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FINAL REPORT

SRDC PROJECT BS34S

ASSESSMENT OF AROMATIC COMPOUNDS AS STRATEGIC LURES IN A CANEGRUB CONTROL PROGRAM

by

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SUMMARY

Anethole, n-butyric acid, citral, citronellal, eucalyptus oil, eugenol, geraniol, hexanoic acid, hexan-1-ol, 3-hexen-1-ol, 1-nonanol, pentanoic acid, phenol, sorbic acid and the standard Trécé Japanese beetle floral lure (10:22:11, 2-phenylethylpropionate: eugenol: geraniol) were tested as attractants for *Anoplognathus porosus*, *Antitrogus consanguineus*, *A. parvulus*, *Dermolepida albohirtum*, *Lepidiota crinita*, *L. negatoria*, *L. noxia*, *L. picticollis*, and *Metanastes vulgivagus*. None were effective attractants. The apparent activity of sorbic acid would justify testing butyl sorbate as an attractant.

BACKGROUND

Sixteen species of melolonthine canegrubs are endemic to eastern Australia, where the larvae feed on the roots of grasses (Allsopp and Chandler, 1989). They are important pests of sugarcane, destroying roots and thus depriving the plant of moisture, nutrients and mechanical support (Allsopp and Hitchcock, 1987). Since 1982 canegrubs have been responsible for an average annual loss of cane valued at $2.4M and growers have treated an annual average of 31 600 ha with insecticides at a cost of $2.4M. The cost of insecticide treatment for canegrub control has increased significantly over the last 7 years with the replacement of low-cost organochlorines with more expensive controlled-release products. However, without insecticides, the level of losses would rise dramatically. The Australian sugar industry is now almost completely dependent on controlled release chlorpyrifos (SuSCon Blue) for canegrub control. Alternative control systems must be developed.

Volatile chemicals can play an important role in aggregating populations of scarab beetles at feeding sites. These chemicals can attract beetles of both sexes from considerable distances. Considerable research has been conducted on such compounds in the USA on scarabs such as Japanese beetle (Ladd *et al*, 1976, 1981), green June beetle (Domek and Johnson, 1988), and rose chafers (Williams and Miller, 1982) and in South Africa on a variety of scarabs (Donaldson *et al*, 1986). Compounds such as eugenol, geraniol and caproic acid have been identified as powerful attractants. McGovern *et al* (1973) patented a mixture of sex pheromone and eugenol, and a mixture of these components is currently used by US agencies as a standard for surveys of Japanese beetle.

Cane beetles fly at dusk or during the night and rely strongly on chemical attractants to find mates and feeding trees. Some species feed as adults and these form large congregations on feeding trees. Beetles are probably attracted to such trees by aromatic plant compounds. If attractive aromatic compounds can be identified, they offer potential to attract beetles of both sexes, unlike pheromones which attract only males. Such attraction offers potential for reducing populations of adult beetles by trapping or, by indicating flight periods, allowing better timing of applications of knockdown chemicals such as Mocap. Additional benefit could be obtained by incorporating a suitable insecticide into the attractant. After contact, this would kill not only the attracted beetle but, if correctly dosed, contaminate and kill any subsequent sex partner. If such chemicals can be identified, they could be used, either on their own or mixed with a sex pheromone, to reduce insecticide usage for grub control by eliminating adults before they complete oviposition.

There is considerable interest in the community in development of pest management strategies which involve environmentally 'soft' pesticides. The development of volatile compounds as a control strategy for canegrubs would be environmentally acceptable and would provide an alternative to persistent pesticides.

OBJECTIVES

- To determine if adult cane beetles are attracted to aromatic compounds and to identify such suitable compounds.
- To investigate the potential of aromatic compounds in disrupting adult behaviour, as attractants for insecticide baits and for monitoring flight periods of cane beetles.

RESEARCH METHODOLOGY

Lures were tested by exposing them in Catch-can Japanese beetle traps (Trécé Inc, Salinas) during the flight period of the target species. Traps were hung 1 m above the ground on steel rods and were placed 10 m apart in randomised block designs. Each treatment was replicated three times. Chemicals evaporated from a covered piece of sponge 4 x 4 x 1 cm placed in the same position in the trap as the standard Trécé lure. Every 2-3 days of each test, 5 ml of the appropriate lure were added to the sponges. Standard Trécé lures were not replaced during each test. Catches were examined each time lures were replaced.

In 1989-90, lures tested were anethole (1-methoxy-4-(1-propenyl)benzene), eugenol (2-methoxy-4-(2-propenyl)phenol), citral (3,7-dimethyl-2,6-octadienal), citronellal (3,7-dimethyl-6-octenal), geraniol (3,7-dimethyl-2,6-octadien-1-ol), hexanoic acid, pentanoic acid, eucalyptus oil (Double "D" Eucalyptus Oil, Sheldon Drug Co, Sydney), and the standard Trécé Japanese beetle floral lure (10:22:11, 2-phenylethylpropionate: eugenol: geraniol). In 1990-91, lures tested were anethole, eugenol, geraniol, phenol, hexan-1-ol, 3-hexen-1-ol, 1-nonanol, sorbic acid, and n-butyric acid. An unbaited control was included in each test. Phenol and sorbic acid were tested as aqueous solutions; other chemicals were tested undiluted.

As none of the raw data sets were normally distributed ($P < 0.01$, Shapiro-Wilk test for normality) and were not normalised by transformation, they were analysed using the non-parametric Friedman two-way analysis of variance (Conover, 1980). All analyses used STATISTIX 3.1 (Analytical Software, 1989).

Tests made against each species were:

Anoplognathus porosus (Dalman) - 1-8 December 1989 and 4-10 December 1990;

Antitrogus consanguineus (Blackburn) - 22 September-20 October 1989 and 20 September-22 October 1990;

Antitrogus parvulus Britton - 22 December 1989-5 January 1990 and 18 December 1990-10 January 1991;

Dermolepida albohirtum (Waterhouse) - 10-18 November 1989;

Lepidiota crinita Brenske - 22-29 December 1989 and 16-30 December 1990;

Lepidiota negatoria Blackburn - 22-29 December 1989 and 16-30 December 1990;

Lepidiota noxia Britton - 22 September-20 October 1989 and 20 September-22 October 1990;

Lepidiota picticollis Lea - 5-8 October 1990;

Metanastes vulgivagus (Olliff) - 5 February-28 February 1990 and 10 February- 10 March 1991.

Target species were taken in nearby light traps through the trapping period or, in the cases of *A. porosus* and *D. albohirtum*, were seen in nearby feeding trees.

RESULTS

Anoplognathus porosus

No *A. porosus* were caught in any traps in either 1989 or 1990.

Antitrogus consanguineus

There were no significant differences in numbers of *A. consanguineus* attracted to different lures or to the unbaited control in 1989 ($\underline{T} = 5.94$, df = 9, $\underline{P} = 0.75$) (Table 1); no *A. consanguineus* were caught in 1990.

Antitrogus parvulus

There were no significant differences in numbers of *A. parvulus* attracted to different lures or to the unbaited control in 1989-90 ($\underline{T} = 2.92$, df = 9, $\underline{P} = 0.23$) (Table 1); no *A. parvulus* were caught in 1990-91.

Table 1

Mean total catches of scarabs in traps baited with volatile compounds in 1989-1990

Lure	*A. consanguineus*	*A. parvulus*	*L. negatoria*	*L. noxia*
Anethole	0.00	0.00	0.67	1.00
Eugenol	0.33	0.00	2.67	0.67
Citral	0.33	0.00	0.67	3.00
Citronellal	0.00	1.00	2.67	4.33
Geraniol	1.00	0.00	2.33	5.67
Hexanoic acid	0.00	0.33	0.33	3.00
Pentanoic acid	0.33	0.00	0.00	3.00
Eucalyptus oil	0.33	0.33	0.67	2.00
Trécé lure	0.67	0.00	0.00	2.00
Unbaited	0.33	1.33	0.00	1.67

Table 2

Mean total catches of scarabs in traps baited with volatile compounds in 1990-91

Lure	*L. negatoria*	*L. noxia*
Anethole	0.33	0.33
Eugenol	0.67	0.00
Geraniol	0.33	0.00
Phenol	0.33	0.67
Hexan-1-ol	0.00	0.33
Hexen-1-ol	0.00	0.00
1-nonanol	0.33	0.00
Sorbic acid	2.00	8.00
n-butyric acid	0.67	1.67
Unbaited	0.00	1.33

Dermolepida albohirtum

Two *D. albohirtum* were caught during the 1989 trapping; they were in separate traps baited with citronellal (T = 18.00, df = 9, P = 0.035).

Lepidiota crinita

Only one *L. crinita* was caught during the 1989 trapping; this was in a trap baited with eugenol (T = 9.00, df = 9, P = 0.44). Two *L. crinita* were caught in the 1990 trapping; one in a trap baited with eugenol and one in a trap baited with sorbic acid (T = 9.00, df = 9, P = 0.44).

Lepidiota negatoria

There were no significant differences in numbers of *L. negatoria* attracted to different lures or to the unbaited control in 1989 (T = 15.21, df = 9, P =0.085) (Table 1) or in 1990 (T = 0.36, df = 9, P = 0.83).

Lepidiota noxia

There were no significant differences in numbers of *L. noxia* attracted to different lures or to the unbaited control in either 1989 ($\underline{T}$ = 8.77, df = 9, $\underline{P}$ = 0.46) (Table 1) or 1990 ($\underline{T}$ = 10.15, df = 9, $\underline{P}$ = 0.34) (Table 2).

Lepidiota picticollis

Only one *L. picticollis* was caught during the 1990 trapping; this was in a trap baited with 1-nonanol ($\underline{T}$ = 9.00, df = 9, $\underline{P}$ = 0.44).

Metanastes vulgivagus

No *M. vulgivagus* were caught in any trap in either 1990 or 1991.

Other species

Observations were also made on the non-economic scarabs *Phyllotocus navicularis*, *Eupoecila australasiae* and *Liparetrus atriceps*, and on the parasitic wasp *Campsomeris tasmaniensis*. Three manuscripts have been submitted to entomology journals and are listed in Appendix.

DISCUSSION

All the compounds tested here are attractive to other scarabs. However, none was an effective attractant for cane beetles. The target species have a variety of flight and feeding behaviours, from strong fliers and feeders such as *Anoplognathus porosus* and *Dermolepida albohirtum*, to *Antitrogus consanguineus* and *A. parvulus* which don't appear to feed as adults and in which the females are very poor fliers. Some of the species such as *A. consanguineus* and *A. parvulus* are short lived as adults, while others such as *Anoplognathus porosus*, *D. albohirtum* and *M. vulgivagus* are long lived.

Citronellal did attract significantly ($\underline{P}$ < 0.05) more *D. albohirtum* than did other lures or the unbaited traps. However, the numbers caught were too low, considering the activity of *D. albohirtum* during the trapping period, to make citronellal an effective attractant.

Although not significantly different ($\underline{P}$ < 0.05) from other lures, one trap baited with sorbic acid collected 22 *L. noxia* in one trapping period and another collected six *L. negatoria* in a trapping period. Sorbic acid is attractive to European chafer (Tashiro *et al*, 1964) but has low volatility. The butyl ester of sorbic acid is more volatile and much more attractive to that species (Tashiro *et al* 1964). Butyl sorbate was unavailable during 1989-90 but a supplier has been found recently. This compound should be field-tested in the 1991-92 summer.

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APPENDIX

Three manuscripts have been submitted for publication, dealing with non-economic scarabs and a wasp which were attracted. These are -

Allsopp, P G and Cherry, R H	Attraction of adult *Phyllotocus navicularis* Blanchard and *Eupoecila australasiae* (Donovan) (Coleoptera: Scarabaeidae) to volatile compounds. Australian Entomology Magazine
Allsopp, P G	Anethole and eugenol as attractants for *Liparetrus atriceps* Macleay (Coleoptera: Scarabaeidae). Coleopterist's Magazine
Allsopp, P G	Volatile compounds as attractants for *Campsomeris tasmaniensis* (Saussure) (Hymenoptera: Scoliidae). Australian Entomology Magazine