Designing an Integrated Pest Management Strategy for Pollen beetles in Oilseed rape

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Pollen beetle pest status

• Most abundant pest of OSR during bud-flowering stages

• Feeding damage causes bud abscission & yield loss

• Damage susceptible stage = green-yellow bud

• When the crop begins to flower, feeding occurs in open flowers and the crop can compensate for damage

• Controlled by insecticides
Pyrethroid resistance in pollen beetles

- Resistance to Pyrethroids 1st detected in France 1999
- Resistant populations spread quickly!
- Detected in Germany 2001 – monitoring started
- Resistance in Germany 2006 led to complete loss of 30,000ha (€22-25 M)
- Now widespread across Europe! Need IPM to reduce selection for resistance

Data: Bayer CropScience
Development of an integrated pest management strategy for control of pollen beetles in winter oilseed rape

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Development of an integrated pest management strategy for control of pollen beetles in winter oilseed rape – Project Aims:

Develop an IPM strategy for pollen beetles in OSR based on:

(i) Monitoring development of a baited monitoring trap

(ii) Risk assessment testing of proPlant phenological model to UK climate

(iii) Crop management validate trap cropping tactic & identify improved cultivars
(i) Developing a monitoring trap for pollen beetle IPM

• A baited monitoring trap will help growers & advisers to more easily and more accurately identify when spray thresholds have been breached than by plant scouting methods.

• Optimal trap colour & volatile bait investigated.
Monitoring trap - colour

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Monitoring trap – colour: Behaviour in the field

![Graph showing beetle catch per trap color](image)
Identification of pollen beetle colour receptors

Electroretinography: Measures voltage change of photoreceptors in response to monochromatic light stimulus

Spectral sensitivity: Maximum at ~540 nm (green); also blue and UV

Model of pollen beetle colour choice behaviour

Green-blue-COM: log (G) – log (B)

Monitoring trap - Bait

In the absence of pollen beetle sex / aggregation pheromones, we are developed a lure derived from OSR host plant volatiles.
Coupled Gas-Chromatography-Electroantennography (GC-EAG)
Coupled GC-EAG of pollen beetle and oilseed rape flower volatiles

1 = phenylacetaldehyde, 2 = indole, 3 = (E,E)-α-farnesene
Results of replicated field trials 2008-2011

• 15 volatile semiochemicals identified & tested
  • Phenylacetaldehyde performed most consistently and was chosen for further development as the lure for the field trap

• Lure reduces total no. non-target insects caught

• IPS Ltd prototype commercial lure selected

• Oecos carrot fly sticky trap selected

● Available from Oecos 2013 www.oecos.co.uk
Monitoring trap – calibration

- Calibration of trap requires an understanding of the relationship between numbers of beetles caught on traps and numbers of beetles on the crop so that a given trap catch can relate to current (or new) threshold levels.
Trapping experiment

Sticky traps placed upwind and downwind in OSR crops

changed 1 or 2/week from green bud – early flowering (~6 weeks)

30m transect conducted at each trap site when traps changed to give mean no. beetles/plant from 10 plants

Sticky traps & transects → trap calibration analysis (& proPlant test)
Polling beetle trapping experiments run across UK

17 sites 2008 (white)
27 sites 2009 (red)
57 sites 2010 (blue)
77 sites 2011 (yellow)
178 sites

<table>
<thead>
<tr>
<th>Year</th>
<th>Total number of pollen beetles caught</th>
<th>Mean (±SE) number of beetles caught per trap</th>
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</thead>
<tbody>
<tr>
<td>2008</td>
<td>3,142</td>
<td>8.12 (0.82)</td>
</tr>
<tr>
<td>2009</td>
<td>16,344</td>
<td>18.85 (1.74)</td>
</tr>
<tr>
<td>2010</td>
<td>60,301</td>
<td>29.46 (2.08)</td>
</tr>
<tr>
<td>2011</td>
<td>75,670</td>
<td>40.49 (2.49)</td>
</tr>
</tbody>
</table>
Monitoring trap – calibration

- Aim to correlate no. beetles on trap with no. in crop
- **NO** simple relationship was found
- So trap cannot be used to detect threshold breaches in the crop (yet)
- In any case the trap can provide good indication of local beetle movement !!!
(ii) Improved risk assessment for pollen beetle IPM

Test proPlant phenological model to UK conditions

proPlant – DSS system used widely in Europe.

Its pollen beetle phenological model uses sunshine, rainfall, windspeed, and temperature data to **predict** immigration up to 3d in advance and could help improve monitoring and management decisions.

- Migration possible
- Good conditions for migration
- Optimum conditions for migration
Testing fit of proPlant phenological model to UK conditions

Compare the output of the proPlant model with the sticky trap data:

- start of migration
- peak(s) of migration
- % completion of migration
2010 data; Woburn farm

Zuflug 100%
Raps glanzkäfer
Schädlinge
Winterraps
Datum

Mai 10
30282624222018161412108642
April 10
302826242220181614121086
März 10

 [%] 100
80
60
40
20
0

-5

°C [mm] [m/s] [h]

Temp. Min (°C) 20cm
Regen (h) >0,1mm
Taupunkt (°C) 14°°
Wind Quer (m/s)
Luftfeuchte (%) 2m
Temp.Min.
Temp.Quer (°C) 2m
Niederschlag
Sonne (h)

WOBURN FARM

58 Horsepool nr Woburn

Optimal conditions for migration
Good conditions for migration
Migration possible

Beetles/1 sticky trap (av.)
Transect (average/1 Plant)
Predictive ability of proPlant may save insurance sprays?

No need to spray if threshold is near-breach and immigration is predicted to be 100%

Gives confidence to hold off if threshold is near-breach but conditions are predicted poor for migration
Improved risk assessment for pollen beetle

proPlant can accurately forecast start, peaks (risk periods) and end of immigration, focusing monitoring effort to when it is most needed.

2012, 2013 ProPlant tool now provided free to UK growers via Bayer CropScience www.bayercropscience.co.uk/
(iii) Crop Management

Validate trap cropping tactic

• Early flowering winter turnip rape (*Brassica rapa*) planted as a trap crop surrounding the main oilseed rape crop can reduce the population of beetles in the main crop to below spray threshold levels

• Cost:benefit not currently favourable for conventional growers
Future directions – breeding for improved pest tolerance

Approach:

• All major insect pests of OSR are crucifer specialists

• Pests locate and select host plants on basis of visual, olfactory, gustatory & tactile plant cues

• Pests show host plant preferences

• Understanding host location / selection behaviours and mechanisms of preferences can contribute to IPM tools for pests AND identify plant traits to inform breeding programmes for resistance (or a reduction in host-finding / selection)
Use of oilseed rape cv. with high proportions of indolyl and low proportions of alkenyl glucosinolates?

Alkenyl GS → 3-butenyl isothiocyanate
Indolyl GS do not catabolise to form stable ITC

Cook et al., 2006; Ent. Exp. Appl. 119:221-9
Potted plants of a white petalled oilseed rape line were dyed red, blue or yellow and colonization by pollen beetles observed in the field.

Colonization of plants by pollen beetles in field experiments

White and yellow treatments equally preferred over blue and red treatments

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