BUREAU OF SUGAR EXPERIMENT STATIONS
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# FIELD EXPERIMENTS TO OPTIMISE LURES FOR MASS-TRAPPING OF CANE WEEVIL BORER

by

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## 1.0 INTRODUCTION

Cane weevil borer, *Rhabdoscelus obscurus* (Boisduval) (Coleoptera: Curculionidae: Rhynchophorinae), is an introduced pest of sugarcane in Queensland, Hawaii and Fiji. It was accidentally introduced from Papua New Guinea about 1900 with sugarcane planting material (Veitch 1917).

Previous research showed that male cane weevil borers produce aggregation pheromones which attract both male and female cane weevil borers. Three compounds emitted by feeding males were identified by Dr R. Gries at Simon Fraser University (see Robertson *et al.* 1997). These compounds were synthetically produced by ChemTica Internacional SA and two of these, 2-methyl-4-octanol and 6-methyl-2-hepten-4-ol (rhynchophorol), were shown to be the active compounds for attracting cane weevil borer (Robertson *et al* 1997).

The experiments reported here were designed to determine the optimum ratio of the two active compounds to attract cane weevil borer. In addition, the relative attractiveness of the synthetic lures was compared with that produced by feeding male cane weevil borers. Finally, a chemical known to increase trap catches of other species of Rhynchophorinae, ethyl acetate (marketed as 'Weevil Magnet'), was tested for its ability to synergise the attractiveness of the aggregation pheromones.

## 2.0 METHODS

The traps used in each experiment were black plastic buckets of approximately 5 L capacity lined with a removable plastic bag. The open top was 25 cm in diameter, and water with detergent was added to a depth of 5 to 8 cm to retain weevils which entered the trap. Lures were suspended from a wire mesh grid (2.5 cm mesh) which covered the top of the bucket. Chopped sugarcane was a component of some treatments; this was placed in a 250 mL plastic cup fitted with a flyscreen lid to allow free movement of air and volatiles from decomposing sugarcane.

All chemicals used in the experiments were formulated by ChemTica and stored at -20°C until required in the field. The pheromones and ethyl acetate were supplied by ChemTica in slow-release plastic bags, which were suspended from the mesh over the appropriate traps without perforating the sealed bag. Each bag of ethyl acetate contained 9,000 mg, designed to last for at least four weeks. The pheromones (2-methyl-4-octanol, and 6-methyl-2-hepten-4-ol) were designed to release approximately 0.3 mg each per day.

All experiments were conducted in a third ratoon crop of cultivar Q138 sugarcane on Spanos Road, Silkwood. The field was adjacent to the crop used in 1997 experiments (Robertson *et al.* 1997). All trials were set out as replicated complete blocks. Traps were placed on the ground in every second inter-row space, with two rows of cane between the edge of the field and the first trap. Cane rows were 1.5 m apart. Each replicate had a row of randomly allocated treatments (traps) at right angles to the row direction, and replicates were separated by 10 m along the row.

Traps were left undisturbed for one week before removing and counting weevils, replacement of water and detergent, and reallocation of treatments within each replicate. Experiment 1 ran for a total of three weeks, and Experiments 2 and 3 for two weeks each. The number of each sex of weevils was determined in each trap catch on each occasion. Results were analysed by ANOVA with separation of means using Least Significant Difference tests (Statistix® ver. 4.1). Deviation of sex ratio from 1:1 was tested by $\chi^2$.

Daily rainfall was recorded at Feluga, approximately 10 km from the study site.

## 3.0 RESULTS

### 3.1 Experiment 1, optimisation of pheromone ratios

The first experiment was initiated on 17 March 1998. Two ratios of 2-methyl-4-octanol ('octanol') and 6-methyl-2-hepten-4-ol ('rhynchophorol') were compared, 1:1 rhynchophorol/octanol and 10:1 rhynchophorol/octanol. These ratios were the extremes of the range produced by male weevils, as determined at Simon Fraser University. The combinations were compared in the same experiment with each pheromone as a sole chemical. Chopped sugarcane was included in every trap with the pheromones. The control treatment was sugarcane alone. Twelve relicates of each treatment were compared.

One trap was excluded from analysis (treated as a missing value) in the cane plus 10:1 rhynchophorol/octanol treatment on 24 March, and from the cane plus rhynchophorol treatment on 7 April 1998, because the traps had been knocked over presumably by an animal. Wallabys and bandicoots were both active in cane in the area.

Trapped weevils were counted and sexed on 24 March, 31 March and 7 April 1998. Results are presented in Table 1. The treatment with 1:1 ratio of rhynchophorol to octanol caught significantly more weevils than the 10:1 ratio in week 2, but not in weeks 1 and 3 of Experiment 1. Both ratios caught significantly more weevils than either pheromone on its own, or cane alone, during each week of the experiment (Table 1). Traps with 1:1 rhynchophorol/octanol plus cane caught six to 10 times more weevils than traps with cane on its own.

### 3.2 Experiment 2, comparison of synthetic lures with natural pheromone

The second experiment started on 7 April, with trap catches assessed on 14 April and 20 April 1998. The second week of this experiment was conducted over six days rather than the full week, because of a conflict with other concurrent work.

Treatments compared 1:1 ratio of synthetically produced rhynchophorol and octanol with five male weevils per trap and 10 male weevils per trap confined on chopped sugarcane, and cane alone. Eight replicates of each treatment were used in week 1, and 10 replicates were used in week 2 of this experiment.

Traps with 1:1 rhynchophorol/octanol caught significantly more weevils than cane with either 5 or 10 males, or cane alone in both weeks (Table 2). Trap catch was increased by a factor of 3 when the combination of pheromones was added to cane, compared to cane alone.

### 3.3 Experiment 3, effect of ethyl acetate on trap catch

Experiment 3 began on 21 April, with weevils counted on 28 April and 5 May 1998. Treatments were 1:1 rhynchophorol/octanol with and without ethyl acetate and with and without cane, cane plus ethyl acetate, ethyl acetate on its own, and cane on its own. Nine replicates were compared in week 1, and 10 replicates in week 2.

In both weeks, the greatest number of weevils was caught with the combination of cane, 1:1 rhynchophorol/octanol and ethyl acetate, although this combination caught significantly more weevils than cane plus 1:1 rhynchophorol only in week 1 (Table 3). Both these treatments caught significantly more weevils than any other treatment on both occasions. Ethyl acetate on its own caught least weevils in both weeks (Table 3). The addition of ethyl acetate to 1:1 rhynchophorol plus cane more than doubled the mean trap catch in week 1, but increased the catch by only 15% in week 2. Mean trap catch was increased by 7 to 11 times by addition of ethyl acetate and 1:1 rhynchophorol/octanol over cane alone in Experiment 3.

One trap with ethyl acetate alone was excluded from the analyses on both occasions due to disruption to a trap, probably by an animal. The data were analysed with missing values.

The sex ratio of weevils captured in each treatment and each experiment is presented in Table 4. Traps with combinations of rhynchophorol and octanol plus cane had a female-biased sex ratio, as also found in 1997. In week 2 of experiment 3, cane plus ethyl acetate caught significantly more males than females.

Lower weekly trap catches were recorded during weeks with high rainfall, and flight activity of adult weevils may have been reduced during wet weather. Daily rainfall records are given for the study period in Table 5.

## 4.0 CONCLUSION

The results of this study indicate that both male and female weevils are caught in water traps, with greatest numbers attracted by a combination of chopped sugarcane, 1:1 rhynchophorol/octanol pheromone, and ethyl acetate. This combination in traps will be the most attractive as a lure to reduce the breeding population of adult weevil borer before damage is done to cane by the larval borers. Significantly more females than males are caught with traps containing rhynchophorol, octanol and cane.

Experiments should start in January 1999 comparing different numbers and placement of optimally-baited traps, and with continuous trapping throughout the period when weevil borer adults are active (January - May). Subsequent damage assessments in cane can then be used to determine the effectiveness of mass-trapping for removal of cane weevil borer, and the density of traps needed to effect control.

## ACKNOWLEDGMENTS

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## REFERENCES

Robertson LN, Giblin-Davis RM, Oehlschlager AC and Gries R (1997). Field evaluation of aggregation pheromones for mass-trapping of cane weevil borer. *BSES Project Report* PR97004: 1-9.

Veitch R (1917). The cane beetle borer in Australia. *Colonial Sugar Refining Co. Agric. Rep.* 3: 1-15.

**TABLE 1 Mean number of adult cane weevil borer caught per trap per week in Experiment 1 designed to determine the optimum ratio of rhynchophorol to octanol as an attractant with sugarcane. Means within columns followed by the same letter do not differ significantly (lower case, P < 0.05, upper case P < 0.001)**

| Treatment | Week 1 | Week 2 | Week 3 |
|---|---|---|---|
| 1. 1:1 rhyn/oct + cane | 29.0 aA | 56.8 aA | 24.7 aA |
| 2. 10:1 rhyn/oct + cane | 30.1 aA | 36.8 bAB | 24.2 aA |
| 3. rhynchophorol + cane | 7.3 bB | 15.3 cBC | 7.6 bAB |
| 4. octanol + cane | 6.3 bB | 8.7 cC | 7.3 bAB |
| 5. cane only | 3.6 bB | 5.3 cC | 4.0 bB |
| $LSD_{(0.05)}$ | 8.9 | 15.4 | 10.9 |

Week 1 $F_{(4,58)} = 17.6$, $P < 0.0001$
Week 2 $F_{(4,59)} = 16.3$, $P < 0.0001$
Week 2 $F_{(4,58)} = 6.9$, $P = 0.0002$.

**TABLE 2. Mean number of adult cane weevil borers caught per trap per week in Experiment 2 designed to compare attractiveness of synthetic lure with living male weevils on sugarcane. Means within columns followed by the same letter do not differ significantly (lower case P < 0.05; upper case P < 0.001)**

| Treatment | | Week 1 | Week 2* |
|---|---|---|---|
| 1. | 1:1 rhyn/oct + cane | 133.9 aA | 63.5 aA |
| 2. | 10 males + cane | 30.4 bB | 31.1 bAB |
| 3. | 5 males + cane | 24.0 bB | 21.3 bB |
| 4. | cane only | 41.5 bAB | 19.7 bB |
| $LSD_{(0.05)}$ | | 55.5 | 19.6 |

Week 1 $F_{(3,31)} = 7.44$, $P = 0.0014$
Week 2 $F_{(3,39)} = 9.12$, $P = 0.0002$
* Week 2 conducted over 6 days.

**TABLE 3 Mean number of adult cane weevil borer caught per trap per week in Experiment 3 designed to determine the effectiveness of ethyl acetate as a synergist to improve the attraction of pheromone and sugarcane lures. Means followed by the same letter do not differ significantly (lower case, P < 0.05; upper case, P < 0.001)**

| Treatment | | Week 1 | Week 2 |
|---|---|---|---|
| 1. | 1:1 rhyn/oct + ethyl acetate + cane | 183.7 aA | 70.5 aA |
| 2. | 1:1 rhyn/oct + cane | 80.7 bB | 59.9 aA |
| 3. | 1:1 rhyn/oct + ethyl acetate | 34.2 cBC | 12.7 bcB |
| 4. | ethyl acetate + cane | 28.2 cBC | 23.8 bB |
| 5. | cane only | 16.6 cC | 10.5 bcB |
| 6. | ethyl acetate only | 1.4 cC | 0.9 cB |
| $LSD_{(0.05)}$ | | 37.0 | 18.0 |

Week 1 $F_{(5,53)} = 27.05$, $P < 0.0001$;
Week 2 $F_{(5,58)} = 20.67$, $P < 0.0001$.

**TABLE 4 Sex ratio of weevils caught in each treatment during experiments 1,2 and 3. Deviation of sex ratio from 1:1 analysed by $\chi^2$. NB. Subsample of 50 weevils per trap sexed when trap count exceeded 50 per week.**

| Experiment | Treatment | Males | Females | Sex ratio |
|---|---|---|---|---|
| 1 week 1 | 1:1 rhyn/oct + cane | 118 | 230 | P<0.0001 |
| 1 week 2 | " | 228 | 440 | P<0.0001 |
| 1 week 3 | " | 106 | 220 | P<0.0001 |
| | | | | |
| 1 week 1 | 10:1 rhyn/oct + cane | 106 | 228 | P<0.0001 |
| 1 week 2 | " | 155 | 287 | P<0.0001 |
| 1 week 3 | " | 100 | 190 | P=0.0002 |
| | | | | |
| 1 week 1 | rhynchophorol + cane | 34 | 54 | 1:1 |
| 1 week 2 | " | 77 | 114 | 1:1 |
| 1 week 3 | " | 30 | 52 | 1:1 |
| | | | | |
| 1 week 1 | octanol + cane | 31 | 44 | 1:1 |
| 1 week 2 | " | 43 | 61 | 1:1 |
| 1 week 3 | " | 38 | 49 | 1:1 |
| | | | | |
| 1 week 1 | cane only | 15 | 28 | 1:1 |
| 1 week 2 | " | 36 | 37 | 1:1 |
| 1 week 3 | " | 20 | 28 | 1:1 |
| | | | | |
| 2 week 1 | 1:1 rhyn/oct + cane | 152 | 302 | P<0.0001 |
| 2 week 2 | " | 190 | 306 | P=0.0002 |
| | | | | |
| 2 week 1 | 10 males + cane | 101 | 88 | 1:1 |
| 2 week 2 | " | 139 | 126 | 1:1 |
| | | | | |
| 2 week 1 | 5 males + cane | 93 | 99 | 1:1 |
| 2 week 2 | " | 84 | 80 | 1:1 |
| | | | | |
| 2 week 1 | cane only | 115 | 102 | 1:1 |
| 2 week 2 | " | 76 | 76 | 1:1 |
| | | | | |
| 3 week 1 | 1:1 rhyn/oct + eth/ace + cane | 146 | 198 | P<0.05 |
| 3 week 2 | " | 303 | 402 | P<0.01 |
| | | | | |
| 3 week 1 | 1:1 rhyn/oct + cane | 244 | 378 | P<0.0001 |
| 3 week 2 | " | 237 | 362 | P=0.0005 |
| | | | | |
| 3 week 1 | 1:1 rhyn/oct + eth/acetate | 123 | 185 | P<0.05 |
| 3 week 2 | " | 32 | 84 | P=0.0005 |
| | | | | |
| 3 week 1 | ethyl acetate + cane | 153 | 137 | 1:1 |
| 3 week 2 | " | 149 | 89 | P<0.01 |
| | | | | |
| 3 week 1 | cane only | 102 | 87 | 1:1 |
| 3 week 2 | " | 49 | 56 | 1:1 |
| | | | | |
| 3 week 1 | ethyl acetate only | 9 | 8 | 1:1 |
| 3 week 2 | " | 6 | 3 | 1:1 |

**TABLE 5 Daily rainfall (mm) recorded at 7 am at Feluga during the study period of Experiments 1,2 and 3, 1998**

| Experiment | Date | Daily rainfall | Experiment | Date | Daily rainfall |
|---|---|---|---|---|---|
| Expt 1 week 1 | 18 March | 0.7 | Expt 1 week 3 | 1 April | 14.0 |
| | 19 March | 18.0 | | 2 April | 3.5 |
| | 20 March | 0 | | 3 April | 86.0 |
| | 21 March | 4.5 | | 4 April | 31.0 |
| | 22 March | 4.0 | | 5 April | 15.0 |
| | 23 March | 4.5 | | 6 April | 19.0 |
| | 24 March | 6.5 | | 7 April | 15.0 |
| Expt 1 week 2 | 25 March | 0 | | | |
| | 26 March | 0 | | | |
| | 27 March | 0 | | | |
| | 28 March | 0 | | | |
| | 29 March | 0 | | | |
| | 30 March | 0 | | | |
| | 31 March | 6.0 | | | |
| Expt 2 week 1 | 8 April | 47.0 | Expt 2 week 2 | 15 April | 4.5 |
| | 9 April | 6.0 | | 16 April | 6.0 |
| | 10 April | 0 | | 17 April | 1.5 |
| | 11 April | 0 | | 18 April | 6.0 |
| | 12 April | 0 | | 19 April | 40.0 |
| | 13 April | 0.5 | | 20 April | 24.0 |
| | 14 April | 1.0 | | 21 April | 12.0 |
| Expt 3 week 1 | 22 April | 3.5 | Expt 3 week 2 | 29 April | 6.0 |
| | 23 April | 0 | | 30 April | 0 |
| | 24 April | 0 | | 1 May | 7.5 |
| | 25 April | 7.0 | | 2 May | 46.0 |
| | 26 April | 0 | | 3 May | 11.0 |
| | 27 April | 28.0 | | 4 May | 64.0 |
| | 28 April | 17.5 | | 5 May | 21.0 |