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Monitoring saddle gall midge (*Haplodiplosis marginata*) larvae and adult emergence

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HGCA is the cereals and oilseeds division of the Agriculture and Horticulture Development Board.

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1. ABSTRACT

The aim of this eight month study was to record development of saddle gall midge larvae and pupae, and the timing of adult emergence. This work was undertaken to determine whether monitoring of soil stages of this pest can provide a useful indication of the risk and timing of adult emergence.

The study had the following objectives:

1. Record numbers of saddle gall midge larvae and pupae by soil sampling at regular intervals.
2. Monitor adult emergence using yellow sticky traps checked at regular intervals.
3. Determine if soil monitoring of larvae and pupae provides a useful early warning of adult emergence.
4. Monitor soil temperature and soil moisture levels at regular intervals.

The work was done at two sites in Buckinghamshire which had previously been affected by the pest. It was funded by HGCA, with additional funding from Dow AgroSciences as part of their Pestwatch campaign.

Saddle gall midge larvae were recorded in every soil sample taken throughout the monitoring period at both sites. Numbers declined by 94% at Wendover and 96% at Cadmore End between February and June 2012. Newly developed (neonate) pupae were first recorded on 10 April at both sites and fully formed pupae at Wendover on 8 May. Numbers of pupae remained low throughout the monitoring period. A small number of pupae were also recorded as being parasitised. Saddle gall midge adults were not recorded on sticky yellow traps until 14 May at either site. Numbers of adults on traps never exceeded 0.5/trap/day. There does not appear to be a simple trigger to initiate pupation and it is likely that further data will need to be collected before any firm conclusions can be drawn.

Soil sampling was an effective method of monitoring saddle gall midge development. It should, therefore, be possible to use soil sampling to give an indication of the likely timing of adult midge emergence. It was interesting that the number of midge developmental stages in the soil declined so significantly during the monitoring period. This could be due to parasitism, predation by other insects or birds, or weather conditions. The biggest drop in numbers of larvae was at the end of April, which coincided with some of the wettest weather. It is also possible that larvae moved back down through the soil profile in response to these adverse conditions. Potential future areas for saddle gall midge research are discussed.

2. SUMMARY

2.1. Introduction

Severe, widespread outbreaks of saddle gall midge occurred in continuous cereals on heavy land in 2010 and 2011, from Wiltshire to the Scottish Borders, with yield losses in the most severe cases reaching 70%. The aim of this study was to record development of saddle gall midge larvae and pupae, and the timing of adult emergence. This work was undertaken to determine whether monitoring of soil stages of this pest can provide a useful indication of the risk and timing of adult emergence. Improved understanding of the risk and timing of saddle gall midge adult emergence will allow more targeted and effective insecticide applications to be made.

The study had the following objectives:

1. Record numbers of saddle gall midge larvae and pupae by soil sampling at regular intervals.
2. Monitor adult emergence using yellow sticky traps checked at regular intervals.
3. Determine if soil monitoring of larvae and pupae provides a useful early warning of adult emergence.
4. Monitor soil temperature and soil moisture levels at regular intervals.

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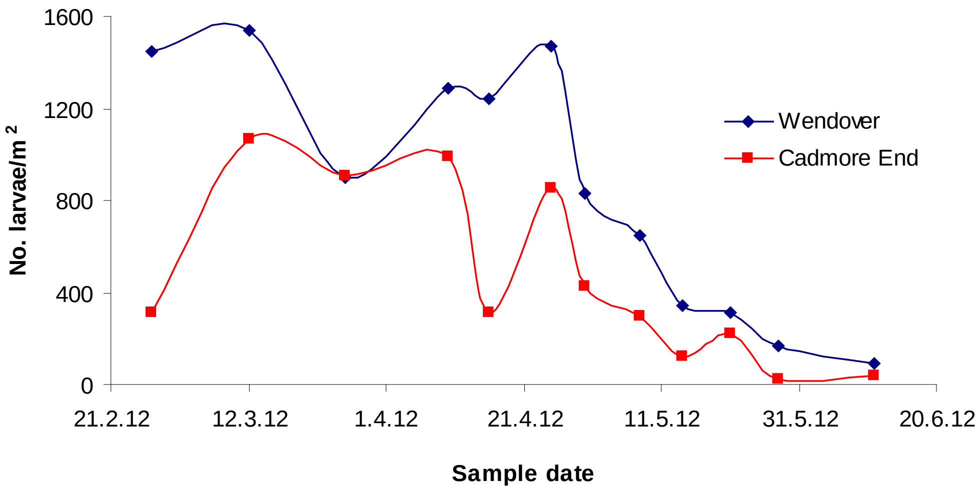
2.2. Results

2.2.1. Saddle gall midge development

Saddle gall midge larvae were recorded in every soil sample taken throughout the monitoring period at two sites in Buckinghamshire. Numbers of larvae recorded throughout the monitoring period are summarised in Summary Figure 1 and a photo of larvae is shown in Summary Figure 2. Numbers declined by 94% at Wendover and 96% at Cadmore End between February and June 2012.

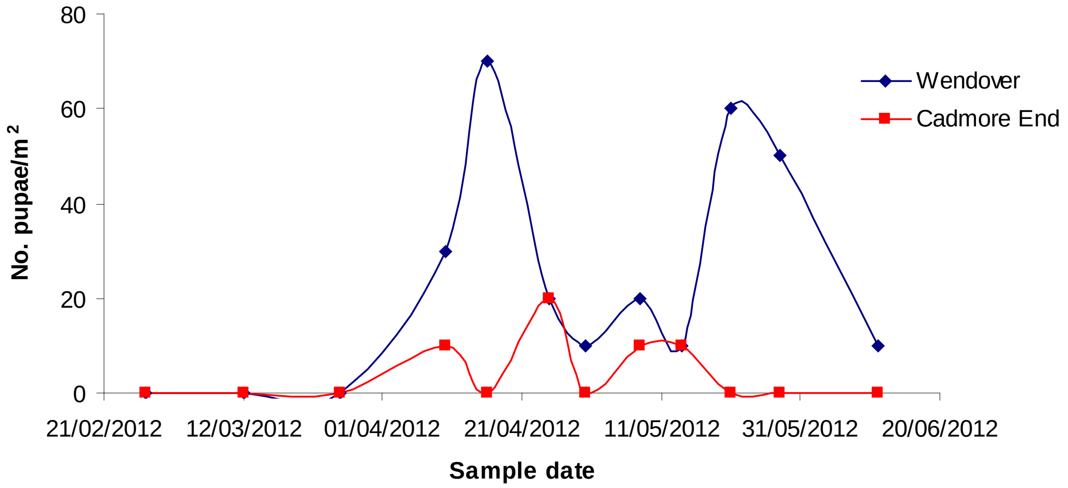


Summary Figure 1. Numbers of saddle gall midge larvae per m^2 recorded throughout the monitoring period at Wendover and Cadmore End, Buckinghamshire.

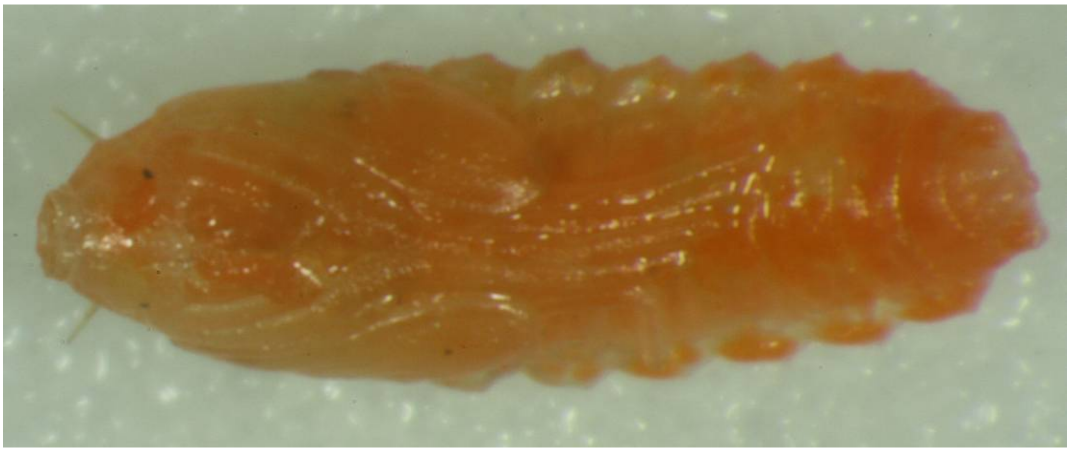
Summary Figure 2. Saddle gall midge larvae on soil surface.

Newly developed (neonate) pupae (Summary Figure 3) were first recorded on 10 April at both sites and fully formed pupae at Wendover on 8 May. No fully formed pupae were recorded at Cadmore End. Numbers of neonate pupae and pupae remained low throughout the monitoring period.

Summary Figure 4 shows a neonate pupa and Summary Figure 5 a fully formed pupa. A small number of pupae were also recorded as being parasitised (Summary Figures 6 and 7).



Summary Figure 3. Numbers of saddle gall midge pupae (neonate and fully developed) per m^2 recorded throughout the monitoring period at Wendover and Cadmore End, Buckinghamshire.



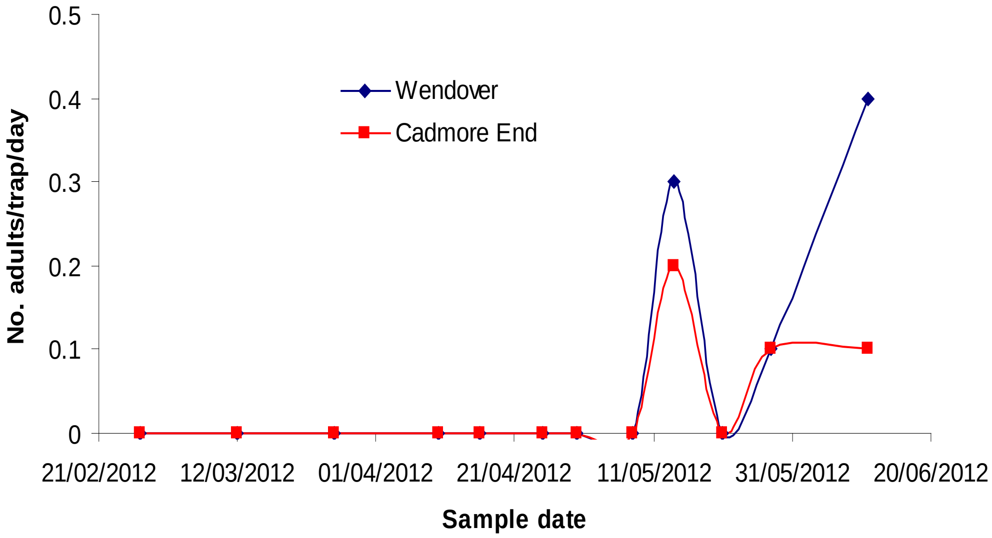
Summary Figure 4. Newly developed (neonate) saddle gall midge pupa

Summary Figure 5. Fully developed saddle gall midge pupa

Summary Figure 6. Parasitised saddle gall midge pupa

Summary Figure 7. Emerged saddle gall midge parasitoid

Saddle gall midge adults were not recorded on yellow sticky traps until 14 May at either site (Summary Figure 8). Numbers of adults on traps never exceeded 0.5/trap/day. An adult female midge laying eggs is shown in Summary Figure 9



Summary Figure 8. Numbers of saddle gall midge adults per trap per day recorded throughout the monitoring period.

Summary Figure 9. Saddle gall midge adult laying eggs.

2.2.2. Meteorological data

Relatively cool conditions persisted throughout April and much of May. Following early season warmth in mid- to late-March maximum temperatures did not return to these levels again until mid- to late May. Minimum temperature data showed night time temperatures below 0°C until mid-April. Soil temperatures remained below 10°C until late-April before increasing to approximately 15°C in late-May. There was little rainfall until early-April and then 267mm fell throughout the remainder of the monitoring period. Indeed, over the final 70 days of the monitoring period, rainfall was recorded on 47 days (67% of days). Relative humidity throughout the monitoring period ranged between 59 and 100%. Soil moisture levels declined throughout March, reflecting the lack of rainfall, but rose again during the wet April and May. However, a period of dry, warm weather at the end of May saw soil moisture levels decline before increasing again in early-June.

2.2.3. Midge development and meteorological data

With few pupae and adult saddle gall midge recorded in 2012 there was limited pest development data with which to link the meteorological data. There does not appear to be a simple trigger to initiate pupation and it is likely that further data will need to be collected before any firm conclusions can be drawn.

2.3. Discussion

2.3.1. Monitoring saddle gall midge development

Soil sampling was an effective method of monitoring saddle gall midge development. All stages of pest development except larvae within mud cells were recorded. This included larvae, neonate pupae and pupae. In addition, it was possible to extract pupae which had been parasitised by a hymenopterous parasitoid. It should therefore be possible to use soil sampling to give an indication of the likely timing of adult saddle gall midge emergence. This would provide an early warning of pest activity which could be used to trigger crop monitoring visits to determine when adults are present in the crop and likely to be laying eggs. Yellow sticky traps caught low numbers of saddle gall midge adults but have been used elsewhere to monitor midge emergence successfully.

2.3.2. Meteorological data and saddle gall midge development

In view of the low numbers of saddle gall midge pupae and adults recorded in 2012 it is very difficult to suggest any link between meteorological data and midge development. At the Wendover site there were two peaks in numbers of pupae approximately one month apart in mid-April and mid-May but there was no clear meteorological trigger for pupation. Further years of monitoring and meteorological data will be required to investigate how saddle gall midge development responds to weather conditions.

2.3.3. Saddle gall midge development and impact on crop yield

Despite extremely high levels of the pest in the soil there was limited, if any, crop damage. This suggests that predicting the risk of crop damage from saddle gall midge is more dependent on the timing and number of adult pests that emerge rather than the number of larvae in the soil. It was also interesting that the number of midge developmental stages in the soil declined by 94% at Wendover and 96% at Cadmore End over the monitoring period. Given the small number of pupae, and consequently adults, recorded at each site it seems likely that other factors may be important in explaining the large reduction in larval populations. This could include parasitism, predation by other insects or birds, or weather conditions. The biggest drop in numbers of larvae was at the end of April, which coincided with some of the wettest weather and when soil moisture levels were at their highest. It is also possible that larvae moved back down through the soil profile in response to these adverse conditions.

2.3.4. Further research

It is clear that an improved understanding of the biology and life cycle of saddle gall midge in conjunction with understanding when it infests the crop and the crop's ability to tolerate damage is pivotal to developing a reliable risk assessment for this pest.

The sporadic nature of saddle gall midge damage suggests that in most years insufficient midges emerge to pose a threat to the crop or that the timing of emergence means that any damage has little impact on crop yield. Being able to predict those years in which saddle gall midge is likely to be a threat is crucial in determining a sustainable control strategy.

An evaluation of chemical control options for saddle gall midge is required. The literature suggests there is a limited window for control of this pest before the larvae are protected beneath the leaf sheath.

In summary, future research should concentrate on a number of key areas:

1. Understanding the life-cycle to enable effective monitoring and forecasting
2. Impacts of pest damage on crop yield
3. Chemical control options and insecticide timing
4. Determining economic treatment thresholds