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where knowledge grows

The insect pests of oilseed rape: biology and potential for control by IPM

Sam Cook
Rothamsted Research, UK

BBSRC bioscience for the future

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Insects love oilseed rape!

Oilseed rape is important for farmland biodiversity

Oilseed rape is important to a wide variety of invertebrates

Surveys in UK using a range of techniques…

…collected 151 species + c. 40 additional groups id to genus or higher taxonomic rank

Skellern & Cook in prep

Oilseed rape is important for farmland biodiversity

Oilseed rape crops support populations of bees, butterflies & other pollinators, natural enemies of crop pests, detritivores & invertebrates used as food resources for farmland birds

British Ornithologists Union

Skellern & Cook in prep

Oilseed rape is important for farmland biodiversity

Need to better manage the crop to harness the biodiversity potential of the crop – towards 'sustainable intensification'

Talk outline: Summarise the insect pests of oilseed rape

Ecological approaches to pest management via IPM

What are the insect pests of rapeseed?

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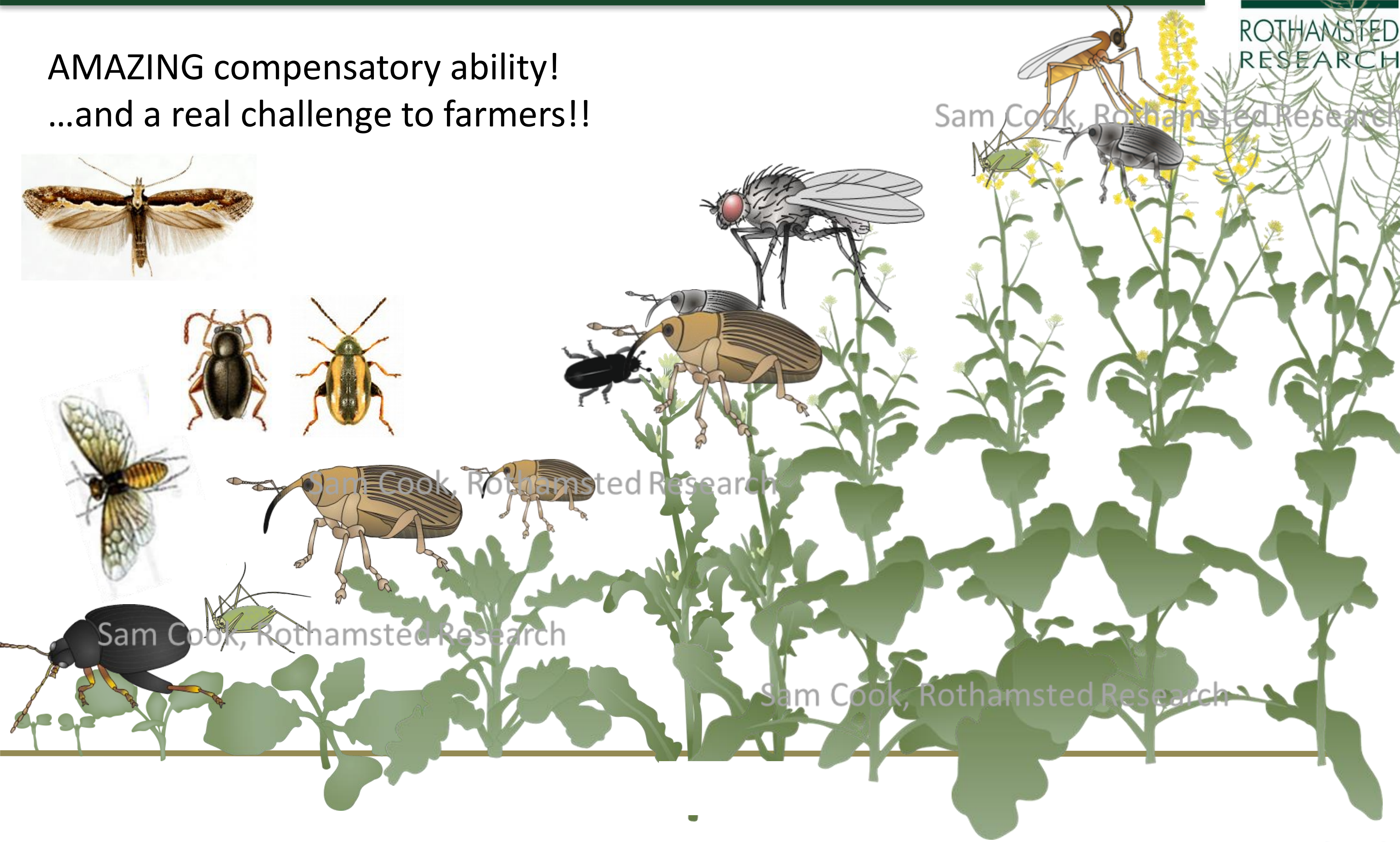
AMAZING compensatory ability!
…and a real challenge to farmers!!



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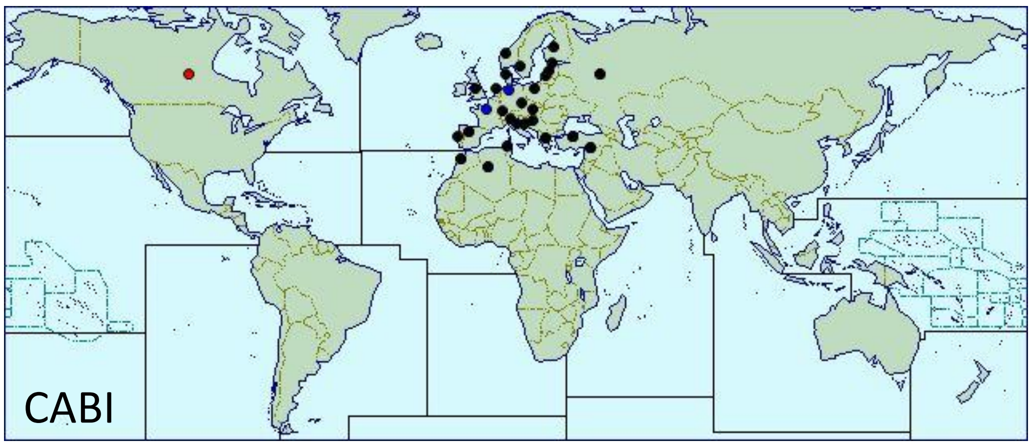
Cabbage stem flea beetle (*Psylliodes chrysocephala*)

- Most widely distributed stem-mining pest in Europe; also recorded from Middle East, Asia, North Africa, Canada



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Cabbage stem flea beetle (*Psylliodes chrysocephala*)

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Life cycle : univoltine

Late Aug- Oct

Adults move into new crop, mate feed on leaves causing 'shot-holing

Aug - Feb

Eggs laid at base of plant when warm & humid

Late Aug – March

Larvae feed in leaf petioles, 3rd instars feed in stem

Dec – May

Larvae drop to the ground ; Pupate in the soil for c. 3 months

May-July

Adults emerge, feed on leaves, pods

July – Sept

Aestivate in sheltered areas

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Cabbage stem flea beetle (*Psylliodes chrysocephala*)

Damage

- Adult feeding damage may threaten establishment (100% crop loss)
- Larvae cause loss of vigour, stem wilting, delayed flowering, stem collapse; increased risk to frost and disease

Dewar Crop Protection

Cabbage stem flea beetle (*Psylliodes chrysocephala*)

- Adult control via neonicotinoid seed treatments since 1990s

Seedgrowth.bayer.com

- On 1/12/13 a 2-year restriction on the use of the neonicotinoids: clothianidin, imidacloprid and thiamethoxam, was enforced by the European Commission.

- The 2014 winter crop was the first for which neonicotinoid seed treatments were not available to protect plants during emergence and establishment

Cabbage stem flea beetle (*Psylliodes chrysocephala*)

October 2013 (before the ban), Suffolk 2013 UK

Untreated | Cruiser-treated

Dewar Crop Protection

Cabbage stem flea beetle (*Psylliodes chrysocephala*)

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- In autumn 2014 Pyrethroid sprays become the main (only?) control option….

- BUT pyrethroid resistance confirmed in Germany

  Zimmer et al., 2014 PBP 108:1-7

- …and widespread in UK (Sept 2014) AHDB Project 214–0019

Cabbage stem flea beetle (*Psylliodes chrysocephala*)

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What happened in 2014?

Simon Kightley, NIAB TAG

NIAB TAG

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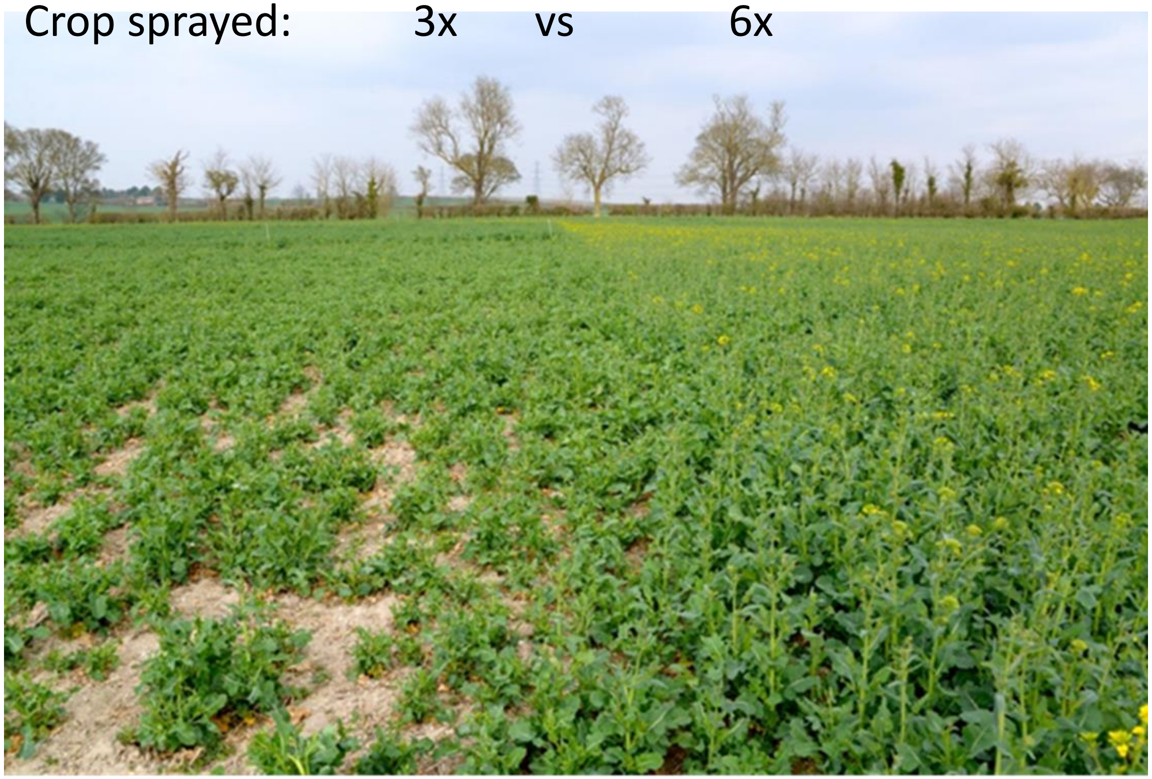
Cabbage stem flea beetle (*Psylliodes chrysocephala*)

What happened in 2014?

- Pyrethroids were repeatedly applied! (What effect on non-targets?!)



Dewar Crop Protection DCP

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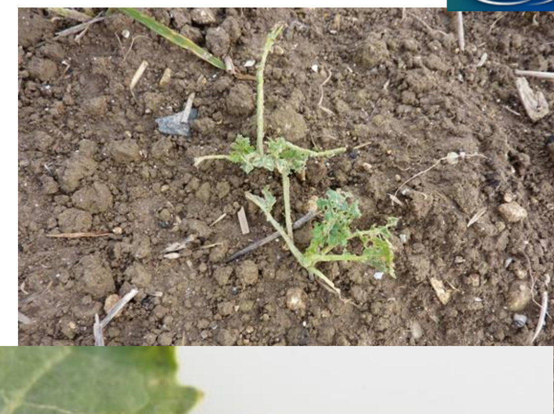
Cabbage stem flea beetle (*Psylliodes chrysocephala*)

ROTHAMSTED RESEARCH

What happened in 2014?

- Pyrethroids were repeatedly applied! (What effect on non-targets?!)

Simon Kightley, NIAB TAG



- By 1 December total crop losses due to adult feeding were c. 5% of the national crop (AHDB survey).
- Reional variations : SE and E worst hit with c. 15% crops showing damage above adult control threshold levels
- Highest larval populations on record (Fera)

- **Many farmers in SE have given up growing OSR**

☹

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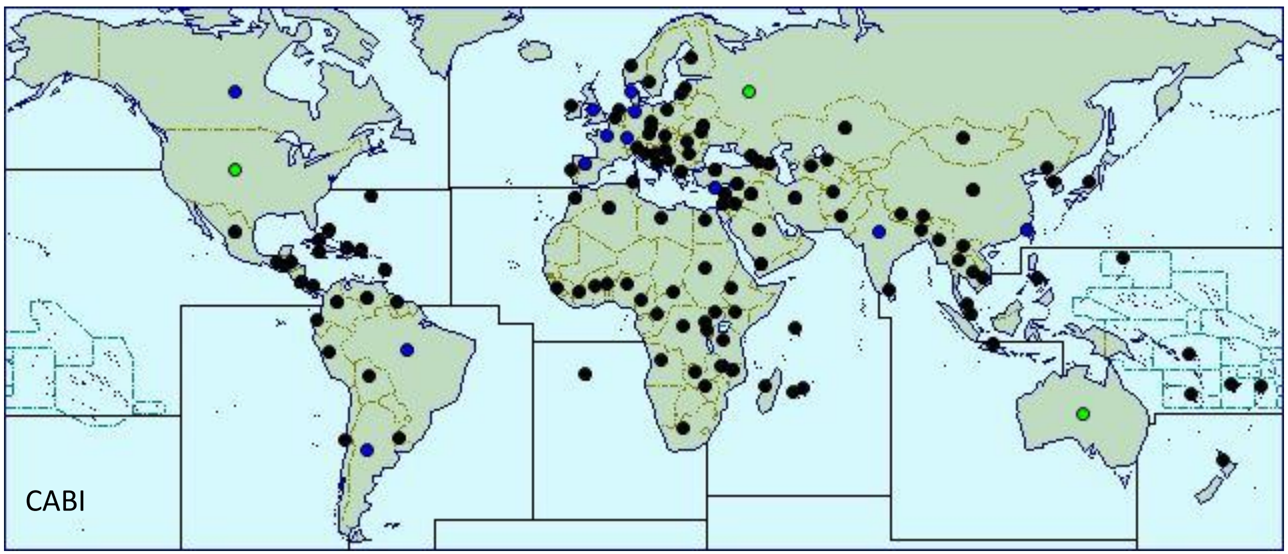
Green peach aphid (*Myzus persicae*)

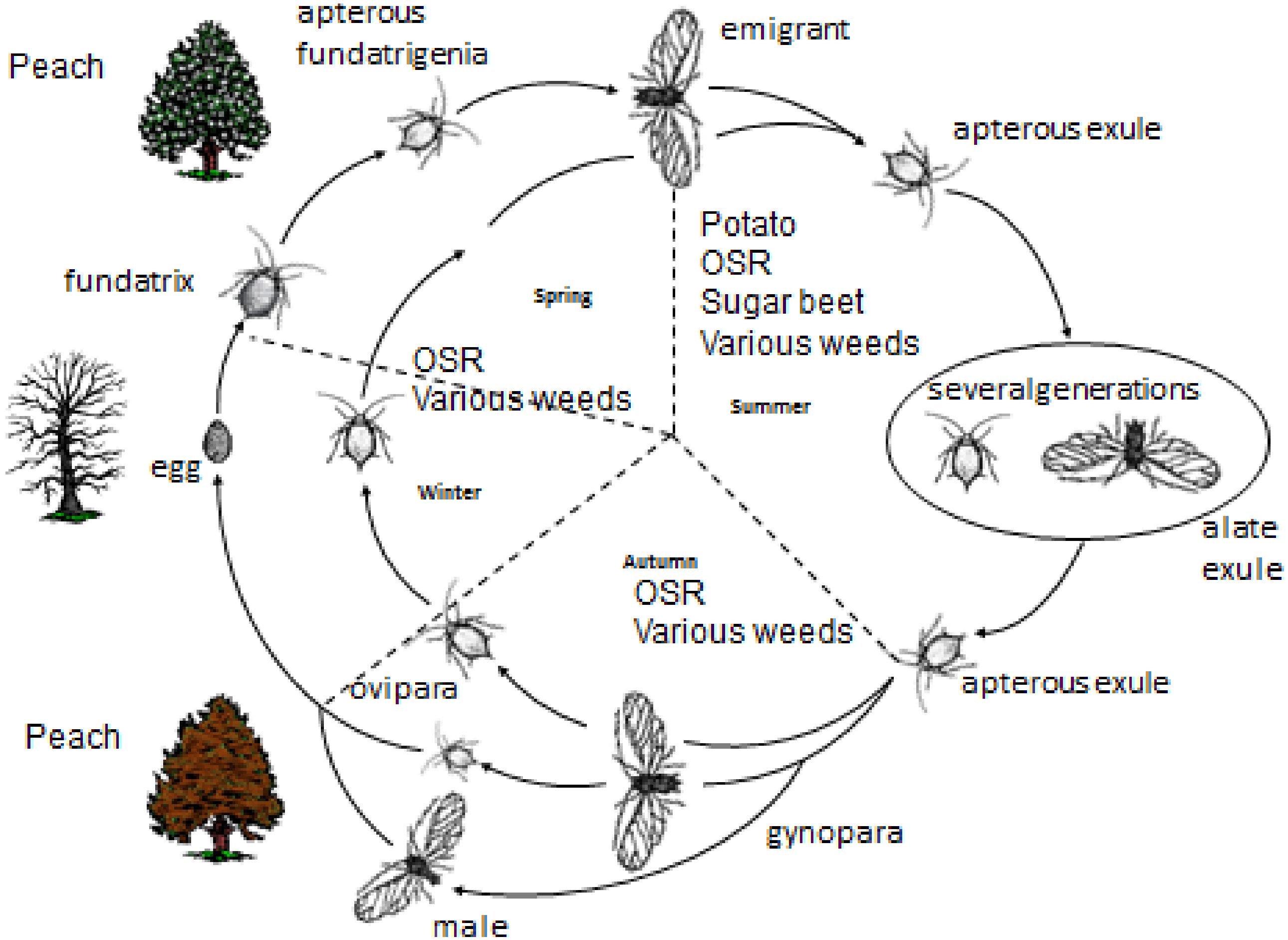
Distribution

- Worldwide!



Green peach aphid (*Myzus persicae*)

Life cycle : multivoltine



Peach-potato aphid (*Myzus persicae*)

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Damage

- Feeding damage by adults and nymphs economically minor
- **Virus vector – Turnip yellows virus (TuYV)**
- Can reduce yield by c. 30%
- Winged aphids can infect a crop from emergence – Oct (or Dec. if mild)
- Increased threat since revocation of neonicotinoid seed treatments
- C. 70% of UK *Myzus* population infected
- Resistance to pyrethroids widespread in UK and Europe; also resistance to pirimicarb; neonicotinoid resistance in S. Europe….

Pymetrozine only viable alternative (timing crucial)

Rape Stem Weevil (*Ceutorhynchus napi*)

Distribution

- Central and southern Europe
- unconfirmed reports in N. America
- NOT yet present in northern Europe (UK)

Rape Stem Weevil (*Ceutorhynchus napi*)

Feb-March

Adults migrate to crops

March-April

Single egg laid into stem pith close to growing tip of plant; eggs hatch within 1-2 weeks

April—May

Larvae feed within stem for 3-5 weeks

May-June

Larvae drop to the ground; pupate in soil

June-March

Adults overwinter in earthen chambers

Rape Stem Weevil (*Ceutorhynchus napi*)

- Adult feeding causes little damage
- Deposition of eggs may cause distortion of plant
- Larval tunnelling causes further damage + 'stem bursting'
- Increases susceptibility to fungal pathogens
- Yield losses c. 50%

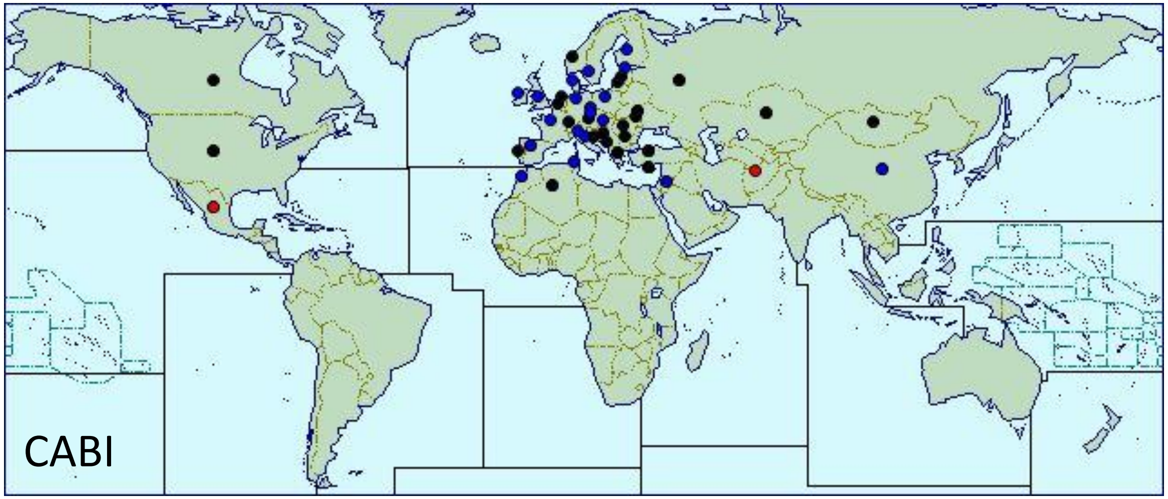
Ivan Juran

Pollen beetle (*Meligethes aeneus*)

- *Brassicogethes aeneus* (Audisio 2009)

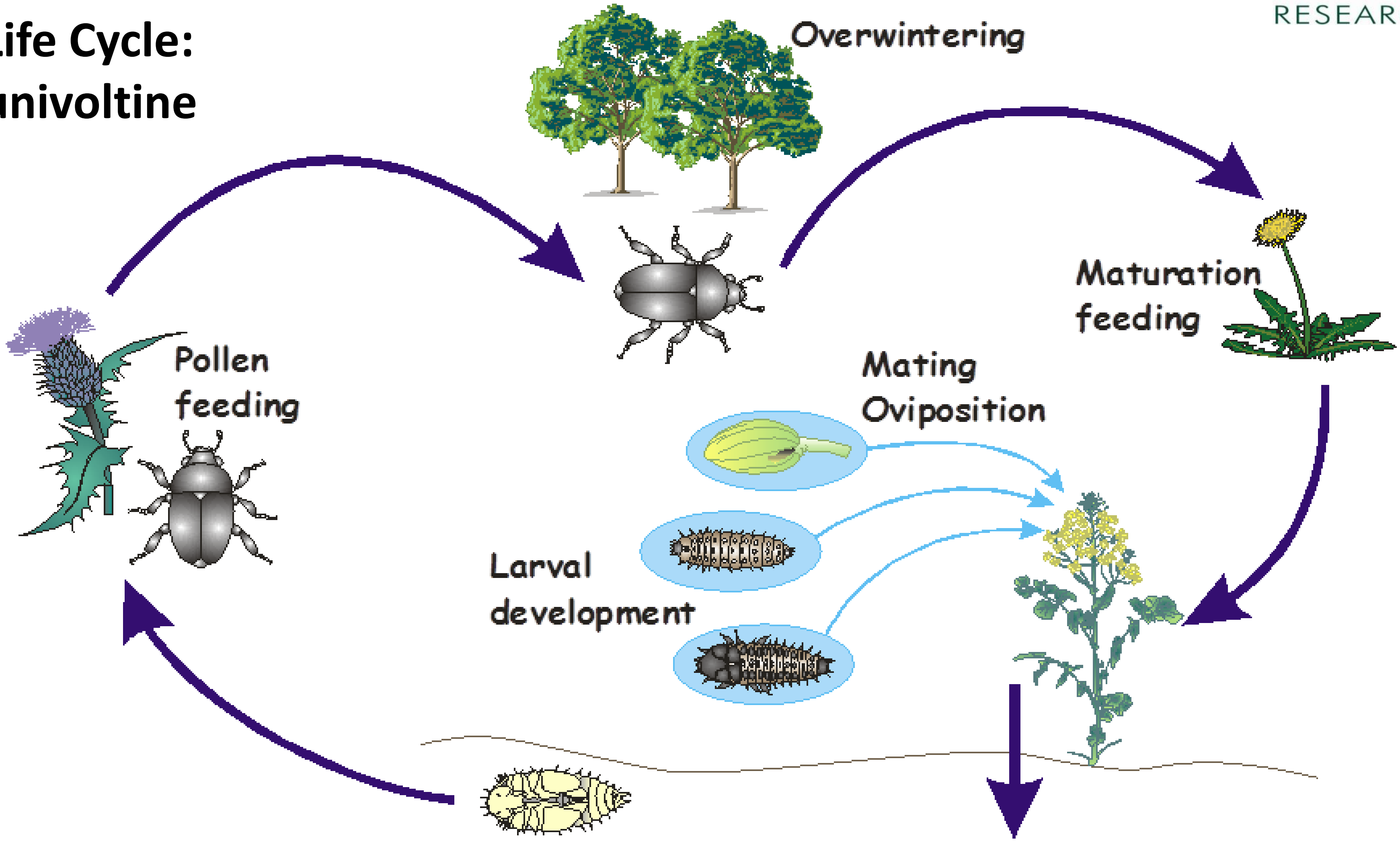
Distribution

- Europe
- Asia: Afghanistan, Jordan, Mongolia, Turkey
- N. Africa: Algeria, Morocco, Tunisia
- N. America: Canada, Mexico, USA



Pollen beetle (*Brassicocgethes /Meligethes aeneus*)

Life Cycle: univoltine



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Pollen beetle (*Meligethes aeneus*)

Damage

- Adult feeding damage at bud stage causes abscission 'blind stalks'

Pollen beetle (*Meligethes aeneus*)

Damage

- Adult feeding damage at bud stage causes abscission ‘blind stalks’
- Pyrethroid resistance widespread across Europe
- Loss of control resulted in complete loss of 30,000ha (€22-25 M) in Germany 2006
- Indoxacarb, neonicotinoids (thiacloprid acetamiprid) & Pymetrozine currently viable alternatives

Cabbage Seed Weevil (*Ceutorhynchus obstrictus*)

Syn. *C. assimilis*

Distribution

- Europe
- Russia
- Asia Minor
- N. America (Canada)

Cabbage Seed Weevil (*Ceutorhynchus obstrictus*)

Life cycle: univoltine

May-June

Adults emerge and migrate to OSR crops; feed, mate

Mid May-July

Lay single egg into pods

Hatch 1-2 weeks

Aug

Larvae feed on seeds 2-5 weeks

July-Aug

3rd instars chew hole in pod, drop to ground to pupate in the soil

Late July-Aug

New generation emerge; feed on Brassicas for 1-2 weeks

Sept – May

Adults overwinter in leaf litter in field margins & woodland

Cabbage Seed Weevil (*Ceutorhynchus obstrictus*)

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Damage

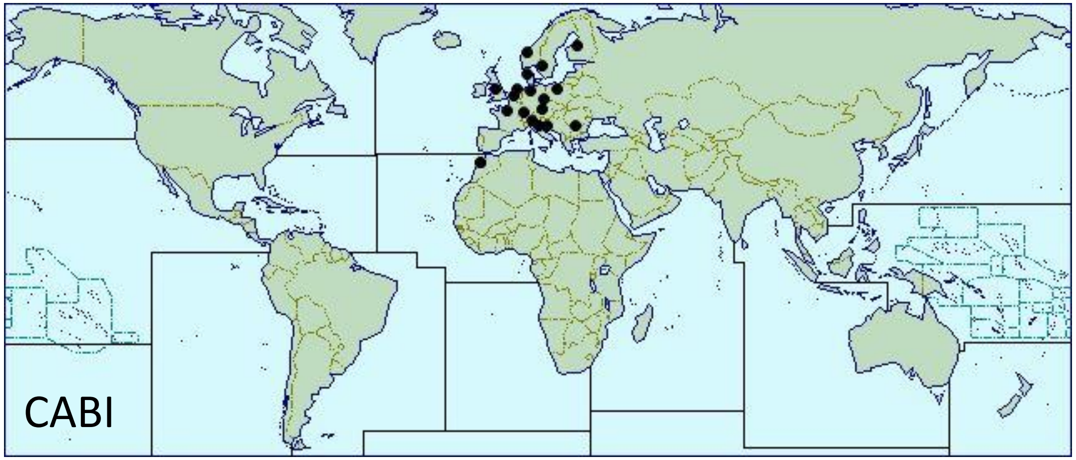
- Adults cause little direct damage but punctures in pod facilitates oviposition by brassica pod midge and increases risk of fungal infection by *Phoma lingam* (*Leptosphaeria maculans*)

- Yield loss through larval feeding on seeds: each larva consumes c. 5 seeds ; yield loss c. 20% (50% in N. America)

Brassica pod midge (*Dasineura brassicae*)

Distribution

- Europe
- N. Africa: Morocco



Brassica pod midge (*Dasineura brassicae*)

Life Cycle: multivoltine

May-July

Adults emerge; mate; ♂ die

♀ migrate to OSR crops ; lay c. 20 eggs per pod

Hatch in 3-4 d

Larvae feed on pod wall; 3 larval instars

Pods split; larvae drop to soil ; spin cocoon

% pupate immediately 2-3 weeks

Overwinter as larvae in cocoons

(diapause can last for 5 years)

Brassica pod midge (*Dasineura brassicae*)

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Damage

- pods yellow, become swollen split prematurely shedding larvae and seed
- Often most severe on headlands
- 82% loss seed weight

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Pest Management
of insect pests of oilseed rape

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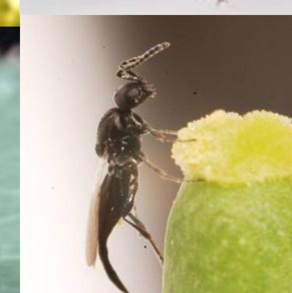

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Integrated Pest Management (IPM) of insect pests of oilseed rape

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- IPM is an effective and environmentally sensitive approach to pest management that relies on a combination practices (including the judicious use of pesticides)

- 4 usual steps in IPM programmes:

1. Set action threshold
2. Monitor pest density & assess risk
3. Prevention – cultural methods e.g. crop rotation, use of pest-resistant cultivars, semiochemical e.g. pheromone repellents, habitat diversification intercropping, trap cropping
4. Control – mechanical (e.g. trapping), biological, conservation biocontrol, botanical insecticides, synthetic pesticides

BBSRC bioscience for the future

1. Set Action Thresholds

Action (economic) thresholds refer to the number of pests or level of pest damage above which require control measures.

Based on:
Pest biology
Effects of damage on yield
Response of pests to insecticides

Expressed as:
Number of pests per plant or per unit area of crop
Amount of damage seen on plants
No. insects in traps

1. Set Action Thresholds

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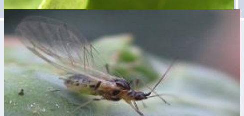
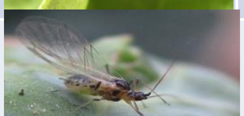
- Defined for each pest species

Pest		UK threshold	
	CSFB	25% leaf area eaten	5 larvae /plant
	Peach-potato aphid	As soon as detected in crop	
	Rape stem weevil	NA	
	pollen beetle	15 adults / plant (5 for backward crops) * to 2012	
	Cabbage seed weevil	0.5 adults/plant in north; 1/plant elsewhere	
	Pod midge	Treat for cabbage seed weevil	

BBSRC bioscience for the future

1. Set Action Thresholds

- Defined for each pest species; vary from country-country

Pest		UK threshold		Germany		Poland	
	CSFB	25% leaf area eaten	5 larvae /plant	10% leaf area eaten	3-5 larvae/plant	1/m plant row	-
	Peach-potato aphid	As soon as detected in crop		As soon as detected in crop		2 aphid colonies/m2 at crop edge	
	Rape stem weevil	NA		10 weevils/trap in 3d		10 weevils /trap in 3d	2-4/25 plants
	pollen beetle	15 adults / plant (5 for backward crops) * to 2012		3-4 adults/plant GS 50-51; 7-8 GS 52-53 (3-4 on backward crops; >8 GS 55-59 (>4)		1 adult/plant GS 50-51; 3-5 GS 52-59	
	Cabbage seed weevil	0.5 adults/plant in north; 1/plant elsewhere		0.5-1 adult / plant		4/25 plants with weevils	
	Pod midge	Treat for cabbage seed weevil		Treat for cabbage seed weevil		Treat for cabbage seed weevil	

1. Set Action Thresholds

- Defined for each pest species; vary from country-country
- Very few have been experimentally validated!

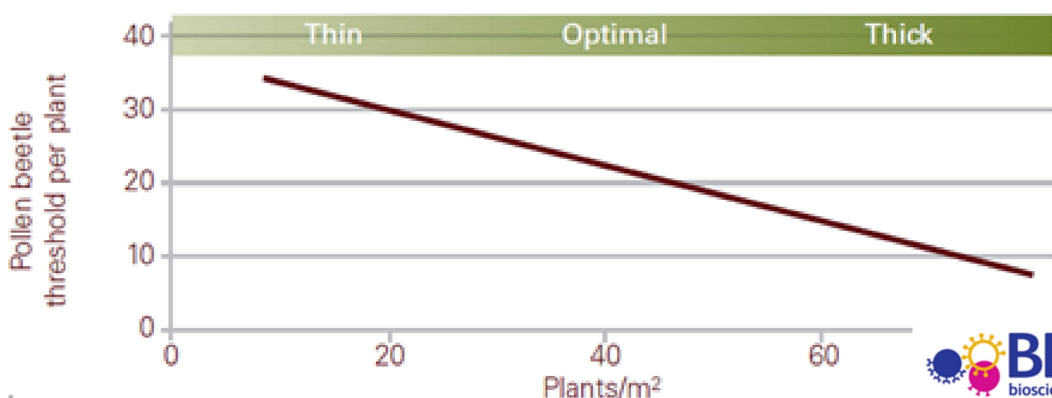
1. Set Action Thresholds

E.g. Revaluation of threshold for pollen beetle (UK)

AHDB Project 495 (Ellis & Berry)

Previous to 2012 UK threshold 15 beetles/plant or 5 for backward crops (GS 50-61)

- Thresholds re-evaluated using logic:
- 1) OSR plants produce more flowers than needed for max yield; buds can be lost to pollen beetles and still produce maximum yield;
- 2) The number of ‘excess flowers’ could be predicted by # plants/m^2 at the bud stage. Crops with fewer plants/m^2 had more excess flowers than more dense crops
- 1 beetle damages 9 buds/season



1. Set Action Thresholds

ROTHAMSTED RESEARCH

Threshold for pollen beetle (UK) now based on plant density

Revised control thresholds for winter and spring oilseed rape

If there are less than 30 plants/m²	the threshold is 25 pollen beetles per plant
If there are 30–50 plants/m²	the threshold is 18 pollen beetles per plant
If there are 50–70 plants/m²	the threshold is 11 pollen beetles per plant
If there are more than 70 plants/m²	the threshold is 7 pollen beetles per plant

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2. Monitor pest density & assess risk

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- Monitoring is necessary to determine the level of pest infestation and/or damage
- Informs when control threshold for a pest has been reached
- Helps to assess efficacy of control measures
- Methods based on understanding of crop location behaviour, phenology, immigration behaviours and spatio-temporal distributions

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2. Monitor pest density & assess risk

Monitoring methods: CSFB – adult damage

- Assess % feeding damage to leaves

2. **Monitor pest density** & assess risk

ROTHAMSTED RESEARCH

Monitoring methods : CSFB – no. larvale/plant

- Count larvae in plant petioles and stems (from at least 25 plants/field) ; threshold = average 5/plant
- Count stem/petiole damage; >50% relates to c. 2-5 larvae/plant

Dewar crop protection

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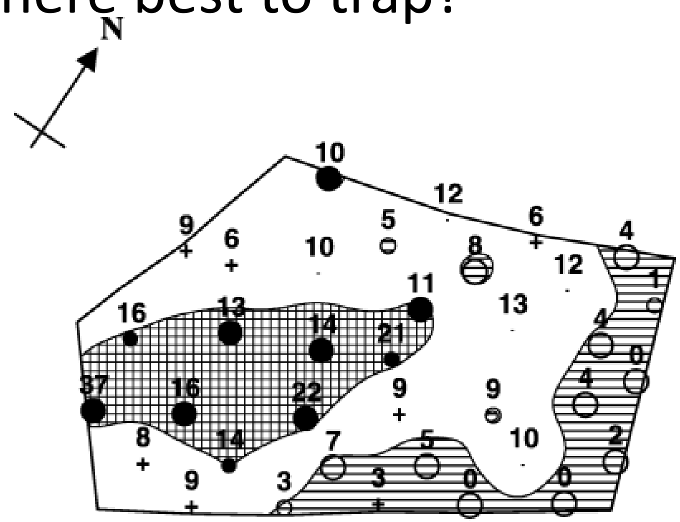
2. **Monitor pest density** & assess risk

Monitoring methods : CSFB – larval damage predicted by no. adults

- Water traps (4/field)
- 2 in headland and 2 in-field
- Threshold: mean total >96/trap over period Sept. to end Oct.
- But timing of larval sprays critical; this measure is rather crude
- Where best to trap?



(A) Total female *P. chrysocephala* distribution
(17 September–29 October 1998) (mean = 17.472)

Warner et al., (2003) Ent. Exp. Appl. 109:225-234

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2. **Monitor pest density** & assess risk

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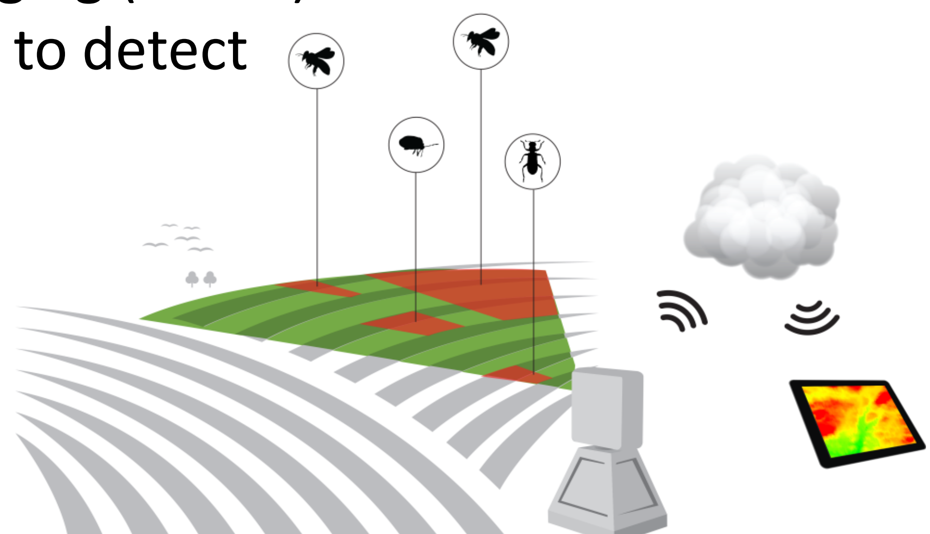
Real-timing monitoring of insect pests is needed!

- Machine learning enables detection and recognition of insect species

- Camera traps being developed by several groups
- LIDAR (Light Detection and Ranging (LIDAR) ‘laser’ sensor technology being tested to detect OSR pests & beneficials



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BAYER

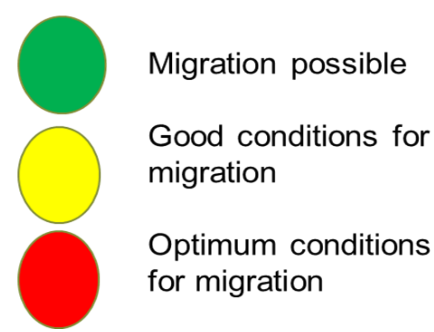
FaunaPhotonics

2. Monitor pest density & **assess risk**

ProPlantexpert.com on-line risk assessment tool

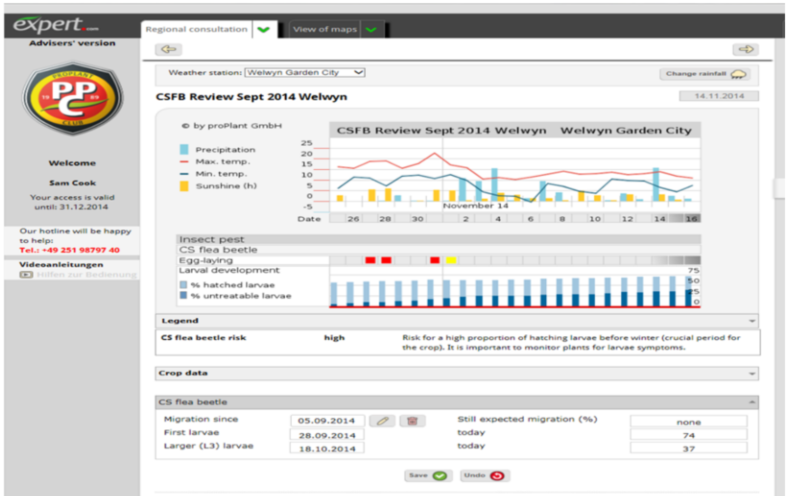
for: Cabbage stem flea beetle, rape stem weevil, pollen beetle, cabbage stem weevil, cabbage seed weevil, brassica pod midge

- proPlant DSS developed in Germany, used widely in Europe
- Based on phenological models of pest immigration and life cycle development parameters
- Uses local weather conditions (temperature, sunshine h, windspeed & rainfall)
- Predicts pest parameters up to 3d in advance
- Uses traffic light warning system

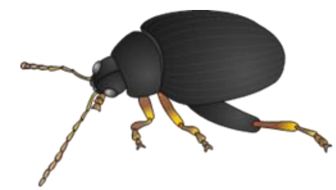


2. Monitor pest density & **assess risk**

ProPlantexpert.com On-line risk assessment tool



1. Indicates start & end of adult migration and highlights risk of migration



- Migration possible
- Good conditions for migration
- Optimum conditions for migration

Low risk (moderate conditions)
Treatment against adults to prevent egg laying still possible

Risk medium (good conditions)
Treat later against larval hatching

Risk high (optimal conditions)
Risk of high proportion of larvae hatching before winter. Important to monitor plants for larval symptoms

2. Warns of start of egg laying, intensity & larval development predictions

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2. **Monitor pest density & assess risk**

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pest aphids

Monitoring: Suction traps

Risk assessment: phenological

Models of 1st flights

AHDB Aphid News (8th Jan 2016)

AHDB ROTHAMSTED RESEARCH

APHID ALERT UPDATE 2

Suction-trapping period 14th December 2015 - 3rd January 2016

APHID-BORNE VIRUSES IN WINTER CEREALS (BYDV) AND OILSEED RAPE (TuYV)

SUCTION-TRAPPING

Suction-trap sites

Met Office figures suggest last month was the wettest December on record. The UK mean temperature for December was a record breaking at 7.9°C, which is 4.1°C above the long-term average. The previous record was 6.9°C in 1934. The temperatures for December 2015 were closer to those normally experienced during April or May. Along with the remarkable warmth, there has been a virtual complete lack of air frost across much of England. The exceptionally mild weather has led to further late aphid flight activity in south west and south east England, particularly during the week 14th-20th December but less so 21st December to 3rd January.

Site	*Rhopalosiphum padi*			*Myzus persicae*	
	14-20/12	21/12 – 3/1		14-20/12	21/12 – 3/1
Newcastle	0	0		0	0
York	0	1		1	0
Preston	8	0		0	0
Kirton	0	2		0	0
Broom's Barn	2	2		0	0
Wellesbourne	0	1		0	2
Hereford	7	7		1	1
Rothamsted	NA	NA		NA	NA
Writtle	13	2		1	0
Silwood	4	2		0	1
Wye	8	7		2	0
Starcross	30	3		1	0

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3. Prevention

Cultural methods e.g.

- Crop rotation
- Use of pest-resistant cultivars
- Habitat diversification : intercropping, cover crops, mixed cropping, trap cropping

Semiochemical e.g.

- pheromone repellents

3. Prevention: Use of pest resistant cultivars

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AHDB CEREALS & OILSEEDS **Recommended List®** **Winter oilseed rape 2015/16 - East/West Region**

YIELD, QUALITY, AGRONOMY AND DISEASE RESISTANCE

RECOMMENDED HGCA

NEW NEW NEW NEW NEW NEW NEW NEW

	V31	Popi	SY	Picti	Cam	Ince	Araz
Variety type	RH	RH	RH	Conv	Conv	RH	RH
Scope of recommendation	UK	UK	UK	UK	UK	UK	E/W
Gross output (yield adjusted for oil content) as % control							
Fungicide treated (5.3 t/ha)	109	107	107	107	106	106	106
Seed yield as % control							
Fungicide treated (5.0 t/ha)	108	106	108	107	105	105	108
Agronomic features							
Resistance to lodging	8	8	8	[8]	8	8	[8]
Stem stiffness	8	8	7	8	8	8	8
Shortness of stem	6	6	7	6	6	6	6
Earliness of flowering	7	6	7	6	6	7	8
Earliness of maturity	5	5	5	5	5	5	5
Seed quality (at 9% moisture)							
Oil content, fungicide treated (%)	46.0	46.0	44.2	44.4	45.6	45.7	43.6
Glucosinolate (µmoles/g of seed)	12.9	10.4	12.3	11.6	11.2	10.1	12.0
Disease resistance							
Light leaf spot	6	6	7	5	6	6	5
Stem canker	6	5	6	5	5	4	4
Status in RL system							
Year first listed	15	15	15	15	15	14	15
RL status	P1	P1	P1	P1	P1	P2	P1

Resistant cultivars available for diseases (Light leaf spot, Stem canker)

No commercial OSR cultivars resistant to any insect pest!

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3. Prevention: Use of pest resistant cultivars

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Exciting genetic breakthrough by Limagrain: Limagrain United Kingdom

Amalie WINTER OILSEED RAPE

cv. Amelie - resistant to TuYV transmitted by *Myzus persicae*

- But resistance based on virus not against the host insect
- Plant resistance to insect pests still in research pipeline

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3. Prevention: Use of pest resistant cultivars

Resynthesised lines

- Potential as sources of resistance to pest insects
- Resynthesized rapeseed lines (*B. oleracea* × *B. rapa*) broaden genetic diversity

e.g. partial resistance to *Ceutorhynchs pallidactylus*

Eickermann et al J. Appl Ent. (2010) 134:542-550; Bull. Ent. Res 101:287-294

3. Prevention: Use of pest resistant cultivars

Hybridization with resistant species

Sinapis alba resistant to attack by *Ceutorhynchus obstrictus*

B. napus x S. alba → novel resistant lines

Resistance due to glucosinolates profile?

McCaffrey et al. (1999) J. Ag Sci. 132 289-295
Tansey, Dosdall et al (2010) Canadian Entomologist 142:212-221; APIS 4:95-106

3. Prevention: Habitat diversification (intercropping, cover crops, mixed cropping, **trap cropping**)

ROTHAMSTED RESEARCH

Turnip rape (*Brassica rapa*) trap crop

More attractive than oilseed rape to pollen beetle, seed weevil and to cabbage stem flea beetle

Cook et al., 2006; Ent. Exp. Appl. 119:221-9
Cook et al., 2007 Arthropod-Plant Interactions 1:57-67

Barari, Cook, Clark & Williams (2005) BioConrol 50: 69-86
Döring, Mennerich & Ulber (2014) Bulletin IOBC/wprs

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3. Prevention: Habitat diversification (intercropping, cover crops, mixed cropping, **trap cropping**)

ROTHAMSTED RESEARCH

Replicated field plots

Pollen beetles & seed weevils can be reduced to below spray threshold

Full field-scale studies (Canada) against C. ostrictus Showed trap cropping can be effective….

…in large, square fields but not smaller, narrower fields

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Cárcamo , Dosdall et al (2007) Crop Protection 26 :1325–1334

3. Prevention: Habitat diversification (intercropping, cover crops, mixed cropping, **trap cropping**)

ROTHAMSTED RESEARCH

Replicated field plots (2005)

TR borders significantly reduced no. CSFB in oilseed rape plots vs controls Barari, Cook, Clark & Williams (2005) BioConrol 50: 69-86

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3. Prevention: Habitat diversification (intercropping, cover crops, mixed cropping, **trap cropping**)

Field trials 2015-26

PhD studentship Duncan Coston *''Quantifying the impacts of the Neonicotinoid restriction on Oilseed Rape''*

Supervised by RRes (Sam Cook, Lin Field) & University of Reading (Tom Breeze & Simon Potts)

- Initial results looked promising but by Christmas ALL OSR plants were gone ☹

3. Prevention: Habitat diversification (**intercropping**, cover crops, mixed cropping, trap cropping)

ROTHAMSTED RESEARCH

- Work from France shows that intercropping or undersowing OSR with legume mixtures can reduce CSFB infestation
- Collaboration with NIAB trial comparing 4 cover crop mixtures on CSFB damage
- Some promise….

Simon Kightley, NIAB TAG

NIAB TAG

University of Reading

ROTHAMSTED RESEARCH

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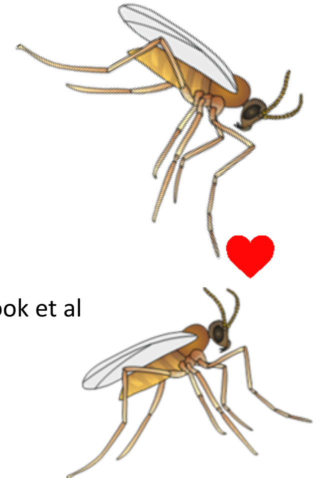
3. Prevention: Use of semiochemicals

- Host plant volatiles (reduced emissions of attractive compounds)
- Non-host volatiles

- Pheromones - several possibilities but not commercialized

CSFB - Evidence for production of male-produced sex pheromone
Bartlet et al (1994) Phys. Ent. 19: 241–250)

Phylotretta flea beetles – male-produced aggregation pheromone Peng & Bartelt et al



Seed weevil - oviposition deterring pheromone Ferguson & Mudd et al

Pollen beetle - Evidence of epideictic pheromone Ruther & Thiemann ; Cook et al

Pod midge – evidence for female-produced sex pheromone
Williams & Isidoro et al

4. Control

Mechanical e.g. trapping

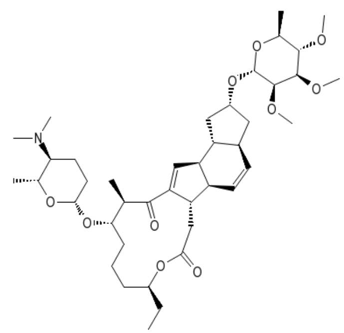
Commercialized trap with 2-phenylethyl isothiocyanate

http://www.csalomontraps.com/

4. Control

Bioinsecticides

Spinosad insecticide active via contact/ingestion based on chemical compounds found in the bacterial species *Saccharopolyspora spinose*



(not in EU)

4. Control: Bio-insecticides

Bioinsecticides - In research pipeline

- Entomopathogenic fungi

e.g. *Metarhizium anisopliae, Beauveria bassiana*

- Pathogenic nematodes

e.g. *Steinernema feltiae*

4. Control

Botanical insecticides

Commercialized
Pyrethrum

Research pipeline:
Neem – activity shown
(pod midge & pollen beetle)

Carum carvi
Thymus vulgaris
Pavela et al

CARE!
Many are broad spectrum!

4. Control

- Mechanical e.g. trapping
- Botanical insecticides
- Rock dusts
- GM
- RNAi's
- Conservation biocontrol

} in research pipeline

4. Control: Conservation biocontrol

ROTHAMSTED RESEARCH

Use of agronomy & habitat management methods to conserve the natural enemies of crop pests in the agri-environment to improve biocontrol

- **Field margins** can support populations of natural enemies of crop pests
- Commercial mixtures for birds, bees/butterflies but none for biocontrol**!**

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4. Control: Conservation biocontrol

- Grassy margins support generalist natural enemies of aphids
  e.g. Holland et al., 2012 Ag. Ecosyt. Env. 155:147-152

- Nectar-rich mixtures can attract other generalists






4. Control: Conservation biocontrol

Most efficient natural enemies of the brassica specialist pests of oilseed rape are the brassica specialist parasitoids

- Parasitism rates up to 80% in untreated crops
- Many overwinter as cocoons in soil; susceptible to tillage

- Undisturbed field margins could boost populations
- But they need Brassicas to reproduce and most commercial mixtures do not contain brassicas!

4. Control: Conservation biocontrol

Optimizing Brassica ‘banker plants’ for use in field margins to improve biocontrol in OSR

14 Brassica types screened

***Brassica napus* subsp. Biennis Forage rape**

best ‘all-rounder’ - Good for parasitoids of:

Pollen beetle

Seed weevil

Pod midge

Skellern, Clark, Ferguson, Watts & Cook *In Prep*

Data from UK Defra project IF0139

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4. Control: Conservation biocontrol

ROTHAMSTED RESEARCH

Do margins containing brassicas improve biocontrol in crops of the rotation?

- Abundance of biocontrol agents was increased in margins ☺
- Abundance decreased with distance into the field
- Little evidence of signficant biocontrol effects ☹
- Challenge for future:
  -move biocontrol agents into the open field
  -show positive effects on yield

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/ 2007-2013) under the grant agreement n°265865- PURE

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Conclusions

Oilseed rape crops are great for invertebrate biodiversity

A large proprtion have functionally useful traits (predators pollinators etc)

For some OSR pests IPM tools are commercially available; many tools still in research pipeline

1. Set action threshold ✓✓
2. Monitor pest density & assess risk ✓✓
3. Prevention ✓
4. Control ✓

Further development of ecological approaches to IPM of oilseed rape pests will ensure insecticides are used only when necessary; prolonging their active life, safeguarding the environment, maximising profitibility & contributing towards sustainable intensification of the crop

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AHDB Cereals & Oilseeds

HSE Health and Safety Executive
Chemicals Regulation Directorate Pesticides

IOBC
OILB

Working Group Integrated Control in Oilseed Crops

17th Biannual Meeting

September 17-19th 2018, Zagreb, Croatia

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WG ICOC

International Organization for Biological and Integrated Control of Noxious Animals and Plants West Palaearctic Regional Section (WPRS)