Discovering tactics to tackle CSFB

AHDB
AGRICULTURE & HORTICULTURE DEVELOPMENT BOARD
from theory to field

There's a pressing need for an approach to controlling cabbage stem flea beetle that doesn't rely on insecticides. *CPM* finds out how an IPM strategy is being developed.

By Lucy de la Pasture

Since the demise of the neonicotinoids, cabbage stem flea beetle (CSFB) have been able to flex their jaw muscles to the point where OSR growing is no longer viable in some regions. It wasn't until the extent of the problem with CSFB became clear that the industry woke up to just how little was known about the pest, explains ADAS entomologist Dr Steve Ellis.

Monitoring projects to date have concentrated on substantiating levels of infestation and damage, primarily to support emergency approvals for the use of neonics in hotspot areas. What's needed now is a strategy to help manage the pest, because there won't be a single solution in the future as we had in the past, adds AHDB's Dr Jon Knight.

In the absence of reliable chemical control options, agronomists and growers have been left in the dark as to what other measures they can take to mitigate damage from CSFB. And that's where the latest AHDB project comes in.

Agronomic mishmash

"Currently there's a real mishmash of agronomic information and anecdotal evidence on the factors that affect CSFB infestation, but there are no clear guidelines available. There's an urgent need for an IPM strategy to be developed and the project aims to do just this," notes Steve.

Lots of work has already been done on CSFB in OSR and these historic data sets will be reviewed and analysed, using a meta-analysis to determine the most important factors which affect CSFB adult feeding and larval infestation.

"We have data from more than 1000 sites which details levels of CSFB and related agronomic factors, such as drilling date, establishment method and soil type. Results from the meta-analysis will be used to help develop a risk assessment scheme, as well as identify the most important agronomic factors that we need to investigate further," he says.

Some of these factors are already being looked at more closely across 75 survey sites in the project's first year. "We're able to look at the effect of agronomic factors on CSFB adult feeding and larval infestation more precisely in this survey. This will be repeated next year and the 150 sites added to the historic data sets.

> *"Once adult CSFBs have migrated into a crop, their wing muscles deteriorate."*

"Examination of some OSR variety plots at ADAS Boxworth has given us the opportunity to assess how they vary in their susceptibility to CSFB and we've seen marked differences in the numbers of larvae in plants — with some varieties having 8 larvae/plant and others up to 25 larvae/plant," he notes.

Further work on varietal susceptibility is being undertaken using the AHDB Recommended List trial sites, where plots are grown under a standard set of conditions.

"The drawback is that we can't destructively sample plants in these trials, which is the norm for assessing larval infestation. So we're using an alternative method to assess this and are counting the number of leaf scars on the petioles and stem to assess larval activity, which previous research suggests correlates well with larval numbers. We're finding some differences in varietal susceptibility but it's not as marked as at the Boxworth site," he comments.

"We suspect that cultivars which establish quickly and have good autumn vigour will be most likely to withstand attack from CSFB, but we'll be looking in depth at the characteristics of each of the monitored cultivars."

As part of this investigation ADAS is drilling further variety trials in Cambs and North Yorks, both at sites with a known history of flea beetle damage. The rationale behind this is that the RL trials aren't necessarily going to be situated in CSFB hotspots for obvious reasons, explains Steve.

"It also gives us the opportunity to use different seed rates this autumn and

Steve Ellis says trap cropping could provide a way of mitigating damage from the beetles.

investigate the impact this has on CSFB damage," he adds.

The third objective of the IPM project is to understand crop tolerance to damage by CSFB and use this to revise the thresholds for both adults and larvae. Previous work conducted by ADAS has shown crops to be incredibly tolerant of simulated adult damage.

The current larval threshold is 5 larvae/plant but Steve has the view that plants can probably tolerate higher numbers. Investigating this has proven problematic in the first year of the project — with insecticides not considered reliable enough to manipulate larval populations, the team resorted to using fleece to keep adult CSFB out of plots for different periods of time.

An IPM strategy for CSFB is urgently needed and researchers are looking at defoliation and trap cropping as possible approaches.

Larval populations

Differences in larval populations were achieved and results are pending, but the problem with using fleece is it can be pierced by stubble, partially negating its effect, he explains.

"We're waiting for a special experimental approval this autumn so we can use an increased dose of an insecticide to overcome any resistance problems."

Another area researchers are looking at is alternative methods for CSFB control, including defoliation and trap cropping.

"In some areas of the UK larval infestations can be up to 40 larvae/plant, which has a very significant effect on crop growth. We know that some adult CSFB are resistant to pyrethroids and suspect that this will be the case for larvae too," says Steve.

Research has been carried out in Canada and Australia which has shown

Survey results have shown a marked difference in the numbers of larvae infesting different OSR varieties.

that mowing the crop off completely, to feed livestock, before the stem begins to extend has no effect on yield or oil content. The thinking behind employing these drastic tactics is that it can used to reduce larval numbers.

"We believe larvae won't come out of the cut material and re-infect OSR plants when they regenerate in the spring. In the first year of UK trials yields were low because of ▸

Jon Knight suggests that the best thing growers can currently do is pay attention to detail at planting to ensure good establishment.

Results from ADAS defoliation work, 2017

Treatment	Treatment description	Average of corrected plot yield (t/ha)	% difference
1	No Defoliation	1.54	
2	Defoliation in December (T1)	1.76	13.9
3	Defoliation in January (approx 1 month after T1)	1.65	7.0
4	Defoliation at stem elongation	1.36	-12.0

The yields are low due to the combined effect of CSFB and pigeons. The results have not yet been statistically analysed but show trends.

Source: ADAS trials, 2017.

▸ pigeon damage, but the defoliated plots did yield more than the plots that were left alone," he notes.

"Interestingly we found that although defoliated plots had a reduced larval infestation, larval numbers did subsequently rise after the crop had been mown off. We don't know whether this was due to a late hatch of CSFB eggs or whether the larvae can re-infect plants from cut material. It's something we're planning on testing this year."

Achieving defoliation in practice during Dec or Jan isn't likely to be a straightforward process but a piece of four-legged, traditional farm equipment may come in useful at a time when heavy equipment often won't travel on the ground — sheep. Although the feasibility of this approach in predominantly arable areas may preclude it as an option, he points out.

Steve highlights an old piece of French research which made an interesting observation on the biology of CSFB that may mean trap cropping could provide a means of mitigating damage from the beetles.

"The authors say that once adult CSFB's have migrated into a crop, their wing muscles deteriorate which means they aren't able to migrate elsewhere. This raises the possibility of using a trap crop as a lure for adult beetles. It may be as simple as leaving

Giving OSR the best possible chance

According to Luke Cotton, independent agronomist and AICC member, it's the agronomist's job to look at the lifecycle of a pest and then exploit it to shift the balance in favour of the crop. The trouble with CSFB is there's a lot of talk about the pest but very little evidence about how best to control it.

"Some people believe night-spraying gives the best results but evidence for this is, at best, anecdotal. With pyrethroid sprays giving unreliable control, we need an IPM strategy, but one of the problems is that no season is the same for CSFB activity," he says.

Most of Luke's OSR crops were drilled around mid-Aug with the aim of getting them in and away early.

"In the past two autumns, CSFB activity has peaked in Sept so by getting crops up and away early, they can get established before CSFB migrate in and plants are able withstand some grazing. Last season there was a peak in temperature in early Sept and there was a resulting mass of beetle activity. Any plants which were still small were absolutely hammered.

"Crops planted late missed this peak in activity so didn't suffer damage, but there can be problems associated with planting late in an autumn that isn't as kind as last year," he notes.

Larval infestation was a massive problem in the 2015-2016 crop with some plants harbouring 15-20 larvae on his patch — spanning Bucks, Oxon and Berks. Fortunately larvae were less of a problem last season, which Luke puts down to more frosts over the winter than in 2015.

"Larvae are retained in the petioles until early spring, when they migrate to the stems. Frosts cause natural leaf loss which gives the potential to lose larvae as the leaves fall off.

Part of the problem with larval infestation is that it weakens the OSR plant, meaning that when another stress factor comes into play, the damage is compounded.

"When plants have a larval load and then get hammered by pigeons, as happened in 2015, the extra stress severely hinders the OSR plants' ability to regrow. Plants just aren't able to recover from pigeon grazing as well as they can when larvae aren't an additional problem," he notes.

Luke also has a role in the AHDB ICM project and will be consulted on the practicalities of possible control strategies on a field scale. He's hopeful that a way will be found to formalise the forecasting of CSFB peak activity in crops during establishment and over the winter period.

"A better understanding of the effect of temperature on the survival of larvae over the winter would help with decision-making regarding the viability of crops in the spring."

Luke Cotton believes that the best hope for tackling CSFB lies in genetics, but it will be a while before resistant or tolerant OSR varieties are developed.

One of his own observations has been that direct-drilled OSR crops had less CSFB damage than where crops were drilled traditionally. "The crop residue reflects heat from the soil surface better than brown soil, so it's possible there's a microclimate effect going on," he suggests.

Looking further ahead, Luke believes that ultimately the best chance of growing CSFB-free OSR lies in genetics, though he's not holding his breath that this will happen any time soon.

Larvae may be found within the petioles of lower leaves when they are shed over winter.

OSR volunteers in situ for as long as possible so they deflect migration away from newly establishing crops."

It's a rationale that will be investigated further at Boxworth this autumn, where pairs of fields have been identified — one that has just come out of OSR and lies adjacent to a field due to be planted this autumn. In one pair, all OSR volunteers will be destroyed, while in the other they will be left in situ and the number of CSFB migrating into both newly planted fields will be monitored.

The ultimate aim of the project is to produce an IPM strategy that will reliably reduce the pressure on OSR crops from CSFB damage. In the meantime, Jon Knight suggests attention to detail on seedbed preparation and drilling in the right conditions, at the right depth, to obtain the best possible establishment is the wisest approach.

Genetic solution

Looking further into the future, the search for a genetic solution to the problem is underway and AHDB is funding a PhD project at James Hutton Institute to investigate whether any cultivars or related species have a tolerance that can be used within breeding projects, he comments.

"Considerable variation has been observed in OSR's response to larval lodging, but this can include yield-preserving developmental responses such as growing in girth around the larvae and outgrowth of axillary buds. Together these suggest response to the action of the plant hormone auxin as a strong candidate process leading to flea beetle larval tolerance," he explains.

Variation also exists among *Sinapis alba* and *Brassica juncea* varieties used in mustard production, and it's believed the tolerance mechanism in these species is similar. "The aim of the PhD project is to identify the precise mechanisms by which OSR and mustards resist flea beetle larvae and identify germplasm, markers and genes that breeders can use to make flea-beetle tolerant varieties of WOSR for the UK market." ■

Research round-up

AHDB Project No 211200, Integrated pest management of cabbage stem flea beetle in oilseed rape, runs from Aug 2016 to Dec 2019 at a cost of £150,000. The work will provide farmers and agronomists with practical guidance to assess the risk of crop damage from CSFB using information about environmental factors and improved action thresholds, and how to avoid and control the pest through targeted crop management and a range of control options.

AHDB Project No 21120064, Genetic basis of winter oilseed rape resistance to the cabbage stem flea beetle will run from Oct 2017 to Sept 2021, costing £70,500. The aim of this PhD studentship project is to identify the precise mechanisms by which WOSR and mustards resist flea beetle larvae and identify germplasm, markers and genes that breeders can use to make flea-beetle tolerant varieties of WOSR for the UK market.