Cereal aphid resistance and control

Dr Louise Mc Namara, Teagasc Oak Park

Dr Michael Gaffney, Teagasc, Horticulture Development Department, Ashtown

Irish Farmers Journal Crops & Spreaders Supplement

Barley Yellow Dwarf virus (BYDV) is a major disease of cereals in Ireland. It is spread through the saliva of aphids feeding on infected plants and then feeding on uninfected plants. The virus is particularly damaging when aphid migration coincides with emerging crops (before GS31), such as in early autumn and late spring sown crops. There is no direct control for the virus, so management focuses on reducing its spread by reducing aphid populations, through the use of insecticides, and drilling crops when aphid migration is less likely (Late Autumn, Early Spring).

Pyrethroid Resistance

Aphids with the knockdown resistance (kdr) mutation, which confers varying resistance to pyrethroids insecticides, were first detected in Ireland in 2013. Subsequent field surveys carried out from 2015 to 2018 found aphids carrying the kdr mutation in the five major grain growing counties surveyed. To date only partially resistant grain aphids have been detected in Ireland, so it is important to use full recommended rates where insecticides are applied to achieve control. Where a suspected control failure occurs it is important not to follow with the same chemistry so as to avoid exasperating the problem. Grain aphids collected in Irish winter barley fields show a substantial variation in response to pyrethroid application. Preliminary work indicates that a second resistance mechanism may also exist in Irish grain aphids which may partially explain this field-to-field variation in aphid response.

Integrated Pest Management

Integrated pest management (IPM) aims to provide sustainable control by utilising multiple control approaches, including cultural, physical, biological and chemical. Examples of how this might work are shown in Table 1.

Cultural control strategies are essential tools for managing BYDV, particularly in light of recent mild winters and the fact that the number of, and efficacy of available insecticides is declining. Due to the recent ban on neonicotinoid seed treatments, there is only one class of insecticides (pyrethroids) for aphid control on winter barley and spring barley. Previous Teagasc studies at Oak Park highlighted that drilling date can have an impact on BYDV incidence and yield losses in cereals in both autumn and spring cereals. Early sown autumn crops, reaching 2/3 leaf stage before and up to mid-October should be sprayed at that stage, followed by a further spray in November. Generally, October sown crops require a single aphicide during the 2/3 leaf stage. If a treatment is delayed due to poor ground conditions, crops may still benefit from a treatment in Dec, Jan, Feb if mild conditions persist and there is evidence of aphid presence within crops. If crops emerge after the end of November they generally do not require spraying, except in high risk areas or in the case of mild winters which would support the presence of aphids.

Table 1. IPM options pre- and post-planting

Pre planting IPM:

- Cultural control
- Drilling date
- Cultivation type
- Minimize “green bridge”
- Variety selection

In season IPM:

Decision making on a field-to-field basis is very challenging

- Improved monitoring/forecasting
- Targeted application of insecticides
- Establishing thresholds
- Anti-resistance strategies: Monitoring for control failure, alternative insecticides
- Biocontrol: Encouraging natural enemies

Integrated Pest Management Tools: Some of these are not currently available for control of BYDV such as resistant variety selection, alternative chemistry (in winter or spring barley) and thresholds based on aphid density.

For spring cereals, where possible, drilling in March generally reduces the risk of BYDV infection and alleviates the need for insecticides in most years. However the risk of BYDV is higher following a mild winter or where crops are planted in a high risk areas, such as costal sites and areas with previous high levels of BYDV. In April-sown spring cereals an insecticide spray is recommended at 4 leaf stage, as there is likely to be a significant number of aphids migrating into crops by this time. The primary goal is not to eliminate all aphids in tillage crops but to reduce aphid populations at critical times when the crop is particularly vulnerable. Apart from transmitting BYDV, aphids can also cause extensive damage by direct feeding on plants. For example, in the case of wheat crops, if more than 5 aphids per ear are recorded after flowering then an aphicide may be beneficial.

However, the challenge with late autumn drilling is that it may leave you more susceptible to broken weather. Additionally, in mild winters where the absence of frost results in higher aphid and BYDV pressure, delayed drilling may not be as effective as planned. Equally planting early in spring may not be as effective for reducing BYDV pressure when there has been a mild winter.

Minimising the "green bridge" provided for aphids by volunteer cereals or weeds through cultivation or desiccation is also important. In the case of grain aphids, grass hosts such as rye grass or volunteer oats can sustain aphid survival between consecutive crops, acting as a refuge sites for aphids. This allows aphids to colonise crops at an earlier stage, potentially increasing the risk of BYDV spread within the crop.

Together, site selection, the timing of when the crop is drilled and minimising the potential for aphid carry over from the previous crop, in combination with a well-timed insecticide application are the most robust IPM strategies to BYDV management currently available. Looking ahead, investment in the creation of more BYDV tolerant or resistant varieties, plus the ability to rapidly detect rapid both virus carrying aphids and plants in the pre-symptomatic phase, through hand held, in-field diagnostic technologies are critical to supplement and support new control strategies and minimise the need for insecticide applications.