Insecticide resistance status in UK oilseed rape crops

Summary

- This publication by the Insecticide Resistance Action Group (IRAG) summarises the resistance status of pest insects of UK oilseed rape (OSR) crops, and should be used in conjunction with IRAG's 'Insecticide resistance and its management' publication'.
- The peach–potato aphid (*Myzus persicae*) and mealy cabbage aphid (*Brevicoryne brassicae*) are the main aphid pests of OSR.
- This information applies primarily to the peach–potato aphid, as this aphid is associated with significant insecticide resistance issues.
- Peach–potato aphids with high levels of resistance to pyrethroids continue to predominate across the UK.
- There is no evidence of resistance to flonicamid in peach–potato aphids in the UK. There is no regular testing of mealy cabbage aphids, but currently there is no evidence of insecticide resistance in this pest.
- Resistance to pyrethroid insecticides has been detected in UK populations of pollen beetle (*Meligethes* spp.), cabbage stem flea beetle (*Psylliodes chrysocephala*) and diamond-back moth (*Plutella xylostella*).
- To minimise the risk of insecticide resistance appearing and spreading, insecticide use should be minimised through the use of pest thresholds and IPM programmes. Products should be used at their **full label rate** and different modes of action (MoA), where available, should be alternated in the spray programme.
- Approved chemical names, or the name of the chemical group they belong to, are used throughout this document. The names of products registered in the UK that contain these insecticides are available at secure.pesticides.gov.uk/pestreg/ProdSearch.asp
- The AHDB 'Encyclopaedia of pests and natural enemies in field crops' contains information on treatment thresholds, life-cycles and monitoring methods for a range of relevant pests.
- All IRAG publications can be accessed via the dedicated web page.

Resistance status of pests of oilseed rape crops

Brassica crops may be infested by numerous insect species. Most of them are occasional pests. Some, however, are frequent and damaging and require control measures on a regular basis. Repeated and widespread use of some insecticides has selected for resistant pest populations, resulting in insecticide control failures (Table 1). The most notable resistance in the UK is to the pyrethroid class of insecticides, where several species are now classified as being resistant.

Table 1. Pests of oilseed rape crops where resistance to insecticides has been identified

		Pyrethroids
Aphids	Peach–potato aphid	X
Beetles	Cabbage stem flea beetle	X
	Pollen beetle	X
Moths and butterflies	Diamond-back moth	X

Resistance status of aphid pests of oilseed rape crops

The peach–potato aphid and mealy cabbage aphid are the main aphid pests of OSR. The peach–potato aphid is most important in the autumn as a vector of turnip yellows virus (TuYV). It can also cause direct feeding damage but only if infestations are severe. Mealy cabbage aphid can cause damage through direct feeding and is primarily a problem in spring and summer.

The various mechanisms of resistance in peach–potato aphids have been monitored for many years (see the 'Insecticide resistance and its management' publication and annual reports from AHDB Project 21510015 for details).

Ongoing resistance screening work, funded by AHDB, BBRO, agronomy and agrochemical companies, has shown that there is currently no evidence of resistance to flonicamid in peach–potato aphids in the UK. However, **at present, peach–potato aphids with high levels of resistance to pyrethroids predominate across the UK meaning that these insecticides are highly unlikely to provide control of this aphid.**

Mealy cabbage aphid has not been screened for evidence of reduced sensitivity to insecticides but there have been no reports of control problems with this pest, suggesting that insecticides remain effective.

Current insecticide options for aphid control

There are several Modes of Action approved (MoA) for use within OSR crops. The active ingredients available for aphid control, their MoA, spray restrictions and notes on resistance that would impact on the level of control achieved, are detailed in Table 2. Further information on the MoA classification scheme can be found at irac-online.org/modes-of-action

Treatment efficacy should be monitored at a suitable time after application (this will be dependent on the active ingredients used but generally should be done after three days; flonicamid will take longer to kill aphids).

Table 2. Aphicides available for professional use on OSR in the UK (as at April 2021), along with the mode of action (MoA), restrictions on use and notes on current UK resistance. For several of the active ingredients, more than one product is available.

Mode of action (chemical group)	Active ingredient(s)	Maximum permitted number of applications†	Peach–potato aphid resistance status in UK
3a (pyrethroids)	Deltamethrin	†	Strong resistance widespread
3a (pyrethroids)	Etofenprox	1	Strong resistance widespread
3a (pyrethroids)	Lambda-cyhalothrin	†	Strong resistance widespread
3a (pyrethroids)	Tau-fluvalinate	†	Strong resistance widespread
29 (chordotonal organ modulators)	Flonicamid	1 up to GS18	No resistance

† Refer to product label for this information

Varietal resistance

TuYV-resistant winter oilseed rape varieties are widely grown in the UK and can be found on the AHDB Recommended Lists. For more information see: ahdb.org.uk/rl

Insecticide resistance status of other pests of oilseed rape crops

Resistance to pyrethroid insecticides has been detected in populations of pollen beetle, cabbage stem flea beetle (CSFB) and diamond-back moth in the UK. Other pests (such as cabbage seed weevil, cabbage stem weevil, rape winter stem weevil) have not been routinely screened for evidence of reduced sensitivity to insecticides.

Pollen beetle

Pyrethroid resistance in pollen beetle was first detected in the UK in 2006. Samples are not routinely or extensively tested for resistance. In 2018, two samples collected from Essex and Leicestershire were tested and both contained adults carrying pyrethroid resistance. The response to lambda-cyhalothrin and tau-fluvalinate (both pyrethroids) was similar. Bioassays applying a synergist prior to a pyrethroid application gave good control demonstrating a metabolic-based mechanism was responsible for the observed resistance. In 2019, eight samples were tested. Seven contained adults carrying pyrethroid resistance but one sample (collected from Lincolnshire) did not contain resistant adults (S. Foster, Rothamsted Research, unpublished).

Cabbage stem flea beetle

Pyrethroid resistance in CSFB adults was first detected in the UK in 2014. The kdr (knock-down resistance) mutation occurs in adults but the high pyrethroid resistance levels that have been reported, with control failures being observed at the full field rate, are not completely explained by kdr as it confers only moderate resistance to pyrethroids. This has led researchers to suggest that another mechanism of resistance, metabolic-based, is also present in the UK. Willis *et al*. (2020) reported results from bioassays, based on pyrethroid-coated glass vial exposure of adult beetles to lambda-cyhalothrin, carried out in 2018 and 2019. Three doses, equivalent to 4%, 20% and 100% of the recommended field application rate (7.5 g a.i./ha) were used. The samples were categorised according to the percentage of beetles per sample that survived treatment with the field rate. Over the two years, the number of samples containing a high percentage of resistant beetles increased. Several samples containing 100% resistant beetles were recorded in England in 2019. There were no resistance 'hotspots' and resistance was highly localised, almost on a farm-by-farm basis, suggesting differences in selection pressure due to differences in spray applications. In 2020, 30 CSFB samples from across England were screened and the results confirm the results from previous years showing widespread pyrethroid resistance. Tests on the 2018 and 2019 samples of the resistant beetles confirmed the presence of the kdr and/or super kdr mutation(s) (with the latter being at low frequency) and that there may well also be P450 mediated-detoxification of lambda-cyhalothrin, although further research is required to identify the specific P450(s) involved to find the exact mechanism of resistance (Willis *et al.* (2020).

CSFB larvae have also been studied for their sensitivity to pyrethroids, using a leaf-dip assay. The results show that in 2020, the 1st and 2nd larval instars collected from the Rothamsted Research farm were fully susceptible to pyrethroids in the bioassay conditions. In contrast, the 3rd instar larvae were found to be 50% resistant at the full field rate of lambda-cyhalothrin (C. Willis, Rothamsted Research, unpublished). In the field, targeting the larval stages with pyrethroids will be difficult due to them being physically protected within the OSR stems (as pyrethroids cannot penetrate the plants) and, as a result, poor control will probably be achieved due to lack of contact between the insecticide and the pest.

Diamond-back moth

The diamond-back moth is a migrant species and, although small numbers may overwinter in the UK (primarily in the South), there are regular influxes of moths from continental Europe during the summer. Diamond-back moths, tested in the UK during 2016–19, were all resistant to pyrethroid insecticides but not to insecticides from the other chemical groups tested (diamides and spinosad – not registered for use in winter oilseed rape).

Current insecticide options for pollen beetle and CSFB control

There are currently three MoA approved for use against pollen beetle: pyrethroids (alpha-cypermethrin, beta-cyfluthrin, cypermethrin, deltamethrin, etofenprox, lambda-cyhalothrin, tau-fluvalinate), oxadiazines (indoxacarb), and neonicotinoids (acetamiprid). Where pyrethroid resistance is present, the most effective insecticides will be indoxacarb, and acetamiprid. If more than one treatment is required, avoid using the same MoA again.

Only pyrethroids are approved for use against CSFB. Where resistance is present, they are unlikely to provide effective control. If a pyrethroid application is not effective, and this cannot be explained by factors such as poor spray coverage, then it is likely that the population is resistant. In such cases, **DO NOT** apply further pyrethroids, as this will continue to select for resistance and harm natural enemies.

A number of natural enemies are known to attack CSFB in the autumn, especially the egg and larval stages. Using pyrethroids against resistant CSFB populations, therefore, may result in higher larval populations than would otherwise have occurred.

Further information

IRAC, 2104. IRAC susceptibility test method 031. http://www.irac-online.org/methods/weevils-and-flee-beetles

AHDB 21510015 Monitoring and managing insecticide resistance in UK pests

Investigating the status of pyrethroid resistance in UK populations of the cabbage stem flea beetle (*Psylliodes chrysocephala*). Willis *et al.* 2020. Crop Protection 138: 105316

ahdb.org.uk/viruses-in-cereals-and-oilseeds

ahdb.org.uk/knowledge-library/encyclopaedia-of-pests-and-natural-enemies

Many principles of insecticide resistance management are common across crops and pest targets. These are detailed in IRAG's 'Insecticide resistance and its management' publication.

All IRAG publications can be accessed via ahdb.org.uk/knowledge-library/irag

Annual reports from the industry-funded insecticide resistance testing project are available from AHDB 21510015 Managing and monitoring insecticide resistance in UK pests

Additional information on integrated pest management methods can be found in AHDB Cereals & Oilseeds Research Review No 86 (2016): A review of pest management in cereals and oilseed rape in the UK: cereals.ahdb.org.uk/media/1100127/rr86.pdf