids as vectors of virus
Cutworms	Cutworms	Cutworm
Black field earwigs	Black field earwigs	Slugs
Black scarabs		Black Scarabs
Wingless cockroaches		

Risk of soil insects increased by:

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Maintenance of suitable environment

- Weedy fallows and volunteer plants (food source)
- moisture (stubble, heavy soil)

Changes in the crop environment

- zero till + wet seasons
- dry conditions limiting available food for pests

Growing conditions

- Dry, cool or waterlogged conditions slowing seedling growth

Click beetle

Larva of the true wireworm

History of soil insects

Managing soil insects

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Seed treatment

- option where pest is frequent or known history
- may not provide complete protection when pest pressure is high
- reduced impact on beneficials

In-furrow spraying

- reduced impact on other soil fauna

Baits (grain, slug)

- attractiveness is relative to other food sources
- applied once pest is detected

Best bet for soil insects

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Northern region Establishment pest best bet IPM strategy

Pest	Pre-season	Sowing	Emergence
Slugs	<u>Assess risk</u> High risk when • High stubble load • Heavy soil • >450 mm rainfall & summer rainfall • History of slug infestation If risk is high, deploy shelter traps prior to sowing. <u>Consider:</u> • Cultivation (affected areas of field) • Rolling to compact seed bed and restrict slug movement along rows. • Burning stubble • Managing weeds to remove food source, at least 8 weeks prior to sowing in paddocks and along fence lines. • Baiting - effective when implemented prior to sowing or crop emergence and when soil is moist. Aim for 25-30 baits/m^2.	If slug pressure is high, repeat baiting may be necessary. Monitoring will guide bait use.	If slug pressure is high, regular baiting may be necessary. Monitoring will guide bait use. Slugs are active at night; night monitoring may be necessary to confirm slugs as the cause of seedling loss.

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Post establishment pests of Sunflower

Soybean looper outbreak 2012

- Widespread (NSW, QLD)
- Accelerated defoliation
- 100% defoliation in worst cases
- Last outbreak in early 2000's
- *What impact on yield?*


196-18

Simulated looper defoliation

Vegetative	
V (number) V16	Determined by counting the number of true leaves at least 4 cm in length beginning as V-1
Reproductive	
R-1	The terminal bud forms a miniature floral head rather than a cluster of leaves.
R-3	The immature bud elongates more than 2.0 cm above the nearest leaf.
R-5	This stage is the beginning of flowering.
R-7	The back of the head has started to turn a pale yellow colour.
R-9	The bracts become yellow and brown. This stage is regarded as physiological maturity.

(adapted from Bellfield and Serafin (2012) Plant Growth and Development. Big Yellow Sunflower Pack)

0% defoliation

25% defoliation

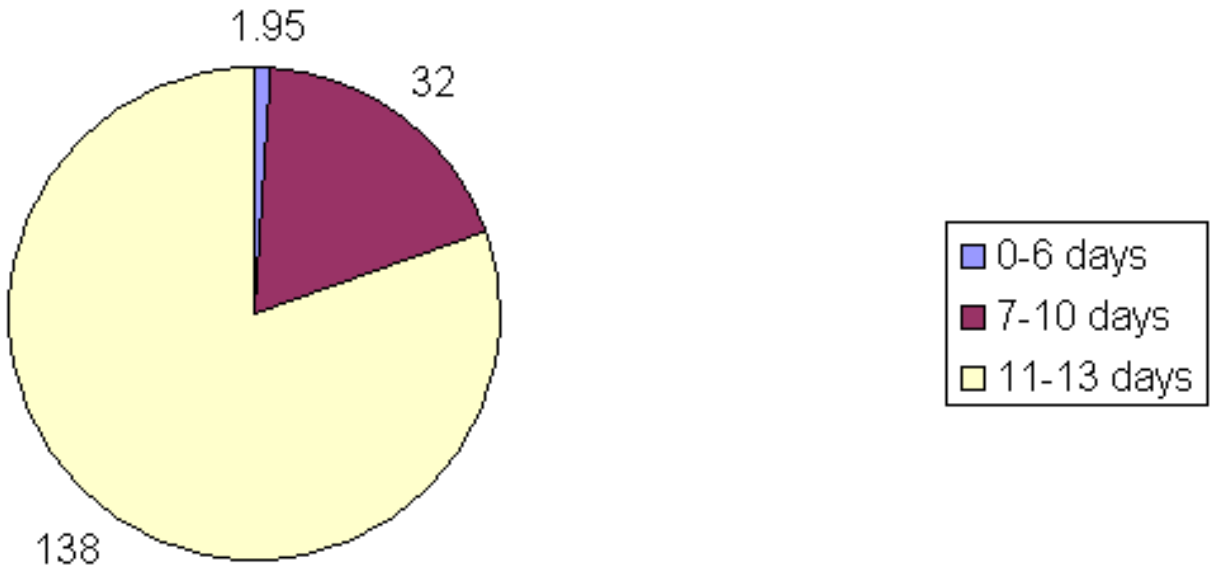
50% defoliation

75% defoliation

100% defoliation

How much does a looper eat?

Leaf area consumed (square cm) (n=45)



80% of total leaf consumed in last 2 instars

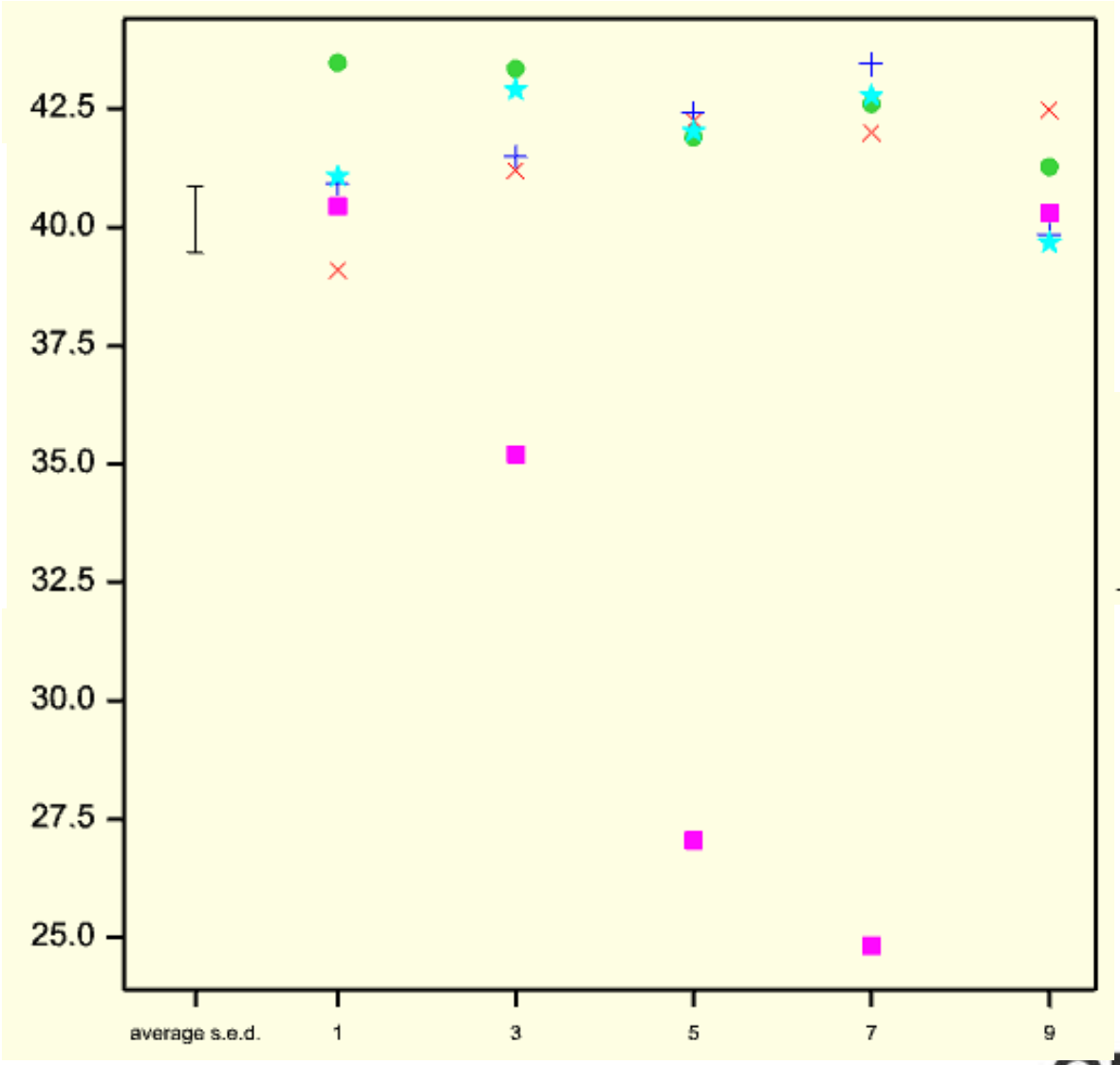
On average, a total of 172 square cm per larva

Yield (t/ha)

R_stage	Treatment (% defoliation)				
	0	25	50	75	100
1	2.18	1.90	2.00	1.75	0.17
3	2.19	2.02	1.92	1.77	0.01
5	1.87	1.72	2.01	1.67	0.37
7	2.27	1.92	1.60	1.89	1.02
9	2.12	2.16	2.27	1.70	1.73

LSD = 0.4

Oil content (%)



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Summary

- Preliminary thresholds and management:
- 50% defoliation (~ 10 larvae per plant R1-R7)
- Target larvae < 20 mm in length
- Dipel (Bt) is effective but good coverage is required
- Susceptible to insecticides used for helicoverpa, except NPV

Rutherglen bug

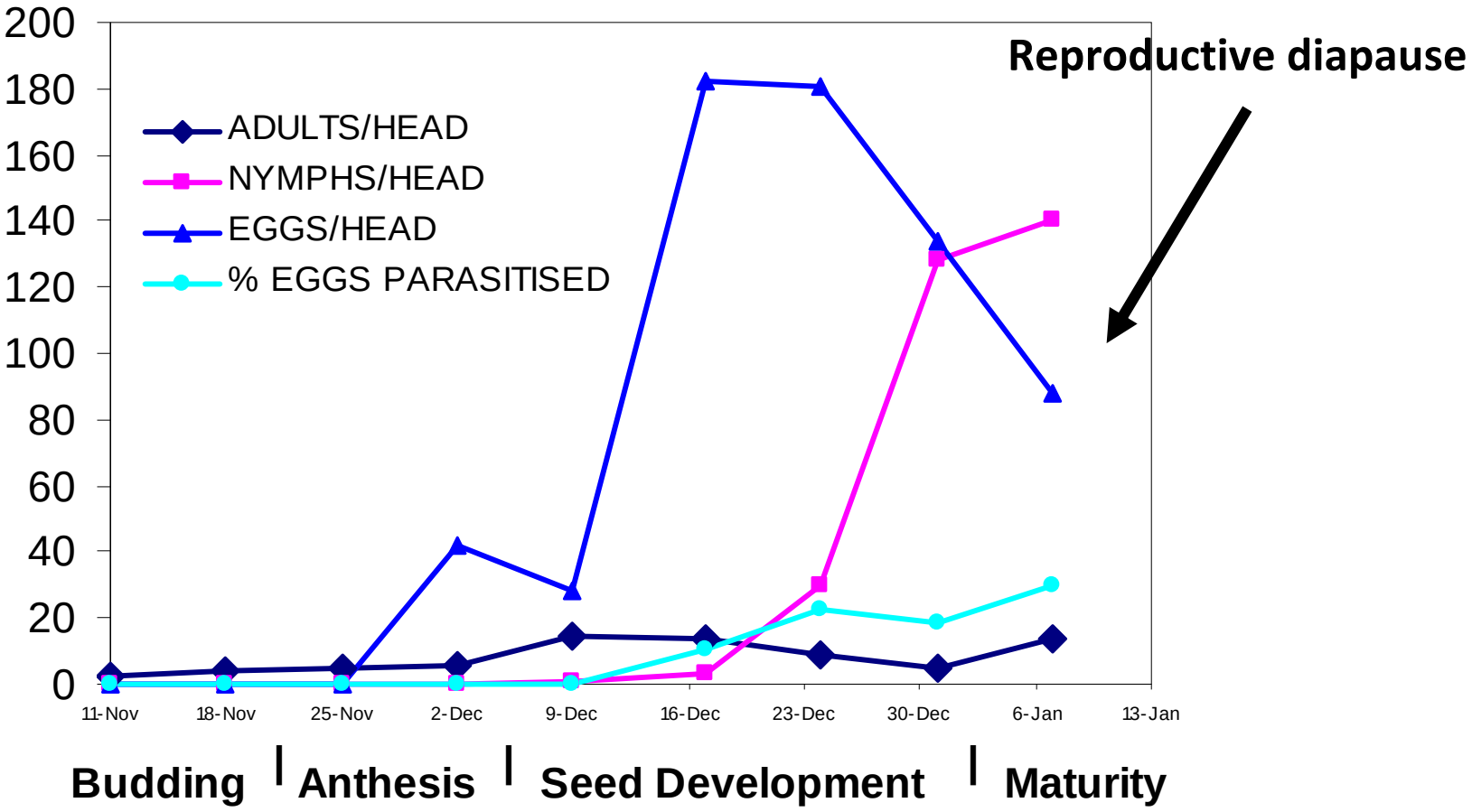
Develop on winter weed hosts locally and inland

Migrate in spring as weed hosts hay off

Spring/summer generations on weeds and crops

Model under development to predict locally generated outbreaks (CSIRO)

Knowing the lifecycle helps understand thresholds and timing



RGB Thresholds

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Growth stage	Thresholds (adult bugs/plant	
	August - December	***January - April***
Budding	10-15	20-25
Seed fill	20-25	50
Confectionary	5	5

Helicoverpa in sunflower

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Budding is most vulnerable (ET = 1medium larvae/plant)

Post flowering
ET = >17 larvae/plant

Association between Helicoverpa and head rots – prediction?

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Post establishment pests of Maize

Caterpillar pests of maize

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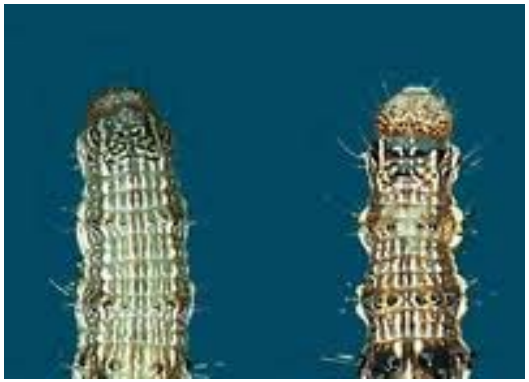
Thresholds high, a few exceptions

Armyworm ET= 90% of plants infested, and more than 70% have at least 75% flag leaf loss.

Helicoverpa, where damage to silks
ET = >2 medium-large larvae

High Beneficial activity

Pupae busting consideration



Helicoverpa armigera

Armyworm

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Managing *Helicoverpa* in Chickpeas

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Queensland Government

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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Economic thresholds

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

* 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

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A ready reckoner
ET for helicoverpa in chickpeas

Cost of control ($/ha)	Chickpea price ($/t)							
	200	250	300	350	400	450	500	550
15	3.8	3.0	2.5	2.1	1.9	1.7	1.5	1.4
20	5.0	4.0	3.3	2.9	2.5	2.2	2.0	1.8
25	6.3	5.0	4.2	3.6	3.1	2.8	2.5	2.3
30	7.5	6.0	5.0	4.3	3.8	3.3	3.0	2.7
35	8.8	7.0	5.8	5.0	4.4	3.9	3.5	3.2
40	10.0	8.0	6.7	5.7	5.0	4.4	4.0	3.6

* Based on beatsheet sample (# per m2)

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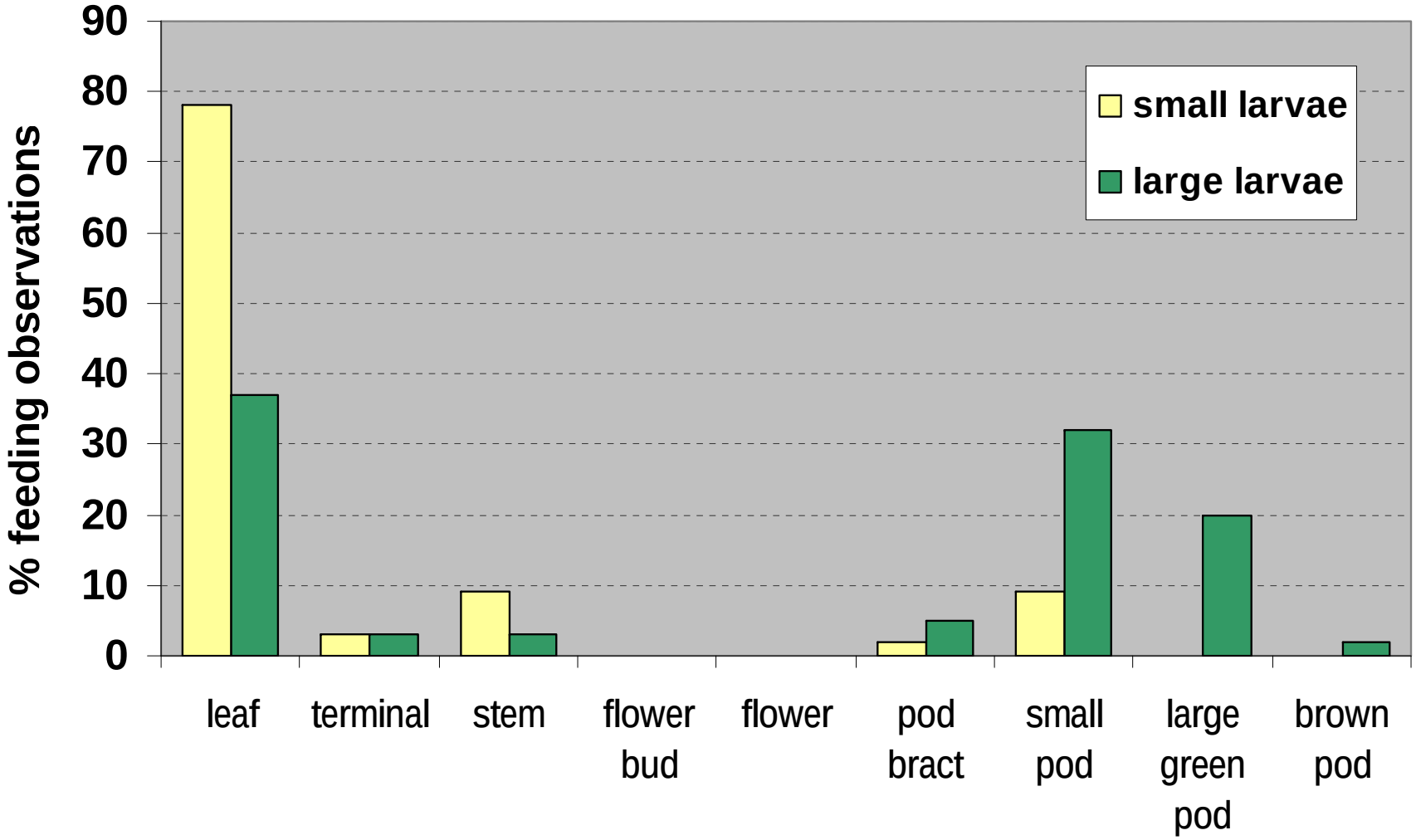
Helicoverpa feeding preferences

Determine the crop stage and susceptibility



Economic Thresholds

Determine the crop stage and susceptibility

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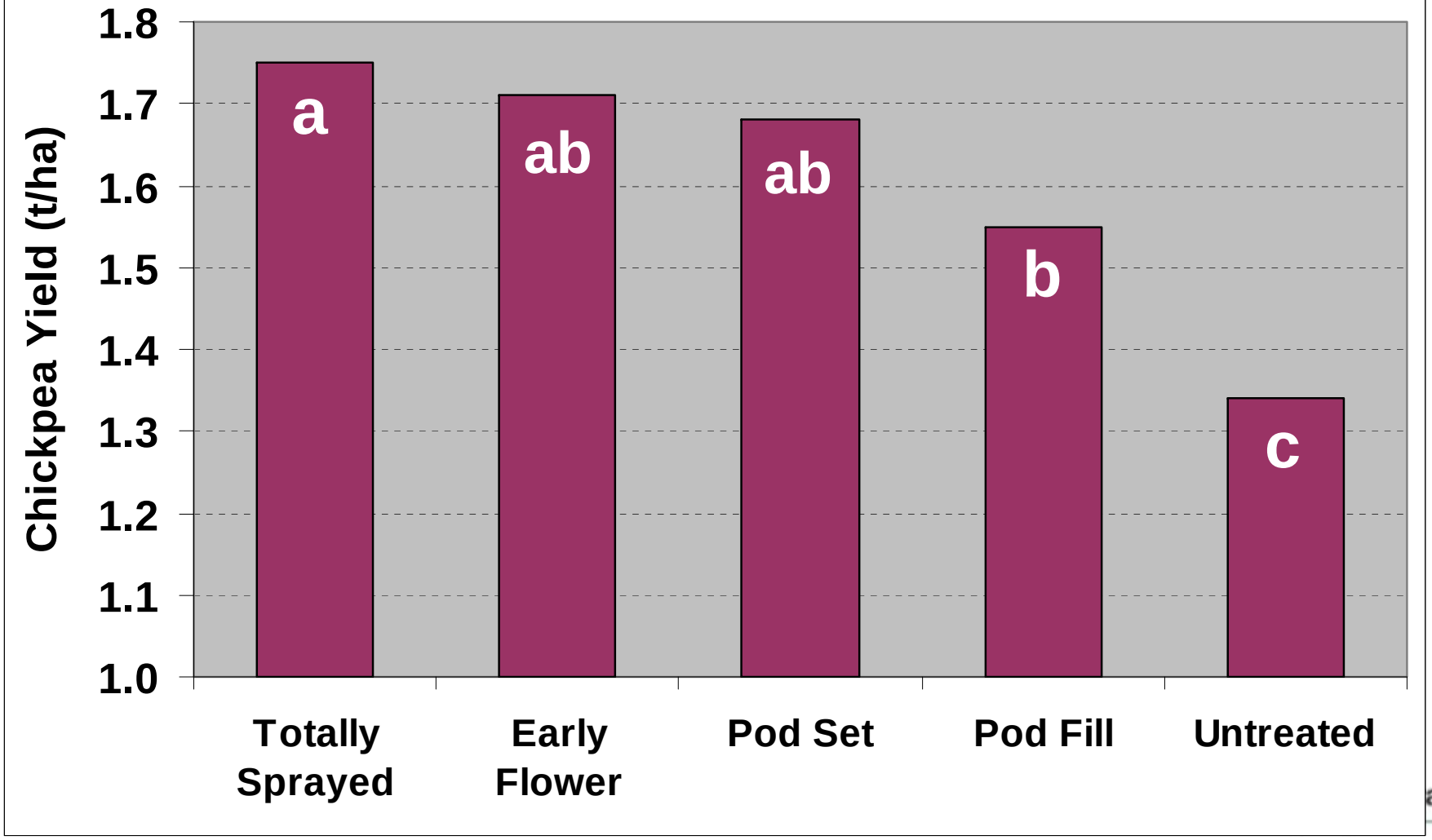
No significant yield loss by delaying spraying until podset



Making a Spray Decision

Additional factors that may influence the decision, timing and product choice -

Loss of yield and quality only occurs from pod set to maturity

- Age structure of the larval population - in relation to time to desiccation or harvest
- Proportion of *H. armigera* and *H. punctigera*
- Spray conditions and drift risk
- Insecticide options, resistance levels for *Helicoverpa* and recent spray results in local area.
- Residual of the products

Aim for one well timed spray