Insecticide resistance status in UK brassica crops

Summary

- This publication by the Insecticide Resistance Action Group (IRAG) summarises the resistance status of pest insects of horticultural brassica crops, and should be used in conjunction with IRAG's 'Insecticide resistance and its management' publication
- Peach-potato aphid (*Myzus persicae*), cabbage stem flea beetle (*Psylliodes chrysocephala*), pollen beetle (*Meligethes* spp.), diamond-back moth (*Plutella xylostella*), cabbage whitefly (*Aleyrodes proletella*) and onion thrips (*Thrips tabaci*) are resistant to pyrethroid insecticides. Peach-potato aphid is also resistant to organophosphates and onion thrips are also resistant to spinosad
- To minimise the risk of insecticide resistance appearing and spreading, insecticide use should be minimised through the use of thresholds and IPM programmes, products should be used at their full label rate and modes of action 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.pestcides.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 accessed via the dedicated web page: ahdb.org.uk/irag

Resistance status of pests of brassica crops

Brassica crops may be infested by almost 50 insect species, including aphids, caterpillars, flies and beetles. Most of these insects are occasional pests. Some of these species, however, are frequent and damaging, and require control measures on a regular basis.

Repeated and widespread use of some insecticides has selected for populations of pest insects that are resistant to them, resulting in 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 horticultural brassica crops where resistance to insecticides has been identified (X)

Brassica pest		Pyrethroids	Organo-phosphates	Spinosad
Aphids	Peach–potato aphid	X	X	
Beetles	Cabbage stem flea beetle	X		
	Pollen beetle	X		
Moths and butterflies	Diamond-back moth	X		
Other pests	Cabbage whitefly	X		
	Onion thrips	X		X

Insecticide resistance status of aphid pests of brassica crops

Three species of aphid infest the foliage of brassica crops – mealy cabbage aphid (*Brevicoryne brassicae*), potato aphid (*Macrosiphum euphorbiae*) and the peach-potato aphid (*Myzus persicae*).

All three species overwinter as adults and immature aphids on suitable host crops. Winged forms migrate to new brassica crops in late spring.

Cabbage aphid is probably the most damaging species. Although it can transmit plant viruses, the damage caused and its physical presence creates the greatest problems for growers. There is no evidence, at present, that cabbage aphid populations are resistant to any insecticide.

The potato aphid is the least important of the three aphid species. There is evidence to suggest that some populations may be less susceptible than others to certain insecticides, but this has no impact currently on the levels of control that can be achieved with approved insecticides.

The peach-potato aphid is responsible for the transmission of plant viruses. In some cases, particularly on Savoy cabbage and Brussels sprout, its presence can reduce crop marketability. Peach-potato aphid populations frequently contain individuals that are resistant to certain insecticides.

Figure 1. Images (left to right) of the horticultural brassica pests: mealy cabbage aphid, potato aphid and the peach-potato aphid

The peach-potato aphid has developed various ways of surviving exposure to insecticides and because, in the UK, females frequently reproduce without mating – this means large populations can build up quickly. The next generation of aphids carries the same genes as their mother, including any insecticide resistance traits. This form of reproduction continues throughout the winter in glasshouses, in clamps, and on outdoor weeds and crops (eg oilseed rape). In this scenario, resistance is carried forward to the following season (although there is evidence that some insecticide-resistant aphids do not survive cold UK winters very well).

The various mechanisms of resistance in peach-potato aphids have been monitored for many years (see the ‘Insecticide resistance and its management’ publication for further details).

Aphids with high esterase (conferring variable resistance to a number of insecticide groups, particularly organophosphates), MACE (conferring strong resistance to pirimicarb) and kdr (conferring moderate resistance to pyrethroids) were widely distributed on potato crops in eastern England in 1996. MACE and esterase resistance then appeared to decline to low levels by 2000, possibly because peach-potato aphids carrying these resistance mechanisms suffer greater mortality during times of stress (eg during colder winters).

MACE aphids resurged in central and eastern Scotland in 2001, however, and have since spread to the rest of the UK. These more recent changes are due to new forms of peach-potato aphid that carry both MACE and an alternative form of kdr called ‘super-kdr’. These aphids appear to be better adapted to the current UK environment. At present, peach-potato aphids with high levels of resistance to pyrethroids and some carbamates predominate across the UK.

There is no evidence of strong resistance to neonicotinoids in peach-potato aphid populations in the UK. As a result, this chemistry, which includes foliar applications of thiacloprid, has an important role to play in aphid management.

Peach-potato aphids that carry strong neonicotinoid resistance (conferred by a combination of a metabolic mechanism and a target site mechanism) are now common in some peach growing regions of southern mainland Europe and have spread to Greece and North Africa, on peach as well as on other crops. This situation is being monitored carefully in the UK and guidelines will be updated if the situation changes.

The maximum number of applications of any neonicotinoid-containing product is a statutory restriction introduced by CRD, in collaboration with IRAG, as a pro-active resistance management measure. Such restrictions take account of exposure of peach-potato aphids to neonicotinoid sprays when they are not the intended target of the spray.

Ongoing resistance screening work has also found no evidence of resistance to flonicamid (not approved currently on brassicas), pymetrozine (final use date 30th Jan 2020), spirotetramat or cyantraniliprole in peach-potato aphid in the UK.

Insecticide resistance status of beetle pests of brassica crops

The most important pest beetles of horticultural brassica crops are flea beetles (several species), pollen beetle (*Meligethes* spp.) and weevils. Resistance to pyrethroid insecticides has been detected in populations of pollen beetle and cabbage stem flea beetle in the UK. Oilseed rape is the main crop at risk from pollen beetle and cabbage stem flea beetle, but pollen beetle adults emerging in summer migrate to brassicas, most notably cauliflower and calabrese, but also ornamentals.

Insecticide resistance status of moth pests of brassica crops

The caterpillars of a number of species of moth and butterfly can be pests of brassica crops. At present, only the diamond-back moth (*Plutella xylostella*) is resistant to insecticides. Globally, populations of diamond-back moth may be resistant to a range of insecticides and also to *Bacillus thuringiensis* (Bt). The diamond-back moth is a migrant species and, although small numbers may overwinter in the UK, there are regular influxes of moths from continental Europe during the summer. Diamond-back moths, tested recently in the UK (2016–2018), are resistant to pyrethroid insecticides but not to insecticides from other chemical groups (diamides and spinosad). Products from all other insecticide groups approved for caterpillar control in brassica crops maintain efficacy against all species.

Insecticide resistance status of other pests of brassica crops

Brassica crops may also be infested by cabbage whitefly (*Aleyrodes proletella*) and onion thrips (*Thrips tabaci*). Resistance to pyrethroid insecticides has been confirmed for both of these pests. Some populations of onion thrips are also resistant to spinosad.

Current insecticide options for aphid control

There are several modes of action approved for use within horticultural brassica crops. It is important to alternate chemical groups with different modes of action throughout the life of the crop.

The only neonicotinoid treatments now approved for brassicas are foliar sprays (e.g. thiacloprid).

Pymetrozine is a selective insecticide that is effective against cabbage aphid and peach-potato aphid. The addition of a seed oil or methylated seed oil as an adjuvant is needed to maximise control of cabbage aphid.

There is no evidence of resistance to pymetrozine in peach-potato aphid. **On 9th October 2018 the European Commission adopted the non-renewal of approval for pymetrozine. Authorisations for products containing pymetrozine were withdrawn on the 30th April 2019, with a use-up period of 9 months. No products containing pymetrozine must be used after 30th January 2020.**

Spirotetramat is a systemic insecticide and is very mobile within the plant. It is effective against a broad range of sucking pests, including aphids and cabbage whitefly.

The diamide cyantraniliprole is a systemic insecticide and is available for use a drench or foliar treatment. When applied as a pre-planting module drench treatment it has approval for control of cabbage root fly. When applied as a foliar spray it has approval for several caterpillar pests. No subsequent foliar applications of cyantraniliprole can be applied where this active ingredient has been used as a module drench, highlighting the need to plan insecticide resistance strategies ahead of planting.

Pyrethroids, such as lambda-cyhalothrin and deltamethrin, are approved for aphid control on some brassica crops. However, peach–potato aphids with the commonly occurring kdr and super-kdr resistance mechanisms will not be controlled by pyrethroids. Pyrethroids are broad spectrum insecticides and there is evidence that they can make aphid infestations ‘worse’ by killing beneficial insects and also failing to control the aphids effectively. They are an effective option for controlling other foliar pests, such as caterpillars (with the exception of diamond-back moth), but growers should consider the whole pest complex carefully before making their choice of insecticide. For example, pyrethroid resistance in pollen beetle is widespread in the UK and resistance has also been identified in populations of diamond-back moth, cabbage whitefly and onion thrips.

Many insecticides work through direct contact with the target. The performance of such insecticides can be impaired when used on dense canopies or where the pest is on the underside of the plant. The exceptions are spirotetramat and the diamide, cyantraniliprole (Verimark pre-planting drench treatment for cabbage root fly control), which have systemic activity and, thus, can move around the plant.

Further information

ahdb.org.uk/pests

ahdb.org.uk/knowledge-library/brassica-crop-walkers-guide

horticulture.ahdb.org.uk/publication/2116-pest-insects-infesting-brassica-crops

Many principles of insecticide resistance management are common across crops and pest targets. These are detailed in IRAGs ‘Insecticide resistance and its management’ publication.

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