Insecticide resistance status in UK cereal crops

Summary

- This publication by the Insecticide Resistance Action Group (IRAG) summarises the resistance status of pest insects of UK cereal crops, and should be used in conjunction with IRAG's 'Insecticide resistance and its management' publication
- Grain aphid (*Sitobion avenae*), bird cherry–oat aphid (*Rhopalosiphum padi*) and rose–grain aphid (*Metopolophium dirhodum*) are the main aphid pests of cereals in the UK
- These guidelines apply primarily to the grain aphid, as this aphid is associated with significant insecticide resistance issues
- Grain aphids with moderate levels of resistance to pyrethroids are widespread in the UK
- Available insecticides in cereals effective against grain aphids include pyrethroids **applied at full label rates** and insecticides containing the active ingredient flonicamid (although this can only be used for summer infestations)
- There is no evidence of insecticide resistance in rose–grain aphid and bird cherry–oat aphid. Both aphid species can be controlled effectively with pyrethroids or insecticides containing the active ingredient flonicamid (although this can only be used for summer infestations)
- Barley yellow dwarf virus (BYDV) virus risk can be reduced by controlling weeds effectively and drilling crops later
- 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 (MoA) should be alternated in the spray programme (where more than one treatment is required)
- 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 accessed via the dedicated web page: ahdb.org.uk/irag

Resistance status of aphid pests of cereals

Grain aphid, bird–cherry oat aphid and rose-grain aphid are the main aphid pests of cereals in the UK (Figure 1). Grain aphid is the main vector of barley yellow dwarf virus (BYDV) in the East, Midlands and the North. Bird cherry–oat aphid is the main vector of BYDV in the South West. All three species (especially grain aphid) can cause direct damage through feeding.

In 2011, 'kdr' resistance was first identified in grain aphid. Aphids carrying kdr have reduced sensitivity to pyrethroid insecticides. Initially, kdr was mainly limited to grain aphid populations in East Anglia. Since then, testing at Rothamsted Research (part-funded by Syngenta and AHDB) has helped monitor its spread. The tests show grain aphids with kdr are now widespread in the UK, with its frequency varying (both regionally and annually). Tests of grain aphids, collected in the Rothamsted Research suction trap network in 2017, showed the

kdr mutation was present in some areas of England at a very high frequency (over 50 per cent). A lower frequency was detected in Scotland (about 30 per cent).

There is no evidence of insecticide resistance in bird cherry–oat aphid or rose-grain aphid.

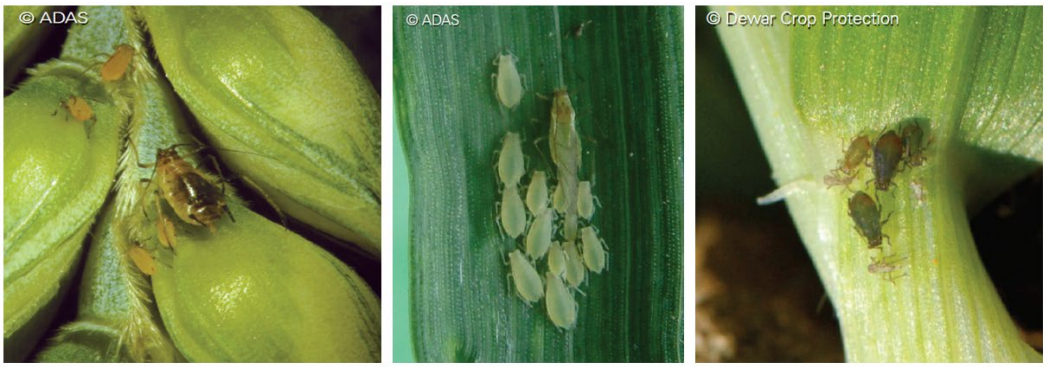

Figure 1. Effective resistance strategies require the target pest to be identified correctly. Images (left to right) show grain aphid, rose–grain aphids and bird cherry–oat aphid. For further information, see the AHDB 'Encyclopaedia of pests and natural enemies in field crops'.

Current insecticide options for aphid control in cereals

Most cereal crops are treated for aphids.

Control in the autumn and winter

Only foliar-applied pyrethroids (IRAC 3A) are registered for control of BYDV aphid vectors in the autumn and winter. Initially, aphids colonise relatively few crop plants. When the second generation offspring are produced, these tend to move away from the plant originally colonised. Controlling this generation is a key component of a BYDV management strategy. Spray applications should be considered once aphids have migrated into crops but before they have had a chance to spread virus from their initial colonisation point (usually mid to late October). Aphid migrations normally cease by early November, however they may continue into December if mild, dry conditions allow.

The timing of the second generation can be approximated by accumulating daily average air temperatures above a baseline temperature of 3ºC. It takes around 170 'day degrees' (DD) for the second generation to be produced. A tool to calculate when the 170 DD threshold is reached is available on the AHDB website (ahdb.org.uk/bydv). It takes into account the region, crop emergence date and insecticide use.

Where grain aphid is identified as the main aphid pest present in the crop, pyrethroid sprays may not be effective, as it has been shown to have moderate levels of resistance to this class of chemistry in laboratory assays. As a result, pyrethroid treatments must be applied at the full recommended rate to maximise the effectiveness of the treatment and to reduce the chances of grain aphid evolving stronger pyrethroid resistance. It is also important to ensure good crop coverage, because pyrethroids only have contact activity against aphids. These actions will maximise control and minimise the selection of resistant individuals.

There is no evidence, to date, of kdr in bird cherry–oat aphid, so pyrethroids will be effective in controlling BYDV, if this is the main vector and timely applications are made.

Tank mixes of herbicides and insecticides are sometimes applied at the optimum time for weed control but not aphid control. Such approaches can result in poor aphid control and increase the risk of the crop being infected by BYDV. Natural enemies can be important in controlling aphid populations. Unnecessary use of broad-spectrum insecticides such as pyrethroids will affect natural enemy populations and reduce the level of control they provide.

Control in the summer

For control of summer infestations, there are three modes of action (MoA) approved for use pyrethroids, organophosphates (e.g. dimethoate) and flonicamid. As there is no evidence, to date, of resistance in bird cherry–oat aphid or rose–grain aphid, pyrethroids will be effective in controlling summer infestations from these pests.

Where grain aphid is the main species in a summer infestation, dimethoate or flonicamid are likely to be most effective. Flonicamid is an insecticide with selective activity against hemipterous pests (such as aphids and whiteflies) and thysanopterous pests (such as thrips) and will have a lower impact on non-target, beneficial organisms (e.g. pollinators and natural enemies of aphids) than pyrethroid insecticides. Dimethoate has a broad spectrum of activity and will affect a range of non-target organisms but is an effective aphicide. Further information on the MoA classification scheme can be found at irac-online.org/modes-of-action

Specific recommendations for BYDV vector control

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, however, will take longer to kill aphids).

To maximise efficacy and to protect insecticides from resistance, it is essential to follow best practice measures. The measures, many of which are common across crop production, are detailed in the IRAG's 'Insecticide resistance and its management' publication. The document includes essential information on aphid monitoring.

Weed control

Aphids can often be found on ploughed-down leaf material (e.g. grass weeds and volunteers). This material can act as a 'green bridge', which allows aphids to move up through the soil to newly emerging crops. Effective control of grass weeds and cereal volunteers, particularly in stubbles prior to seedbed preparation, helps reduce the risk of aphid movement.

Drilling date

Early drilled crops (e.g. drilled in September) are at the highest risk from BYDV. In most years, late-sown crops (i.e. drilled post mid-October), do not usually require a spray for aphid control. The exception is when weather conditions are conducive for aphid migration in late autumn.

Varietal tolerance

BYDV tolerant winter barley varieties are starting to be grown in the UK.

Further information

ahdb.org.uk/pests

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

Many principles of insecticide resistance management are common across crops and pest targets.

These are detailed in IRAGs 'Insecticide resistance and its management' publication.

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

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