

Loss of insecticides in the UK

Professor Lin Field

Head: Biointeractions and Crop Protection



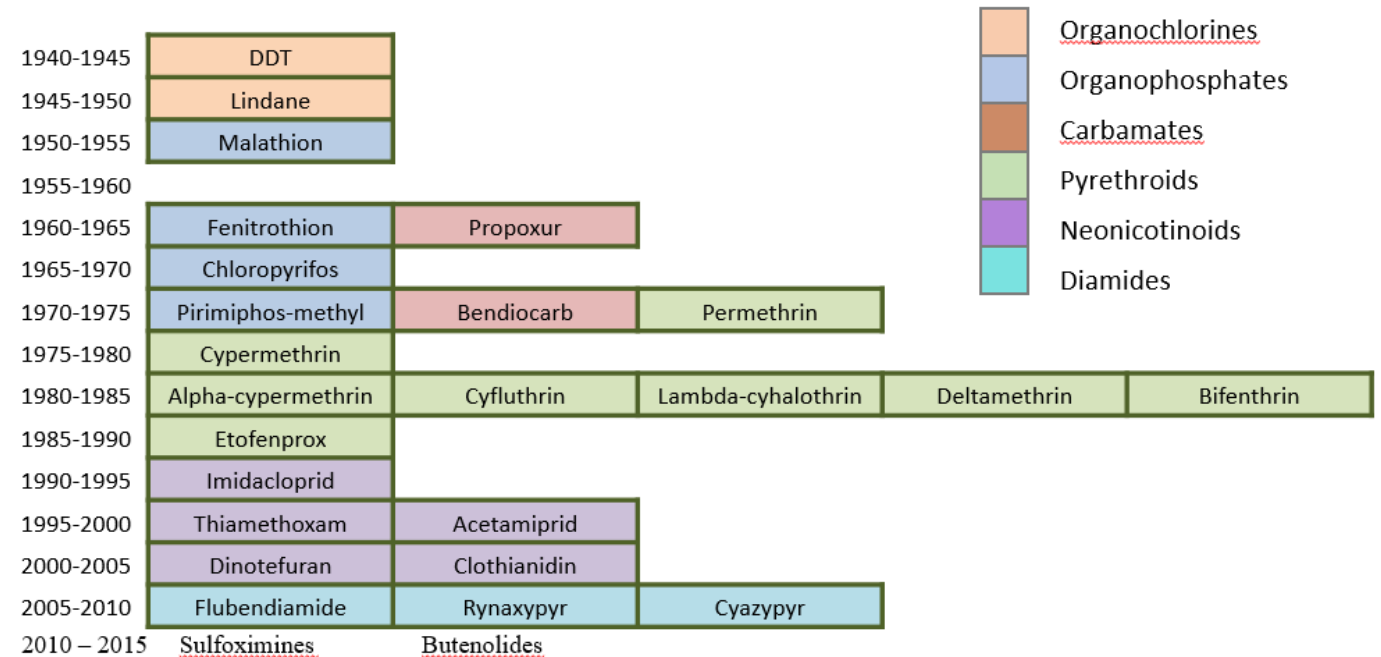
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**Biotechnology and
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Tool box for pest insect control

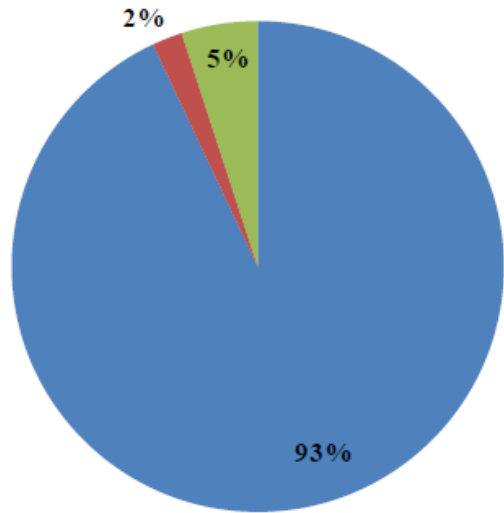


Pesticides can be 'lost' as a result of:

- **Resistance** developing in the pest
- Changes in **legislation** governing usage



For wheat - Aphids are the major target for insecticides



Reasons for using insecticides in UK:

Blue = aphids

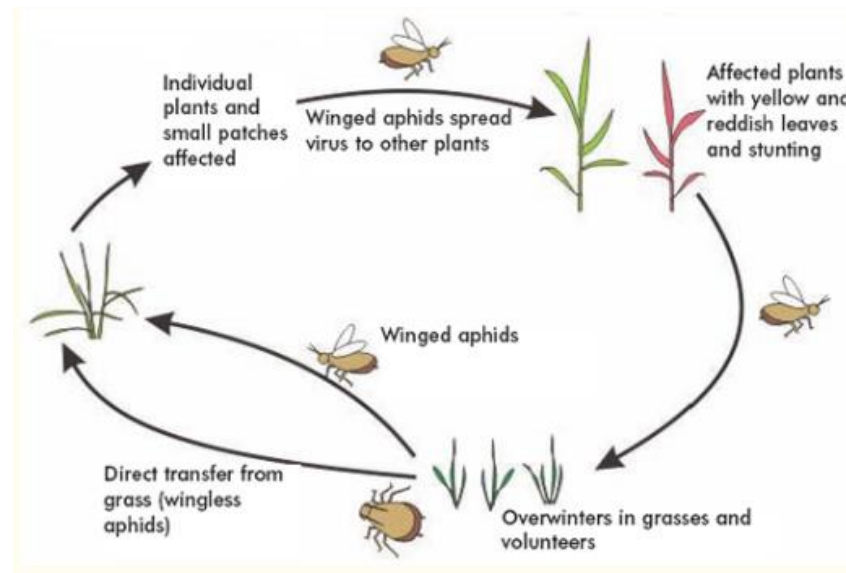
Orange = Orange wheat blossom midge

Green = Other pests

There are three species of cereal aphids: *Sitobion avenae* and *Rhopalosiphum padi* and *Metopolophium dirhodum*



S. avenae and *R. padi* transmit Barley Yellow Dwarf Virus (BYDV)



[From Garthwaite *et al.*

UK Pesticide Usage Survey Report 271]

[Courtesy AHDB Website]

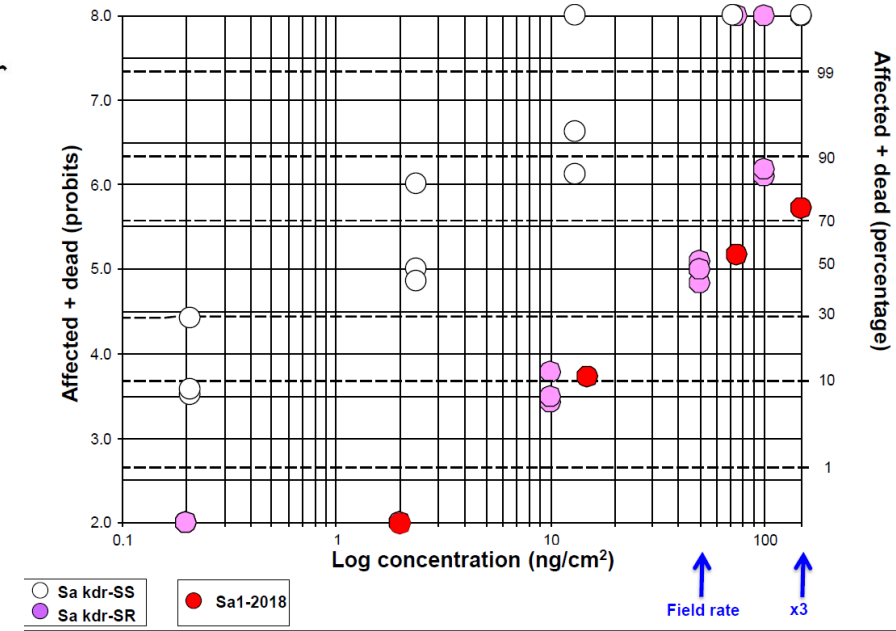


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Pyrethroids and cereal aphids

S. avenae:

- *kdr* resistance reported in 2014 and going back through stored samples showed it has been present since 2009
- Currently there is one 'Super clone' in the UK with ca. 5 - 20% carrying BYDV
- Clone is heterozygous for *kdr* i.e. *kdr-SR*
- Appears to be an asexual clone which doesn't produce males and females
- This may be why *kdr-SR* hasn't led to *kdr-RR*
- *kdr-RR* likely to be more resistant?
- Could lead to loss of pyrethroids?



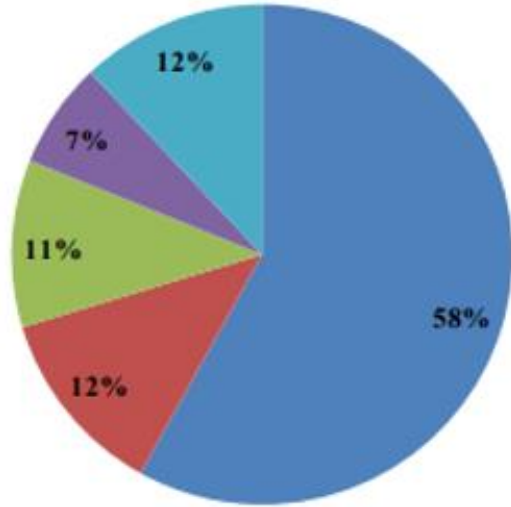
- Lab bio-assays suggest that *kdr-SR* would be a resistant phenotype and pyrethroids might not be effective in the field at recommended rates
- But there are no reports of them failing in the field
- Unless you know differently?

R. padi:

No reported resistance



For OSR – Aphids and CSFB are the major targets for insecticides



Reasons for using insecticides in UK:
Blue = Cabbage Stem Flea Beetle
Orange = Aphids



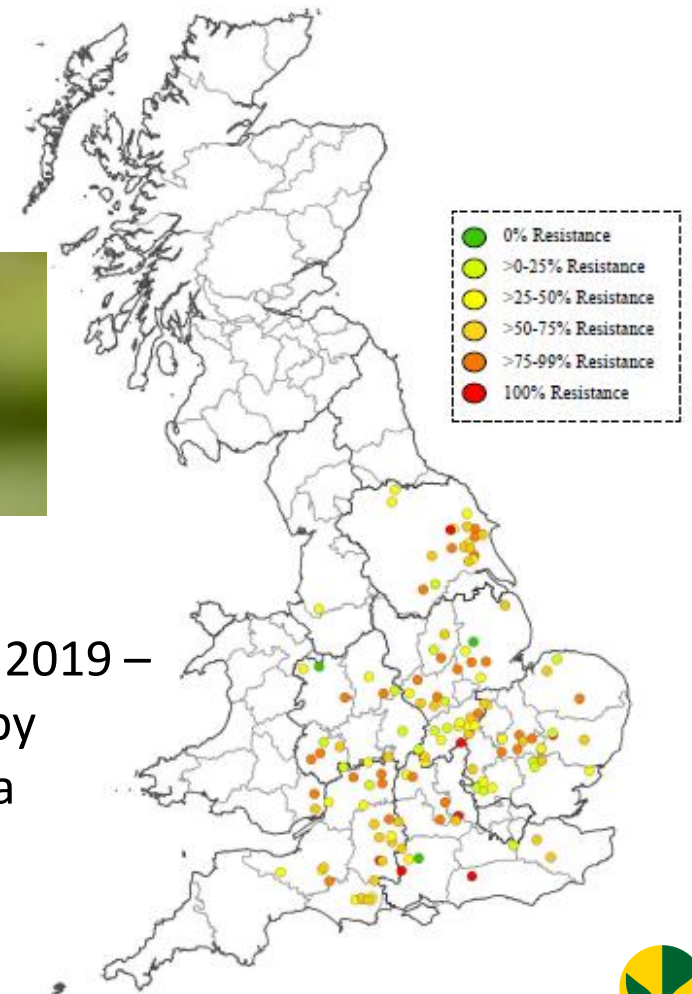
CSFB causes direct damage as both adults and larvae



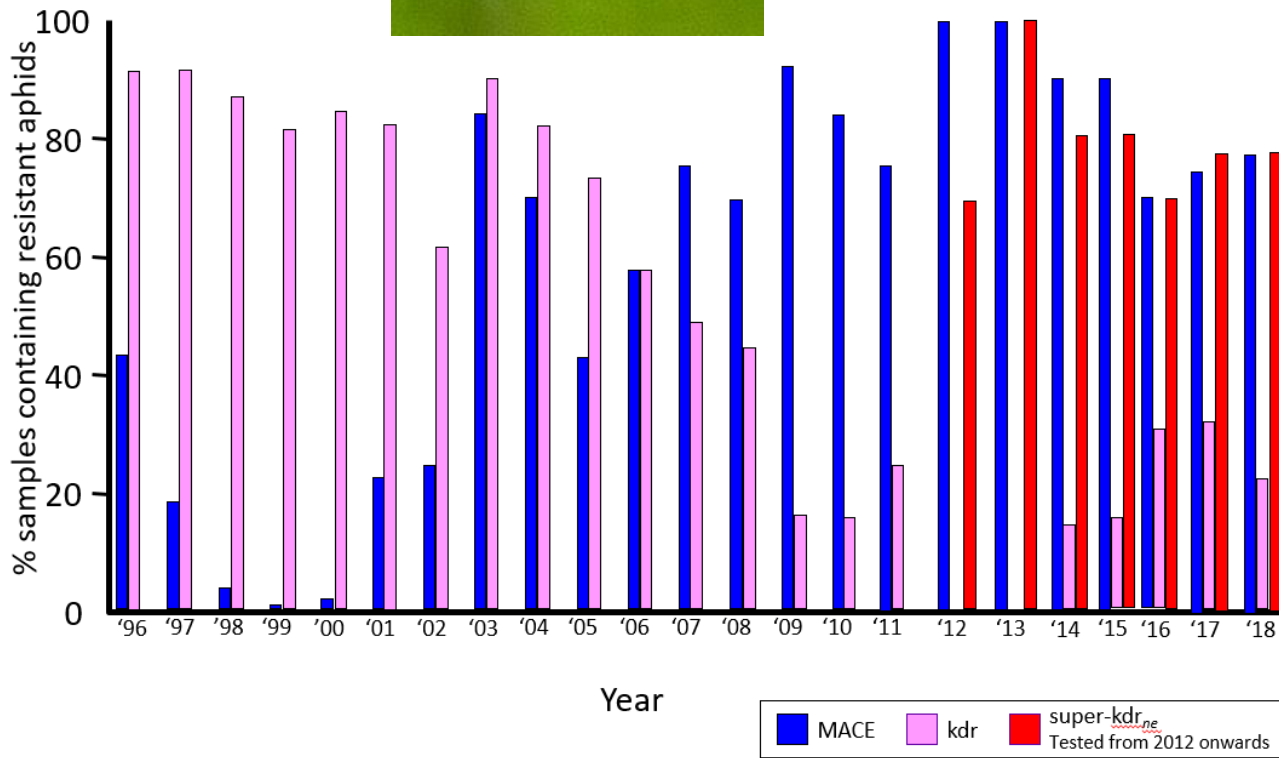
The aphid *Myzus persicae* causes indirect damage by transmitting Turnip Yellow Virus (TuYV)



Pyrethroids and OSR pests



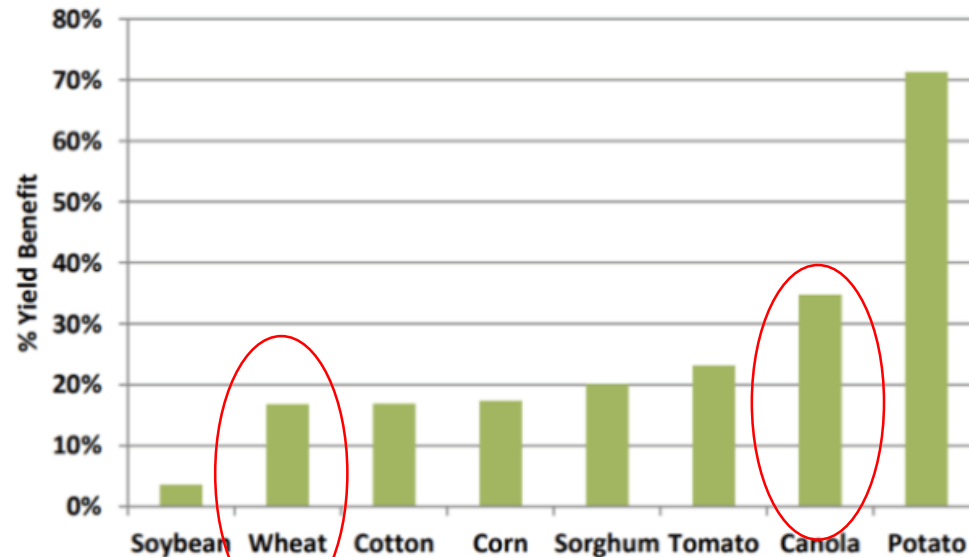
Data for 2019 –
funded by
Syngenta



Neonicotinoids as seed treatments

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of seed treatment-treated area	Proportion of census area treated (excluding unspecified treatments)
Clothianidin/prothioconazole	680,581	72,487	0.35	0.37
Prochloraz/triticonazole	249,085	7,276	0.13	0.13
Prothioconazole	208,735	3,739	0.11	0.11
Fludioxonil	124,965	1,145	0.07	0.07
Prothioconazole/tebuconazole	104,256	2,124	0.05	0.06

[From Garthwaite *et al.* UK Pesticide Usage Survey Report 271]



From the 2014 AgInformatics report: Average yield benefit by crop for neonicotinoid insecticide treatments relative to untreated control treatments.

Neonicotinoid seed treatments are a good way of controlling aphids and CSFB (no resistance reported in *S. avenae*, *R. padi*, *M. persicae* or CSFB)



Neonicotinoid legislation



EU voted to restrict use of neonicotinoids from **1st December 2013** for two years in the first instance. Involved a ban on three neonicotinoids (clothianidin, imidacloprid and thiamethoxam) on outdoor crops attractive to bees and cereals (except winter cereals). In UK this had most effect on **oil seed rape**

Then on **27th April 2018**, EU agreed to extend the ban on the 3 neonicotinoids (from end 2018) to all outdoors crops, so this year **wheat** could not be treated



Impacts of the first neonicotinoid restrictions

Impacts on agricultural productivity



The neonics ban has resulted in a **↓ of 912,000 ton of oilseed rape annually**.
In the UK, **oilseed rape acreage ↓ by 14%**.

The European oilseed rape industry alone **has lost around €900 mn per year**.



An **↑ 533,000 ha of land is required** outside the EU to compensate for the missing oilseed rape yields, equal to the territory of Cyprus.

Without neonicotinoids, the EU will **quickly become a net importer of key staple crops**, including maize, potatoes and oilseed rape.



Neonics contribute an annual crop volume of **21-31 mn tons** in the EU, worth a farm income of **€3-4 bn per year**.

Presence of TuYV in *M. persicae* has gone up to 80%. Growing evidence that yield is being lost in OSR



OSR is now heavily infested with cabbage stem flea beetles



Potential Impacts of the second neonicotinoid restrictions

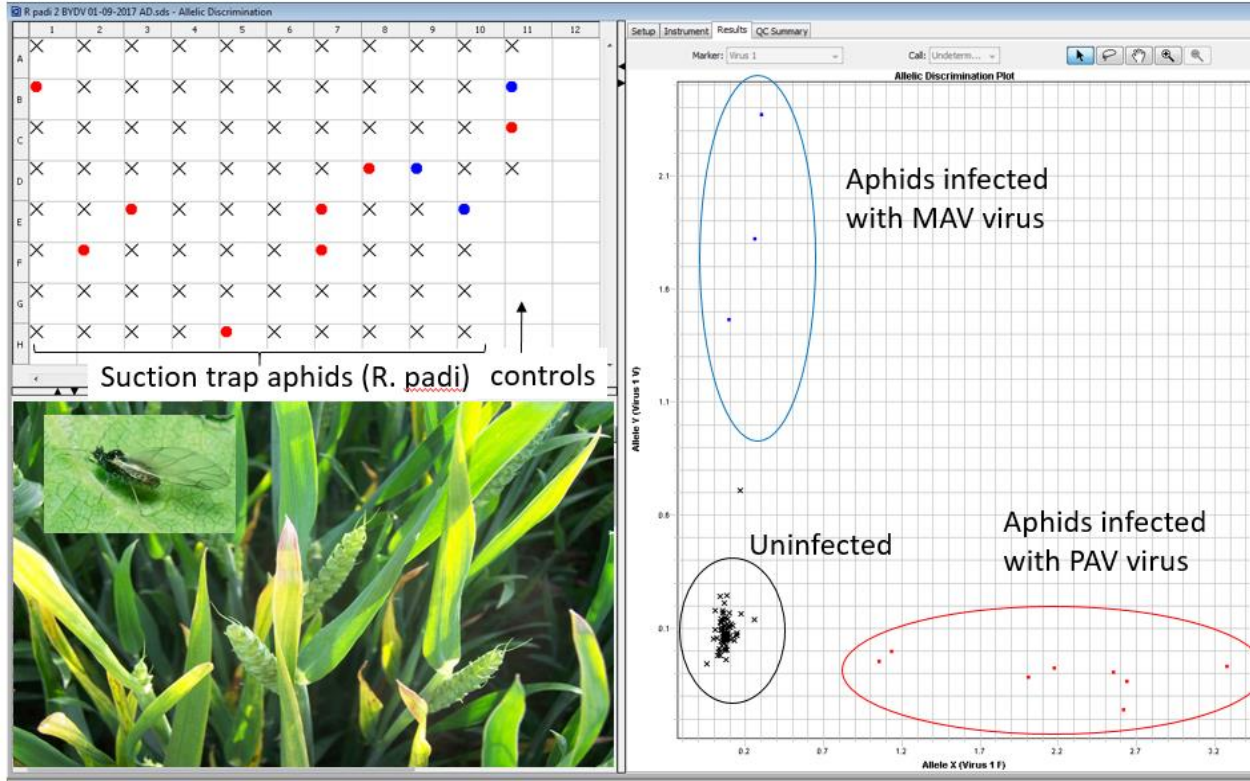
The extension of the ban to all outdoor crops means that the levels of virus in sugar beet and **cereals** is likely to increase, with a likely loss of yield

Prof. Lin Field, Head of Department of Biological Chemistry and Crop Protection, Rothamsted Research said:

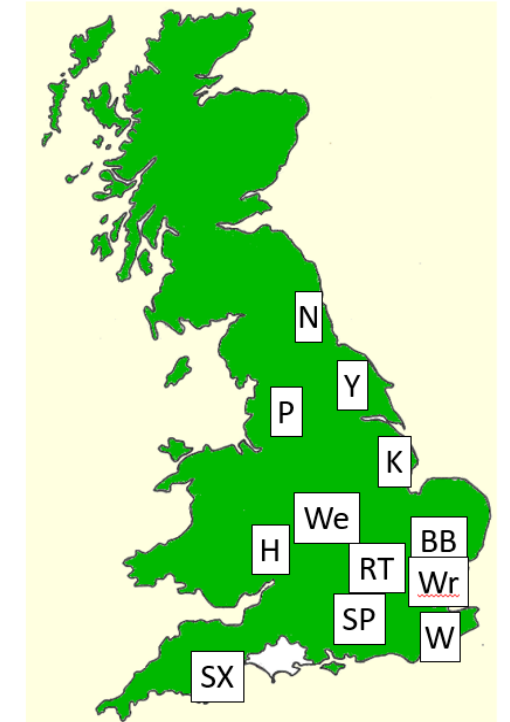
“I think that extending the ban to crops that don’t flower will create problems for UK farmers, especially for sugar beet and cereals. For sugar beet there are no alternatives for control of aphids and the viruses they vector, with widespread resistance to pyrethroids and carbamates. For cereal aphids pyrethroids are currently working but we know that resistance mutations are in the population and if pyrethroids become the main control measure it will make selection more likely.”



For cereal aphids need to know if control is needed – virus diagnostics



Trap	R padi	% BYDV
N	625	18
Y	15808	12
P	15995	15
K	11887	3
BB	8696	13
We	6929	6
H	6445	3
RT	3734	0
Wr	10471	21
SP	2752	4
W	6406	8
SX	3971	8



Insect Survey network: Newcastle, York, Kirton, Wellesbourne, Hereford, Rothamsted, Brooms Barn, Writtle, Silwood Park, Wye & Starcross

- Developed and optimised an RT-PCR assay
- Assay discriminates between the two major BYDV strain types
- Assay adapted to 96-well plates, so is reasonably high throughput

Data for 2019

- Considerable geographic variation
- Further monitoring with new funding from AHDB (who see the diagnostic as gold standard)



Alternatives to Neonicotinoids?

Other Insecticides:

- Pirimicarb – carbamate very specific for aphids – would work on cereal aphids but not *M. persicae*
- Pymetrozine – being phased out
- Sulfoxaflor – not approved in the UK
- Cyantraniliprole - marketed in UK but not for cereals- Lumiposa-treated OSR available for use in UK
- Flonicamid – approved for use on wheat in the UK

Host Plant Resistance:

- ‘Wolverine’ – BYDV-resistant wheat variety (RAGT Seeds)

The hard-milling group 4 feed variety is currently the top-yielding variety in the company's trials. It will come up for National Listing in November and could be included in the AHDB Recommended List in December 2020.

EU sets phase-out dates for pymetrozine

11 Oct 2018 | NEWS

by Jackie Bird

The European Commission has instructed EU member states to withdraw approvals for products based on the insecticide, pymetrozine, by April 30th 2019, with any grace period for existing stocks to expire by January 30th 2020.

Site of action	Class of insecticide
Nicotinic acetylcholine receptor (nAChR)	Nicotine Neonicotinoids Sulfoximines





Thank you for your attention

