HGCA

from theory to field

Stem invaders

Saddle gall midge damage

In recent years, wheat bulb fly and saddle gall midge have emerged as serious threats to wheat crops. Grower-funded pest-monitoring projects are shedding new light on their control.

By Tom Allen-Stevens

Cereal pests are a problem growers can seldom prepare for — all too often, you don't realise there's been a problem until the damage is done.

But precautionary treatments can sometimes be overzealous, notes Caroline Nicholls of HGCA. "The incidence of wheat bulb fly (WBF) varies each year according to the season, so a routine treatment against the pest could be a waste of money, and a needless application that could do more harm than good."

But that's not to say it's not an important pest that warrants treatment, she concedes. "It can cause 40-50% yield reduction in some cases, but it can be difficult to treat effectively post emergence. Alternatively growers can use a seed treatment, but the decision to apply one would have to be taken months before the crop is at risk."

This is where HGCA-funded pest monitoring comes in. "The WBF survey picks up the variations in pest incidence and determines the risks associated with different cropping situations and the best control options to adopt," she explains.

Intermittent behaviour

"The incidence of saddle gall midge (SGM) also varies considerably and, because of its recent occurrence and intermittent behaviour, it's a pest we're still learning about. The monitoring project will help us learn more about its biology, and that's the first step to better control."

Yield preservation isn't the only reason these projects are important, she says. "There are fewer insecticides available to growers, and those that remain are coming under increasing pressure at European level. In the meantime, there's a lot of pressure for growers to make more use of Integrated Pest Management (IPM) strategies. Sound research in this area will form the basis for practical measures growers can take that'll help them meet these objectives."

Leading the work is ADAS entomologist Dr Steve Ellis. "WBF's an interesting beast," he says.

"It's a gambler — it lays its eggs on bare soil in early autumn, just hoping that the following crop will be a cereal. The eggs lie dormant until Jan or Feb and then hatch. If they're lucky, there's a wheat crop for the larvae and they invade the young tillers and can be found within the shoots they feed on."

This causes the classic 'deadheart' symptoms, where the central shoot withers and dies. "But what's crucial is the growth stage of the crop when the larvae get in. If there's only one or two tillers, such as a late-drilled crop or one that has overwintered badly, the damage can be devastating. But a well advanced crop can probably tolerate losing a tiller or two."

And there's another key aspect about WBF that makes it an important cereal pest, explains Steve Ellis. "It's a dipterous stem borer that's distinguished from others because it moves from tiller to tiller. So there's the potential for it to do a lot more damage than other, similar pests."

Crops in eastern counties are most at risk, and the threat stretches from Kent to East Lothian, he warns. Late-sown cereals, such as after potatoes or sugar beet, are most

> *"The monitoring project will help us learn more about saddle gall midge biology, and that's the first step to better control."*

vulnerable. “The question for growers in these situations is whether or not to use an insecticidal seed treatment. For crops sown after Nov, Austral Plus (fludioxonil+ tefluthrin) is effective and warranted if threshold levels are reached. But the treatment would’ve run out of steam by egg hatch in early sown crops.”

The aim of the project is to give growers an early indication of pest pressure, and therefore whether to treat at all. “WBF is one of the few pests that’s still monitored on a regular basis. We’ve data stretching back to 1984, which means we’ve amassed enough information to potentially predict incidence from year to year.”

Wet conditions

Researchers have learnt that wet, long harvests tend to result in an increased number of eggs laid. “We believe the adults thrive on fungi in wheat ears — the more fungal infection and the longer crops remain unharvested, the more eggs are laid. But if conditions are too wet, few adults survive, so it’s difficult to know what the pressure will be until we do the egg counts in Sept.”

This is a time-consuming task that involves taking a 20-30kg soil sample from a number of sites and analysing these for eggs. More than 250 eggs/m^2 indicates a high risk of damage in autumn-drilled crops, while a seed treatment can be worthwhile at populations as low as 100/m^2.

“2010 was the last year when we saw a lot of damage. A total of 40% of monitored sites had egg counts above threshold and the hatch followed a particularly harsh winter — some crops were devastated.”

For crops that haven’t received a seed treatment, there’s a narrow window during egg hatch itself when chlorpyrifos can be applied. Also, a ‘deadheart’ spray of dimethoate can be used to target larvae within the plant. “The monitoring work provides crucial evidence of the need to spray,” notes Steve Ellis.

“What we’re now looking at is matching up what we know about the pest with our knowledge of plant physiology. In particular taking account of crop tolerance is fundamental to improving pest risk assessment.”

According to crop physiologists, wheat crops require a minimum of 400-450 fertile shoots/m^2 to achieve potential yield, but typically produce more than 1000 shoots/m^2, so a proportion of tillers could be lost without affecting yield. Crops sown late or with low plant populations tend to produce fewer excess tillers and therefore have a lower tolerance to shoot loss.

“We may be able to use tiller population as an indicator of crop tolerance to WBF, so growers can more accurately gauge the potential damage and decide on the need for treatment. If we know how many tillers a larva can kill, and have an ▸

Sound research on WBF and SGM is helping inform growers on practical measures they can take that will minimise the damage from the pests, says Caroline Nicholls.

The WBF adult (left) lays its eggs on bare soil in early autumn, and larvae (right) then hatch in Jan or Feb to invade young wheat tillers. *Pictures courtesy of ADAS*

Adult SGM lay their eggs in lines down the leaf (left) while the larvae feed on the stem just under the leaf sheath (right).

Picture courtesy of Luke Cotton

▸ estimate of pest numbers, we can calculate the potential total tiller loss and decide whether this is likely to impact on yield."

By contrast, SGM is a pest shrouded in relative mystery. "It's a sporadic beast. For quite a few years, it hadn't really been a problem. Then just recently, there've been a few severe outbreaks. Rather like orange wheat blossom midge (OWBM), in years when it becomes more prominent, the damage it causes — up to 70% yield loss — warrants some investigation to see if we can predict when those incidents will occur."

SGM spends the winter as a larva in mud cells in the soil. In early spring it pupates, if the conditions are right, and adults then lay eggs on the leaves of the young cereal crop. Once hatched, the larvae move down the leaf to feed on the surface of the stem, within the protection of the leaf sheath. The feeding creates a 'saddle-shaped' gall and this interferes with the flow of nutrients to the ear. Once beneath the leaf sheath, the pest is very difficult to control.

"A lot of growers are caught on the hop — by the time they know they have it, it's too difficult to control. So we were keen to monitor how this pest developed in the soil and determine whether it was possible to give an early warning of emergence."

The team carried out investigations at two highly infested sites in Bucks — one at Wendover, funded by HGCA, and the other at Cadmore End, funded by Dow AgroSciences. "We took soil samples at regular intervals, and counted larvae and pupae. Once the larvae pupated, we set yellow sticky traps in the crop to monitor adult emergence and took plant samples to monitor egg-laying."

But what happened this year took the

Continuous crop falls foul of midge

Charlie Edgley found large numbers of adult SGM in his crop around Easter last year.

The first sign of trouble was when blisters started to appear on the stems of Charlie Edgley's milling wheat in July 2010. "These galls appeared, and no one had ever seen them before. It was our agronomist, Andrew Cotton, who identified the problem as saddle gall midge (SGM)."

Until then, the crop of continuous wheat over the 850ha of arable for Kensham Farms in Bucks had looked "fantastic", according to Andrew Cotton. "We found the pest was pretty widespread in the crop. My son, Luke, also found some in a crop in Warwicks," he reports.

"The crops were going off prematurely, and there was the odd bit of brackling. On careful examination you find the galls, just under the leaf sheath, that contain the red larvae. By then it was too late to do anything about it, although there wasn't too much damage in that year."

By the next year, they were ready for the pest, but pupation was particularly early, recalls Charlie Edgley. "It was Good Friday, and a remarkably warm day when we first noticed the adults. On still days, Andrew and I could see them flying about and laying eggs — the females lay them in lines down the leaf."

Applications of Dursban (chlorpyrifos), applied for orange wheat blossom midge, also offered some control of the SGM, but the crop was exposed for an extended period. "On some blocks, it was timed just right, but by the time we got round to other fields, the ideal timing for the SGM had been missed, and here we got very variable yields. The crop was visibly damaged in microplots within the field, with a lot of brackling."

The yield monitor on the combine showed yields varied from 3.7-10t/ha, reports Charlie Edgley. Overall, his wheat yield was 1t/ha below the usual farm average of 8.5t/ha. But the legacy the pest left was daunting. "When we cultivated the fields, the packer roller of our 4m Sumo Trio was filled with orange cocoons."

The decision was taken to introduce a rotation. "We were reluctant to break the take-all decline, but planted oilseed rape and oats in the worst fields."

A two-year break is needed, explains Andrew Cotton. "Oats are affected less — the survival in the leaf sheath is much lower, according to the literature.

"But the difficulty is that we know very little about SGM. It's been a steep learning curve for us, and I'd heard reports from around the UK of others with similar infestations of SGM, sometimes even in a first wheat. So we pushed hard for some monitoring."

One of Charlie Edgley's fields was included in the HGCA-funded project. "Clearly, the conditions this year didn't favour the pest — perhaps it went further into the soil profile," speculates Andrew Cotton. "But SGM was a big problem in the 1970s, and who knows when it'll be an issue again? We now understand a lot more than we did when we first spotted the galls, but still a lot of questions remain unanswered."

There are still a lot of questions that remain unanswered, says Andrew Cotton.

Low-risk year for wheat bulb fly

The latest WBF survey, conducted by ADAS, has revealed the lowest number of eggs in UK soils for 17 years. Just one of the 30 sites sampled at the end of Sept had more than the threshold 250 eggs/m^2, reports Steve Ellis.

"The weather's been so horrendous, I think few flies have survived and been able to lay eggs. However, crops sown after 1 Nov may need protection as they are vulnerable to the lower threshold of 100 eggs/m^2." Sites in the north east of England had lower counts than East Anglia, he adds.

Galling survey

Over half of growers and agronomists have seen evidence of SGM infestation, according to results of a survey conducted by ADAS, AICC, Dow AgroSciences, HGCA and NIAB TAG earlier this year. Of the 140 responses, most of these (70%) had been the larvae, or the blood red eggs laid on leaves, while 42% saw the galls on the stem. Of those who'd seen evidence of infestation, 52% experienced yield loss. Although 48% of problems were in continuous crops, 24% were found in first wheats.

research team completely by surprise. "We started in Feb at Wendover with a huge number of larvae — 1500/m^2. But by June this dropped to less than 100/m^2. There was a 95% drop in numbers but we just don't know what happened to them."

The more fungal infection in wheat ears and the longer crops remain unharvested, the more WBF eggs are laid, notes Steve Ellis.

It could be that the midges emerged, but weren't intercepted by the traps, suggests Steve Ellis, or they could've been predated, or that simply the conditions weren't suitable for development. "Could they have burrowed deeper into the soil? We know that OWBM is very picky, only emerging if conditions are right. If SGM is the same, we need to know what conditions will induce emergence."

Other questions remain, such as how to control it. "There are currently no approved insecticides. Moreover, there's a very narrow window for treatment between egg hatch and when the larva moves beneath the leaf sheaf and is protected from insecticide treatment.

"But thanks to this study, we now know a lot more about the pest than we did before, and understand more about how it moves through its developmental stages. We're now in a better position to move forward and do more work on the conditions that'll favour outbreaks in years to come." ■

The bright orange or red pupae can sometimes be seen in the soil during cultivations.

Research round-up

HGCA project 3758, Autumn survey of wheat bulb fly incidence, runs for three years from 1 Aug 2011. Its aim is to establish the annual incidence of WBF in the autumn to allow farmers and agronomists to decide on the need for insecticidal seed treatment and sprays. Its total cost is £24,950, of which HGCA is funding £21,450, with Syngenta as a project partner in 2011 and the research carried out by ADAS.

HGCA project 3765, Monitoring saddle gall midge *(Haplodiplosis marginata)* larvae and adult emergence, runs for nine months from 1 Feb 2012. Its aims are to record numbers of SGM larvae and pupae and monitor adult emergence at two sites, and so determine if soil monitoring provides a useful early warning. Its total cost is £11,800, of which HGCA is finding £7500, with Dow AgroSciences as a project partner and the research carried out by ADAS.

For more information on WBF risk assessment and control, refer to HGCA Topic Sheet 118, while HGCA Information Sheet 15 has more on biology and control of SGM.