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Final Report

Cotton Research Council Grant 1986-87

CS28L

"Identification of the sex pheromones of
two cotton pests, Cotton Tipworm Crocidosema
plebejana Zeller and the Pink Spotted Bollworm
Pectinophora scutigera (Holdaway)"

Duration: 1 year Commenced July 1986
Interim final report December 1987
Field tests completed 1988

Funds: \$13,753

Project Supervisor: Dr C.P. Whittle

The information in this report
is confidential to the Cotton
Research Council and CSIRO and
should not be disclosed without
prior consultation.

Part A

Previously submitted as an interim final report December 1987.

Objectives:

The cotton tipworm Crociosema plebejana Zeller is a tortricid pest of cotton seedlings. Damage from larval feeding can result in the death of young seedlings and can lead to distorted growth in older seedlings. The abnormal growth of the plant can in turn lead to late maturation, harvesting difficulties and lower yields.

The pink spotted bollworm Pectinophora scutigera (Holdaway) is a sporadically serious pest of cotton in Queensland. The attractant currently used to bait monitor traps for P. scutigera was determined by empirically testing candidate compounds (Rothschild 1975). It is likely that synthetic mixtures which more closely mimic the natural sex pheromone may enhance the efficiency of monitor traps and may be required for effective disruption of sexual behaviour.

The objectives of the present work are the identification of the sex pheromones for C. plebejana and P. scutigera and the testing of synthetic candidate mixtures as attractants in monitor traps in the field.

Results:

a) The sex pheromone of the Cotton Tipworm

Larvae of the Cotton Tipworm Crociosema plebejana were obtained in the field from Toowoomba Qld and Narrabri NSW. Initial attempts to rear larvae on cotton seedlings were not very successful and better results were obtained with mallow (Malva sp.). Repeated gas liquid chromatographic (glc) analyses of gland extracts from female moths failed to detect volatiles which could be associated with a sex pheromone. It is possible that either the pheromone occurs in amounts below limits of detection or, more likely, the production of pheromone is cued by conditions currently unknown.

In a different approach to the problem, 55 compounds (chosen from all the E and Z isomers of the dodecenyl, tetradecenyl and hexadecenyl acetates and E and Z dodecenols) were used as substrates in electroantennograms (EAGs) with antennae of male C. plebejana as detector. A marked electrophysiological response was obtained only with (Z)-7-dodecenol. This compound is currently being tested as an attractant in monitor traps at Narrabri N.S.W.: the results are not yet available.

b) The sex pheromone of the Pink spotted Bollworm

In a preliminary study, glc analyses of pheromone gland extracts taken from a laboratory culture (CSIRO, Canberra) of Pectinophora scutigera confirmed the presence of (Z,Z) and (Z,E)-7,11-hexadecadienyl acetates as primary components of the sex pheromone. Previous empirical tests of candidate mixtures in the field had shown that a 10:1 mixture of these compounds was an effective attractant. However, in this study the ratio of these two compounds found in individual moths differed consistently and by a small amount from this value and the glc traces indicated the presence of small amounts of additional materials.

The preliminary study was carried out with material taken from an old culture which had been maintained for many generations in the laboratory and therefore possibly not representative of populations in the wild. Accordingly, further specimens from the Canberra culture were examined together with material obtained from cotton bolls, "Kurrajong" (Brachychiton australis), hibiscus and a Biloela (DPI, Qld) culture. The identity of representative specimens was confirmed by taxonomic investigation and extracts of pheromone glands from individual moths were analysed at various times during the course of a season.

The ratio of (Z,Z) and (Z,E)-7,11-hexadecadienyl acetates was found to be a consistent 100:15(+3) (87%:13%) and was unaffected by either the source of the material or time during the season. Further analyses using several glands at a time showed small glc peaks consistent with (Z)-7-hexadecenyl acetate and (Z)-9-hexadecenyl acetate (3% and 1% respectively compared to the major component). The average amount of pheromone was found to be 8 ng/moth (N=26).

The results obtained for P. scutigera are in contrast with those described for the closely related P. gossypiella in the USA, where it was shown that P. gossypiella emits and responds to mixtures of (Z,Z)-7,11-hexadecadienyl acetate and (Z,E)-7,11-hexadecadienyl acetate in ratios between 50:50 and 60:40, the mixture varying over the course of a season. P. gossypiella, a pest of cotton world wide, is the only Pectinophora species with a distribution outside of Australia. In Australia three species are known. P. endema occurs in NSW and Qld and is sympatric with P. scutigera for at least part of its range. P. gossypiella occurs in northern WA and the NT where it is probably parapatric, if not sympatric, with P. scutigera. To the extent that sex pheromone differences contribute to the reproductive isolation of the three species, the differences will be important in the formulation of synthetic pheromones for the control of P. scutigera. For this reason, the sex pheromones of P. gossypiella and P. endema were also examined.

P. gossypiella taken from Kununurra WA, Lee Pt. NT and Adelaide River NT gave results very similar to those obtained in the U.S.A. (i.e. a 50:50 to 60:40 ratio of the (Z,Z) and (Z,E)-7,11-hexadecadienyl acetates) with the exception that there was no evidence for a seasonal variation and there was evidence for (Z)-7- and (Z)-11-hexadecenyl

acetate as minor compounds (<3%).

P. endema collected from hibiscus near Blackwater Qld showed a 56:44 ratio of the diene isomers but in this case the dienes were accompanied by a significant amount (11%) of (Z)-11-hexadecenyl acetate.

One specimen, also identified as P. endema, collected from ornamental hibiscus in Brisbane Qld, showed an 80:20 ratio of the dienes and no (Z)-11-hexadecenyl acetate.

A comparison of the data for the three species indicates that the minor components of the sex pheromones will probably be necessary to enhance discrimination in synthetic mixtures. Taxonomically the Pectinophora species are not easy to separate and there is now some indication that there are more species than have yet been described.

Synthetic pheromone baits based on data found in this study will be tested against P. scutigera in Queensland early in 1988.

Part B

Results of field test carried out in 1988.

Field Tests 1988

At the time of submission of the interim final report (23 December 1987) field tests had not been completed. Field tests have now been carried out and the results follow.

(a) Crocidosema plebejana, the cotton tipworm

The only compound to show any electrophysiological activity against male moths in the laboratory viz. (Z)-7-dodecenol, was tested as a potential attractant in monitor traps at Narrabri N.S.W. The compound failed to attract any male C. plebejana. However numbers in the field at the time were not high and the trial is about to be repeated at Biloela, Qld.

(b) Pectinophora scutigera, the pink spotted bollworm (and related species)

In collaboration with Mr B. Ingram (Qld Department of Primary Industries, Biloela), monitor traps baited with several different synthetic pheromone blends were tested. The various mixtures used are shown in Table 1. As indicated, the baits A, B and C are based on the glc analysis of P. scutigera pheromone glands, D and E on the analyses for P. gossypiella and P. endema respectively and F is the mixture previously determined empirically as a P. scutigera attractant.

Traps baited with these mixtures were tested in cotton at Biloela Qld over a two month period. There was no significant difference in the efficacy of traps A B C and F. Traps of type A caught just under 200 moths while traps B C and F caught approximately 250 moths each. Less than thirty moths were caught in either D or E type traps. The results show that P. scutigera discriminates between a 9:1 and 1:1 mixture of (Z,Z)-and (Z,E)-7,11-hexadecadienyl acetate but the small change in ratio from the empirically determined 9:1 mixture to the analytically found 87:13 blend has no effect. More importantly

the addition of components which occur less abundantly in the sex pheromone gland failed to increase the attractive potency of the blend.

The traps A-F were also set at Kingaroy and Mt Isa in Queensland. The catches at Mt Isa were interesting in so far as most moths were caught in the E type trap. This trap might normally be expected to attract P. endema or perhaps P. gossypiella. Nevertheless the total number of moths caught was not high and the result will have to be verified. Moths from all traps have been kept for taxonomic examination particularly with respect to differences in the genitalia.

Although the addition of minor components to the P. scutigera blend did not improve the efficacy of the attractant, it is possible that the additional components may be important for discrimination between Pectinophora species and in the use of synthetic pheromones for sexual disruption. Mr Paul Walker (University of Queensland) is currently conducting disruption trials at Biloela using a 9:1 mixture of (Z,Z)- and (Z,E)-hexadecadienyl acetates (Cotton Research Grant UQ9L). Arrangements have been made to test the 3 and 4 component blends as attractants within an area treated with the disruptant mixture.

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Table 1

Trap type	Component Proportions				
	Z,Z-7,11-16:0Ac	Z,E-7,11-16:0Ac	Z-7-16:0Ac	Z-9-16:0Ac	Z-11-16:0Ac
A	870	130	-	-	-
B	870	130	30	-	-
C	870	130	30	10	-
D	500	500	-	-	-
E	500	500	-	-	130
F	900	100	-	-	-

A,B,C 2,3 and 4 component mixtures based on glc analysis of

P. scutigera

D based on glc analysis of P. gossypiella

E based on glc analysis of Pectinophora collected from hibiscus

Blackwater Qld

F Attractant for P. scutigera determined empirically by G. Rothschild.

Summary

CS28L - Sex Pheromones of two
Cotton Pests (short title) \$13 753

ORGANISATION: CSIRO Division of Entomology

PERIOD: JULY 1986 - JUNE 1987, Field tests 1988

COMMENCED: JULY 1986

LOCALITY: Black Mountain Laboratories, Canberra

PROJECT SUPERVISOR: C.P. Whittle

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OBJECTIVES: To identify the sex pheromones of two cotton pests,
the cotton tipworm Crociosema plebejana, and the
pink spotted bollworm Pectinophora scutigera, and
to test candidate synthetic blends in the field.

PROGRESS: Candidate pheromones have been determined for
Crociosema plebejana (the cotton tipworm) and
Pectinophora scutigera (the pink spotted bollworm).
The analytical results for P. scutigera have been
compared with those also obtained for two other
closely related species (P. gossypiella and P.
endema) in order to assess the possible importance
of minor components and component ratios. Synthetic
mixtures based on the analytical data have been
tested as attractants in the field. The presence of
additional components in the P. scutigera blend
failed to increase the potency of the attractant.

A candidate synthetic pheromone for C. plebejana has
failed to attract moths at Narrabri and further tests
are being carried out at Biloela.