The curious case of saddle gall midge

“The potential for damage can be huge.”

Picture: Will Corrigan, Dow AgroSciences

HGCA *from theory to field*

Research is beginning to peel back the mystery that shrouds a pest believed to have caused significant damage to a few localised wheat crops five years ago. *CPM* gets an update.

By Tom Allen-Stevens

The most difficult of all pests to control would probably be the one that lurks unnoticed in your fields, has a couple of years where numbers multiply enormously, causing devastating damage, and then it almost disappears without a trace.

Saddle gall midge (SGM) is a pest that fits that description down to a T, believes Caroline Nicholls of HGCA, and that's what makes it important to take an opportunity to research it. “The fact that it's such a sporadic pest means we know very little about it. There was a significant outbreak about five years ago, and we've used this to learn as much as we can about the pest.”

Monitoring study

An initial nine-month monitoring study, undertaken in 2012, has been developed into a three-year project, which still has a year to run (see panel on p63). What's more, a three-year post-graduate study is now running alongside it, to investigate the roles of natural enemies and environmental conditions. “Both projects have been designed to be very flexible, so that the schedule of work can adapt as we learn more about this curious pest,” she notes.

Along with a fuller understanding of its life cycle, and effective monitoring methods, outcomes of the main project include an evaluation of control strategies, and its hoped some idea of thresholds can be established to help growers decide whether and how to control it.

“One of the really fascinating aspects of this work is a strange fungus that's been identified and appears to have some effect on SGM. In the postgraduate study, progress has been made on developing a model to predict the likelihood of future outbreaks,” notes Caroline Nicholls.

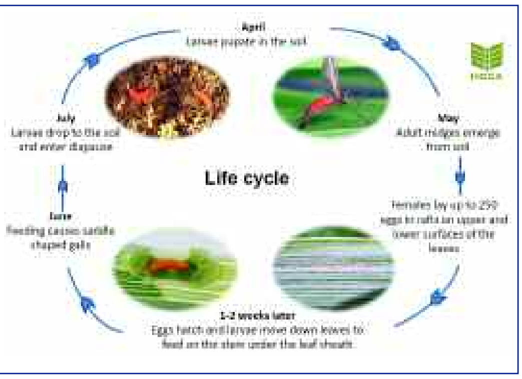
The sporadic nature of the beast makes SGM a pest to look out for, reckons Dr Steve Ellis of ADAS. “The problem with SGM is that you don't know if and when you'll get it, but if you do, the potential for damage can be huge.”

It spends most of its life in mud cells in the soil in its larval stage — a brightly coloured orange/red grub about 5mm long. During winter it enters a diapause, where growth and development are suspended, eventually emerging as an adult midge usually in May that lays eggs on the leaves of wheat and barley plants. It's the resulting larvae burrowing into cereal stems that causes the galls that give the pest its name and damage the crop, explains Steve Ellis.

“The impact on the crop can be quite significant — up to 70% yield loss. But the occurrence of the pest is rare, and it's localised which makes SGM hard to research.”

Severe, widespread outbreaks reported in 2011 provided the perfect opportunity. In Wendover, Bucks, for example, the pest had been identified in a continuous wheat the previous year and by harvest 2011, the crop was suffering widespread damage.

The fact that it's such a sporadic pest means we know very little about SGM, says Caroline Nicholls.



During winter the larvae enter a diapause, where growth and development are suspended. (Picture: HGCA)

This provided the focus for a study conducted in 2012.

"We took soil samples at regular intervals, and counted larvae and pupae. The population was huge, starting at 1500/m² in Feb," recalls Steve Ellis.

But then they just seemed to vanish — by June the count had dropped to less than 100/m². "There was a 95% drop in numbers, but we just didn't know what had happened to them."

It was to find some answers and learn more about this mysterious pest that the new, three-year project was undertaken. Monitoring of populations is one of four specific objectives carried out at Wendover, and another cereal field at Knaresborough, N Yorks, which had a similar infestation of SGM.

"The counts determine the numbers and stages of development. What we've found is that you can use soil sampling to monitor development and so provide a warning of when midges are likely to emerge."

The larvae didn't move much in the soil, staying mainly in the top 10cm, but the research team made an important discovery at the N Yorks site. "There were some larvae that looked different — they didn't pupate and just seemed to die. We sent a sample to the University of Warwick where a mysterious fungus was isolated."

Adult midge usually emerge from pupae in the soil in May to lay eggs on the leaves of wheat and barley plants. (Picture: Luke Cotton)

Parasitic fungus

It turned out to be a parasitic fungus, *Lecanicillium* sp. "It looks as if this fungus may exert a natural control on an SGM population, but we don't know how widespread it is, nor whether it needs certain conditions to develop."Traps for catching adult midges have also been tested. "Water traps are by far the best. The trouble is, they catch a lot of other insects as well, and it's easy to miss the midges. Pheromone traps may be the better solution," he suggests.

The research team has also been assessing the level of damage the pest inflicts on a plant. A total of 100 infested and another 100 uninfested plants have been collected — a total of five wheat fields sampled to date. "We're also planning to look at barley," says Steve Ellis.

The level of infestation has been ▸

SGM can cause up to 70% yield loss, but its occurrence is rare and it's localised, notes Steve Ellis.

SGM search centres on Bucks farms

Luke Cotton was stunned when the population peaked in 2012, reaching well into several million larvae per ha.

It's become part of the routine for Luke Cotton of Bucks-based Cotton Farm Consultancy to monitor and manage SGM. A number of farms in his patch became the focus for renewed interest in the pest following an outbreak first noticed in 2010.

"At its height, in 2012, we were stunned at the population — the count reached well into several million larvae per ha. The soil behind the plough was turning over orange. Then the population dropped dramatically, and it's currently very low — it's a job to know just how much impact the pest now has on the crop," he says.

There are four sites where SGM has been found in significant numbers across two farms — two sites are at Shalstone and Wendover near Aylesbury and the other two in the Chilterns. "It's mostly heavy clay, and the pest seems to prefer this soil. Numbers have been slightly lower where the soil's chalkier."

When it was first discovered, all of the fields in question were in continuous wheat. "What you notice are bumps on the stems of tillers, and closer examination reveals the larvae in the galls. At harvest, you get a lot of white heads and lodging associated with the pest. Actual damage varied and we believe yield loss was up to 70% in places. One badly affected block of 135ha of Hereward suffered a 20% yield drop in 2011," he reports.

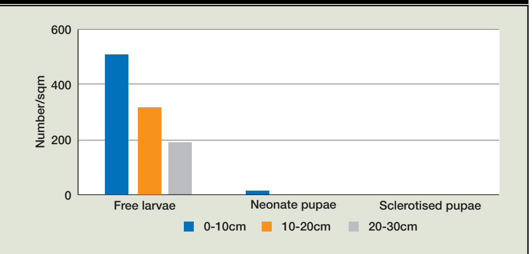
Although a high population was noted in 2010, and the crop suffered significant damage, no control measures were taken. The following year, an application of Dursban (chlorpyrifos) for orange wheat blossom midge also helped reduce the pressure from SGM, reckons Luke Cotton.

"You need quite a lot of factors to come together before there's any significant impact on the crop. I'm convinced the weather around Easter played a major role in 2011. Easter was early and hot, and this is when the adults hatched. That means the larvae had plenty of time to colonise the crop and do their worst — the earlier the infestation, the more damage is done."

While the Chilterns farm introduced a double break to reduce the SGM pressure, the other sites are still in a continuous cereal rotation — spring cropping and fallow have been introduced for the three-crop rule. "The adults hatch in the break crop, but don't do much. We've noticed the pest migrates into first and second wheats, however, so a rotation isn't a panacea.

"It's been very useful having the monitoring as part of the on-going research project — it's put our management of this pest into perspective. One drawback is that the research didn't start in earnest until the outbreak had subsided. Hopefully what we're now learning will help growers manage future outbreaks," concludes Luke Cotton.

Saddle gall midge development stages at three soil depths



Source: ADAS, Knaresborough, N Yorks

▸ assessed, as well as impact on the plants. "The infested plants have fewer grains per ear and a lower weight per grain. But we found the level of infestation is also important — this can vary from 0-20 galls per plant. The trouble is, there's no clear correlation between the level of infestation and the dry weight of grains."

Timing of infestation is also important, he reckons. "This tallies with what's been found in the field — where the infestation starts relatively early, the level of damage can be severe. But the number of larvae in a crop can be quite high with minimal impact, especially if they appear late."

Chemical control is difficult, he recognises. "There are still no approved products for SGM and larvae need to be killed before they move beneath the leaf sheaths to feed." So three different actives have been tried at four timings — chlorpyrifos, lambda-cyhalothrin, and thiacloprid applied when the adult midges appear, 7-10 days after, when eggs are seen and when larvae are first visible.

"The best timing appears to be when you see the adults, although we also got good results with sprays applied when eggs were first seen last year. But once the larvae are visible, it's too late to treat." However, there was very little difference between various treatments, he notes.

Setting thresholds is going to be a tricky job, he admits. Just because there are galls doesn't necessarily mean the yield will be reduced, and once galls are seen, it's too late to treat anyway.

"The problem is that much of the impact

of SGM comes down to when the larvae start to feed. The sporadic nature of the pest means we don't have enough data to give reliable figures on thresholds. A better way forward may be to build what we have to date and what we collect in the last year of the project to help develop a model," he suggests.

This is part of work carried by Charlotte Rowley, a postgraduate student at Harper Adams University. A three-year project looking into natural enemies of SGM is also studying the impact of environmental conditions on the pest.

"We're one year into the project and have developed a degree/day database model that relates soil temperatures to when the first adult midges are found within the crop," she reports. "It's very approximate at the moment, so we'll work over the next two years to refine the model."

She's developing pheromone traps in collaboration with Professor David Hall at the University of Greenwich as a more reliable way to monitor for adult midges than water or sticky traps. "What we hope to develop is a way to assess populations that's easier than digging around in the soil."

There's a mysterious fungus that may exert a natural control on an SGM population.

Environmental conditions have an enormous impact on emergence, however. "The key parameters are soil moisture and temperature — these affect mortality as well as when the adults actually emerge."

Impact of fungus

What remains a mystery is the impact of the fungus. "We know that large numbers of larvae were attacked at Knaresborough, for example. We've been working with the University of Warwick to identify the fungus — we know the species, but haven't been able to identify the exact strain. Hopefully we'll find more of it and develop our understanding.

"But I don't think it was the fungus that brought about the collapse in numbers we experienced in 2012 — it's far more likely this was down to the miserable weather we had that year."

Part of her project is to study other natural enemies of SGM. "These include carabid beetles and spiders. We've done a small survey of potential predators so far. The plan is to look in more detail at whether SGM forms part of their diet, through gut analysis, for example."

Ultimately, it's hoped the current research on SGM will result in a predictive model growers can use to assess when and whether to spray. "This will be a big improvement on existing guidance — there's really not much growers can rely on at present. In the future, we may be able to isolate resistance genes in cereals. This resistance could then be introduced into breeding lines, in the same way as orange wheat blossom midge resistance," she suggests. ■

Charlotte Rowley is developing more reliable ways to monitor for adult midges and predict outbreaks.

Research round-up

HGCA project 3806, Improving risk assessment and control of saddle gall midge (Haplodiplosis marginata), runs from Feb 2013 to March 2016. Its aims are to monitor midge development, measure the impact of infestations on crop yield, evaluate the efficacy of control options, and propose thresholds for the pest. Led by ADAS, its cost is £89,547, funded by HGCA.

HGCA project 214-0002, Investigating the effect of natural enemies and environmental conditions on soil populations of saddle gall midge, runs from Sept 2013 to Sept 2016. Its aim is to investigate the role of natural enemies in supressing soil populations of saddle gall midge, as well as environmental conditions, such as soil moisture, and the effectiveness of break crops. Led by Harper Adams University, its cost is £37,500, funded by HGCA.

For more information, go to www.hgca.com