Project title:	Development of a sex pheromone monitoring trap for gooseberry sawfly
Project number:	SF 147
Project leader:	Dr Michelle Fountain, East Malling Research, New Road, East Malling ME19 6BJ
Report:	Year 2 Annual Report
Previous report:	Year 1 Annual Report
Key staff:	Prof David Hall, Dudley Farman (NRI)
Location of project:	EMR, NRI
Industry Representative:	Scott Raffle
Date project commenced:	April 2014
Date project completed (or expected completion date):	March 2017

The results and conclusions in this report are based on an investigation conducted over a one-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results, especially if they are used as the basis for commercial product recommendations.

AUTHENTICATION

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

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GROWER SUMMARY

Headline

- A potential component of the female sex pheromone of the gooseberry sawfly has been identified and will be tested during 2016.

Background and expected deliverables

The common gooseberry sawfly, *Nematus ribesii*, is a sporadic, localised and unpredictable pest of gooseberry with lesser attacks on redcurrant and whitecurrant. The feeding larvae are able to defoliate whole gooseberry bushes if not detected and controlled in a timely manner. The monitoring of the pest relies on the detection of the eggs on the underside of leaves in the centre of the bushes. Larval damage begins in the centre of the plants, low down, and radiates outwards devouring the leafy areas of the bush. Crop scouting in plantations for eggs and larvae is not always the most reliable method as an adequate search is time-consuming. This project aims to identify the gooseberry sex pheromone which would lead to the development of a sex pheromone monitoring trap: a more sensitive and rapid monitoring method. The production of a sex pheromone attractive to males by virgin female gooseberry sawfly was reported by other workers but never identified. In other work by NRI and EMR, potential components of the female sex pheromone of the closely-related blackcurrant sawfly, *N. olfaciens,* have been identified and synthesised.

Summary of the project and main conclusions

In the first year of the project (2014) larvae of common gooseberry sawfly, *N. ribesii*, were collected by growers and reared through to adults in the laboratory at EMR. Volatiles were collected from unmated males and females and analysed by gas chromatography (GC) with flame ionisation detection (FID) or linked to a mass spectrometer (MS). Collections from both males and females contained large amounts of long-chain hydrocarbons, probably derived from the cuticle, but the pattern of these was identical in male and female gooseberry sawfly and very similar to those in collections from male and female blackcurrant sawfly.

There were no obvious differences in the composition of volatiles from female or male gooseberry sawfly that might be attributable to potential components of a female sex pheromone. However, after fractionation of the collections to remove the hydrocarbons and analysis by GC-MS with selective ion monitoring to maximise sensitivity, traces of a mono-unsaturated, 16-carbon isopropyl ester, similar to one of the compounds proposed to be a component of the pheromone of the blackcurrant sawfly could be detected.

In the second year of the project, gooseberry sawfly were again collected by growers as larvae and reared through to adults at EMR. Collections of volatiles were made from virgin females and analysed by GC-MS at NRI. Similar results were obtained to those in the first year, and again there were indications of the presence of a mono-unsaturated, 16-carbon isopropyl ester.

In this second year, GC-EAG analyses were also carried out using male gooseberry sawfly. Strong EAG responses were obtained to the isopropyl esters previously identified as components of the sex pheromone of female blackcurrant sawfly. However, in analyses of volatile collections from female gooseberry sawfly no EAG responses were observed at the retention times corresponding to the 14-carbon or 16-carbon isopropyl esters. Instead a single EAG response was observed at a later retention time on the polar GC column. This seemed to be associated with one of the hydrocarbon components, ZZ6,9-23:H, but neither the synthetic compound nor the purified natural compound elicited an EAG response.

Unfortunately, no EAG response was observed in GC-EAG analyses of volatile collections on a non-polar GC column. This will be repeated next year and, taken with the data obtained to date, should indicate the structure of the compound responsible for the EAG response which is presumed to be a component of the sex pheromone.

In addition, virtually no gooseberry sawfly were captured on traps in growers' holdings or gardens where they were deployed (to date). The potential attractants, including the blackcurrant sawfly pheromone, will be further field tested in 2016.

Financial benefits

Gooseberry sawfly is a devastating pest of gooseberry which is difficult to predict and may lead to unnecessary plant protection products being applied for control. A trap and lure designed to accurately time and target sprays would decrease or even eliminate the use of unnecessary pesticide applications. Targeting products better, usually chlorpyrifos, thiacloprid, lambda-cyhalothrin or pyrethrins, would protect crops from defoliation and the related fruit losses.

'Invicta' and 'Careless' are the two principal varieties grown and it is estimated that there are at least 600 pick-your-own and farm shop growers (39% and 50% of fruit respectively), and 116 commercial growers registered with AHDB Horticulture growing gooseberries in the UK. At least three growers supply to supermarkets and 11% of fruit is grown for processing. 238 hectares of gooseberries are grown in the United Kingdom. In 2013, the price for gooseberry was ~£3.79/kg, and approximately 4,000 kg of fruit are produced per ha making

the UK gooseberry industry worth over £3.5 million revenue per annum (238 ha x 4000 kg x £3.79).

Action points for growers

- Look for adults flying in April and May and target with approved insecticides to prevent egg laying.
- Check for eggs on the underside of leaves in the centre of the bush.
- Check for larval damage low down in the centre of the bush.
- Contact michelle.fountain@emr.ac.uk if you would like to trial the test trap and lure.
- Please send live gooseberry sawfly larvae, with leaves, in a crush proof box to Michelle Fountain, NIAB EMR, New Road, East Malling, Kent ME19 6BJ.

SCIENCE SECTION

Introduction

The common gooseberry sawfly, *Nematus ribesii*, is a sporadic, localised and unpredictable pest of gooseberry (Mitchell et al., 2011; Raffle, 2012). This species causes significant and devastating damage to gooseberry crops and also lesser attacks on red- and white-currant (Alford 1984). Adult gooseberry sawflies are between 5-7 mm long with the females being larger (Figure 1). Females lay eggs on the underside of the leaves in rows (Figure 2) and the larval damage starts as small holes (also seen in Figure 2). The larvae devour large sections of the leaf lamina, often leading to complete bush defoliation. Damage often occurs in the centre of the bush first, but soon disperses to feed on leaves throughout the whole plant. In addition, feeding attacks are often sporadic and unpredictable.

Figure 1. Adult common gooseberry sawfly female

Figure 2. Gooseberry sawfly eggs along the leaf vein and larvae feeding on leaf lamina

Monitoring the pest relies on the detection of the eggs on the underside of leaves in the centre of the bushes and this egg laying may be aggregated within a plantation. Hence, crop scouting is not always reliable because doing an adequate search is time consuming. It is not uncommon for early infestations to be missed if the plantation is not well covered during an inspection.

The identification of the gooseberry sawfly sex pheromone and development of a pheromone-baited trap would allow growers to predict adult emergence in the crop accurately and time and target plant protection products better to control adults and larvae feeding on the foliage. Longhurst & Baker (1980) showed that male gooseberry sawfly were attracted to virgin females and to dichloromethane washes of virgin females, indicating the production of a sex pheromone by the females. In recent work at EMR and NRI, components of the female sex pheromone of the closely-related blackcurrant sawfly, *Nematus olfaciens,* have been identified, and it is likely that components of the pheromone of gooseberry sawfly will have related chemical structures.

The aim of this project is to confirm the production of a sex pheromone by female gooseberry sawfly, to identify and synthesise components of the pheromone and to evaluate these for attraction of males in the field.

The objectives for 2015 were;

1. To test possible combinations of compounds for attraction to gooseberry sawfly on growers holdings.
2. To rear virgin males and females in the laboratory.
3. To make collections of volatiles from virgin females.
4. To analyse collections of volatiles by GC-MS and also by GC coupled to electroantennographic (EAG) recording from insect antennae.

Materials and Methods

Field testing

Eight traps and lures, two replicates of four treatments, were sent to seven growers/gardeners towards the end of April 2015. Traps were red delta traps with a sticky glue card insert and colour coded so that treatments remained anonymous. Traps were baited with the compounds in rubber septa and compared to an untreated control (Table 1). An instruction sheet, record sheet and freepost address was also provided. Traps were

placed near to edge of a plantation adjacent to woody hedgerow/woodland about 10 m apart. Growers were requested to take photographs or send in sticky inserts with sawfly for confirmation by EMR staff.

Table 1. Blend of sawfly pheromone components for testing at growers holdings.

Code	Treat	Colour
A.	Z7-16COOiPr	yellow
B.	Z7-16COOiPr + Z9-23H	black
C.	Z9-23H	red
D.	No lure	green

Collection of sawfly

A list of 19 gooseberry growers and gardeners were contacted (including the project industry representatives) on 08 April 2015. Contacts were asked to communicate with us as soon as they detected eggs, larvae or adult sawfly in their crop. Larvae were sent by post for culture at EMR.

Culturing

N. ribesii larvae were housed in ventilated, transparent push-fit insect rearing boxes (20 cm x 10 cm x 10 cm, Figure 3). The boxes contained 2 cm of standard compost (EMR) and fresh gooseberry leaves to allow the larvae to continue feeding. Boxes were stored at 20°C on 16:8 h light: dark (L:D) cycle. Larvae pupated in the soil and then boxes were checked daily for adult emergence. Males and females were separated into tubes and fed a drop of honey. A total of 33 females and 10 males emerged. In addition a high number (31) of hymenopteran (wasp) parasitoids emerged from culture.

Figure 3. Gooseberry sawfly larvae feeding and developing in laboratory culture.

Collection of volatiles

Entrainments of sawfly were done in room CT2 at EMR within the quarantine building at 20°C on 16:8 h L:D cycle. Insects were contained in silanised glass vessels (12 cm x 5 cm) and air was drawn in (1000 ml min^{-1}) through an activated charcoal filter (20 cm x 2 cm; 8-10 mesh) and out through a collection filter consisting of Porapak Q (200 mg; 50/80 mesh) held between glass wool plugs in a Pasteur pipette (4 mm in diameter, Figure 4).

Before entrainment the apparatus was cleaned by passing a continuous air flow through for 24 h. Collections were made for varying lengths of time but ended at the death of an insect. Females were entrained separately in varying group sizes. The filters were connected and the pumps were switched on for 30 min after placing the sawfly in the chamber to give the insects time to settle. This was to reduce the likelihood of collection of any potential alarm compounds. At the end of volatile collection, all chambers were wiped clean with 100% ethanol and passing a continuous air flow through for 24 h. During May and June 2015 eight collections were made from groups of three to six females. Males were sent to NRI for EAG.

Figure 4. Sawfly females in collection chanber and equipment for collection of volatiles from gooseberry sawfly

Analysis of collections of volatiles

Adsorbed volatiles were extracted from Porapak collection filters with dichloromethane (Pesticide Residue Grade; 1 ml). Extracts were analysed un-concentrated and then concentrated by a factor of approximately ten times under a gentle stream of purified nitrogen.

Extracts were analysed by gas chromatography coupled to mass spectrometry (GC-MS) using a Varian 3500 GC coupled to a Saturn 2200 MS (Agilent) operated in electron impact mode. GC columns (30 m x 0.25 mm in diameter x 0.25 µ) coated with polar DBWax

(Supelco) or non-polar VF5 (Varian) were used and the oven temperature was programmed from 40°C for 2 min then at 10°C min^{-1} to 250°C. Compounds were identified by their mass spectra, their GC retention indices relative to the retention times of *n*-alkanes and comparison with synthetic standards.

Extracts were also analysed by GC with flame ionisation detection (FID) using an Agilent 6850 GC fitted with a polar GC column as above.

Fractionation of collections of volatiles

One of the collections of volatiles in dichloromethane was evaporated almost to dryness under a gentle stream of nitrogen. Hexane (0.15 ml) was added and this was evaporated almost to dryness again. The residue was applied to the top of a silica gel column (230-400 mesh; 250 mg) held in a Pasteur pipette (4 mm in diameter) in a total of 0.5 ml hexane. The column was then eluted with 1 ml portions of hexane, 1%, 2%, 5%, 10%, 20% 50% diethyl ether in hexane and finally diethyl ether. Fractions of 1 ml were collected.

Analysis by Gas Chromatography (GC) linked to Electroantennography (EAG)

GC-EAG analyses were carried out with an HP 6890 instrument (Agilent) with two capillary GC columns (30 m × 0.32 mm in diameter with 0.25 µm film thickness) coated with polar (Wax10; Supelco) and non-polar (SPB1; Supelco) phases respectively. Carrier gas was helium (2.4 ml min^{-1}) and the oven temperature was programmed from 50°C for 2 min, then at 10 °C min^{-1} to 250°C. Injection was splitless (220°C) on the polar column and by a Programmed Temperature Vaporiser (PTV) on the non-polar column. The PTV temperature was held at 50°C for 0.2 min then programmed at 600°C min^{-1} to 220°C with the split opened after 1 min. The GC column effluent was split (1:1) with a zero dead volume connector between the FID (250 °C) and a silanized glass T-piece in the column. Air (300 ml min^{-1}) was blown at 17 sec intervals for 3 sec through the T-piece delivering the sample to the EAG preparation.

For the EAG preparation, the sawfly was anaesthetised by refrigeration for 10 min before excising the head. The reference electrode (0.1 M potassium chloride with 1% polyvinylpyrrolidone) was inserted into the back of the head and attached to silver electrode held in micromanipulators on a portable EAG device (INR-02; Syntech, Hilversum, The Netherlands). The end of one antenna was inserted into the recording glass electrode. Both FID and EAG signals were collected and analyzed with EZChrom software (Elite v3.0; Agilent).

Results

Field testing

From the samples received to date, only 3 sawfly males have been captured at one farm in Hereford; all in black treatment (Z7-16COOiPr + Z9-23H).

Collection of sawfly

A total of 33 females and 10 males emerged. In addition 31 hymenopteran (wasp) parasitoids emerged.

Collection of volatiles

During May and June 2015 eight collections were made from groups of three to six females. Males were sent to NRI for EAG.

Analysis of collections of volatiles

Analyses of the collections of volatiles from virgin female gooseberry sawfly by GC-MS on both polar and non-polar columns showed all eight collections were similar with a group of compounds late in the run (Figure 5).

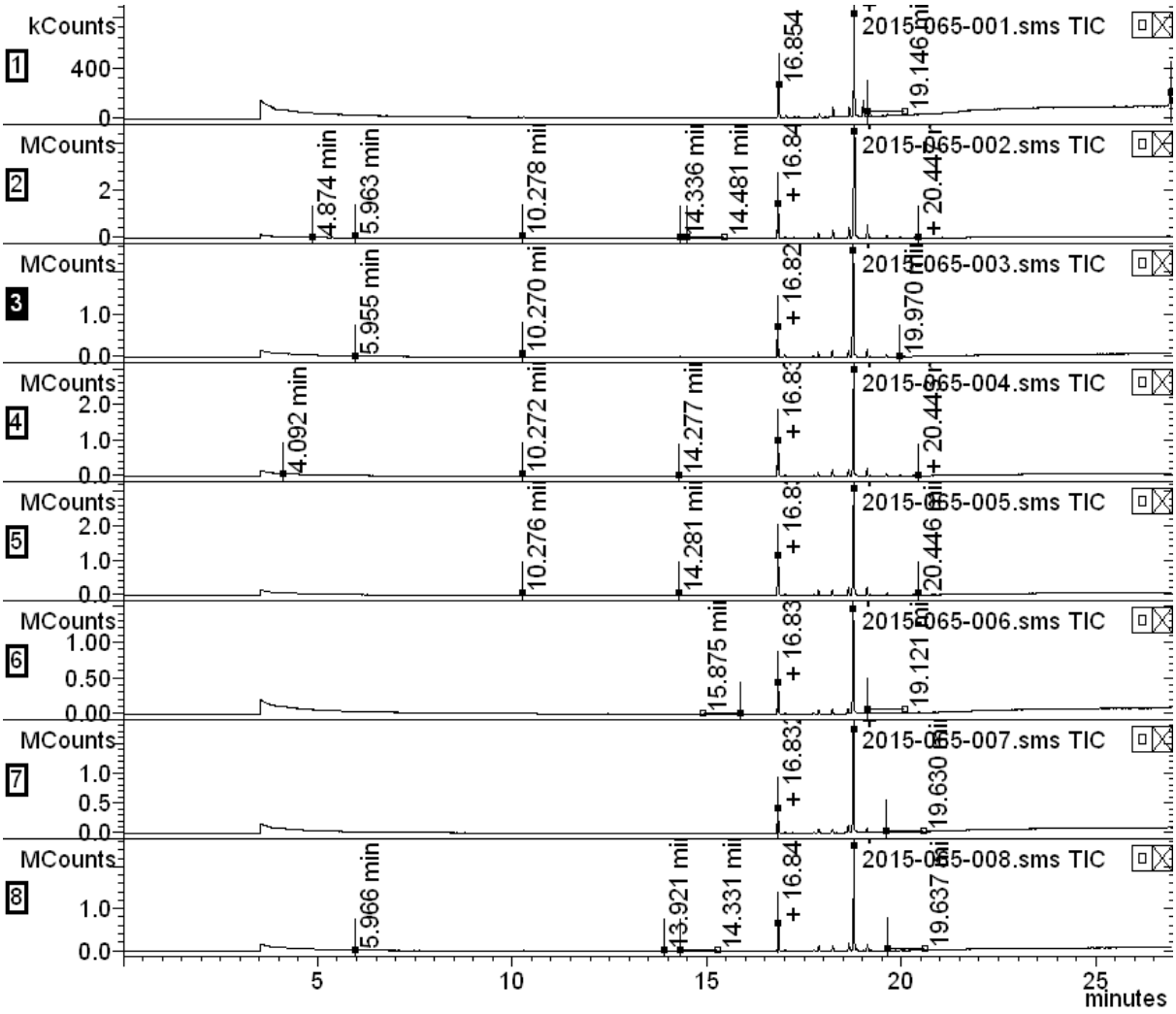

Figure 5. GC-MS Analyses of eight collections of volatiles from female gooseberry sawfly on polar GC column.

These compounds were the same as those observed in Year 1 from both males and females. The major components were (*Z*)-9-tricosene (Z9-23:H) and heneicosane (21:H) with smaller amounts of the corresponding 22-carbon compounds, tricosane (23:H), 4-methyldocosane (4Me-22:H) and a diunsaturated 23-carbon compound, probably (Z,Z)-6,9-tricosadiene (ZZ6,9-23:H) (Figure 6).

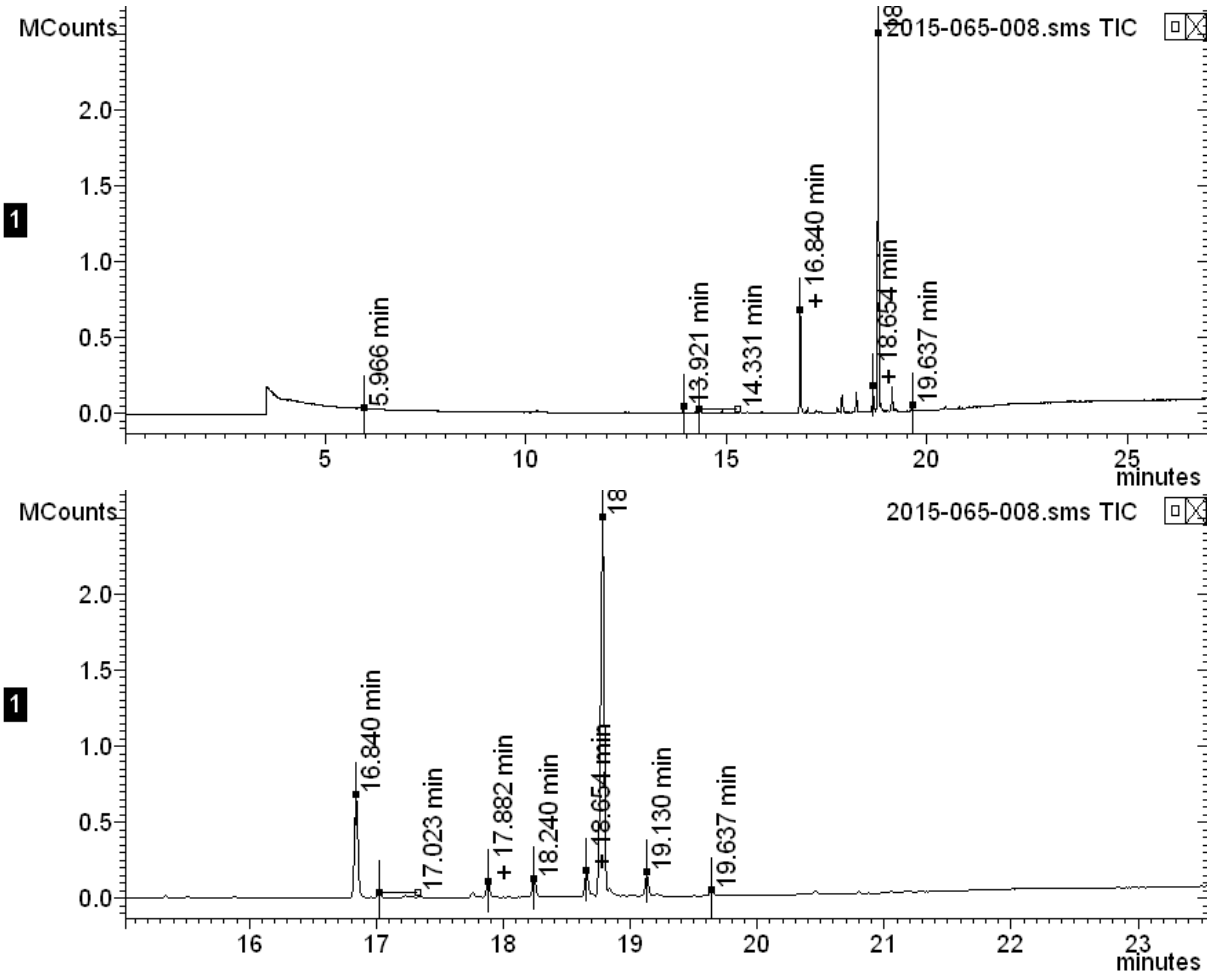

Figure 6. GC-MS analysis of volatiles from virgin female gooseberry sawfly on polar column (21:H 16.84 min; 22:H 17.75 min; Z9-22:H 17.88 min; 4Me-22:H 18.24 min; 23:H 19.65 min; Z9-23:H 18.78 min; ZZ6,9-23:H 19.13 min; ZZZ3,6,9-23:H 19.64 min).

As in Year 1, GC-MS analyses were examined for the presence of the isopropyl esters identified as components of the sex pheromone of females of the closely-related blackcurrant sawfly, *Nematus olfaciens,* i.e. isopropyl (*Z*)-5-tetradecenoate (Z5-14iPr), (*Z*)-7-tetradecenoate (Z7-14iPr) and (*Z*)-7-hexadecenoate (Z7-16iPr). These have GC retention times quite similar to the much larger quantities of hydrocarbons on both polar and non-polar GC columns (Figure 7 and Table 4).

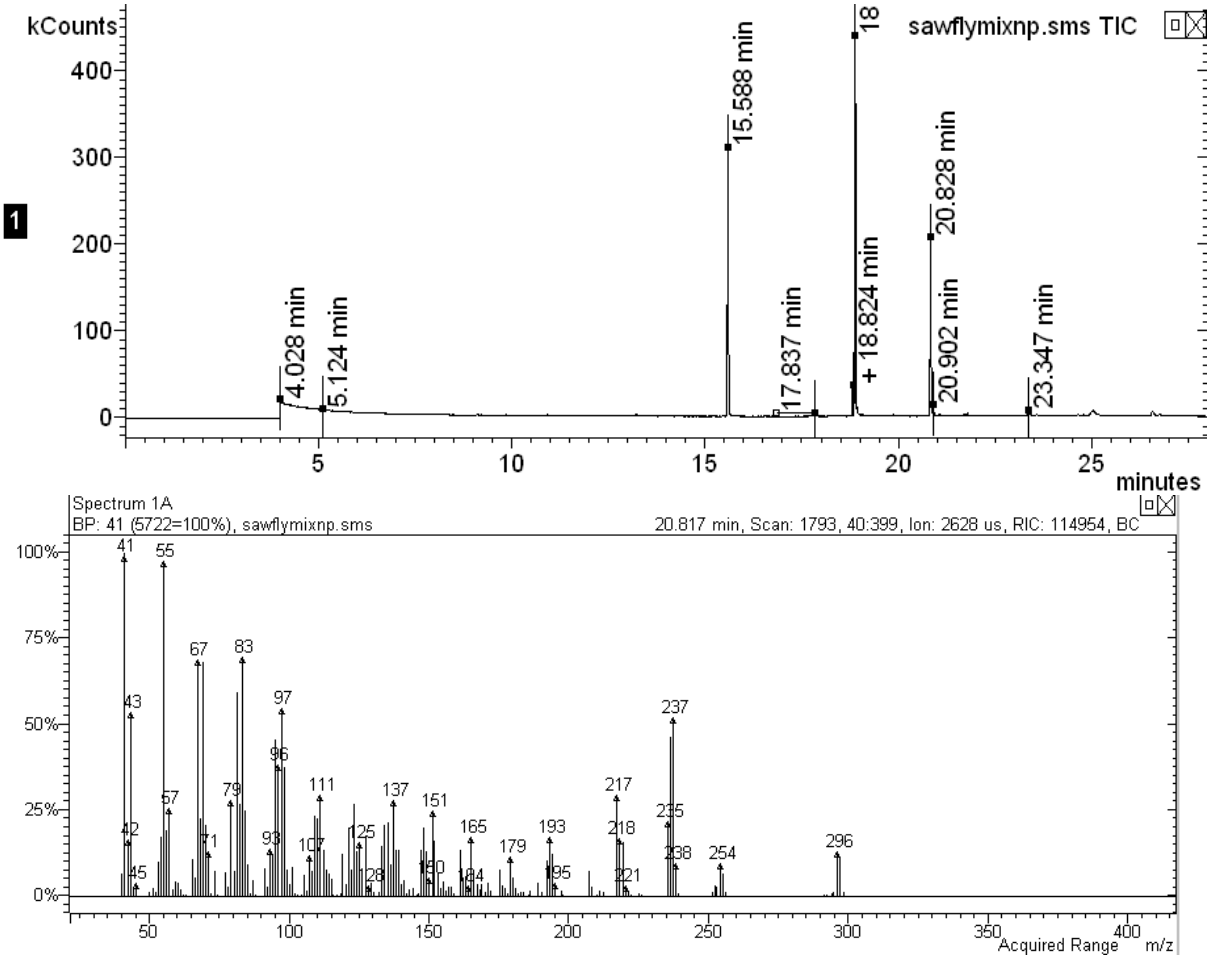

Figure 7. GC-MS Analysis on non-polar column of isopropyl esters, components of female sex pheromone of blackcurrant sawfly (upper; BHT antioxidant 15.59 min; Z5-14iPr 18.82 min; Z7-14iPr 18.83 min; Z7-16iPr 20.83 min) and mass spectrum of Z7-16iPr (lower).

Table 4. Retention indices (RI) of compounds relative to retention times of *n*-alkanes on non-polar and polar GC columns

	Retention Index	
Compound	Non-polar	Polar
Z5-14iPr	1797	2042
Z7-14iPr	1803	2054
Z7-16iPr	2003	2252
21:H	2100	2100
22:H	2200	2200
Z9-22:H	2175	2216
4Me-22:H	2267	2249
23:H	2300	2300
Z9-23:H	2272	2320
ZZ6,9-23:H	2265	2359
ZZZ3,6,9-23:H		2460

All the collections of volatiles were examined for the presence of isopropyl esters by selective ion monitoring (SIM) on both polar and non-polar columns using ions at *m/z* 189 and 209 for 14-carbon esters and *m/z* 217, 237 ad 296 for 16-carbon esters (Figure 7). These could not be detected reliably in any of the collections.

The most promising collection was fractionated by liquid chromatography on silica gel using the approach developed in the first year of the project. This removes all the hydrocarbons in the first fraction and synthetic isopropyl esters were found to elute in fractions 4 and 5. All the fractions were analysed with SIM as above. No 14-carbon esters were detected in the fractions but there was some evidence for the presence of an unsaturated 16-carbon ester at the appropriate retention time and in the appropriate fraction (Figure 8). When the results of subsequent GC-EAG analyses were known, the GC-MS analyses were re-examined for the presence of 17-carbon isopropyl esters using SIM at m/z 251 and 310, but none could be detected.

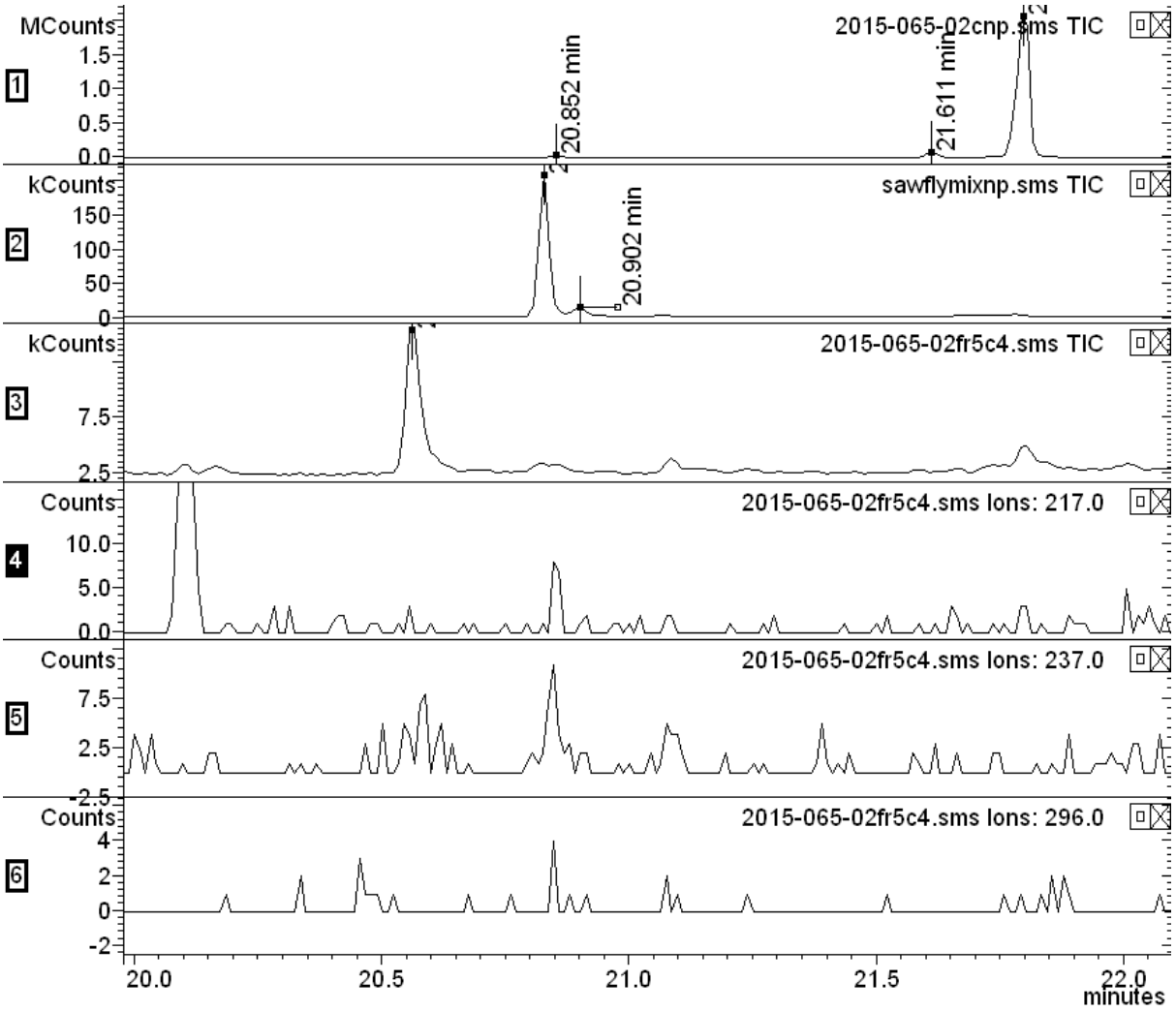

Figure 8. GC-MS Analyses on non-polar column of (from top) collection of volatiles from female gooseberry sawfly, Z7-16iPr, Fraction 5 from liquid chromatography, selective ion monitoring of Fraction 5 at *m/z* 217, 237 and 296 indicating possible presence of Z7-16iPr at 20.85 min.

GC-EAG Analyses

In GC-EAG analyses, strong responses were observed from male gooseberry sawfly to the synthetic isopropyl esters identified as components of the sex pheromone of female blackcurrant sawfly (e.g. Figure 9).

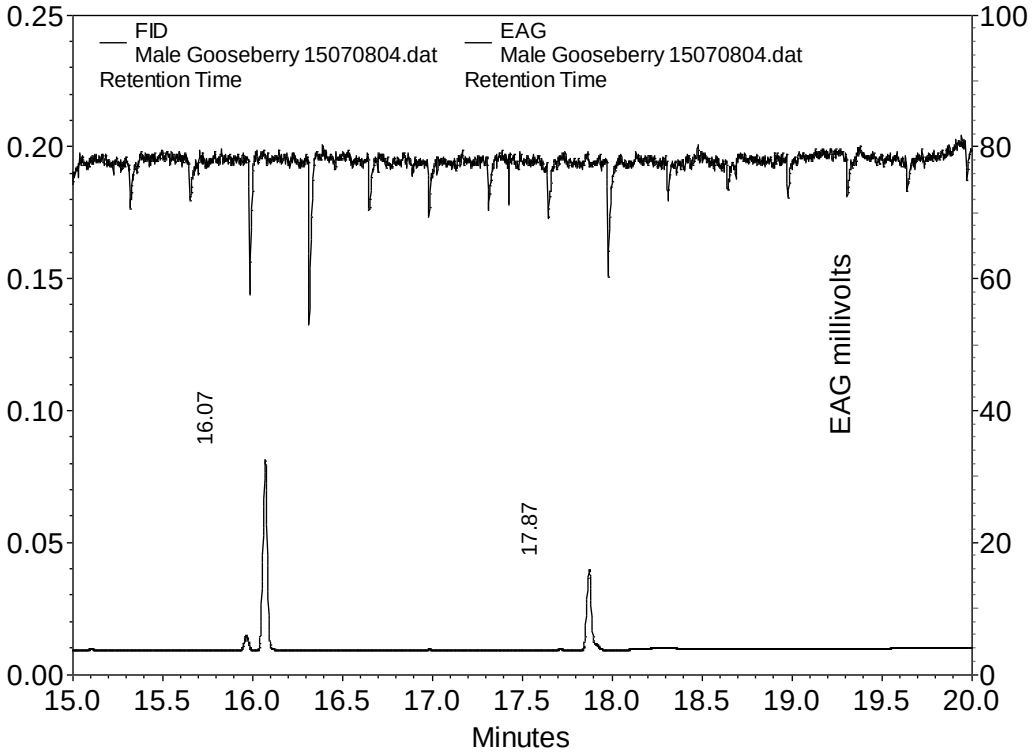

Figure 9. GC-EAG Analysis of synthetic compounds on polar GC column with male gooseberry sawfly EAG preparation showing EAG response to Z5-14:iPr at 15.96 min, Z7-14iPr at 16.07min and Z7-16iPr at 17.87 min.

In GC-EAG analyses of volatiles from virgin female gooseberry sawfly on a polar GC column, no responses were observed at the retention times corresponding to the 14- and 16-carbon isopropyl esters, but a consistent EAG response (*N* = 5) was observed at a later retention time (e.g. Figure 10).

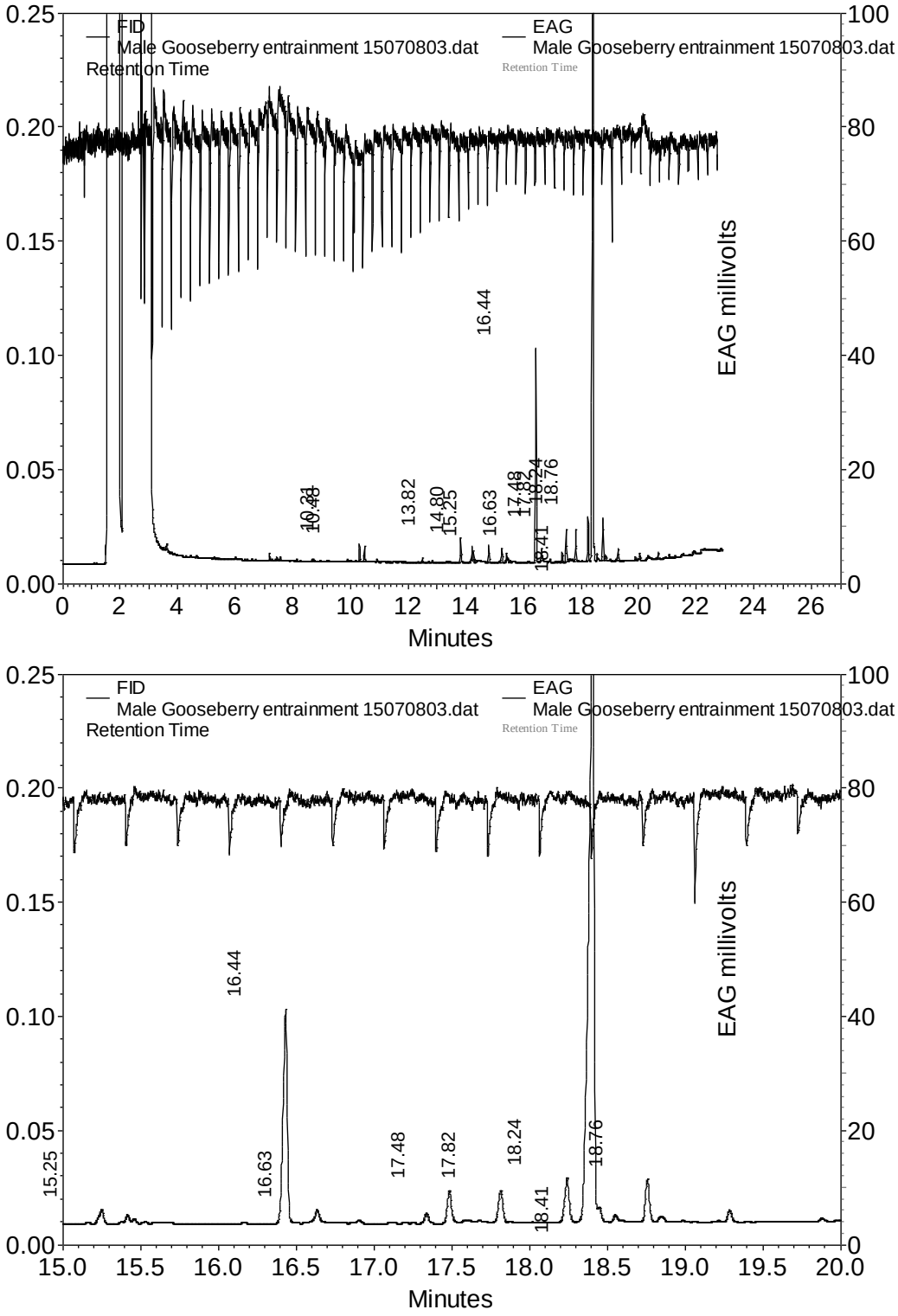

Figure 10. GC-EAG Analysis of collection of volatiles from virgin female gooseberry sawfly on polar column with male EAG preparation showing EAG response at 19.2 min.

The EAG response seemed to be associated with the compound at 18.76 min (Figure 10) which was identified as ZZ6,9-23:H. However, in GC-EAG analysis of this compound with the isopropyl esters, good responses were observed to the latter but not the former.

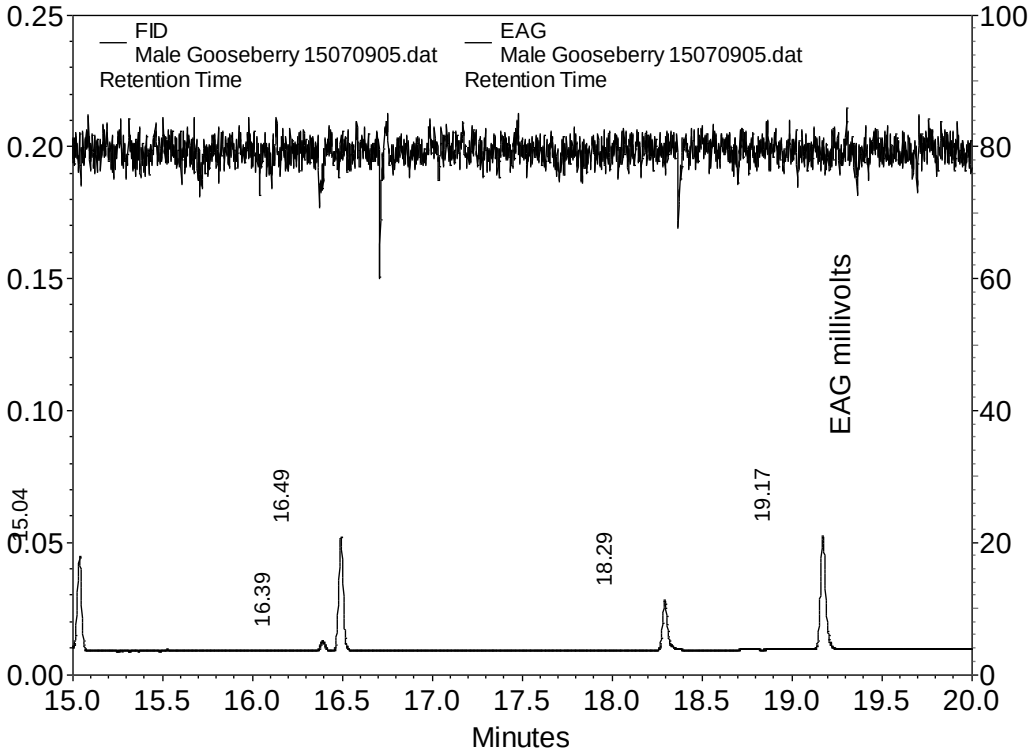

Figure 11. GC-EAG Analysis of synthetic compounds on polar GC column showing EAG responses to isopropyl esters but not to ZZ6,9-23:H (Z5-14iPr 16.39 min; Z7-14iPr 16.49 min; Z7-16iPr 18.29 min; ZZ6,9-23:H 19.17 min).

Furthermore, when the hydrocarbon fraction from a collection of volatiles from female gooseberry sawfly was analysed by GC-EAG with the isopropyl esters added in, EAG responses were only observed to the isopropyl esters and not to the ZZ6,9-23:H (Figure 12).

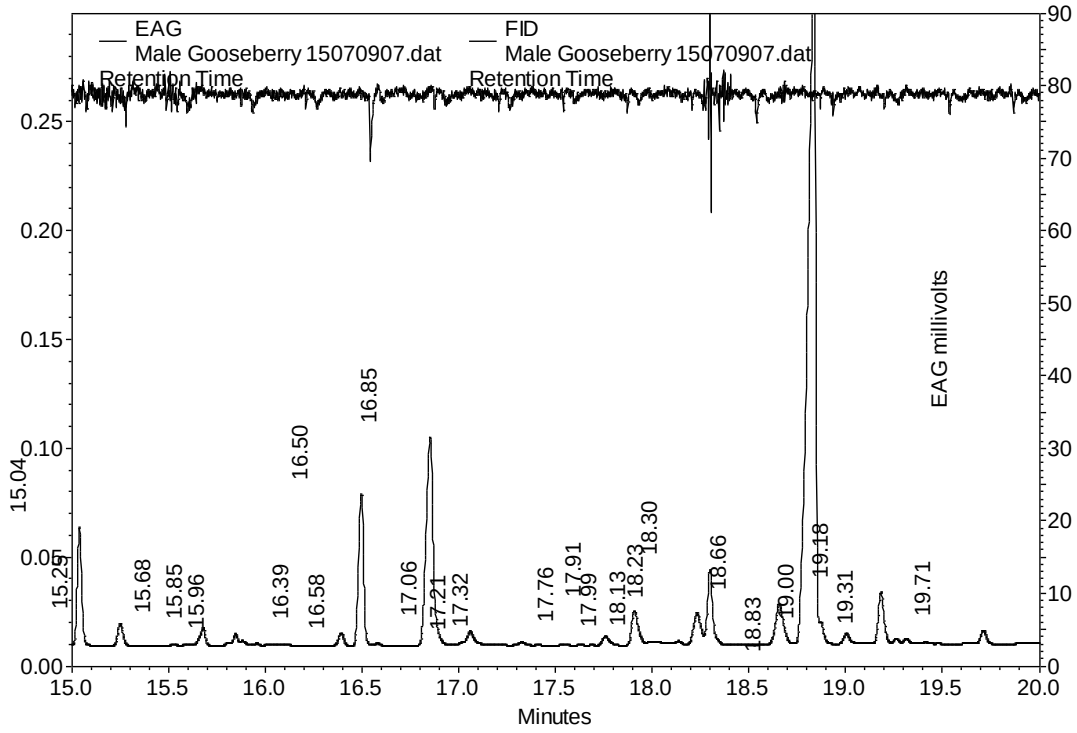

Figure 12. GC-EAG Analysis of hydrocarbon fraction from collection of volatiles from female gooseberry sawfly with Z7-14iPr (16.50 min) and Z7-16iPr (18.20 min) added showing EAG responses to isopropyl esters but not to ZZ6,9-23:H (19.18 min).

The collections of volatiles from female gooseberry sawfly were also analysed by GC-EAG using a non-polar GC column, but no significant EAG responses were consistently observed (Figure 13). Furthermore, when the volatile collections were analysed with the isopropyl esters added, EAG responses were observed to the latter, confirming that the EAG preparation was functioning (Figure 14).

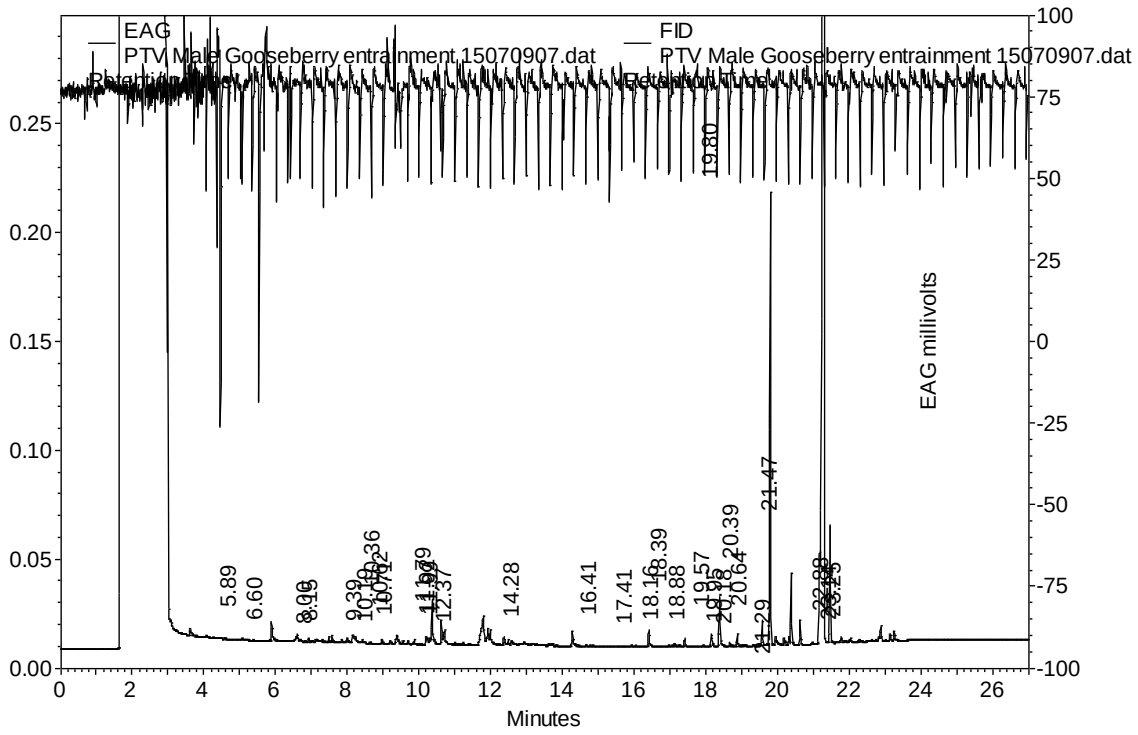

Figure 13. GC-EAG Analysis of collection of volatiles from virgin female gooseberry sawfly on non-polar GC column with male EAG preparation (21:H 19.79 min; Z9-23:H 21.28 min; 23:H 21.47 min).

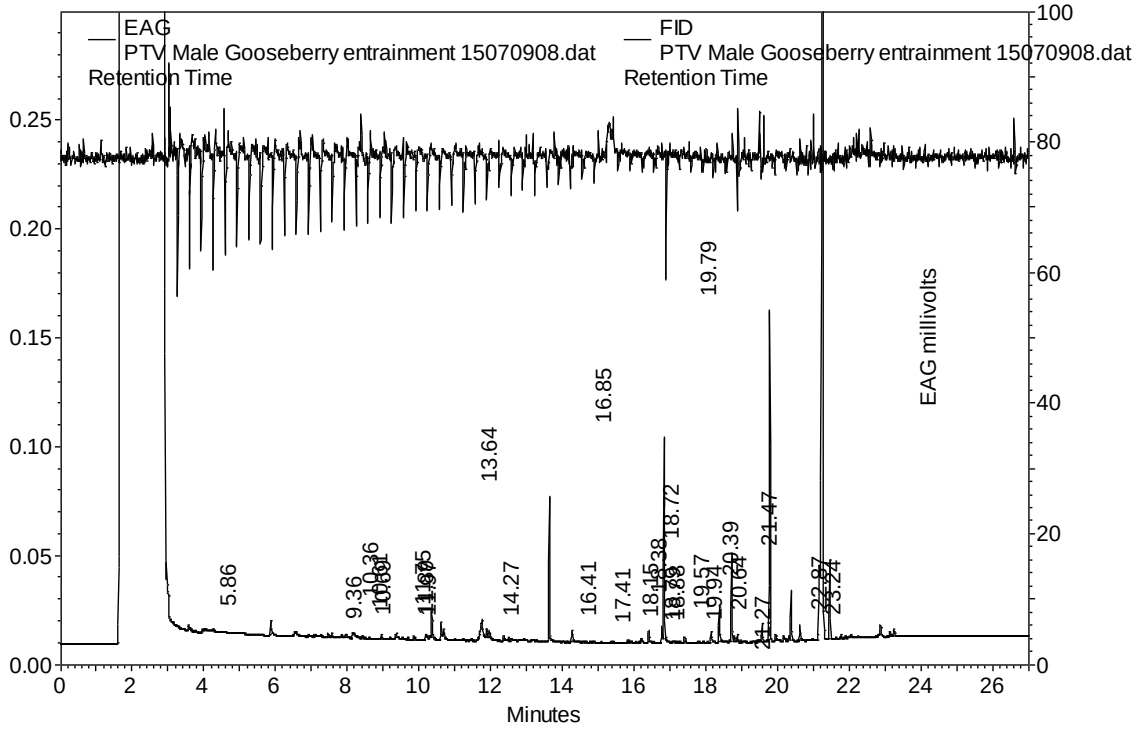

Figure 14. GC-EAG Analysis of collection of volatiles from virgin female gooseberry sawfly on non-polar GC column with male EAG preparation with Z7-14iPr (16.85 min) and Z7-16iPr (18.72 min) added showing EAG responses only to the latter two compounds.

Discussion

Longhurst and Baker (1980) showed that traps baited with a virgin female gooseberry sawfly attracted significant numbers of males. Traps baited with a dichloromethane wash of females applied to a rubber septum attracted far fewer males, but significantly more than unbaited traps.

In the first year of this project, larvae of the common gooseberry sawfly, *Nematus ribesii,* were collected and successfully reared through to adults in the laboratory. Volatiles were collected from virgin females or males and analysed by GC-FID and GC-MS. Collections from both males and females contained large amounts of long-chain hydrocarbons, probably derived from the cuticle, but the pattern of these was identical in male and female gooseberry sawfly. Interestingly, the patterns were very similar to those in collections from male and female blackcurrant sawfly with Z9-23:H and 21:H as major components and other saturated, monounsaturated and di-unsaturated long-chain hydrocarbons as minor components.

There were no obvious differences in the composition of volatiles from female or male gooseberry sawfly that might be attributable to potential components of a female sex pheromone. Examination for the presence of the compounds proposed to be components of the female sex pheromone of the blackcurrant sawfly was hampered by the large quantities of hydrocarbons which co-chromatographed on both non-polar and polar GC columns. However, an approach was developed to separate out the hydrocarbons by chromatography on a small silica gel column. The fraction that would contain the components of the blackcurrant sawfly pheromone could then be analysed by GC-MS with selective ion monitoring (SIM) to maximise sensitivity. No trace of the 14-carbon isopropyl esters could be found in any of the collections. However, traces of a mono-unsaturated, 16-carbon isopropyl ester, similar to one of the compounds proposed to be a component of the pheromone of the blackcurrant sawfly, could be detected in collections from female gooseberry sawfly, but not in those from males or blank collections.

In the second year of the project these results were confirmed. Growers were requested to send in gooseberry sawfly larvae. These were successfully reared to adults in the laboratory at EMR and collections of volatiles made from virgin females. Analysis of these collections by GC-MS at NRI showed the same long-chain hydrocarbons as observed previously. Analysis with SIM of the collections failed to detect any isopropyl esters, at least in part because of the relatively large quantities of the hydrocarbons. Fractionation of a collection by liquid chromatography and analysis of the fractions by GC-MS with SIM indicated the possible presence of an unsaturated 16-carbon isopropyl ester as previously.

In this second year, sufficient insects were available to carry out analyses using GC-EAG. Male gooseberry sawfly showed strong EAG responses to the synthetic isopropyl esters previously identified by EMR and NRI as components of the female sex pheromone of blackcurrant sawfly. Analysis of collections of volatiles from female gooseberry sawfly on a polar GC column showed no responses at the retention time of 14-carbon and 16-carbon isopropyl esters but a consistent response at a longer retention time. This seemed to coincide with a hydrocarbon component identified as ZZ6,9-23:H. However, no EAG response was observed to the synthetic ZZ6,9-23:H, even in runs spiked with Z7-14iPr and Z7-16iPr which elicited EAG responses. Similarly, no EAG response was obtained to the ZZ6,9-23:H when the hydrocarbon fraction from volatile collections from female gooseberry sawfly was analysed.

Unfortunately, no consistent EAG responses were observed in GC-EAG analyses of volatile collections from virgin female gooseberry sawfly on a non-polar column. In analyses with the isopropyl esters added there were strong EAG responses to the latter.

Thus it would seem the EAG response observed in GC-EAG analyses of the volatile collections must be due to a compound with similar retention time on a polar GC column as that of the ZZ6,9-23:H (from blackcurrant sawfly). A 17-carbon isopropyl ester would have similar retention time (Table 4), but SIM of the GC-MS analyses did not show any evidence for the presence of such a compound.

Conclusions

- Gooseberry sawfly have been collected as larvae and successfully reared through to adults in the laboratory.
- Volatiles have been collected from male and female gooseberry sawfly and analysed by GC-FID and GC-MS.
- Traces of one of the proposed pheromone components of the blackcurrant sawfly were detected in collections from female gooseberry sawfly and not in collections from males or blank collections.
- In GC-EAG analyses of volatiles collected from female gooseberry sawfly, a single EAG response from male sawfly was consistently observed using a polar GC column. This seemed to be associated with one of the hydrocarbon components, ZZ6,9-23:H, but neither the synthetic compound nor the purified natural compound elicited an EAG response.

- The retention time of the EAG response would also have been consistent with that of a 17-carbon isopropyl ester, but none could be detected in SIM of GC-MS analyses.
- Unfortunately, no EAG response from male sawfly was consistently observed in GC-EAG analyses of volatiles from virgin female gooseberry sawfly using a non-polar GC column.
- This will be repeated next year and, taken with the data obtained already, should indicate the type of structure responsible for the EAG response which is presumed to be a component of the sex pheromone.
- In addition, virtually no gooseberry sawfly were captured on traps in growers holdings or gardens where they were deployed (to date). The potential attractants, including the blackcurrant sawfly pheromone, will be further field tested in 2016.

Knowledge and Technology Transfer

None to date

References

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