

BUREAU OF SUGAR EXPERIMENT STATIONS
QUEENSLAND, AUSTRALIA

SRDC PROJECT REPORT BS151S
FACTORS AFFECTING THE INCIDENCE
OF AND DAMAGE CAUSED BY WEEVIL BORERS
by
JK Stringer and DE Telford
PR98004

Principal Investigators:

Miss JK Stringer
Research Officer
BSES
PO Box 86
INDOORROOPILLY Q 4068

Mrs DE Telford
Extension Officer
BSES
PO Box 630
INNISFAIL Q 4860

This project was funded by the Sugar Research and Development Corporation during 1995-96 financial years.

TABLE OF CONTENTS

SUMMARY

1.0	BACKGROUND	1
2.0	OBJECTIVES	1
3.0	INTRODUCTION	2
4.0	MATERIALS AND METHODS.....	2
4.1	BSES Data	2
4.2	Mulgrave Mill Data.....	2
5.0	RESULTS AND DISCUSSION	3
5.1	Recommendations.....	7
5.2	Comparison to other studies.....	7
5.3	Difficulties in project	8
6.0	REFERENCES	8

SUMMARY

This study has shown that sampling billets for weevil borer damage through the extraneous matter system of a sugar mill gives reliable data as it supports in field data collected by BSES. These data may allow the simple field assessments to be related to the entire mill area. This would benefit other mill areas who do not currently sample for weevil borer damage.

The Mulgrave mill data shows high susceptibility to weevil borer by some varieties such as Q113 and Q138 while Q117 has low susceptibility.

There is greater damage in green cane than in burnt cane which reflects historical data. Weevil borers were not a significant problem when pre-harvest burning of cane was standard practice prior to the introduction of green cane harvesting.

By continuing the sampling method undertaken by Mulgrave mill, a good comparison of weevil borer damage across years can be obtained. This may be useful in the long term for predicting weevil borer outbreaks. However, a large amount of data across years are needed to reliably predict outbreaks as damage is dependent on a number of factors such as variety, location and soil type.

By identifying districts and their levels of damage a management strategy for weevil borer control can be implemented.

The sampling method used at the mill changed many times during the season. The most accurate method commenced from week 18 onwards and this may bias the results.

1.0 BACKGROUND

Sugarcane weevil borer was the second most damaging pest of sugarcane prior to the introduction of pre-harvest burning in the 1940s. After burning before harvest became accepted as standard practice, weevil borer virtually disappeared as a pest of sugarcane. With widespread adoption of green cane harvesting and trash blanketing (GCTB), weevil borer has again increased to severe pest levels from Cairns to Tully. Localised infestations have been reported in the Mossman, Herbert and Mackay districts.

2.0 OBJECTIVES

The objectives of this study were to:

- Analyse data collected by Mulgrave mill to determine losses caused by weevil borer.
- Develop strategies for collection of data on weevil borer damage in future years.
- Determine factors that contribute to economic losses by weevil borer damage.
- Identify varieties with weevil borer resistance.

3.0 INTRODUCTION

Weevil borer damage in the northern mill districts in both 1993 and 1994 seasons caused annual losses of approximately \$1m worth of raw sugar. Total losses to weevil borer exceed \$3m per annum, with severe damage in parts of Mulgrave, Babinda, Mourilyan, South Johnstone and Tully mill areas. Boring by weevils reduces sugar by an average 1.1 ccs units, and allows the ingress of secondary rots. Impurities such as dextran which are associated with rots interfere with the production of raw sugar in the mill. Removal of these impurities imposes an additional cost to the millers. In addition, raw sugar shipped from the Mourilyan terminal is less acceptable to Singapore refineries due to reduced filterability. Sugar from the north is shipped from Mourilyan Harbour, and impurities from weevil borer damage have been suggested as the cause of changes in crystal structure of raw sugar from mills in this area.

Surveys have indicated that commercial clones have different levels of susceptibility or resistance to weevil borer damage. GCTB and the growing of susceptible clones in the north were the only farm practices identified in the surveys as predisposing cane to attack from weevil borers. Research in Hawaii resulted in the development and adoption of resistant clones, which in turn reduced weevil borer damage to low levels (Chang *et al* 1970). Commercial clones with a high level of resistance to weevil borer damage are required for the wet tropics to improve the economic and environmental sustainability of northern canegrowing districts. A return to trash burning to control weevil borer would jeopardise long-term benefits gained from GCTB.

4.0 MATERIALS AND METHODS

4.1 BSES Data

A study was conducted by Nils Berding from BSES Meringa to determine whether selection for resistance to sugarcane weevil borer would be possible. The findings of this research are published in the 1996 proceedings of ASSCT.

4.2 Mulgrave Mill Data

Mulgrave Mill samples 80% of the cane entering the factory for extraneous matter. During the 1995 season, in addition to sampling for extraneous matter, pest damage by weevil borer and rats was also recorded.

Extraneous matter samples were removed from the hopper above the shredder feed rolls using a small bucket. Samples were taken every four minutes which resulted in more than 30 000 samples taken per season (Pope and Johnson 1996). This individual rake data was converted to a block basis so it would be more manageable for statistical analysis. On the advice of Mulgrave mill staff, class 8 (standover) and districts 15 (Productivity Board) and 16 (Tablelands) were omitted prior to data analysis.

For all 24 weeks of the 1995 season, the following data were recorded:

- Week, farm, rake, district, variety, crop class, state, ccs, rake weight, gross weight of extraneous matter, net weight of extraneous matter, number of red billets, number of bored billets and the number of dead billets

In week 18 of the season, an improved method of cane quality assessment commenced. This was to examine the possibility that weevil borer was the major cause of red colouration in the cane supply. Billets were split to check for the presence of weevil borers and were separated into different damage categories and weighed. Hence, from week 18 onwards additional data available were:

- Number of rat damaged billets, weight of dead/rotten billets, weight of bored billets, weight of rat damaged billets, weight of rind cracks.

It was not until week 22 of the season that the weight of 10 average sized billets was obtained. This allowed the average weight of a sound billet to be determined and from this the number of billets per sample to be calculated.

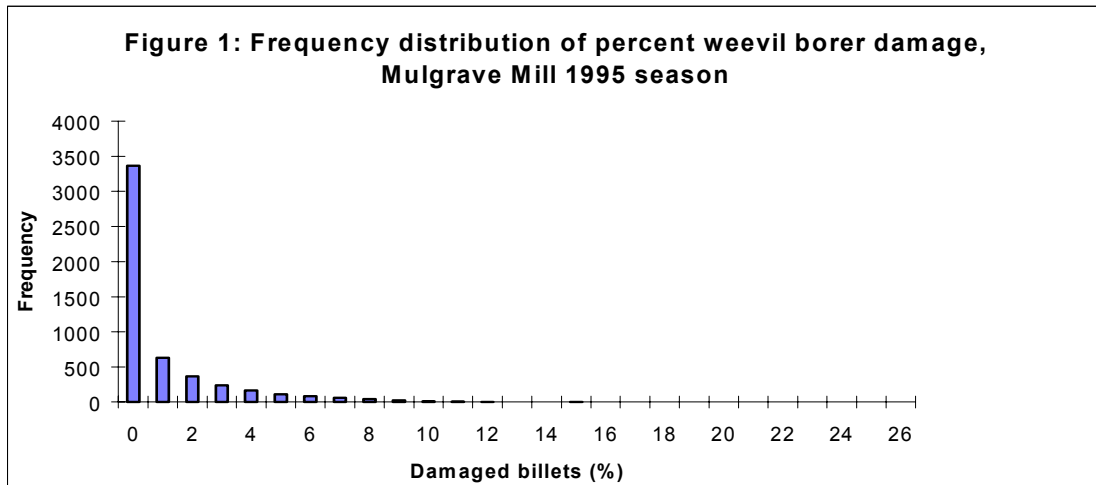
Data used for statistical analysis were:

- Week, district, farm, block, variety, class, state, ccs, percent damaged billets due to weevil borers

Following Pope and Johnson (1996), analyses were undertaken on the seven major varieties viz: H56-752, Q113, Q117, Q120, Q124, Q138 and Q152. As the data set from Mulgrave mill was large but unbalanced, this necessitated simple statistical analyses to be undertaken. All analyses were performed using SAS (SAS Institute 1990). As percent weevil borer damage was not normally distributed, an arcsin transformation was applied to the data prior to analyses. In the results section, raw means are given in the Tables but the significance tests are based on arcsin transformed data.

5.0 RESULTS AND DISCUSSION

During the 1995 season at Mulgrave mill, the mean percent billets damaged due to weevil borers ranged from 0 to 27% with an average of 1.3%. Three quarters of the rakes analysed had damage levels less than 1.7% (Figure 1).



In 1995, Mulgrave mill crushed 1.39 million tonnes with an average ccs of 11.84. The loss due to weevil borer amounted to approximately \$400,000 - \$600,000. This was calculated as a loss of 7 units on 1.3% of the crop. CCS loss due to weevil borers was measured by Pope and Johnson in 1995. BSES measured an average loss of 1.1 units on whole stalks (unpublished data) and Pope and Johnson used billets. Not only does weevil borers have a direct effect by decreasing ccs, but there are also other costs to the industry that BSES has been unable to calculate. These include yield loss and costs associated with increased impurities in juice and sugar.

Figure 2 shows the weekly variation in weevil borer damage during the 1995 season at Mulgrave mill. The level of damage fluctuated during the season with the second half of the season having more damage than the first: viz 2.2% compared to 0.4%. This would be due to the better sampling method used from week 18 on giving more accurate results.

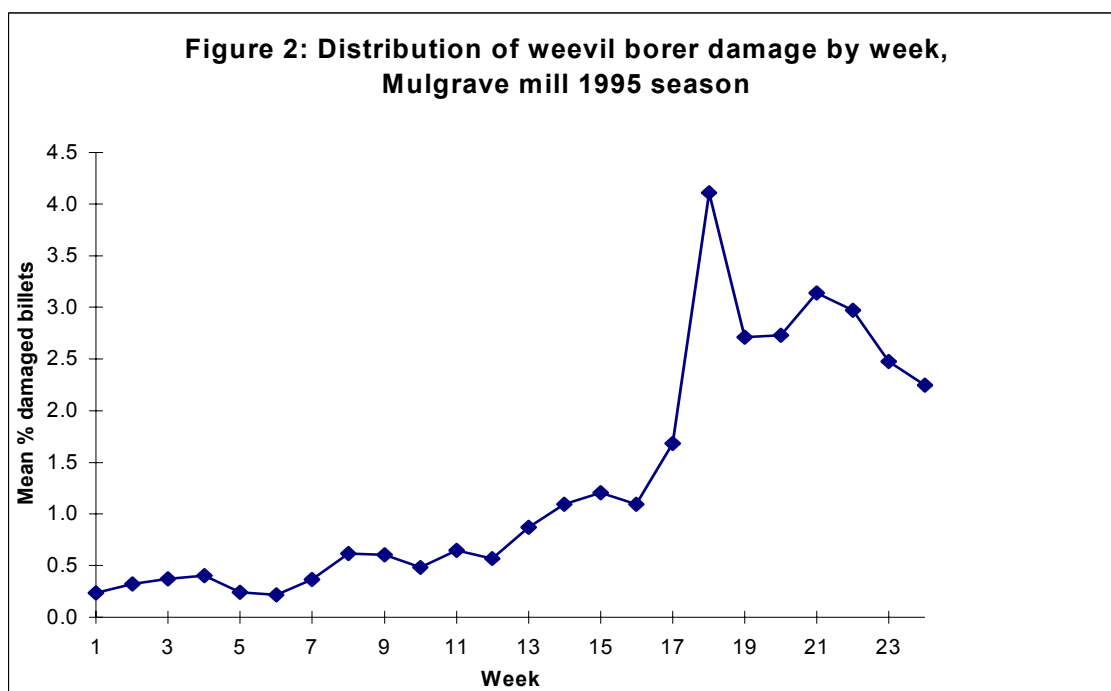


Table 1 gives the percent billets damaged by weevil borers for the major varieties in the Mulgrave mill area during the 1995 season.

From Table 1, it can be seen that the level of weevil borer damage in Q138 and Q113 were significantly greater than in any other variety ($p < 0.05$). Q117 was the most tolerant variety and the level of damage was significantly less than in any of the other varieties ($p < 0.05$).

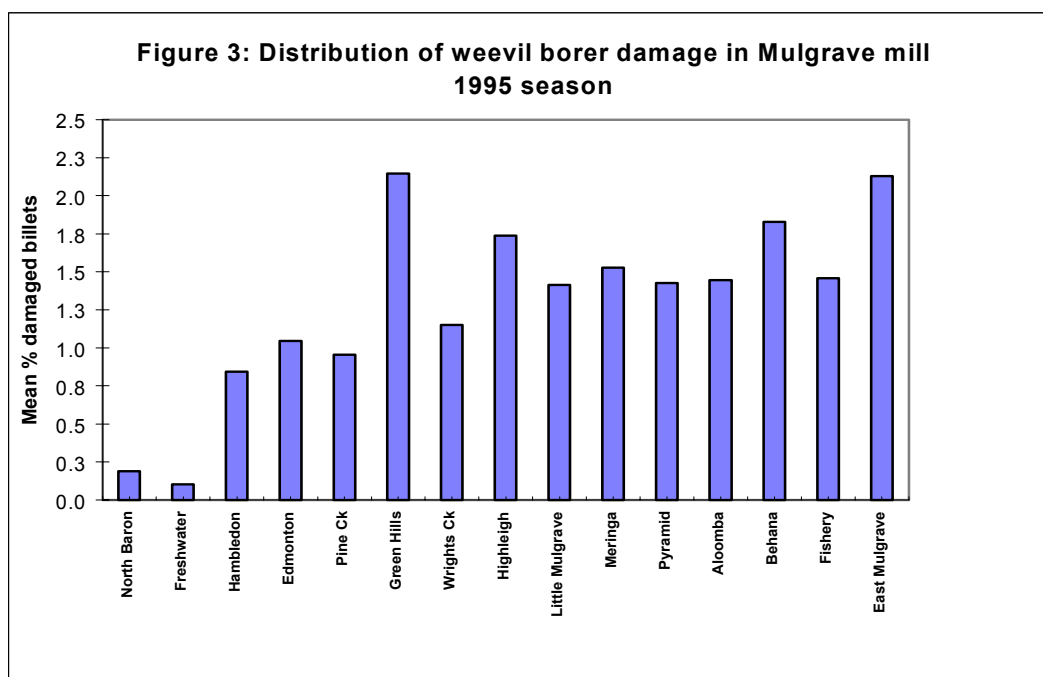
Table 1: Percent billets damaged by weevil borers for the major varieties, Mulgrave mill area, 1995 season.

Variety	Damaged billets (%)
Q138	2.08 ^a
Q113	1.71 ^a
Q120	1.10 ^b
H56-752	1.02 ^{bc}
Q124	1.00 ^{bc}
Q152	0.85 ^c
Q117	0.37 ^d

Note: Means followed by the same letter are not significantly different $P > 0.05$

These results have also been shown by BSES through field sampling (BSES unpublished data). Consequently, BSES now breeds and selects varieties tolerant to weevil borers as part of a management strategy.

Figure 3 shows the distribution of weevil borer damage throughout the 15 districts in the Mulgrave Mill area.



The two northern-most areas of Freshwater and North Baron had the lowest amount of damage while Green Hill and East Mulgrave had the highest. Data from Pope and Johnson (1996) on the percentage of cane supply by district reveals that Freshwater and North Baron had the highest proportion of the least susceptible variety, Q117 and this was reflected in a low level of damage. Green Hills has highest percentage of the most susceptible variety, Q138. Data were not available for East Mulgrave.

Damage in each crop class is given in Table 3.

Table 3: Percent billets damaged by weevil borers for each crop class, Mulgrave mill 1995 season

Crop Class	Damaged Billets (%)
Plant	0.9 ^c
Replant	0.7 ^c
First ratoon	1.6 ^a
Second ratoon	1.3 ^{ab}
Third ratoon	1.5 ^a
Fourth ratoon	1.2 ^b
Other ratoon	0.9 ^c

Note: Means followed by the same letter are not significantly different $P > 0.05$. Ploughout replant had the lowest level of damage but this was not significantly different to plant and other ratoon crops ($p > 0.05$).

The level of damage in green cane was 1.3 % and this was significantly greater than the 0.7% in burnt cane ($p < 0.05$). For burnt and green cane a comparison of the level of weevil borer damage in each variety was undertaken and this is summarised in Table 4.

Table 4: Percent billets damaged by weevil borer in burnt and green cane for the major varieties, Mulgrave mill 1995 season

Variety – Damaged billets (%)							
	H56-752	Q113	Q117	Q120	Q124	Q138	Q152
Burnt	1.1	1.3	0.1	0.6	0.4	1.4	0.9
Green	1.1	1.7	0.4	1.1	1.1	2.0	0.9

The results of statistical analyses undertaken on the data in Table 4 revealed that there was no significant interaction between variety and harvesting condition. This means the differences in percent weevil borer damage that exist among varieties and between harvesting conditions can be examined independently. You do not have to examine the interaction between variety and harvesting condition.

5.1 Recommendations

At a meeting that was held at Mulgrave mill in June 1996 the following recommendations were made:

- The method of assessment for weevil borer damage during routine extraneous matter analyses would be enhanced during the 1996 season. The total number of billets in each sample would be counted. Damaged billets would be weighed during the 1996 season to allow BSES to determine yield loss estimates due to weevil borer.
- A report presenting the proportion of tonnes damaged and the severity of damage by weevil borer would be more beneficial to the industry than displaying the proportion of samples showing damage.

5.2 Comparison to other studies

The level of weevil borer damage BSES found in the Mulgrave mill cane supply was remarkably different to that reported by Pope and Johnson (1996). BSES analyses were based on the proportion of the cane supply damaged while Mulgrave mill staff reported the proportion of samples damaged. Their high levels indicate that damage is widespread throughout the district but this does not take into account the severity.

Mulgrave mill data compares well with the field data collected by BSES. Both data sets show varieties with different levels of damage as well as identifying zones within a mill area more prone to weevil borer damage. The large number of samples done by Mulgrave mill compared to the small number by BSES reinforced the field sampling methodology and its results.

5.3 Difficulties in project

There were many difficulties in this project and these are summarised below:

- There were large delays in receiving the data due to the workload of Mulgrave mill staff and the complexity of the data due to method changes in assessing damage during the 1995 season.
- The very large data files that needed to be downloaded from the Mulgrave mill mainframe to BSES PCs made manipulation difficult.

6.0 REFERENCES

- Chang et al (1970) Clonal resistance of sugarcane to New Guinea sugarcane weevil (Coleoptera:Curculionidae) in Hawaii, *Hawaiian Planters' Record*, 58(8): 103-118.
- Pope, GM and Johnson, LR (1996) Assessment of Pest Damage in the Mulgrave Area Through Extension of the Extraneous Matter Analysis System, *Proc. Aust Soc. Sugar Cane Technol* 18: 82-89.
- SAS Institute (1990) SAS Stat Users Guide, version 6, Fourth Edition, Volumes 1 and 2, SAS Institute Inc, Cary, NC, USA.