BUREAU OF SUGAR EXPERIMENT STATIONS
QUEENSLAND, AUSTRALIA

THE USE OF AGGREGATION PHEROMONES FOR THE MANAGEMENT OF WEEVIL BORERS IN CANE FIELDS

by

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BSES Publication **February 2000**
Project Report PR00001

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SUMMARY

Pheromone mass trapping of adult sugarcane weevil borer, *Rhabdoscelus obscurus*, was conducted during February-June 1999 in far-north Queensland using a combination of rhynchophorol/octanol, ethyl acetate and pieces of split cane. Though traps attracted large numbers of adult borers, treated plots had higher numbers of borers compared to control plots. Cane plants in pheromone treated plots experienced higher percentage of infested stalks and a higher proportion of damaged internodes compared to control plots. This work suggests a change in the trapping technique to prevent damage early in the season. More work is needed to investigate the potential of placing pheromone traps outside cane fields so that the number of adults is reduced in the neighbouring paddocks. Pheromone traps can also be placed in one block planted with a tolerant variety within the area of infestation, then an insecticide can be applied in the treated block targeting the adults that escaped getting trapped. The potential of using a pesticide along with pheromone trapping still however needs to be investigated.

1.0 INTRODUCTION

Sugarcane weevil borer, *Rhabdoscelus obscurus* (Boisduval) (Coleoptera: Curculionidae), is a pest of sugarcane in certain areas of far-north Queensland (FNQ). After the wide adoption of green-cane trash blanketing, weevil borer infestation may readily build up in favourable humid climates and cause considerable damage. Larvae tunnel in cane stalks and cause reduction of sugar content (ccs). Moreover, infested stalks may be split during harvest and fail to end up in the harvest bin.

An aggregation pheromone has been identified for *R. obscurus* and two compounds were shown to attract both sexes of the borers, these are 2-methyl-4-octanol and 6-methyl-2-hepton-4-ol (rhynchophorol) (see Robertson *et al* 1997).

In an attempt to reduce weevil damage in cane, pheromone mass trapping of adults was conducted in fields in far-north Queensland. The first trials on pheromone trapping in FNQ took place in sugarcane fields at Silkwood by Robertson *et al*. (1998). A follow up of that work was required to assess the effectiveness of mass trapping in reducing borer damage in cane, and to determine to which degree this method can contribute to an overall IPM program against weevil borers in north Queensland. This was done during February-June 1999.

2.0 OBJECTIVE

The main aim of this work was to compare weevil borer abundance and damage in sugarcane fields, where intensive mass trapping of adults has been maintained throughout the season, against damage in similar (but untrapped) plots of sugarcane.

3.0 METHODOLOGY

Prior to installing pheromone traps, split-cane traps were distributed at 6 traps/ha in 17 chosen paddocks through the Mulgrave and Tully area to monitor borer abundance (see map - Appendix 1). Split-cane traps are bundles of six to nine split lengths of cane wrapped in black plastic with the ends left open (Fig.1). Split-cane traps attract and retain weevil borers, and these were released upon counting. Split-cane trap counts were obtained on 5 January and 3 February 1999 before the actual pheromone trapping had started. Traps were then removed and pheromone traps were placed in the paddock.

3.1 Pheromone trap construction

Pheromone traps were constructed from 8 inch black plastic pots as used in plant nurseries with a clear plastic bag inserted to hold water with several drops of detergent to drown the attracted weevils (Fig. 2). Based on the work done by Robertson *et al.* (1998), best combination of the weevil aggregation lures was when packets of rhynchophorol/octanol plus ethyl acetate are combined with several 5-cm lengths of split cane. All chemicals were supplied to BSES by ChemTica International, Costa Rica. Chemicals and cane pieces were placed together in a plastic container and suspended over the water from a square of wire mesh. The mesh also kept toads and rats out of the traps.

Pheromone treatment consisted of 16 traps covering an area of approximately 1 ha arranged within the downwind end of a cane block, with the other end of the block treated as control (untrapped) (Fig.3). Cultivars chosen for the experiments were Q120 or Q138, these are more susceptible to infestation. Based on the results obtained from split-cane traps, 13 blocks of advanced cane were initially chosen to conduct pheromone trapping, of which nine were distributed throughout the Mulgrave area and four were located at Silkwood (near Tully). After Cyclone 'Rona' on 11 February 1999, inspection of the blocks at three of the Mulgrave sites showed that it was impossible to continue the work. These were sites with the oldest cane that had the longest growing period since harvest. One more site had to be abandoned later due to extreme waterlogging conditions and flowing springs following flood events that occurred through February and March. At Tully, a record-breaking rainfall was experienced (1293.4 mm in March and 515.7 mm in April 1999) and no meaningful data could be obtained. However, the remaining five sites at Gordonvale were visited at intervals of four to five weeks until harvest time. These sites were the properties of Castini, Leotta, Galligan, Piccolo and Ferrando (see map - Appendix 1). Sites will be referred to as A, B, C, D and E, respectively.

To provide means of comparing weevil populations in the control and treatment blocks, pheromone traps were removed on 25 May 1999 and six split-cane traps were placed in both treated and untreated plots; counts were obtained on 8 June 1999. Pheromone traps were installed back in treated plots on 11 June 1999 until 24 June 1999, then collected and replaced with split-cane traps for a final estimation of the abundance of weevils.

Despite heavy rains, traps were found to be losing water after four to five weeks. The plastic bags were being attacked by insects (presumably ants or crickets) leaving small holes. Bags were replaced with a thicker grade of plastic bag that gave satisfactory results.

3.2 Estimation of damage

Prior to assessment of damage, preliminary sampling took place on the 28 July 1999 to calculate the number of plants required to give an accurate estimation of the mean. This was conducted in different plots experiencing varied levels of infestation. Damage in this case is identified as the number of bored internodes per stalk. Number of stalks required to give a 20% estimation of the actual mean was determined as 175 stalks/plot. Accordingly, seven rows were chosen randomly from each plot and 25 stalks (one stalk every 4 m) were sampled per row. One stalk per plant had the top cut off and split all the way down to the base to check for damage. The number of damaged internodes was recorded for each sampled stalk, and damage was estimated by dividing the total number of damaged internodes by the total number of stalks sampled (175). Just prior to harvest, a sample was taken from the two ends of each block for ccs determination. The sample consisted of six bundles of cane, each containing five stalks, chosen randomly from the four corners and the middle of each block giving a total of 30 stalks.

4.0 RESULTS AND DISCUSSION

Results showed that pheromone traps attracted large numbers of adult borers, and that numbers of trapped adult declined over time (Fig.4). Contrary to our expectations, split-cane trap counts on 8 June indicated a higher incidence of adult weevils in treated areas compared to control blocks ($P = 0.0039$; $df = 1,54$; $F = 9.06$). However, borer counts obtained on 12 July from split-cane traps did not differ significantly in either treated or control blocks ($P = 0.23$; $df = 1,57$; $F = 1.24$).

Percentage of stalks infested ranged from 16.0–23.4% and from 9.7–36.6% in treated and control paddocks, respectively (Fig. 6). However in plots A, C, D and E, treated plots had a higher percentage of infested stalks compared to control paddocks ($P = 0.008$; $df = 6$; $t = 1.94$). The only plot where this was not the case was plot B. This plot had a very heavy rat infestation within the first 50 m of the paddock, which may have encouraged intense invasion of the borers; we considered plot B aberrant. Likewise, proportion of damaged internodes per sampled stalks ranged from 0.21-0.80 and from 0.19–1.30 in treated and control plots, respectively, with treated plots experiencing a significantly higher damage compared to control plots with the exception of plot B ($P = 0.06$; $df = 6$; $t = 1.94$) (Fig. 7). This means that adults migrated to the treated plots but many escaped getting trapped; this shows a need for change in the trapping technique to capture more adults.

Older internodes at the base of the plant were more frequently infested than recent younger ones (Figs. 8-12). However, plots B, C and D seem to have experienced a second wave of infestation showing as a rise of the frequency of the damaged internodes in the middle of the stalk (nodes 6-12). This coincides with the timing of the cyclone that apparently had a serious impact on the recently formed nodes at the top of the stalks. This may have encouraged borers to attack stressed internodes which were mainly lying on the ground and easily accessed by borers. The control end of plot B, again, showed a drastic increase in the frequency of infested middle internodes which seems to have followed a high rat infestation due to the situation of the paddock towards the Mulgrave River. An area of unshaded grassland between the creek and the control end provided adequate harbourage for rats following the flood events.

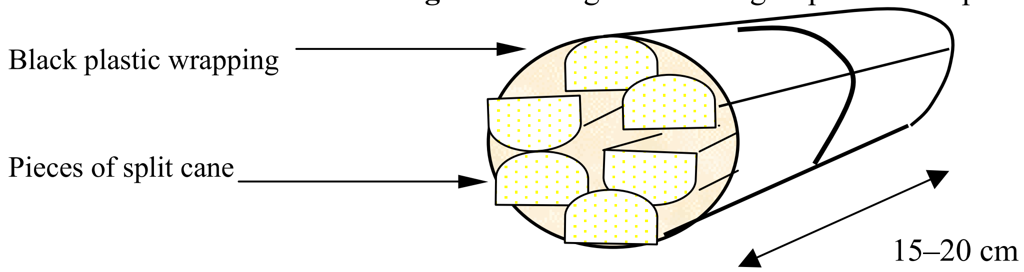
Sugar content from both the control and treated plots were compared, but there was no significant difference between the two samples ($P = 0.69$; $df = 1,48$; $F = 0.15$). Determination of the ccs value for the entire block may be required to give accurate comparison between treatments.

Total number of infested stalks showed no correlation with number of borers obtained from split-cane traps on 12 July 1999 in either control or treated plots ($r = -0.20$; $df = 4$; $P = 0.73$) and ($r = -0.57$; $df = 4$; $P = 0.31$) respectively. However, results indicated a negative correlation between number of infested stalks, in treated plots only, and the total number of borers trapped over the entire period of the experiment ($r = -0.89$; $df = 4$; $P = 0.042$). This suggests that, though adults are concentrated in treated paddocks, pheromone treatment may have potential to reduce damage in cane provided that a considerably larger range is covered encompassing a significant proportion of the infested area. A change in the trapping technique is therefore required to achieve a significant level of borer control, and maintain suppression of the population throughout the season.

5.0 CONCLUSION

It is clear that pheromone lures do attract adult borers effectively. Infestation however may increase in treated plots while borer numbers are decreased in the surrounding (untreated) paddocks. This suggests a change in control strategy; for example, massive trapping can be applied in one block planted with a tolerant variety located within a highly infested area. An insecticide may then be applied only in the pheromone treated area where adults are confined. It may also be crucial to start trapping earlier in the season (eg November–December) in order to maintain significant suppression of the population before numbers build up and cause considerable damage (see Telford 1999). Moreover, traps may not necessarily be placed within a paddock. More work is needed to investigate the potential of placing pheromone traps outside cane fields, eg on the head land, so that number of adults is reduced in the neighbouring paddocks.

Figure 1: Diagram showing a split-cane trap



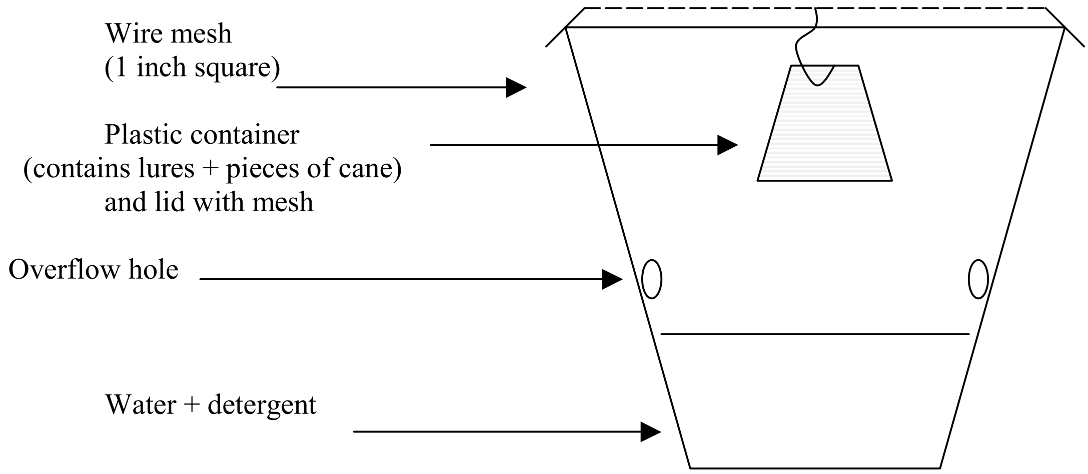


Figure 2: Diagram showing a pheromone trap.

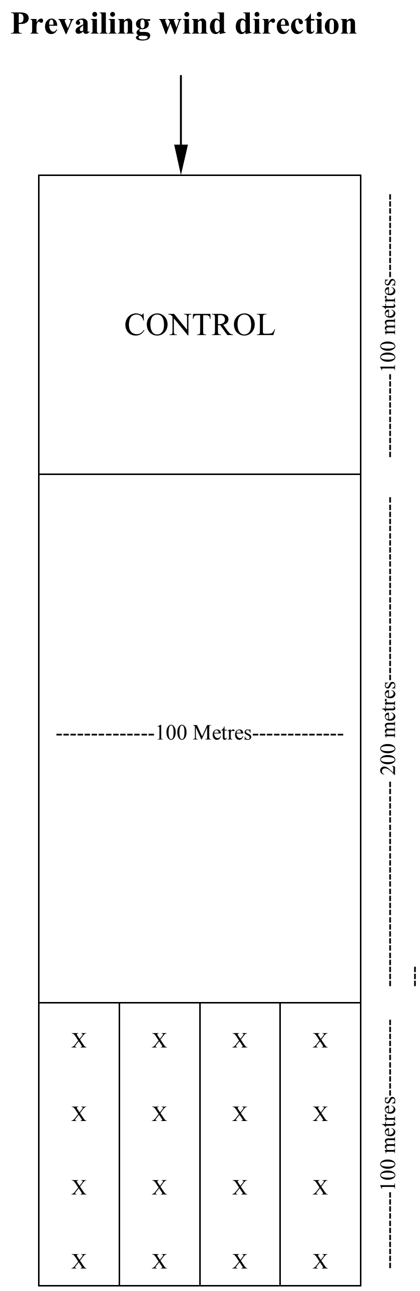


Figure 3: Distribution of pheromone traps in 1-hectare section of cane block
X = Pheromone trap

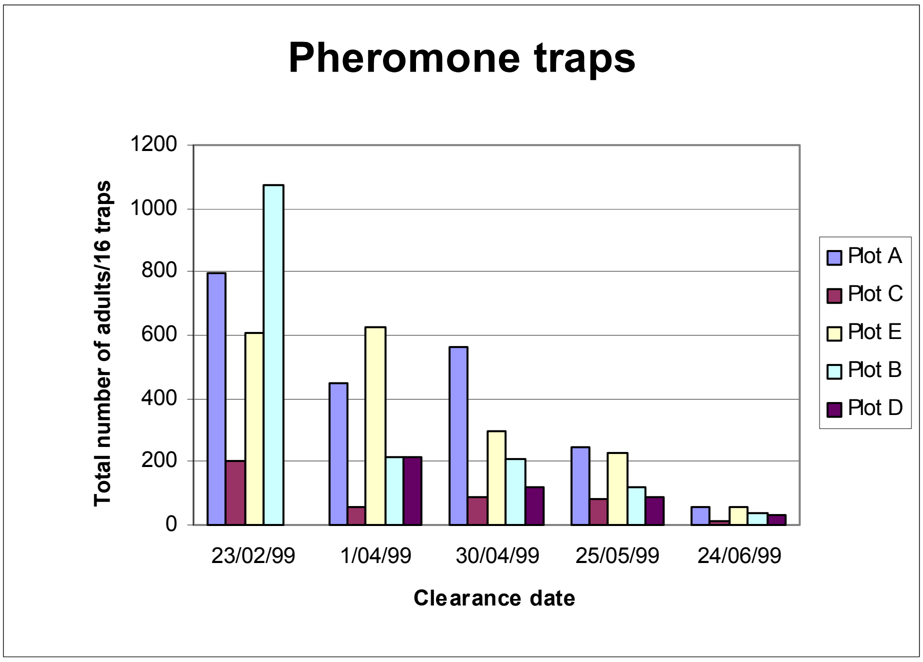


Figure 4: Numbers of adult borers caught in pheromone traps in treated blocks

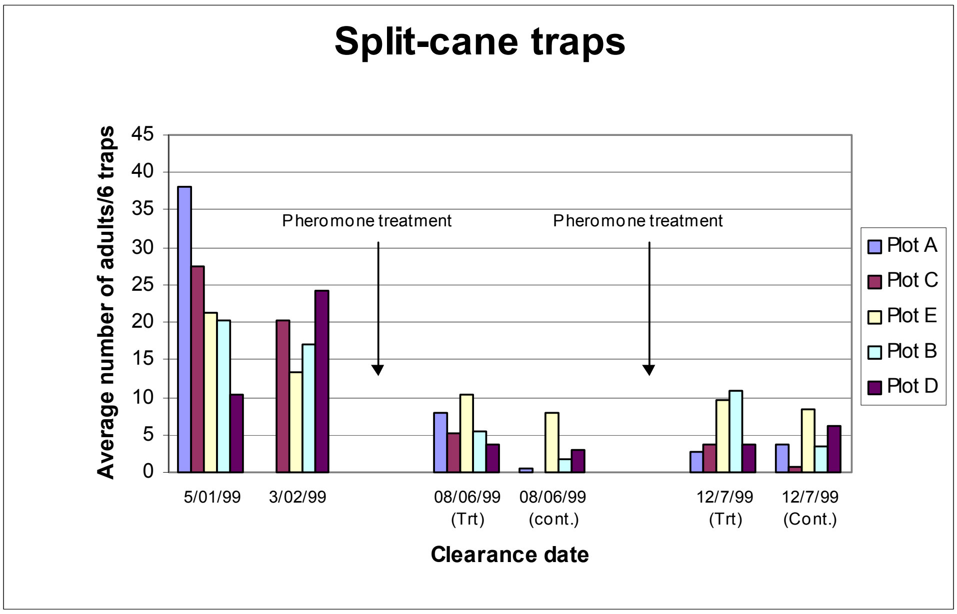


Figure 5: Average numbers of adult borers caught in split-cane traps in treated and control blocks

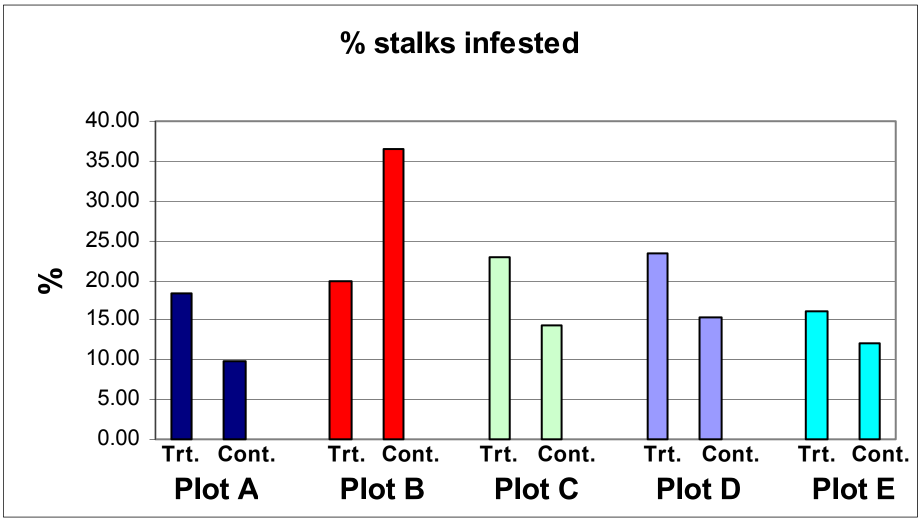


Figure 6: Percentage of cane stalks infested in treated and control blocks at the end of the season (August 1999)

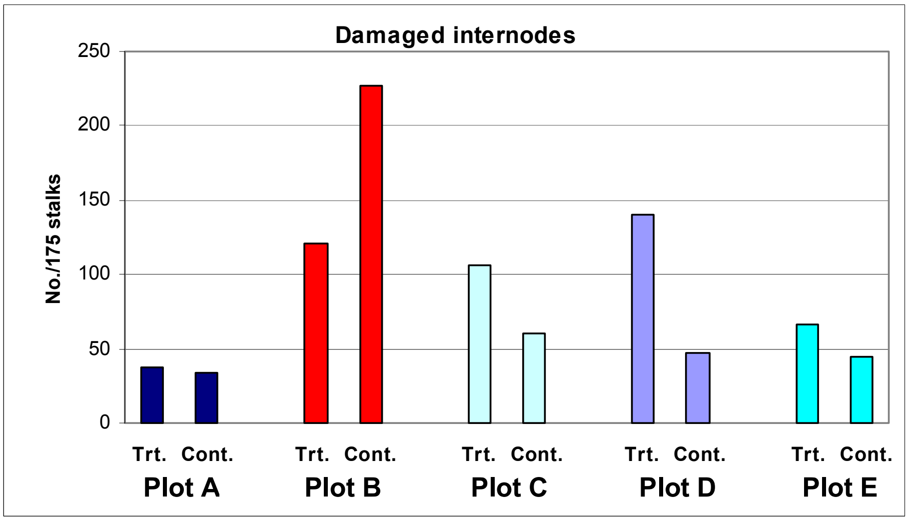


Figure 7: Number of damaged internodes in treated and control blocks at the end of the season (August 1999)

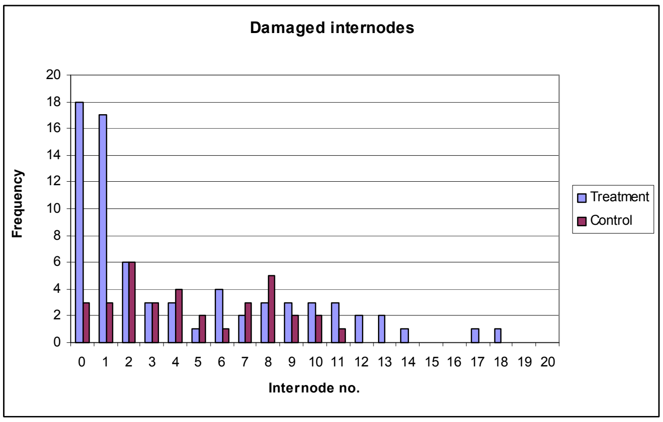


Fig. 8 Plot A

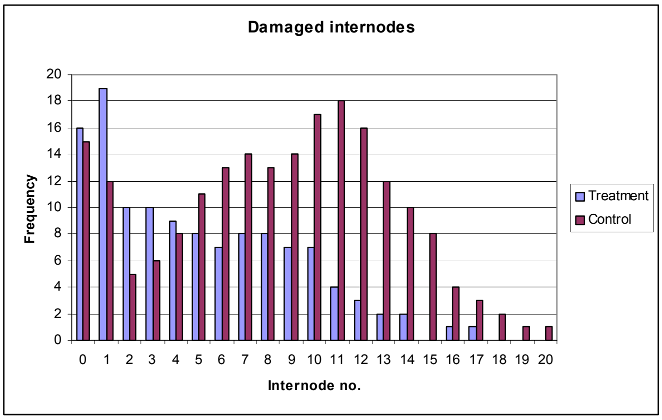


Fig. 9 Plot B

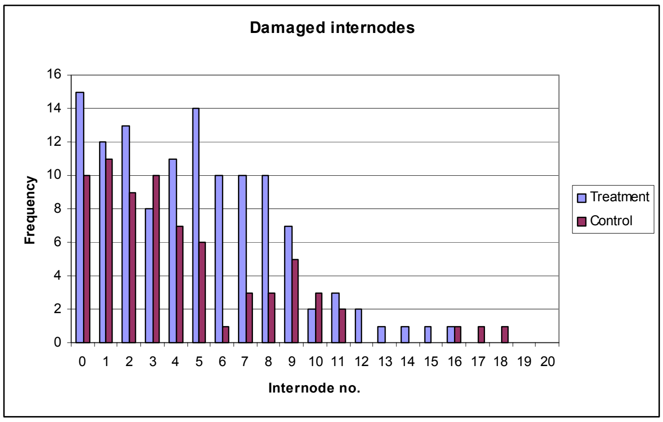


Fig. 10 Plot C

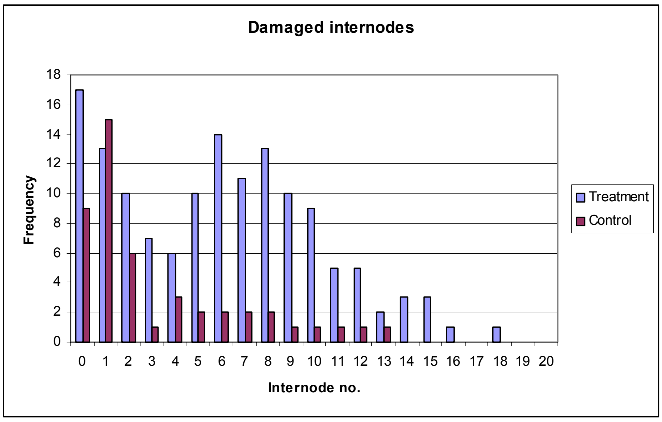


Fig. 11 Plot D

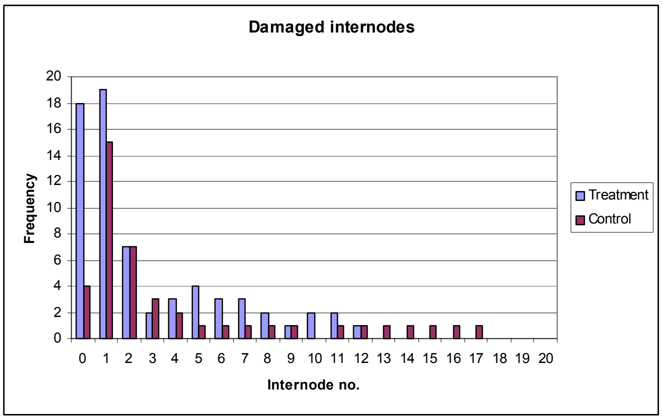


Fig. 12 Plot E

Figures 8-12: Frequency of damage in plant internodes in plots A, B, C, D and E

6.0 ACKNOWLEDGMENTS

The contribution of the following in this trial work is acknowledged:

Allan Morton and Richie Falla, supervisors of the Mulgrave Cane Protection and Productivity Board for their invaluable assistance in site selection and data collection - especially after Cyclone Rona. Katie McAvoy, BSES Innisfail, whom very actively helped in the field work. Debra Telford and Keith Chandler, BSES Innisfail and Meringa respectively, for their contribution in the development of the trial design. Peter Bakker of BSES Tully for his input into the trap design. Included in the field work and the development of the trial are Trevor Crook and Alan Hopkins of the Mulgrave Central Mill Productivity staff. Terry Hilliard and John Erbacher, Research Assistants at BSES Meringa, who assisted in the closing stages of the work when time and resources were in demand. Peter Allsopp, BSES Bundaberg, is acknowledged for his help in revising the manuscript. Thanks to the five sugarcane growers throughout the Mulgrave mill area who allowed the work to be conducted on their farms and maintained an interest in the proceedings.

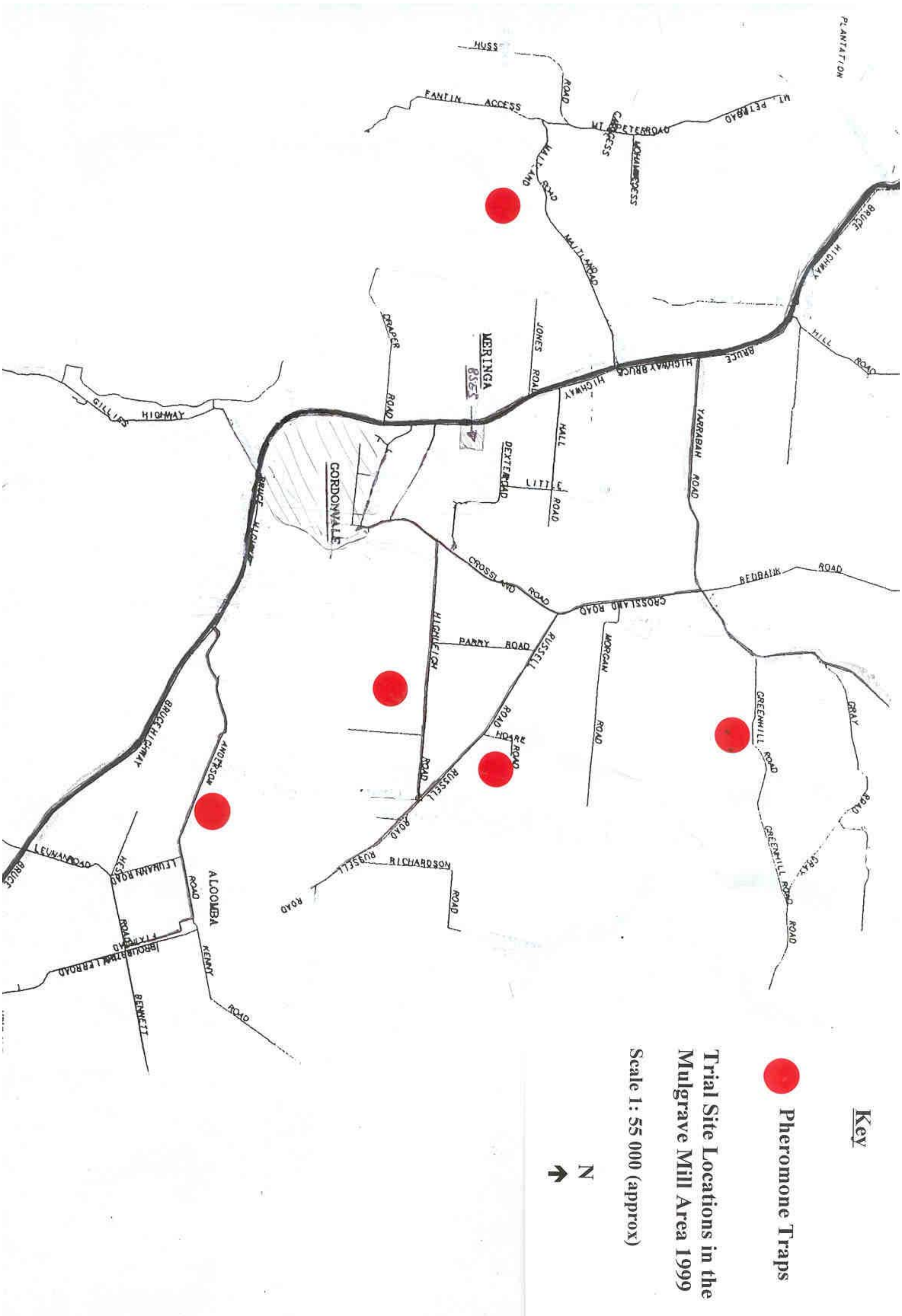
7.0 REFERENCES

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

Robertson L N, Giblin-Davis R M and Oehlschlager A C (1998). Field experiments to optimise lures for mass-trapping of cane weevil borer. *BSES Project Report* PR98003: 1-7.

Telford D E (1999). Sugarcane weevil borer. Summary of activities 1993 – 1997. *BSES Project Report* TE99001: 1-23.

APPENDIX 1


Key
Pheromone Traps
Trial Site Locations in the Mulgrave Mill Area 1999
Scale 1: 55 000 (approx)
N
GORDONVALE
MERINGA
BSES
ALOOMBA
BRUCE HIGHWAY
GILLIES HIGHWAY
CROSSLAND ROAD
REDBANK ROAD
YARRABAH ROAD
RUSSELL ROAD
GREENHILL ROAD
MORGAN ROAD
JONES ROAD
DRAPER ROAD
MAITLAND ROAD
FANTIN ACCESS
HUSS ROAD
HILL ROAD
LITTLE ROAD
HALL ROAD
PARRY ROAD
HIGHLEIGH ROAD
HOARE ROAD
RICHARDSON ROAD
KENNY ROAD
GRAY ROAD
PLANTATION