TECHNICAL NOTE TN723 April 2019 • ELEC

Pest Management Post Neonicotinoids (Integrated Pest Management Technical Note 2)

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Summary

- **Several neonicotinoid insecticides have been withdrawn**
- **One of the two remaining neonicotinoid insecticides are being withdrawn in 2022 or under review**
- **The impact of the loss of all bar one of the neonicotinoid insecticides is summarised below**

Introduction

The neonicotinoid class of insecticides have been in use in the UK for the last 20 years or so, with uses in the arable and horticultural sector targeting a wide range of insect pests.

One of the first neonicotinoid actives to become available was imidacloprid which was used as a seed treatment on oilseed rape, cereals and sugar beet and also available as a foliar spray treatment and granules for adding to soil/compost. Imidacloprid was soon followed by other neonicotinoid actives such as clothianidin (seed treatment), thiacloprid (foliar and soil treatment), thiamethoxam (foliar and soil treatment) and acetamiprid (foliar treatment).

A rise in the number of annual beehive losses noticed in various countries worldwide around 2006 focused attention on factors potentially affecting bee health. Pesticide use was quickly highlighted as one of the potential causes in bee decline, with the widespread use of neonicotinoids becoming a focus for environmental campaigners and researchers.

Over the next few years neonicotinoids were linked to effects on honey bees as well as other pollinating insects such as impacting bees' ability to forage, learn and remember navigation routes to and from food sources, and to have lethal and sublethal effects. These include detrimental effects on bumble bee colony growth and queen production. However, there has been a dichotomy of opinion between researchers on whether neonicotinoids are the cause of observed effects on bees and other beneficial insects; whilst laboratory based studies have demonstrated adverse sub-lethal effects of neonicotinoid insecticides on honey bees and bumble bees, these same effects have not been consistently observed in field studies.

Based on a review commissioned by the European Commission, a restriction of neonicotinoid use across the European Union was proposed in 2013, which led to the restriction of imidacloprid, clothianidin and thiamethoxam for seed treatment, soil application (granules) and foliar treatment in crops attractive to bees. In Scotland this particularly impacted winter oilseed rape, where these seed treatments were routinely used for controlling pests at the emergence of the crop. In April 2018, member states of the European Union agreed upon a total ban on imidacloprid, clothianidin and thiamethoxam use from the end of 2018 except within closed greenhouses. This led to the final use of clothianidin seed treatments on cereals in the autumn of 2018. Other neonicotinoid actives such as thiacloprid and acetamiprid are not subject to this restriction, however, thiacloprid has a use up date of October 2022, and acetamiprid remains as the only neonicotinoid insecticide available for use at the current time.

The loss of the neonicotinoids to date, and the loss of thiacloprid in October 2022 will have an impact on pest management on a range of Scottish crops, particularly in conjunction with issues concerning insecticide resistance and loss of other insecticide active groups. The potential impacts are outlined below.

Impacts on Scottish crops

Winter oilseed rape

The loss of the neonicotinoid seed treatments on oilseed rape in 2013 meant than the only options available to growers for protection of the crop from flea beetles and cabbage stem flea beetle were the use of insecticides as a foliar treatment. Currently the only insecticides approved against these pests are the pyrethroid insecticides; alpha-cypermethrin, beta-cyfluthrin, cypermethrin, deltamethrin, lambda-cyhalothrin, tau-fluvalinate and zeta-cypermethrin. The use of the pyrethroids is problematical due to the issue of widespread pyrethroid resistance in the cabbage stem flea beetle, which, whilst not currently a serious issue in Scottish oilseed rape crops, has caused serious issues in English rape crops where resistance is rife. There were reports of poor 'flea beetle' control in some Scottish crops in 2018, however, confirmation of what specific flea beetle was causing damage to crops was not possible. We do not currently have a good handle on the resistance status of cabbage stem flea beetle in Scotland. Whilst cabbage stem flea beetle is present in Scotland, most of the crop

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damage can be attributed to the smaller flea beetle. However, climate change favours the increased spread and prevalence of cabbage stem flea beetle in Scottish rape crops.
There is a seed treatment available in some European countries with the active ingredient cyantraniliprole, that has activity against cabbage stem flea beetle and flea beetles. This seed treatment (marketed as Lumiposa) is not yet approved for use in the UK, however, some growers, particularly in SE England (where cabbage stem flea beetle is a major problem) are getting treated seed imported from countries such as Poland for planting in autumn 2019. A decision on UK approval is pending.

Peach-potato aphids are a vector of turnip yellows virus, and the use of the neonicotinoid seed treatments kept this pest at bay, as the aphid is resistant to the pyrethroid insecticides. The revocation of the neonicotinoid seed treatments in 2013 led to approvals for the azomethine active pymetrozine (end of use date of January 2020), the pyridine carboxamide active flonicamid, and the neonicotinoid active thiacloprid (October 2022 use up date) specifically focused on managing peach-potato aphid and reducing virus transmission. After October 2022 only flonicamid will be available for managing peach-potato aphid/turnip yellows virus. The neonicotinoid acetamiprid currently does not have an approval for use on oilseed rape against peach-potato aphid/turnip yellows virus.

In the spring pollen beetles are a potential issue on oilseed rape, and because of resistance to the pyrethroid insecticides, the use of the neonicotinoids thiacloprid and acetamiprid to target resistant pollen beetles has been the recommendation for the last few years, along with other insecticide options such as pymetrozine and indoxacarb. With thiacloprid going in October 2022 and pymetrozine in January 2020, the neonicotinoid acetamiprid and the oxadiazine active indoxacarb will be the only alternatives to pyrethroids for the control of pollen beetle.

Cereals
Clothianidin was a component of winter cereal seed treatments (last use in autumn 2018), and focused on the prevention of Barley Yellow Dwarf Virus (BYDV) which is vectored by several aphid species. As it stands the only current alternative to the use of the seed treatments for managing BYDV is the use of foliar sprays of pyrethroid insecticides at the time of aphid migration into crops in the autumn. Whilst these sprays are effective if timed properly, the issue of pyrethroid resistance in the cereal aphid (*Sitobion avenae*) has led, in some instances, to poor control of this aphid in Scottish winter cereal crops. The now total reliance on pyrethroids for BYDV management in winter cereals will increase the prevalence of resistance in the grain aphid, potentially jeopardising future management of BYDV.

The grain aphid is also a problem (along with other aphid species) in spring-sown cereals, and the issue of pyrethroid resistance is again of concern. Pyrethroid insecticides are the primary insecticide option for managing the risk of BYDV in spring cereals, and also the risk of aphid feeding damage on the flag leaf and heads of spring cereals. On durum wheat, rye, triticale and wheat the organophosphate active dimethoate can be used after April 1st and up to GS69. The pyridine carboxamide active flonicamid can be used on winter wheat from GS53. However, there are no options other than pyrethroids on barley and oats increasing the risk of BYDV and aphid feeding damage.

Potatoes
Neonicotinoid insecticides have played a key role in the management of aphid-borne potato viruses in Scottish seed potato crops for several years. The peach-potato aphid is the main virus vector species, and is resistant to pyrethroid insecticides. Consequently, advice provided by the Scottish Aphid-Virus Working Group has been to use non-pyrethroid insecticides every two weeks when peach-potato aphids are flying into the Crop to specifically target this aphid, with a maximum of two neonicotinoid treatments a season. The loss of the neonicotinoid thiamethoxam has now limited the neonicotinoid choice to acetamiprid and thiacloprid (October 2022 use up date). Consequently, in the near future there will be just the one neonicotinoid active (acetamiprid) available for use on potatoes, with the alternatives being pymetrozine (approval ending in early 2020), the tetramic acid active spirotetramat and the pyridine carboxamide active flonicamid being the only other options currently available. Reliance on acetamiprid, spirotetramat (which can only be applied when the crop is not in flower) and flonicamid will increase the risk of resistance to these actives in the peach-potato aphid and restrict the number of applications on the crop to 8 in total; 2 of acetamiprid, 4 of spirotetramat and 2 of flonicamid. This poses a risk of increased virus levels in the Scottish seed potato crop which would have an impact on seed health and seed exports.

Vegetable crops
The neonicotinoid actives thiacloprid and acetamiprid are widely used on a range of vegetable crops as 'on-label' approvals and also as Extensions of Authorisation for Minor Use (EAMU's or off-label approvals). With thiacloprid being withdrawn in October 2022, there will be an increased emphasis on the use of acetamiprid and pyrethroid actives, and with it the issues of insecticide resistance. Peach-potato aphid, diamond-back moth, pollen beetle and pea and bean weevil are all demonstrating resistance to the pyrethroids to some degree. Neonicotinoid resistance in peach-potato aphids has been confirmed in southern France and North East Spain. Consequently, in the future there will be a need for growers to utilise the alternative insecticides available to reduce the risk and spread of insecticide resistance, either as full approvals or EAMU's. These alternatives include spirotetramat, the bacterial biopesticide *Bacillus thuringiensis*, the spinosoid active spinosad (approval ending in October 2022), indoxacarb, pymetrozine (approval ending in January 2020), the ryanoid actives cyantraniliprole and chlorantraniliprole, the carbamate active pirimicarb (approval ending in October 2022) and flonicamid.
Whilst there are potentially a wide range of alternative insecticides, many of them are crop or pest specific, so growers will need to pay close attention to product labels and EAMU documentation.

Soft fruit
As with vegetable crops, the neonicotinoid actives thiacloprid and acetamiprid are widely used on a range of soft fruit crops as 'on-label' approvals and also as Extensions of Authorisation for Minor Use (EAMU's or off-label approvals). With the approval for thiacloprid ending in October 2022, this leaves acetamiprid as the only neonicotinoid available to growers. As with other crop sectors, insecticide resistance is a threat, however, with less reliance on pyrethroid insecticides within the Scottish soft fruit sector, there are a range of alternative options available to the pyrethroids and neonicotinoids either as full approvals or EAMU's. These include spirotetramat, *Bacillus thuringiensis*, spinosad (approval ending in October 2022), indoxacarb, pymetrozine (approval ending in January 2020) and chlorantraniliprole.
Whilst there are potentially a wide range of alternative insecticides to the neonicotinoid acetamiprid, many of them are crop or pest specific so growers will need to pay close attention to product labels and EAMU documentation.

Key points

- The loss of the vast majority of the neonicotinoid insecticides will have a significant impact on some major Scottish crops. Their loss is exacerbated by issues with resistance in several pests to pyrethroid insecticides, and loss (known and potential) of other insecticides.
- In winter oilseed rape management of cabbage stem flea beetle, peach-potato aphid/turnip yellows virus and pollen beetle will become challenging due to issues with pyrethroid resistance and limited or no alternative insecticides. An approval on a new insecticide seed treatment (cyantraniliprole) would target the flea beetles but not the aphid/virus threat.

- Cereal crops may have an increased risk of BYDV and direct feeding damage due to grain aphid pyrethroid resistance and limited or no alternative insecticides.
- The seed potato crop is at increased risk of aphid-borne viruses due to pyrethroid resistance in the peach-potato aphid, and there being restrictions on the timing and number of applications allowed of the alternative insecticides.
- For field vegetables and soft fruit there are alternatives to the neonicotinoid insecticides, however, there is likely be a reliance on the use of EAMU's to ensure that key pests are managed successfully.
- Whilst there are potential alternatives to the neonicotinoids going through the pesticide approval process, their availability in the future is not guaranteed. With issues such as insecticide resistance, ongoing campaigns against the remaining neonicotinoid insecticides, Brexit, environmental concerns regarding other insecticide groups, and potential insecticide revocation/withdrawals, the options for pest management may well be further reduced, emphasising the need for growers to utilise integrated pest management (IPM) approaches on-farm to mitigate the loss of neonicotinoids, insecticide resistance and loss of other insecticides.

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Production of this SRUC Technical Note was funded by the Scottish Government as part of its Farm Advisory Service.