Future Prospects for the Management of Diamondback Moth in Australian Canola

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Diamondback Moth (DBM)

- Periodic outbreaks in spring
  - In green-bridge years can attack establishing canola
- Larvae defoliate and damage inflorescences
  - Reduce seed number & size
- Associated with summer rains (green-bridge) and warm, dry winter/spring

The Canola Production System and Environment

Trends over the past several decades:

- Large increase in DBM host-plant resources (canola, forage, weedy crucifers)
- Major increase in broad-spectrum insecticide use in canola:
  - selection for SP/OP resistance
  - suppression of DBM natural enemies
- Climate trends have favoured DBM

SP control failure due to resistance

Current DBM Control in Canola

- Reliant on limited number of registered insecticides:
  - Old synthetic SP/OP/carbamates
    - IPM incompatible & significant resistance
  - New synthetics – Affirm®(Group 6 emamectin benzoate) and Success Neo® (Group 5 spinetoram)
    - Less toxic to beneficials, resistance low but increasing
  - *Bacillus thuringiensis* – Dipel SC, etc.
    - Nil beneficial toxicity, nil resistance, good coverage essential
- Insecticidal control is challenging:
  - Overlapping generations
  - Poor canopy coverage/penetration
  - Resistance

DBM Insecticide Resistance Levels

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

Insecticide	1st registered in AUS	Veges	Canola
Diazinon (OP)	1960's	-	45
B. t. (Dipel® etc)	early 1970's	4	-
ά-cypermethrin (SP)	~1980	44	600
Affirm®	1998	31	17
Success Neo®	1999	5	3
Indoxacarb	2000	12	-
Chlorantraniliprole	2009	55	51

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An indoxacarb-novaluron mixture is being tested for canola registration.
Likely to require extended withholding period.

Future Insecticidal Control Challenges

1. Resistance management

   - As a result of their likely use pattern in canola, the selection pressure for DBM resistance to the new insecticides is considered relatively low.
     - low DBM outbreak frequency in canola, and
     - minimal other registered uses in canola and other grain crops

   - The resistance risk may be more dependent on non-canola use patterns (crucifer vegetables & forage crops).
     - The dynamics of DBM movement between canola, crucifer vegetable and forage crops is the focus of a new PhD study (Kym Perry, SARDI)

Future Insecticidal Control Challenges

2. Strong industry stewardship to ensure residue compliance

3. Compliance with new drift legislation

    - Improved application technology required to reduce spray drift and increase spray efficacy
        - Focus of new GRDC investment (UWA00165)

Potential New DBM Management Tactic

- Attract and Kill
  - Magnet ™ (Prof 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

Natural Enemies & Biological Control

- Little known about DBM natural enemies in canola.
- What do we know?
  - The DBM parasitoids in canola are the same as occur in vegetable crops.
  - The canola pest complex is treated multiple times with broad-spectrum insecticides prior to the spring build-up of DBM.
    - These treatments adversely affect natural enemy populations.
- Future research on the role of DBM natural enemies must address:
  - Dynamics of canola crop colonization
    - Identify sources
    - Timing synchrony between DBM and its parasitoids
  - Identity key predators and their contribution to DBM control

The Role of Plant Resistance

Plant resistance is an unexplored avenue for the improved management of DBM in Australia.

For example:

- conventional selection of canola varieties that exhibit reduced susceptibility to DBM attack (Dr Baxter, AU), or
- transgenic *Bt* canola grown in conjunction with crop refugia.

Used in conjunction with environmentally-benign chemical and biological control strategies, plant resistance is likely to be an essential tool for the future sustainable management of DBM.

Conclusions

Grounds for optimism that more effective and sustainable DBM management is achievable longer term.

Key gaps that require solution:

1. Dynamics of crop colonization and identity of source populations of DBM and key natural enemies
2. Weather-based DBM outbreak predictive model
3. Plant resistance
4. More selective insecticides with different modes of action
5. Improved spray application technologies