

Understanding CSFB guides action

AHDB

from theory
to field

With more and more OSR crops falling victim to the adults or larvae of this voracious pest, is there a glimmer of light at the end of the tunnel? *CPM* catches up with the research to date.

By Lucy de la Pasture

Scientists have been frantically playing catch-up with cabbage stem flea beetle (CSFB) as they seek to find cultural methods to curb their activity. The process has moved from finding agronomic factors that influence CSFB numbers to small plot trials and ultimately testing possible IPM strategies in the field.

ADAS senior research entomologist Dr Sacha White has been spearheading the effort to find ways of keeping OSR as a staple in the rotation. "There was already a huge data set available on CSFB from around 1500 sites. We began by reviewing it all and carrying out a modelling analysis to help pinpoint the agronomic factors that affect the severity of CSFB attack so we could narrow it down to the ones with the biggest influence," he explains.

Sacha's team identified the majority of the

key factors are weather-related, which he says is unsurprising for an insect where temperature is usually an important factor.

"Adult feeding is favoured by a warm June/July and a dry Aug, which makes sense as it's been noticed in the field that CSFB adults aren't a big fan of rain and seek shelter. For larvae in the autumn, a warm Sept was associated with higher numbers of larvae in the autumn.

Dry conditions

At this time adults are developing eggs inside them and start laying them in soil. These activities are temperature driven, so speed up the warmer it is which leads to earlier plant invasion. However, dry conditions at the end of spring/beginning of summer prior to the crop being sown were also associated with high larval numbers in the autumn.

"The cause of this effect is unclear at the moment but indicates that dry conditions during this period is not conducive to adult pupation and emergence in previous crops."

But for many it's larval numbers in spring that's becoming increasingly important, not least because high numbers can cause crops to fail late in the season when they've already seen heavy investment.

"Analysis of the data shows spring larval numbers increase after a warm Nov and Jan. Over the past few seasons we've seen a massive increase in larval populations in

“A higher seed rate may put increased pressure on next year's crop.”

crops over the winter. We know from other work that temperatures need to drop below 3-4°C for egg laying and development to cease and such conditions have often been absent in recent winters."

The data analysis showed sowing date was the agronomic factor that growers could control with most influence on CSFB numbers, explains Sacha. "Crops drilled in Aug tended to have less adult damage than those drilled in Sept. CSFB adults migrate into crops towards the end of Aug so the earlier slot allows the crop to establish before the main feeding period, whereas late Aug-early Sept sowings are vulnerable as they emerge."

But for larval populations the exact opposite applies — Aug sowings tend to have higher numbers of larvae in the autumn and spring. "There may be only a few weeks difference in dates, but the timing has a huge effect on larval numbers.

"As part of an integrated strategy to control CSFB, the modelling found sowing date to be the only factor that growers could control and have a fairly consistent effect and so it's an important tool for growers.

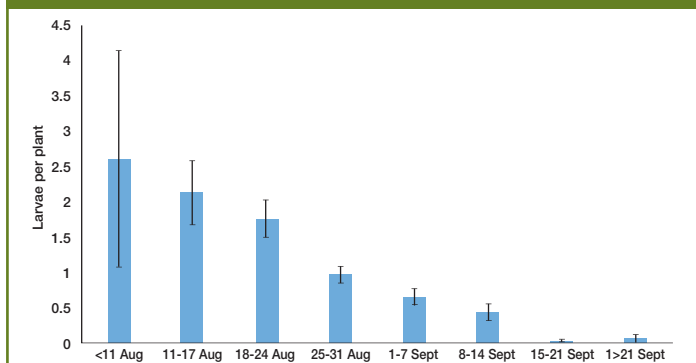
"By the second half of Sept temperatures are cooling off and it's the tail end of adult CSFB migration so CSFB will move into later drilled crops later, often in lower numbers and will be developing eggs more slowly. There are perceived risks to drilling later but evidence on the impact of late drilling on yield is mixed," he notes.

A lot of growers are increasing seed rates to compensate for damage, so this was something the AHDB project looked at in trials. "We drilled plots at 10, 40, 80, 100 and 120 seeds/m² and found the percentage of



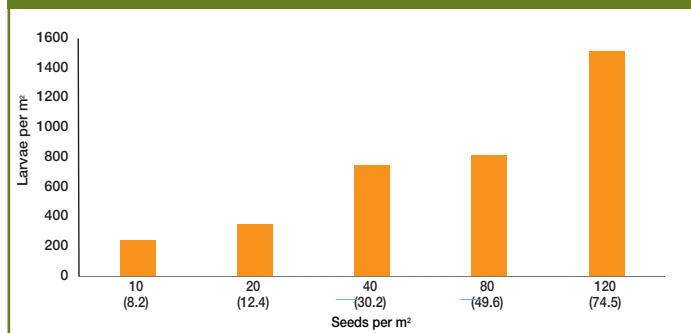
Sacha White says sowing date is the most important agronomic tool growers have to limit CSFB damage.

Drill date and autumn larval populations



Source: ADAS, 2020. Data collated as part of the AHDB-funded CSFB IPM project, and comes from various sources but is primarily survey data. These results are currently interim/unpublished.

Seed rate and autumn larval populations



Mean larvae/m² in the autumn in plots drilled at different seed rates (seeds/m² in a randomised, replicated field trial in Cambridgeshire 2018/19. Values in brackets indicate the plant population achieved at each seed rate.

Source: Data collated as part of the AHDB-funded CSFB IPM project. These results are currently interim/unpublished.

plants establishing was the same across all seed rates — CSFB adults were taking out the same proportion of plants. There were also very few differences in adult feeding damage between the

seed rates. So for establishing the crop there's no huge benefit in increasing the seed rate," he explains.

Perhaps even more surprisingly, there were no

significant differences in the number of larvae per plant. "We expected to find more where there were fewer plants/m², but this didn't happen.

"This also means that higher seed rate plots had higher numbers of larvae per m². In one trial, we found <300 larvae/m² at the lowest seed rate and ▶

Simple measures to more drastic ones

Previous research had shown some potential in planting a brassica trap-crop next to OSR to reduce the CSFB damage in the crop. Sacha's team evolved this idea by using OSR volunteers in the stubble of the previous crop as a trap-crop and assessed whether this simple strategy could 'protect' nearby, newly planted fields during the autumn.

"Adults are attracted to isothiocyanate volatiles and we suspect that they can detect them from a long way away so a thick carpet of volunteers could potentially be more attractive than the crop. We found that if volunteers were left

until the end of Sept there was a significant decrease in adult damage in the adjacent crop, an increase in establishment and more than a 50% reduction in larvae, so the effect is long-lasting," he explains.

"It's a very simple thing growers can do to help take the pressure off. The important thing is to leave volunteers in the ground until at least late Sept to make a difference."

With no insecticides to provide larval control, the project has also looked at more drastic measures which physically remove the larvae by defoliating the crop. The research has progressed from plot trials within the

project to field-scale trials within the Innovative Farmers Field Labs initiative where crops are either topped or grazed.

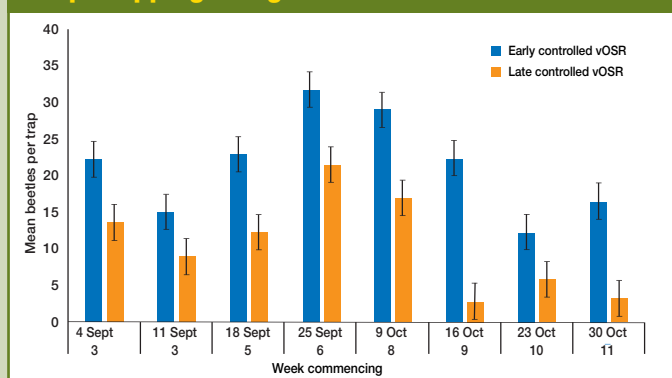
"In the AHDB project we saw the greatest decrease in larvae at the later timings we looked at — with up to a 55% reduction in Feb-early March. We saw no significant effects of defoliation on yield in the 2016/17 trial, with a hint of an increase in yield at the early defoliation timings."

Last season, the plot trial and Field Lab did see significant yield reductions due to defoliation. It wasn't a very conducive spring for crop recovery — at first it was dry

which would have reduced nutrient uptake, limiting the ability of defoliated crops to produce additional branches to compensate for the defoliation. Then the cool weather at the beginning of May would have hindered pod set, especially on the more backward defoliated crops," explains Sacha.

The defoliation Field Labs are continuing this year and it's not been a winter without its challenges. "OSR crops are looking very mixed but it's been another extreme winter in terms of rainfall and CSFB pressure. At the moment it's a case of 'watch this space'."

Trap cropping using volunteers

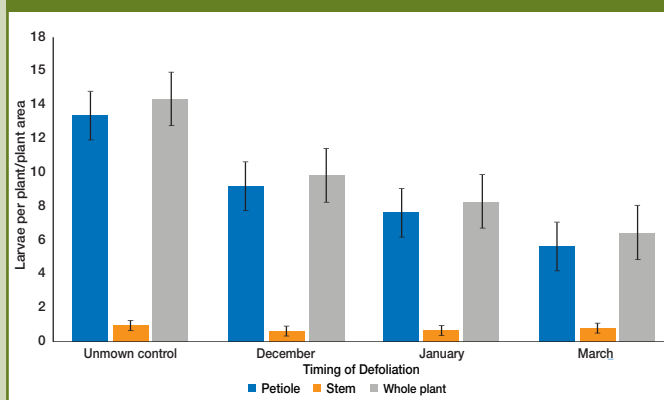


Mean numbers of adult CSFB caught in yellow water traps in new OSR crops adjacent to a field in which vOSR had been controlled early (blue bars) or late (red bars) in 2017/18.

Asterisks indicate significant differences.

Source: White et al. Non-chemical control options for cabbage stem flea beetle in oilseed rape, *Aspects of Applied Biology*, 141 (2018).

Defoliation



Mean larvae per plant (petioles, stems and whole plant) in each defoliation treatment two weeks after the final defoliation treatment. Letters indicate significant differences between treatments were observed — petioles (a–c) and whole plant (y–z).

Source: White et al. (2018).

Introduction of sheep has benefits

New Zealand Romney sheep have recently been introduced to Peter Trickett's farm in Yorkshire and in 2018 the OSR crop provided an opportunity for some 'free' grazing. In contrast to the results of Innovative Farmers field labs, Peter found there were no yield differences between the OSR fields he grazed and those he didn't.

"We believe that as long as the crop isn't grazed too hard and the sheep are out by Christmas, then the defoliation doesn't occur too late and the crop has time for recovery."

Peter notes that compared with pigeon damage, the sheep graze the crop more evenly with the added benefit of returning nutrients to the soil. The flock is mob grazed, so moved every two or three days and back-fenced so the sheep can't return to the area they have just been grazing.

"It's a very controlled grazing system and the sheep do really well on it. At first it took a while for them to get used to eating OSR but now they're always trying to find a way back into the crop when they've been taken out."

Peter says the sheep can damage the crop slightly, snapping off some plants as they walk through it. "Grazing alters the canopy structure — where stems have been snapped off, four or five new shoots will be produced but this doesn't seem to affect the yield. The crop height is also reduced by about 25cm and flowering is delayed by a week or so after grazing."

This year some of the 73ha of OSR on Peter's farm has become part of the field lab initiative. CSFB larvae are being monitored by Sacha's team and the sheep appear to have done a good job reducing their numbers.

"We don't have as bad a CSFB problem



On Peter Trickett's farm defoliation using their flock of New Zealand Romneys bucked the trend last season and didn't adversely affect yield.

as some parts of the country and our larval numbers are comparatively low. Assessments which have just been done on the OSR showed there were four larvae/plant where the crop wasn't grazed and one larvae/plant where the crop was sheep keep," he says.

► >1500 larvae/m² (or 15 million/ha) at the highest seed rate. Therefore, a higher seed rate may put increased pressure on next year's crop, assuming a good percentage turn into adults," comments Sacha.

There's been much speculation that some OSR varieties cope better than others with CSFB attack. During the project numbers of larvae were monitored in different varieties in the AHDB Recommended List trials during the first year and subsequently in ADAS's own cultivar trials in years two and three.

"We didn't find any significant differences in adult damage or larval pressure between varieties, but that's not to say there aren't any as we weren't able to look at all OSR varieties. There may be differences in variety tolerance and we still need to crunch the data to assess how they've coped with the larval load," he adds. ■

Research roundup

Information on CSFB can be found at ahdb.org.uk/csfb

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 project is led by ADAS.

AHDB Project No 91580001: 'Innovative Farmers field labs' runs from April 2019 to March 2022 at a total cost of £1,294,194 of which AHDB contribute £224,190 (cash £177,000, in kind £47,190). Non-AHDB funds are from the Prince of Wales's Charitable Fund (PWCF) £800,000 and other sponsorship (including BBSRC) £270,000.

AHDB Project No 21120064: 'Genetic basis of winter oilseed rape resistance to the

cabbage stem flea beetle (PhD)' runs from Oct 2017 to Sept 2021, costing £116,452 (AHDB-funding £70,500). The project is led by John Innes Centre, with commercial partner Elsoms Seeds.

AHDB Project No 21510042: 'Novel approaches to control cabbage stem flea beetle (PhD)' runs from Sept 2019 to Oct 2022 at a cost of £42,150 (AHDB-funding £36,150). The project is led by Harper Adams University.

From Theory to Field is part of AHDB's delivery of knowledge exchange on grower-funded research projects. CPM would like to thank AHDB for its support and in providing privileged access to staff and others involved in helping put these articles together.

Further research offers hope

Further AHDB research is being carried out by PhD students, explains Charlotte Rowley, who manages pest research at AHDB. Jess Hughes is working at John Innes Centre to identify genetic differences in CSFB feeding preferences and plant tolerance to damage.

"In initial field trials, lines identified as least palatable in the laboratory appear to also have increased resistance in the field."

Jess has also been assessing larval damage in a controlled environment. She's observed significant variation in plant damage from CSFB larval infestation between Brassica species but not between Brassica napus lines.

Claire Hoarau's in the early stages of her PhD at Harper Adams University, says Charlotte. "The work will initially involve screening entomopathogenic fungi, provided by the University of Warwick, to assess their suitability as potential biological control agents — focusing on strains that are active at low temperatures which would be more suitable for use in the field."

"Entomopathogenic bacteria, nematodes and plant extracts will also be tested over the course of the project, including some commercial products already on the market. Claire will also investigate whether the use

of certain biopesticides in combination with chemical insecticides can be used to target pyrethroid-resistant populations of CSFB and test the most promising candidates under field conditions."

AHDB are currently planning the next phase of CSFB work so will be working with researchers and industry to identify some immediate research priorities. "It would be great to get some feedback from growers about what these priorities should be and they can contact me direct (Charlotte.Rowley@ahdb.org.uk) with any views on this," says Charlotte.