

**BUREAU OF SUGAR EXPERIMENT STATIONS
QUEENSLAND, AUSTRALIA**

**SRDC PROJECT BSS230
SURVEY OF SUGARCANE IN EASTERN AUSTRALIA
FOR SUGARCANE SMUT**

by

B J Croft, R C Magarey and D J Smith

PR99003

Principal Investigators: B J Croft
Senior Research Officer
BSES
207 Old Cove Road
WOODFORD QLD 4514
Phone (07) 5496 3357

R C Magarey
Senior Research Officer
BSES
PO Box 566
TULLY QLD 4854
Phone (07) 4068 1488

Other Investigators: D J Smith
Research Assistant
BSES
207 Old Cove Road
WOODFORD QLD 4514
Phone (07) 5496 3357

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SUMMARY

Sugarcane smut is a serious disease of sugarcane that can cause yield losses in excess of 30% in susceptible varieties. The disease was found for the first time in Australia on 21 July 1998 in the Ord River Irrigation Area (ORIA) of Western Australia. An initial rapid survey in eastern Australian sugarcane crops and a review of disease inspections conducted in 1998 has failed to locate smut in eastern Australia.

Initiation of a more extensive sugarcane smut survey throughout Queensland and New South Wales was funded to systematically inspect 3.75% of the sugar production area. Over the two years, two surveys will be carried out to assess the presence of smut in Queensland and New South Wales. The presence or absence of sugarcane smut will enable appropriate quarantine or incursion management decisions to be made to reduce production losses.

The 1998-99 Queensland and New South Wales sugarcane smut survey was completed on 17 March 1999. No sugarcane smut was found within the 3,429 ha inspected. Approximately 4,774 blocks were inspected on 1,083 farms. During the survey, detailed pest and disease records were made and these will be of benefit to the local industries.

Growers and other industry personnel in Queensland and New South Wales were educated in the symptoms, optimal inspection time and production losses of sugarcane smut, by BSES extension officers soon after smut was found in the Ord. Publicity by the BSES Smut Survey Coordinator, CPPB staff and BSES extension officers during the 1998-99 season, re-emphasised the importance of smut while explaining the methodology of the survey. Farmers were encouraged to stay vigilant in surveying their blocks during daily farm operations.

Two four wheel motorbikes were purchased to assist with the smut survey. The bikes performed well in most situations and a number of CPPBs have purchased bikes for surveys and maintenance of seed plots.

Modifications were made to the cage design of the two four wheel motorbikes used by the smut survey coordinator. Crop diverters were bolted to the front corners of the cage to direct overhanging cane from the path of the bike. It was found that overhanging stalks remained undamaged after running the improved bike through the inter-row. CPPB staff commented on visibility problems associated with the mesh size of the cage. The mesh on the front face was removed after it was found that this part of the cage was unnecessary for protection against leaf abrasion.

The second east coast smut survey will commence in September 1999, two months earlier than the 1998-99 smut survey. During this survey the Survey Coordinator will spend five days with each CPPB. The extra two months will allow more fields to be inspected in each mill area.

1.0 INTRODUCTION

Sugarcane smut is a serious disease of sugarcane that can cause yield losses in excess of 30% in susceptible varieties. The disease was found for the first time in Australia on 21 July 1998 in the Ord River Irrigation Area (ORIA) of Western Australia.

An initial rapid survey in eastern Australian sugarcane crops failed to locate smut in eastern Australia. Travel by cane farmers to the ORIA and movement of machinery from the ORIA to eastern states prior to the discovery of smut has created opportunities for the disease to enter Queensland and New South Wales. There is also some chance that the atmospheric conditions that facilitated the incursion into the ORIA, may have carried the disease to the eastern states.

The disease primarily infects buds and may remain dormant until the buds germinate. Because of this it may be 6-12 months before any symptoms develop with the disease going undetected until it reaches sufficient intensity for a survey to have a reasonable chance of detecting an infected plant. Sugarcane smut may already be in the eastern states but undetected.

Detection of sugarcane smut as early as possible will allow action to be taken in conjunction with the sugarcane smut contingency plan, to slow the spread of the disease and to initiate control measures to reduce yield losses. If the disease cannot be found in the eastern states, continued quarantine and action to limit inoculum in the ORIA will be required. These actions can only be taken with confidence if the presence or absence of the disease in eastern states is known.

The major benefit from the project will be a better indication as to whether smut is in the eastern states. This will enable the most appropriate decisions to be made about actions to either prevent entry or control the disease if it is already present. Preventing entry of smut will save the sugar industry in the eastern states an estimated \$100 M for every year it is kept out. Early detection will allow the speedy implementation of control procedures and the minimisation of losses.

This report highlights the results of the first sugarcane smut survey carried out in Queensland and New South Wales from 10 November 1998 to 17 March 1999.

Smut was not found in any district during this survey.

2.0 OBJECTIVES

The objectives are to:

- Conduct specific smut surveys to determine whether sugarcane smut is present in eastern Australia.
- Through publicity campaigns encourage cane farmers to inspect their farms for smut.
- Collate all survey results and produce reports at least every year or as required.
- Educate industry in all aspects of smut as a threat to the eastern Australian industry.

3.0 EQUIPMENT

3.1 Survey equipment

Inspections within the cane blocks were carried out in the following ways:

3.1.1 Four wheel motorbikes

Two Yamaha Timberwolves (250cc 2wd) were used by the smut survey coordinator during surveys. Cages were engineered for the bikes to prevent face and eye injury from sugarcane leaves. The following CPPBs have used four wheel motorbikes: Mossman, Atherton Tablelands, Mulgrave, South Johnstone, Invicta, Ayr, Inkerman, Proserpine, Maryborough, Moreton, Rocky Point and Broadwater.

The Tully, Herbert, Mackay CPPB staff have purchased four wheel bikes.

3.1.2 Walking

Inspections took place in every district via this method, at some time during the survey.

3.1.3 Over-row spray machine

Farmer manufactured over-row spray machines were used by Mulgrave and Mourilyan CPPBs to inspect cane from above the crop. Safety harnesses and rails were put in place for safety reasons.

3.1.4 Inspections from the back of a utility

Cane was inspected from the tray of a utility along headlands and winch tracks in Isis, Bingera, Millaquin-Qunaba and Fairymead CPPBs.

3.2 Disinfection equipment

As a contingency for a smut incursion, a trailer with a set of protective clothing and disinfection equipment was carried to the sites being inspected.

The trailer contained:

- Spitwater cold water petrol HP 152/A high pressure water cleaner (2000 psi - 11 litres/min)
- 200 litre plastic drum and holder
- Toolbox
- 20 litre and 10 litre jerry cans for motorbike and pressure cleaner fuel (unleaded)
- 5 litre container of Chemtech CT – 18 concentrate truck wash
- Box of 20 Kimberly-Clarke Heavy duty Kleenguard disposable overalls (blue).

The washing equipment was used by the survey coordinator to wash all dirt, mud and seeds from the four wheel motorbikes, Ford Courier and trailer between mill areas. If the bikes became very muddy or the blocks within a farm had heavy weed infestations, the bikes were washed thoroughly at the farmer's shed before moving to another farm.

Personal disinfection equipment was placed in a backpack as a precautionary measure in case of smut incursion. This equipment was referred to as a Smut Incursion Kit (SIN kit) and included:

- Stiff bristled scrubbing brush to remove mud and dust
- Spray bottle for application of 70% alcohol
- Screw driver for removal of mud in soles of shoes
- 1 litre of 70% alcohol (diluted methylated spirits)
- Spare set of clothes (pants and shirt)
- Packet of 9 GLAD tie heavy duty garbage bags.

The SIN kit remained in the vehicle at all times.

4.0 METHODOLOGY

4.1 Survey area

The combined sugarcane smut surveys are expected to cover an area of 15,000 ha or 3.75% of the eastern Australian crop over two years. This would give approximately a >95% chance of detecting a 0.1% infection (assumptions: 100,000 - 4ha units = total 400,000 ha; 3,750 - 4ha units will be inspected.)

A target of 1% of the eastern Australian crop was set as a minimum coverage area for the 1998-99 sugarcane smut survey. The potential infection area per mill was comprised of the:

- Total ha harvested for milling
- Ha harvested for plants
- Ha left standover.

These three estimates were combined to produce the Area Under Cane (AUC) and referred to as the potential survey area. The required inspection rate per mill area was 1% of the AUC. The 1% was covered by inspecting 10% of blocks in a mill area then 10% of the rows within those blocks.

4.2 Inspections per mill area

Smut surveys were carried out by the Cane Protection and Productivity Board (CPPB) supervisor, staff and the smut survey coordinator when he visited each mill area. CPPB staff were given survey guidelines and training in identifying smut symptoms.

4.3 Area inspected per block

CPPB staff carried out 10% inspections in each block surveyed for sugarcane smut. This was achieved by inspecting two rows in twenty until the block was completed (ie 200 row block = 10 runs through block). A higher inspection intensity was used in approved seed plots and high risk farms. Inspections were made by either four wheel motorbike with cage, walking, over-row spray trike, the back of a utility or a mixture of these methods. The survey coordinator demonstrated and used the bikes with CPPB staff in most mill areas during his visits. Permission was sought by CPPB staff to enter cane farms before commencing a block inspection.

4.4 Crop class

Inspections were carried out in a mixture of plant and ratoon crops.

4.5 Varieties

Susceptible varieties were targeted; if no susceptible varieties were available, random selection of various varieties within the mill area were carried out.

4.6 Contact with the Ord

Farms which had a connection to the Ord, (personal contact or machines) were inspected first.

4.7 Age/Size of inspectable cane

Sugarcane was inspected if it was at waist to shoulder height (2-6 months old). Shoulder height cane was preferable. Smut whips are reported to peak in 6-7 month old cane.

4.8 Routine plant source inspection and disease surveys

CPPB staff generally conduct routine plant source inspections and some conduct surveys for diseases such as Fiji disease, mosaic, leaf scald and chlorotic streak. While conducting these surveys, CPPB staff also inspected for smut and these results were included in the smut survey data.

4.9 Database

A smut survey form was enclosed with the guidelines for conducting smut surveys which was sent to all CPPBs. Required details included:

CPPB Name	Block Number	Variety
Farm Name	Area of Block	Diseases Noted
Farm Number	Actual Area Inspected	
Inspection Date	Crop Class	

Mill maps were used to provide details on susceptible varieties, farm numbers, block numbers, variety, and crop class. Inspection results were recorded on disc by CPPB staff in Microsoft Excel or Microsoft Access under the above field names. On completion of the 1998-99 smut survey, the results were sent to the survey coordinator on disc or by e-mail and were analysed.

This information would be important should smut be located. It also allowed detailed records of the incidence of other important diseases such as Fiji disease and mosaic.

4.10 Publicity and awareness

Publicity was carried out during each visit to all mill areas through local papers, television, radio, shed meetings and BSES field days. Information presented highlighted the symptoms of smut, when to look for smut, the methodology of the smut survey and answers to questions about the four wheel motorbikes as survey transport. A number of specimens showing symptoms similar to smut were reported by growers.

4.11 Smut incursion

If smut was found by CPPB staff or the survey coordinator they were instructed to leave the specimen in the field after noting the location, then contact Barry Croft or Rob Magarey for positive identification.

Before entering the vehicle to leave a potentially infected block, thorough cleaning with the SIN kit was prescribed. This entailed the removal of clothes worn in the block; which were later sealed in a plastic bag before leaving the block, removal of soil from boots and spraying of hands, hats and boots with 70% alcohol. Details of personal disinfection were circulated through a BSES/CPPB fortnightly report.

Further information with regard to smut incursion was available in the “Sugarcane Smut – A Contingency Plan for the Australian Sugar Industry” report compiled by B J Croft and R C Magarey.

5.0 RESULTS

No sugarcane smut was found throughout Queensland and New South Wales during the 1998-99 survey.

5.1 Area inspected

The smut survey inspected a block area of 16.041 ha (actual area inspected 3,429 ha). A total of 4,774 blocks were inspected over 1,083 farms. Approximately 0.78% of the sugarcane fields on the eastern Australian coast were inspected for sugarcane smut disease.

A summary of the areas inspected in each Productivity Board district is shown in Table 1. Eight CPPBs inspected the target 1% or above with 16 CPPBs surveying between 0.20% to 0.76% of their mill areas.

5.2 Crop class

Plant crops made up 10% of the inspected area with the remainder being ratoon crops (*Appendix 1*). Inspections were biased toward ratoon crops because it was thought they may have been exposed to infection for a longer period than plant cane.

5.3 Varieties

A total of 65 varieties were inspected for sugarcane smut disease, including both experimental and commercial varieties (*see Appendix 2.1*). Of these 65 varieties, 26% (17) were susceptible, 5% (3) intermediate-susceptible, 8% (5) intermediate, 5% (3) resistant and 56% (37) unknown (*see Appendix 2.2*).

5.4 Publicity

An ABC radio interview was given by the survey coordinator during the Tully visit. Newspaper interviews were provided at Mossman, Proserpine and in the Herbert. Channel Seven local news interviewed the survey coordinator during the Mackay visit. The smut survey coordinator spoke at one of the Bingera cell group meetings, at a Moreton grower meeting, and a Rocky Point grower meeting. A display on smut disease and the survey was prepared and presented at all BSES field days. Articles on the survey were included in two issues of the BSES Bulletin.

**Table 1. Percentage of Mill Areas Surveyed during the 1998/99
Smut Survey as at 28 March 1999**

CPPB	TBA	AAI	AUC	% INSP
MOSSMAN	311	32	12407	0.26
ATHERTON TABLELANDS	15	4	2170	0.20
MULGRAVE	631	87	13900	0.62
BABINDA	664	66	10496	0.63
MOURILYAN	138	138	12028	1.14
SOUTH JOHNSTONE	102	38	14844	0.26
TULLY	198	64	23684	0.27
HERBERT	541	366	60476	0.60
INVICTA	1673	201	26376	0.76
AYR	650	212	29662	0.72
INKERMAN	282	70	16190	0.43
PROSERPINE	885	169	22226	0.76
MACKAY	956	179	81775	0.22
PLANE CREEK	448	319	20564	1.55
BINGERA	257	138	12537	1.10
FAIRYMEAD	2711	154	14087	1.09
MILLAQUIN-QUNABA	641	87	11742	0.74
ISIS	2920	363	13039	2.78
MARYBOROUGH	170	33	10871	0.30
MORETON	975	235	7470	3.15
ROCKY POINT	204	29	5003	0.59
CONDONG	205	23	5817	0.39
BROADWATER	222	207	7288	2.84
HARWOOD	216	216	6343	3.41
TOTAL AREA INSPECTED	16014	3429	440995	0.78

TBA Total Block Area (Total block area inspected per district)

AAI	Actual Area Inspected	(Area inspected by eye)
AUC	Area Under Cane	(Area including ha harvested for milling, ha harvested for plants and ha left standover).

6.0 DISCUSSION

6.1 1% Inspection target

The statewide 1% inspection target was not achieved during the 1998-99 sugarcane smut survey. This was due to a number of reasons.

The 1998/99 season has been the wettest season for many years in most districts of the Queensland and New South Wales sugar industry. This wet weather hampered the survey in many districts.

Rapid growth brought about by wet conditions and hot sunny days reduced the number of blocks at inspectable height.

After the finding of smut in Western Australia, BSES and the CPPBs conducted an initial rapid survey. No smut was found during the survey and planning commenced to conduct a more exhaustive survey. The requirements for a survey were defined and a protocol prepared. Equipment was purchased and staff appointed and trained. After this preparation, CPPBs commenced surveys as soon as suitable cane was available and their other responsibilities allowed. The survey coordinator commenced work with the CPPBs in Tully in November. Surveys continued until March with plant source inspections for autumn planting in many areas and Fiji disease surveys continuing until May.

In the 1999-2000 crop, surveys will commence in September which will allow a greater area to be covered. Hopefully better weather conditions will also assist the survey.

6.2 Survey equipment

The four modes of infield survey transport worked well in the smut survey. However each method had its down side.

The four wheel motorbike had trouble fitting through inter-rows less than 1.5m or where the cane exceeded 3rd ratoon. However the four wheel motorbike was the best infield survey transport in most mill areas due to the following characteristics:

- Easy access on/off utility
- Easily transported between mill areas on back of utility
- No licence required
- Cheap to run [1 tank per 2 days (5 hour day)]
- Easy access up inter-row space (1.5m)
- Handles wet conditions in trash blanket blocks
- Easy to clean
- Easy to store
- Little down time between block inspections in the one area
- Caged version prevents leaf abrasions
- Reduces fatigue in tropical conditions.

Walking inspections were carried out by most CPPB staff during the survey. This method of transport is the cheapest and access up narrow inter-row spaces was easy; however it has the following downsides.

- Leaf abrasion occurs
- Fatigue in tropical conditions
- Down time walking between blocks in one area
- Concentration can deteriorate

Over-row spray trikes were used by the Mulgrave and Mourilyan CPPBs. These machines carried out fast block inspections by surveying six rows in one pass. The complete crop could be browsed due to high elevation in the field. Fatigue was also reduced by being above the crop in circulating air. The over-row spray trike has the following downsides.

- Expensive running and hire costs compared to four wheel bike
- Transport of machine difficult on highways or between areas
- Licensed driver required
- Storage of machine difficult
- Organisation of farmer for survey with machine must be arranged
- Hard to inspect base of stool for smut whips due to elevation.

The back of a utility was used to gain elevation to inspect cane inside and along headlands and winch tracks surrounding inspectable blocks. This method allowed quick coverage of headlands and winch tracks in many blocks with no fatigue and little cost. Inspections can be carried out when CPPB staff have spare time or are called to a farm for other reasons. The downside of this method includes:

- Area inspected depends on size of block (2.5% inspected per 5 ha block) and inspectors ability to survey
- Extensive inspection of cane within the block does not occur (may miss infected stools within block)
- Two people required to carry out inspections in larger cane for accurate inspections (one driver, one inspector).

6.3 Crop class

Ratoon cane was preferred for smut inspections because of longer exposure to possible infection. Unspecified ratoon cane was grouped into one column in Appendix 2 and made up 36% of the area covered in the survey. The absence of ratoon status in this group was due to the lack of correct information at the time of inspection.

6.4 Varieties

The varieties inspected of unknown smut resistance totalled 37 of the 65 varieties inspected. These varieties are composed of varieties above Q146 which have not yet been rated for smut resistance. The unknown group also included clones from BSES trials. Ratings for these clones will be available from smut resistance trials in Indonesia in the near future.

The intermediate variety Q124 was inspected in most districts because it makes up such a large proportion of the crop. A total of 1,277 ha of Q124 was inspected which was the largest area inspected per variety in the survey. Field observations in the Ord suggest that Q117 is susceptible to smut which makes this variety a priority for inspection; 683ha of this variety were inspected. Another susceptible variety Q120, covering 187 ha, made up the third largest area, with mixed blocks and Q151 making up the fourth and fifth largest areas respectively. Random inspections of intermediate and resistant varieties were carried out if susceptible varieties were not available.

6.5 Publicity

Canegrowers throughout Queensland and New South Wales are well informed on the symptoms, production losses and transmission of sugarcane smut as a result of meetings held by BSES extension officers. The follow-up publicity carried out by BSES survey coordinator, BSES extension officers and the CPPB staff reinforced this information and encouraged farmers to inspect their own farms during daily farm operations. Publicity of this kind was used to explain what the smut survey was about and to keep the issue of sugarcane smut in the minds of farmers.

Given the transmission pathways of the fungus and the proximity of the Ord and Indonesia to the eastern Australian production area, it is possible that Queensland and New South Wales may be affected by the disease. Awareness of sugarcane smut within the sugar industry is therefore paramount for early detection of the fungus. Early detection will reduce production losses.

7.0 DIFFICULTIES ENCOUNTERED DURING SURVEY

7.1 Rain

The La Nina event experienced during the 1998-99 smut survey hampered inspections. The absence of trash blankets in cane blocks prevented access in some fields. Where trash blankets were present on sandy soils, the four wheel motorbikes and walking inspections could be carried out even when water covered the trash blanket.

A moderate amount of time was spent waiting for blocks to dry out, which in some cases was responsible for itinerary changes for the survey coordinator's visits.

7.2 Visibility through cages of four wheel motorbikes

Visibility through the cages on the four wheel motorbikes was affected by the 1 inch holes of the mesh. Initially survey focused on the cage rather than the cane. However after making 4-5 runs through a block, the cage ceased to be the centre of focus.

To help alleviate the problem, the mesh on the front face of the cage was removed as it was not needed for facial protection.

7.3 Damage of stalks in inter-rows

When travelling along the inter-row on the four wheel motor bikes it was found that stalks growing at 65-90 degrees to the stool would be damaged. The number of stalks damaged was minimal but mainly occurred in inter-rows less than 1.5 m, or crops greater than 4th ratoon. Cage design was responsible for the damage.

The damage of stalks in inter-rows was minimised by the attachment of crop diverters to the front corners of the cage. When tested on sprawled cane, the cane was diverted out of the bike's path, which prevented damage.

7.4 Data requirements updated

The smut survey form circulated to all CPPBs contained the required information for the survey database. Variety and crop class were not included on the form. CPPBs were notified in the BSES/CPPB smut survey fortnightly report (18/03/1999) of these additional requirements before the recall of smut survey results.

The program used for recording results was mainly Excel; a standardised format was not circulated. This made compilation of the database lengthy.

8.0 RECOMMENDATIONS FOR THE 1999-2000 SMUT SURVEY

8.1 Survey start

The 1999-2000 smut survey should start in September 1999 when the early cut blocks are 2-6 months old. This will allow a larger area to be inspected given two months extra survey time on the previous survey.

The survey coordinator should spend five days surveying with staff of each CPPB during the 1999-2000 smut survey.

8.2 Database revision

A standardised database with the following information should be circulated before the commencement of the 1999-2000 statewide smut survey:

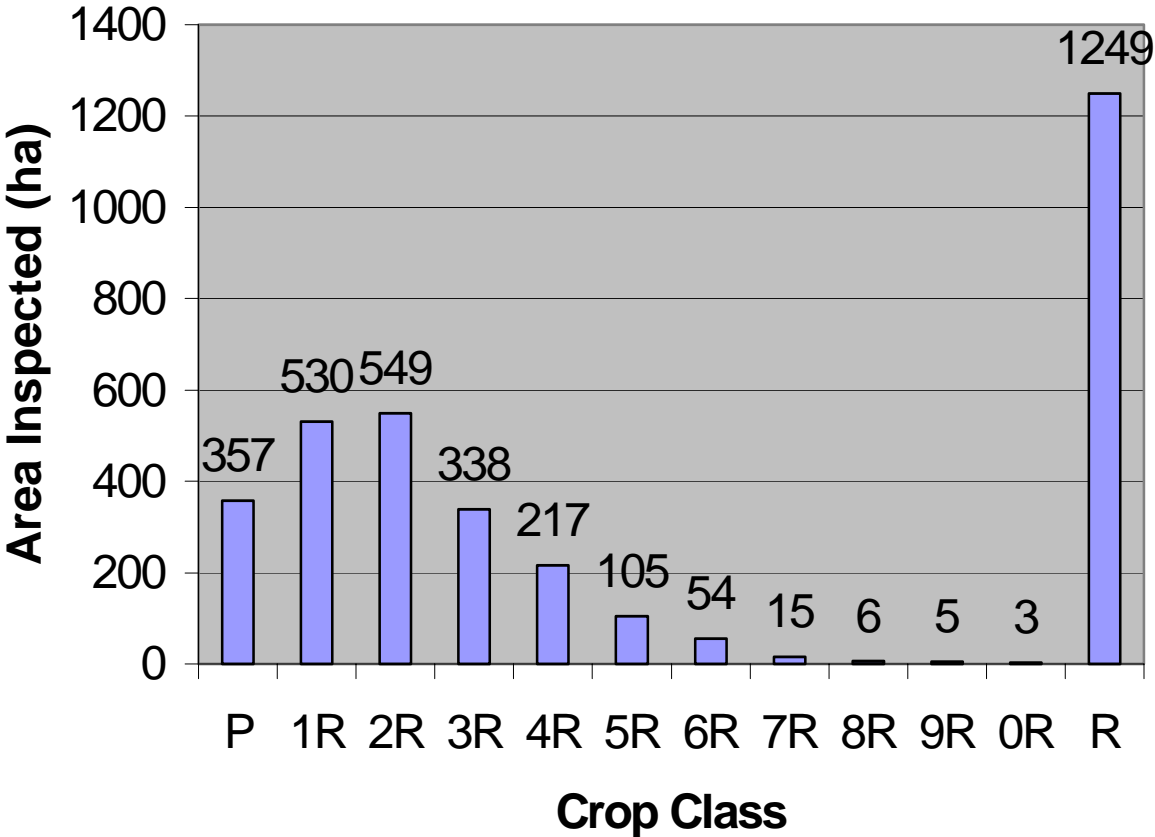
CPPB	DATE	GROWER'S NAME
FARM NUMBER	BLOCK NUMBER	VARIETY
CROP CLASS	AREA OF BLOCK	ACTUAL AREA INSPECTED
DISEASES		

9.0 ACKNOWLEDGMENTS

We acknowledge the support of all CPPB staff throughout Queensland and New South Wales who contributed to the survey through inspection.

APPENDIX 1

Area Inspected per Crop Class during the 1998-1999 Queensland and New South Wales Sugarcane Smut Survey



APPENDIX 2.1

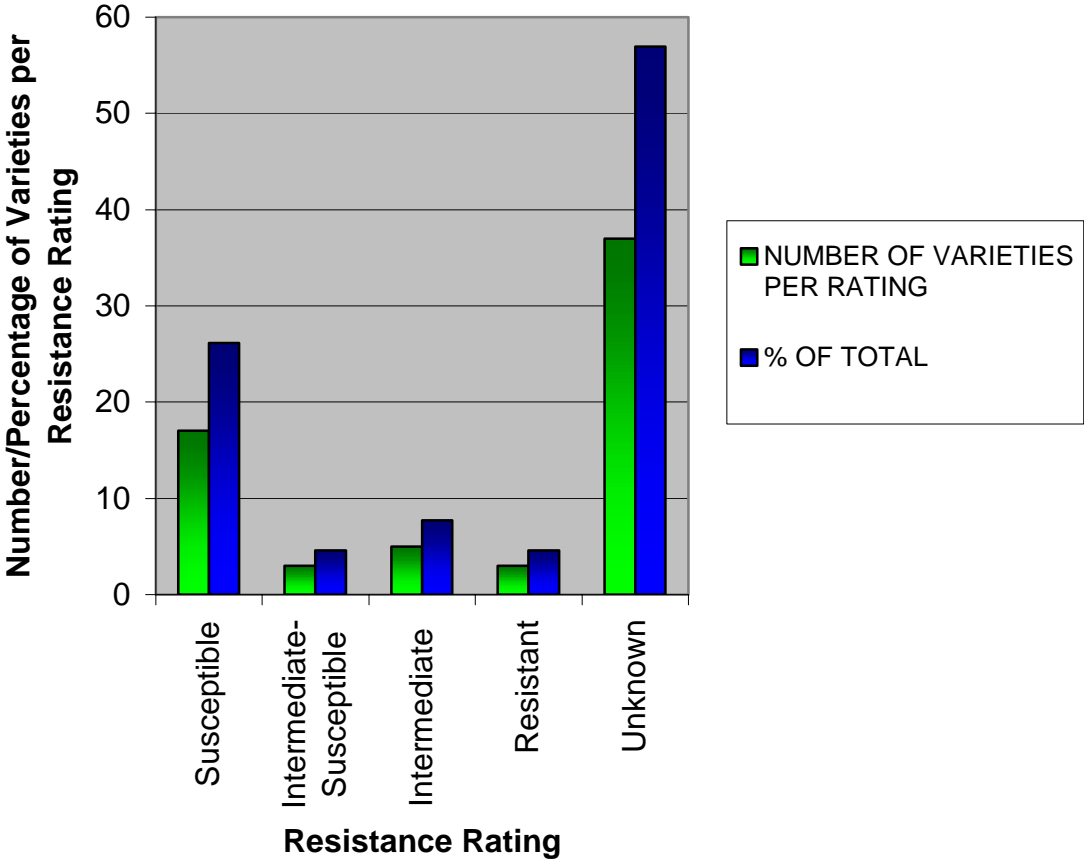
Variety	Smut Rating	Actual Area Inspected (ha)
75C326	U	0.22
83S1825	U	2.18
ARRIS	U	65.84
BN1064	U	0.81
BN332H	U	3.6
BN73-3416	U	21.91
BN74-4445	U	1.9
BN81-1394	U	2.69
CONCORD	U	1.08
CP44-101	S	8.89
CP51-21	S	66.86
DART	U	1.685
DELTA	U	0.722
ENCORE	U	1.33
EOS	U	0.03
ESK	U	11.69
H56-752	U	1.53
MIXED	U	168.65
NA	U	171.26
PINDAR	I	3.71
Q107	S	15.02
Q110	S	54.76

Variety	Smut Rating	Actual Area Inspected (ha)
Q113	I-S	3.79
Q115	S	0.25
Q117	S	683.04
Q119	I-S	8.03
Q120	S	187.65
Q121	S	7.85
Q122	S	2.21
Q124	I	1277.12
Q125	S	4.31
Q127	S	21.14
Q130	S	1.99
Q133	R	28.07
Q135	S	49.95
Q136	S	41.36
Q137	S	22.485
Q138	I	66.96
Q140	U	0.15
Q141	S	87.55
Q143	U	1.18
Q145	R	1.46
Q146	I	30.63
Q150	U	12.56

Variety	Smut Rating	Actual Area Inspected (ha)
Q151	I	121.23
Q152	U	4.14
Q153	U	0.208
Q154	U	11.89
Q155	U	40.352
Q158	U	0.8
Q159	U	0.8
Q163	U	0.8
Q164	U	6.51
Q165	U	14.6
Q167	U	1.48
Q168	U	0.03
Q169	U	0.68
Q170	U	13.12
Q174	U	0.3
Q179	U	0.2
Q68	I-S	0.69
Q96	R	30.22
RB72-454	S	5.73
TRIAL	U	27.33
TS65-28	U	1.63

APPENDIX 2.2

Number of Varieties Inspected per Smut Resistance Rating during the 1998-99 Queensland and New South Wales Sugarcane Smut Survey



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SRDC PROJECT BSS230 - SURVEY OF SUGARCANE IN EASTERN AUSTRALIA FOR SUGARCANE SMUT

BY

B J CROFT, R C MAGAREY AND D J SMITH

SENT TO:

AS PER ATTACHED

**BY CHRIS
2 JUNE 1999**