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| **Project Title:** | **Monitoring commercial blackcurrant crops for natural enemies of blackcurrant leaf midge 2006** |
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**Authentication**

I declare this work was done under my supervision according to the procedures described herein and that this report is a true and accurate record of the results obtained.

Signatures (project leaders)…………………………………..

date………………………………….

Co-signature (EMR science director or deputy)………………………………..

date……………………………………

J V Cross, East Malling Research,
1 December 2006

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# Grower summary

# SF12

## Final report 2006

## Monitoring commercial blackcurrant crops for natural enemies of blackcurrant leaf midge 2006

### Headline

No parasitism of blackcurrant leaf midge larvae by the parasitoid *Platygaster demades* was found in larvae in commercial blackcurrant plantations 2006. Large populations of insect predators occurred in IPM, organic and untreated plantations compared to conventionally sprayed plantations.

### Background and deliverables

Work at EMR under DERFRA project HH1942SSF indicated that the parasitic wasp *Platygaster demades* Walker, can be an important natural enemy (egg-larval parasite) of blackcurrant leaf midge and can cause very high levels of parasitism if not disrupted by broad-spectrum pesticides. Observations also indicated that predatory flower bugs are important natural enemies of blackcurrant leaf midge and it is likely that predatory ground beetles also make a contribution to natural regulation by predating larvae and pupae in the soil. This occurrence led to the hypothesis that the blackcurrant leaf midge is a secondary pest of blackcurrant. It appeared that damaging outbreaks of the midge were caused by the use of broad-spectrum pesticides (including fenpropathrin) because they are harmful to the midge's key natural enemies.

This hypothesis has been tested in the current Defra/GSK blackcurrant IPM project HH3115STF in a large-scale replicated field experiment at Upper Horton Farm, Bridge.

However, in this experiment only a small percentage of first-generation leaf midge larvae (< 2%) were found to be parasitised by *P. demades.* This rate of parasitism was not sufficient to significantly affect leaf midge populations. A possible explanation for failure of *P. demades* to establish was the lack of growing shoots to support second and third generation midge attacks due to the fruit load being carried by the bushes which deprived *P. demades* of its host at crucial periods, so preventing more rapid establishment. The experiment was terminated in 2005 when the plantation was grubbed.

This work was done to ascertain the incidence of parasitism of blackcurrant leaf midge larvae by *P. demades* in commercial blackcurrant plantations. Additionally, four blackcurrant plantations in western England subject to different pesticide management were beat sampled to determine the relative abundance on generalist predators and pests to gain insights into the effects of pesticide management on generalist predator communities.

**Summary of the project and main conclusions**

In 2006, the incidence of parasitism of blackcurrant leaf midge larvae by the egg-larval parasitoid *Platygaster demades* Walker, was determined in commercial blackcurrant plantations in Kent, Norfolk and Herefordshire. Samples of mature first generation leaf midge larvae were collected from 6 commercial plantations on 12 - 23 May 2006 and of second generation larvae from 11 plantations on 20 June - 3 July 2006.

Additionally, on 28 June 2006, four blackcurrant plantations in Herefordshire subject to different pesticide management were beat-sampled to determine the relative abundance of generalist predators and pests to gain insights into the effects of pesticide management on generalist predator communities.

No parasitisation by *P. demades* was detected in any of the first or second generation larval samples, indicating that the parasite was virtually absent from those plantations in 2006. The parasite had been found at significant levels in samples from various farms in previous years.

A likely reason for the failure of the parasitoid to establish in 2006 was poor synchronisation with its host. Monitoring the of the flight adult *P. demades* using yellow sticky traps in an apple orchard at East Malling showed that the first flight of *P. demades* occurred in June –

July with a second generation flight in August-September. Thus the first generation of the midge occurred well before the first parasitoid flight. The first flight of the parasitoid coincided better with the second generation of the midge. Further work is needed to investigate the incidence of the parasitoid.

The beat sampling indicated that large populations of insect predators occur in IPM, organic and untreated plantations with few predators in conventionally sprayed plantations. However, despite the occurrence of high populations of predators, leaf midge was still a significant pest in all plantations, attacking practically every available shoot. This suggests that such predators are of only secondary importance in regulating leaf midge numbers. Predator populations only developed in response to high pest populations and were not able to reduce leaf midge numbers to very low levels to prevent significant attack. Observations suggest that anthocorid bugs are the dominant leaf midge predator. The results also suggests that nabid bugs establish at high levels in long established organic plantations and these might out-compete anthocorids and possibly prey on the predatory mite *Anystis sp.*. The results suggest that conventional pesticide management appears to more or less eliminate the bulk of predatory arthropods including the predatory mirid bug *Heterotoma planicornis* (Pallas 1772) nabid bugs, earwigs and *Anystis sp.*. Very high populations of leaf hoppers occurred in the unsprayed plantation and these were causing severe leaf discolouration. Very high populations of capsid bugs (mainly *Lygocoris pabulinus* (Linnaeus 1761)) occurred in the IPM plantation causing damage to shoots. Selective insecticides for controlling these pests need to be identified for future development of IPM in blackcurrants.

**Financial benefits**

Losses due to blackcurrant leaf midge in blackcurrant plantations in the UK have not been quantified. However, the midge is a widespread and important pest. Severe attacks cause stunting of new growth (by > 30%). No direct financial benefits to growers arise from this work.

**Action points for growers**

Growers should avoid using broad-spectrum pesticides to encourage the development of natural enemy populations in their blackcurrant plantations. An alternative selective insecticide for control of the midge needs to be identified.

# Science section

### Introduction

Work at EMR under DEFRA project HH1942SSF indicated that the parasitic wasp *Platygaster demades* Walker, can be an important natural enemy (egg-larval parasite) of blackcurrant leaf midge and can cause very high levels of parasitism if not disrupted by broad-spectrum pesticides. The same parasitoid was successfully introduced and exploited as a natural enemy of apple leaf midge in DEFRA project HH1933SSF. Observations indicated that predatory flower bugs are important natural enemies of blackcurrant leaf midge and it is likely that predatory ground beetles also make a contribution to natural regulation by predating larvae and pupae in the soil. The midge was a serious pest in the experimental plots at East Malling at the outset of the previous projects. However, it has now declined to very low levels in all of the experimental plots and has remained so for >6 years. This occurrence led to the hypothesis that the blackcurrant leaf midge is a secondary pest of blackcurrant. It appeared that damaging outbreaks of the midge were caused by the use of broad-spectrum pesticides (including fenpropathrin) because they are harmful to the midge's key natural enemies. This hypothesis has been tested in the current Defra/GSK blackcurrant IPM project HH3115STF in a large-scale replicated field experiment at Upper Horton Farm, Bridge. The IPM experiment compared three treatments; an IPM treatment using selective insecticides and acaricides only, a conventional treatment using broad spectrum products and an untreated control. Large plots were used to prevent significant ingress of natural enemies between insecticide-treated and untreated areas. However, only a small percentage of first-generation leaf midge larvae (< 2%) were found to be parasitised by *P. demades.* This rate of parasitism was not sufficient to significantly affect leaf midge populations. A possible explanation for failure of *P. demades* to establish was the high fruit load of the bushes resulting in a lack of growing shoots to support second and third generation midge attacks. This deprived *P. demades* of its host at crucial periods and prevented a more rapid establishment of the parasite. The experiment was terminated in 2005 when the plantation was grubbed.

In 2006, further work was done to ascertain the incidence of parasitism of blackcurrant leaf midge larvae by *P. demades* in commercial blackcurrant plantations. Additionally, in late

June, four blackcurrant plantations in western England subject to different pesticide management were beat sampled to determine the relative abundance on generalist predators and pests to gain insights into the effects of pesticide management on generalist predator communities. The results of this work are reported here.

## Methods and materials

*Platygaster demades*

Samples of first generation blackcurrant leaf midge galls containing mature blackcurrant leaf midge larvae were collected from 6 commercial plantations in Norfolk, Kent and Herefordshire between 12 and 23 May 2006. Similar samples of second generation galls were collected from 11 plantations between 20 June and 3 July 2006 (Table 1). Up to 100 larvae from each sample were removed from the galls and transferred to a watch glass containing a small quantity of tap water. The anterior region of each larva was torn open with dissecting needles and the contents examined for the presence of proto-larvae of *Platygaster demades* (Figure 1). The number of larvae examined and the number found to be parasitized was recorded.

**Figure 1. Proto-larva (right) of *Platygaster demades* dissected from the anterior of an apple leaf midge larva**

*Generalist arthropod predators*

Four blackcurrant plantations in western England that were subject to different pesticide management programmes were beat-sampled on 28 June 2008 (Table 2). Twenty five individual bushes widely spread throughout the area of each plantation were beat sampled using the standard beating method (2 beats per bush over 0.25 $m^2$ beating tray). Additionally, 2 blackcurrant leaf midge galls from each of the 25 bushes were unfurled and the numbers of leaf midge larvae and anthocorid predators contained in the galls counted.

## Results

*Platygaster demades*

A total of 1345 larvae were examined from 17 samples but none were found to be parasitised by *P. demades* (Table 1).

*Generalist arthropod predators*

Leaf midge galls were abundant in all four plantations, practically every growing shoot being attacked by blackcurrant leaf midge. However, on the date of sampling, live leaf midge larvae were only found in galls in the conventionally sprayed Ben Lomond plantation at Oxhouse Farm, Shobdon. No larvae were found in the galls at the other sites.

Generalist arthropod predators were abundant in beat samples from the IPM, unsprayed and organic plantations (totals of 115, 158 and 94 individuals/25 bushes respectively) but much less numerous in the conventionally treated plantation (7 indiviuals/25 bushes) (Table 2). In the IPM and unsprayed plantations at Pixley Court, anthocorid predators and the predatory mite *Anystis sp.* were particularly abundant but no nabid bugs were found. In contrast in the organic plantation, there were comparatively few anthocorids or *Anystis sp.*, but nabid bugs were abundant. Few anthocorids and no nabids were found in the conventional plantation.

The predatory mirid *Heterotoma planicornis* ((Pallis 1772) Figure 2)) was abundant in the IPM and organic plantations but infrequent in the unsprayed and conventional plantations.

Caspid bugs were particularly abundant in the IPM plantation and were causing extensive damage to shoots. Small numbers of adult vine weevils were also found in this plantation.

Anthocorids were found inside leaf midge galls, and nymphs were most numerous in galls containing leaf midge larvae (Table 2).

**Figure 2. Adults of the predatory mired bug *Heterotoma planicornis* (left) and adult predatory nabid bug *Nabis rugosus* (right) (photos taken from www. insektenphotos.de and www. koleopterologie.de respectively).**

**Discussion**

*Platygaster demades*

Failure to detect parasitisation by *P. demades* in any of the first or second generation larval samples was unexpected and seemed to indicate that the parasite was absent in 2006. This was surprising because the parasite has been found at significant levels in samples from various farms in previous years. A likely reason for the failure of the parasitoid to establish in 2006 is poor synchronisation with its host. Monitoring of the flight of apple leaf midge using sex pheromone traps and adult *P. demades* using yellow sticky traps at East Malling indicated that the first flight of *P. demades* occurs in June - July with a second generation flight in August-September (Figure 3). Thus, the first generation of the midge occurred well before

the midge flight. The first flight of the parasitoid seems to coincide better with the second generation of the midge. Further work is needed to investigate the incidence of the parasitoid.

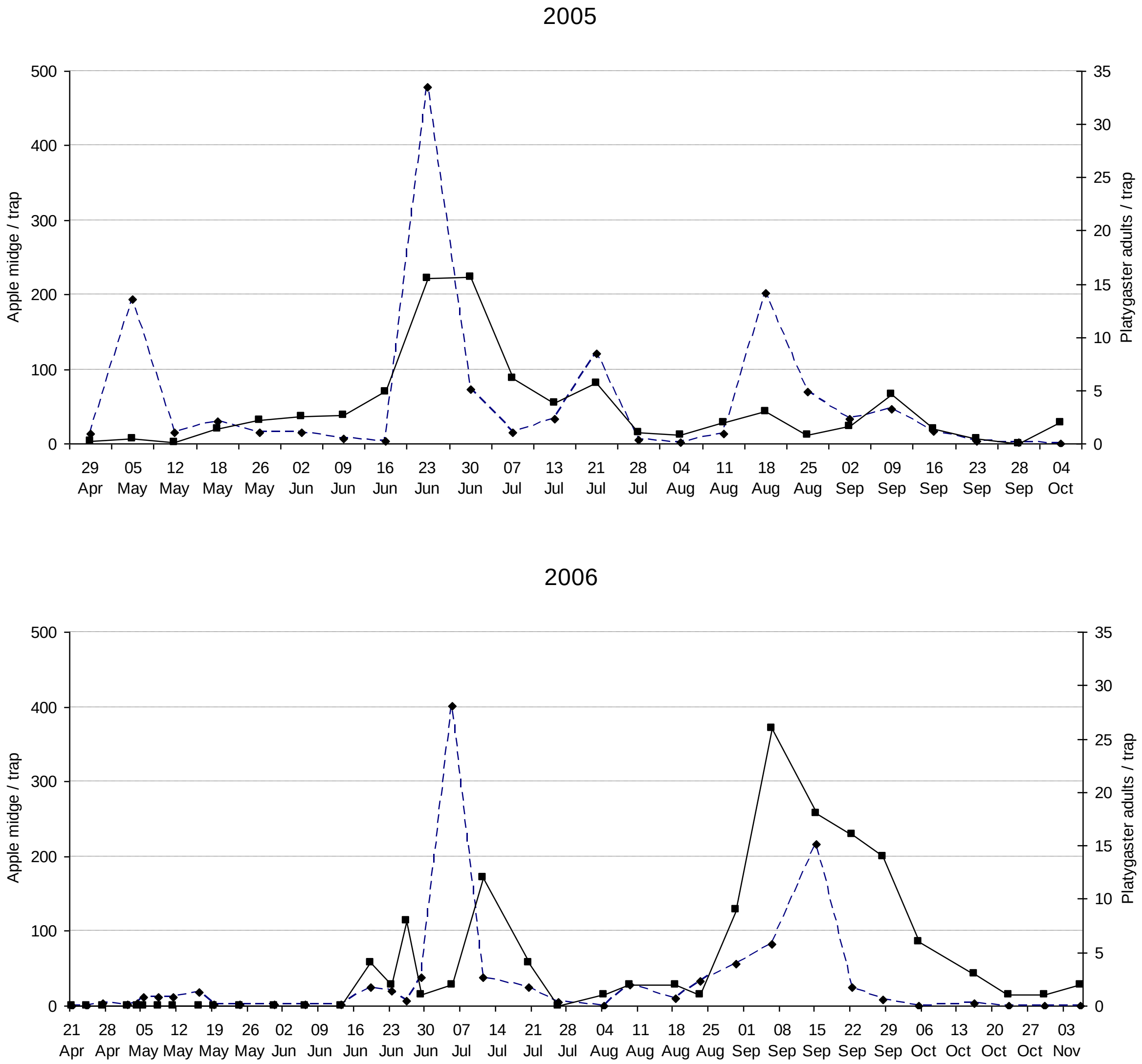


**Figure 3. Numbers of apple leaf midge (dashed line ▲) caught in pheromone traps and numbers of *Platygaster demades* adults (solid line ■) caught in yellow sticky traps in Wiseman apple orchard at EMR in 2005 and 2006.**

*Generalist predators*

The beat sampling suggests that large populations of insect predators occur in IPM, organic and untreated plantations with few predators in conventionally sprayed plantations. However, despite the occurrence of high populations of predators, leaf midge was still a significant pest in all plantations, attacking practically every available shoot. This suggests that such predators are of only secondary importance in regulating leaf midge numbers, populations only developing in response to high pest populations and that they are not able to reduce leaf midge numbers to the low levels needed to prevent considerable attack. Observations suggest that anthocorid bugs are the dominant leaf midge predator. The results also suggests that nabid bugs establish at high levels in long established organic plantations and these might out-compete anthocorids and possibly prey on the predatory mite *Anystis sp.*. The results suggest that conventional pesticide management appears to more or less eliminate the bulk of predatory arthropods including the predatory mirid bug *Heterotoma planicornis*, nabid bugs, earwigs and *Anystis sp.*.

Very high populations of leaf hoppers occurred in the unsprayed plantation and these were causing severe leaf discolouration. Very high populations of capsid bugs (mainly *Lygocoris pabulinus* (Linnaeus)) occurred in the IPM plantation causing damage to shoots. Selective insecticides for controlling these pests need to be identified for future development of IPM in blackcurrants.

**Acknowledgements**

We are most grateful to Edward Thompson, Anthony Snell, Richard Bowen, John Atwood, Tom Maynard, Rob Saunders, Nigel Wickham, Ed Wharton whose crops were used or who assisted with sampling.

# Appendix

**Table 1. Blackcurrant plantations sampled for blackcurrant leaf midge larvae and incidence of parasitism by *Platygaster demades*.**

| Date (2006) | Farm | Field | Variety | Sprayed | No. larvae | |
|---|---|---|---|---|---|---|
| | | | | | Sampled | Parasitised |
| **1st gen.** | | | | | | |
| 12 May | Winsford Hall, Gt Yarmouth, Norfolk | Back of Brian's | Alder | - | 100 | 0 |
| 12 May | Hall Farm, Gressenhall, Dereham | Goregate Field 18 Acre | Hope | - | 100 | 0 |
| 18 May | Pixley Court, Ledbury, Hereford | Wonder Field, Hall End | Gairn | Yes | 75 | 0 |
| | | Glebe | Hope | No | 100 | 0 |
| 18 May | Hallwood Farm, Kent | 10 acre | Alder | - | 100 | 0 |
| 23 May | Stonecross Farm, Ticehurst, Kent | - | Tirran | No | 18 | 0 |
| **2nd gen.** | | | | | | |
| 20 June | Burrs Farm, Brenchley, Kent | - | Lomond | No 2006 | 100 | 0 |
| 21 June | Stonecross Farm,Ticehurst, Kent | - | Tirran | No | 100 | 0 |
| 26 June | Hill Fruit Farm, Swafield, N Walsham, Norfolk | Field SW1 | Alder | - | 100 | 0 |
| | | Field SW7 | Lomond | - | 100 | 0 |
| | | Field SW9 | Alder | - | 100 | 0 |
| 28 June | Oxhouse Farm, Shobdon, Hereford | Centre pruned | Lomond | Yes | 100 | 0 |
| 28 June | Pencoyd Court, Hereford | Next to blueberries | ? | Yes | 80 | 0 |
| | | Organic | Gairn | - | 50 | 0 |
| 28 June | Pixley Court, Ledbury, Hereford | Camp Hill | Gairn | No | 10 | 0 |
| | | Birchall (IPM site) | Gairn | - | 12 | 0 |
| 03 July | Winsford Hall, Gt Yarmouth, Norfolk | Back of Brian's | Alder | - | 100 | 0 |

**Table 2. Numbers of predatory arthropods found in four blackcurrant plantations in western England subject to different pesticide management, by beat sampling 25 bushes on each plot. Numbers of anthocorid predators and leaf midge larvae found in 50 leaf midge gall on 28 June 2006 were also counted.**

| Pesticide management† | Variety | No. of individuals found in beat samples from 25 bushes | | | | | | | | No. in 50 midge galls | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Anthocorid | | Other predators | | | | Pest species | | Anthocorid | | Leaf midge larvae |
| | | adults | nymphs | *Heterotoma planicornis* | Nabids | *Anystis sp.* | Earwigs | Capsid | Vine weevil | adults | nymphs | |
| 1. IPM | Gairn | 28 | 28 | 32 | 0 | 25 | 2 | 36 | 2 | 2 | 2 | 0 |
| 2. Unsprayed | Gairn | 27 | 43 | 7 | 0 | 69 | 12 | 6 | 0 | 5 | 5 | 0 |
| 3. Organic | Gairn | 7 | 4 | 22 | 40 | 6 | 15 | 3 | 0 | 2 | 1 | 0 |
| 4. Conventional | Lomond | 2 | 3 | 2 | 0 | 0 | 0 | 1 | 0 | 1 | 8 | 26 |

† Plantations 1 and 2 are at Pixley Court (Birchall & Camp Hill respectively), plantations 3 is at Pencoyd Court farm, Hereford and plantation 4 is at Oxhouse Farm, Shobdon, Hereford