Sex pheromone of raspberry cane midge

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Summary

The sex pheromone of the raspberry cane midge has been identified and synthesised by EMR and NRI and has proved to be highly attractive and useful for pest monitoring. Sex pheromone traps will be available for Beta testing in 2006. Those who wish to take part in the test should register their names by 31 January 2006. For the tests, a nominal threshold of 30 midges per trap is proposed for timing first chlorpyrifos sprays in spring.

Introduction

The raspberry cane midge, *Resseliella theobaldi* (Barnes), is an important pest of raspberry in the UK and in many other areas of the world. The adult midge lays eggs in splits in young canes and larvae feed on the pith beneath the rind causing penetrating lesions which allow entry of diseases such as the cane blight fungus *Leptosphaeria coniothyrium.* There are three or more generations per annum.

The pest is controlled currently by routine sprays of the organophosphorus (OP) insecticide chlorpyrifos applied to control the first generation in spring. This also prevents significant damage by the subsequent generations, although population increase almost certainly occurs. Traditionally, a spray was applied in late April or early May when the spawn was 20-30 cm high, and again about two weeks later. However, more recently a temperature-based forecasting model was developed by Gordon *et al.* (1989) for predicting spring oviposition by the raspberry cane midge to aid better timing of sprays. Spray warnings are made available to growers by ADAS. First oviposition occurs when a temperature sum of 339ºC days above 4ºC is accumulated. Values are interpolated from the nearest Meteorological station making a correction for the altitude and aspect of the particular location. The forecast is believed to be accurate to ± 5 days. The problem with this system is that it results in routine use of OP insecticides in most commercial plantations.

The existence of a female sex pheromone in raspberry cane midge had not previously been proven, but it was known that it was likely that one existed, by analogy with related species. The pheromone will be useful for monitoring the pest making the forecasting model redundant and obviating the need for routine sprays. It could possibly be used for control by mating disruption, lure and kill or by mass trapping approaches.

Identification of the raspberry cane midge sex pheromone

Components of the female sex pheromone of the raspberry cane midge have been identified and synthesised by EMR and NRI. Pheromone components were collected

by trapping of volatiles and could be detected by comparison of GC analyses of collections from females and males as well as by linked GC-EAG analyses. One major component and three minor components were identified by interpretation of their mass spectra and comparison with synthetic standards. The major component and two of the minor components have a single chiral centre but only one enantiomer of each is produced by the insect. The major component belongs to a new class of midge pheromone structures that is currently the subject of a patent application but which will be described in the oral presentation.

Attractiveness in the field

In initial field tests in May 2005, delta traps suspended in raspberry plantations at 50 cm height above ground and bated with rubber septa or polythene vial dispensers impregnated with 100 µg of the synthetic, racemic major component of the pheromone, alone or in admixture with the minor components each at 30% of the amount of the major component (the natural ratio), all proved highly attractive to males. There were no obvious differences between the dispensers and no clear benefit from addition of the minor components. In a subsequent experiment, the attractiveness of rubber septa lures loaded with 0, 0.1, 1, 10, 100 and 1000 µg of the racemic major component alone were compared over a 4 week period. The 0.1 µg loading proved highly attractive catching an average of 150 males per trap. The maximum catch occurred with the 100 µg loading there being a significant reduction in catch at the highest loading.

Pest monitoring in 2005

Single white delta traps bated with polythene vial dispensers containing 100 µg of the racemic major component of the pheromone plus 30% of each of the minor components, were deployed in 10 raspberry plantations in Kent and monitored weekly from 10 May to end of September 2005. Plantations comprised a range of varieties grown under protection or in the open field (Table 1). Two plantations at East Malling Research contained a very wide range of varieties (variety collections) and had not received any pesticide sprays. The other plantations were sprayed with pesticides including chlorpyrifos for cane midge control.

Regrettably, the pheromone was not available for deployment until 10 May, 4 days after the forecast date of first emergence by ADAS on 6 May 2005 at East Malling Research.

There was no clear pattern of midge emergence at the 10 sites making it difficult to discern distinct generations of midge emergence. Small numbers of midges were captured in the first week the traps were deployed at all sites. There was evidence of a first generation in May at approximately the time of the ADAS forecast but this was difficult to distinguish and numbers were small compared to numbers that emerged later in May or in June or July (Figure 1, Table 1). There were large differences in the numbers of midges caught, very large numbers (>>1000 over the season) being caught in 5 of the plantations with small numbers (< 1000) in the 5 others. First catches from 10-17 May varied from 1 to 112 midges/trap and were not necessarily a good indication of the magnitude of subsequent total catches.

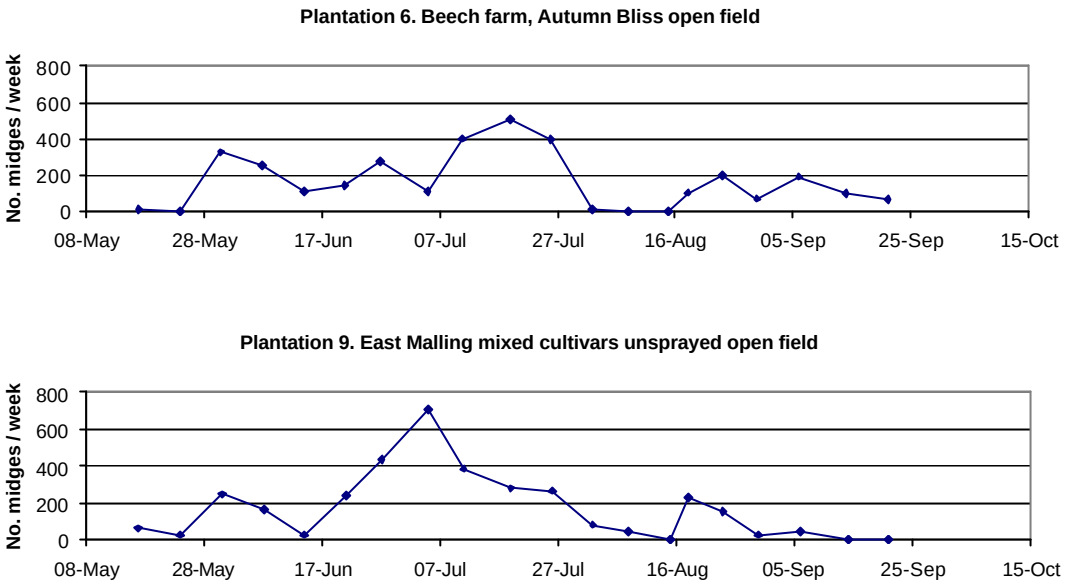

Figure 1. Catches of raspberry cane midge males in a sex pheromone trap in an open field Autumn Bliss plantation at Beech Farm, W. Peckham (above) and in unsprayed raspberry plantation of mixed cultivars at East Malling Research (below) in 2005

Advantages of the raspberry cane midge sex pheromone trap

There are many important advantages of the raspberry cane midge sex pheromone trap over the current system of temperature based forecasting of the start of spring emergence. The most important are that records are site/plantation specific and indicate the timing and intensity of midge attack through the season.

Commercial availability of sex pheromone traps for Beta testing in 2006

The results of work in 2005 clearly show that the raspberry cane midge sex pheromone is highly useful for monitoring midge populations. EMR and NRI will be making traps available for testing in 2006 at £50 per trapping station. A trapping station will include:

- A standard white delta trap and hanger
- Sufficient lures for 1 April to 30 September for the trap
- 24 sticky bases to be changed weekly
- Instructions on how to deploy and monitor the traps including a colour photograph to aid midge identification
- Instruction on data collation and relay of results and details of plantations and insecticide applications to EMR

The traps should be deployed from early April to the end of September and the catch recorded weekly. Those interested in participating are asked to complete the Beta test application form and return it to J V Cross by 31 January 2006. The form can be downloaded from the EMR or NRI website. EMR and NRI will collect the data from

participants, either from participants directly during the season by email, or at the end of the season. If acceptable, EMR staff will visit the monitored plantations to determine the severity of cane midge attack

Interpretation of trap catches for 2006

No scientific work has yet been done on the relationship between pheromone trap catches, time of season, crop susceptibility and the intensity of larval attack. No firm guidance thus can be given on the use of the trap catches to time sprays for large scale commercial purposes. For the Beta testing, a nominal trap threshold of 30 midges per trap in May to trigger chlorpyrifos application is proposed but the authors accept no liability for the efficacy of this approach.

Future R&D

The results to date have thus provided a basis for development of a much-needed monitoring tool for cane midge. A Hort LINK project will fund this and future field investigations into the cane midge sex pheromone. The Beta test results will provide data for correlation catches in the pheromone traps with field populations of the midge. Work will start in 2006 to investigate controlling the pest by mass trapping, attract-and-kill and/or mating disruption, avoiding or at least minimising use of conventional insecticides.

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Table 1. Seasons catches in single raspberry cane midge sex pheromone traps in 10 raspberry plantations in Kent in 2005

Plantation	Variety	Protected/ open field	Pesticide for cane midge	Total no. of midges caught in single trap						
				10-17 May	May	June	July	Aug	Sep	Total
1. Belks fm, Otham	G. Ample	Open	Yes	16	17	20	117	112	24	290
2. Belks fm, Otham	G. Lion	Protected	Yes	7	44	210	123	166	29	572
3. Belks fm, Otham	G. Ample	Open	Yes	112	123	73	341	76	0	613
4. Belks fm, Otham	G. Lion	Protected	Yes	11	12	71	170	185	80	518
5. Beech fm, W. Peckham	J Squire	Open	Yes	3	283	749	1129	1724	259	4144
6. Beech fm, W. Peckham	A Bliss	Open	Yes	7	333	769	1406	370	338	3216
7. Beech fm, W. Peckham	G Ample	Protected	Yes	97	208	826	1284	3944	1018	7280
8. Beech fm, W. Peckham	G Ample/Tulameen	Open	Yes	1	13	265	149	256	72	755
9. East Malling Research	Mixed	Open	No	61	335	863	1635	523	37	3393
10. East Malling Research	Mixed	Open	No	12	36	253	465	803	70	1627