

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

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

by

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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) in Western Australia. An initial rapid survey in eastern Australian sugarcane crops and a review of disease inspections conducted in 1998 failed to locate smut in eastern Australia.

Determining the true status of sugarcane smut in Queensland and New South Wales is important so that appropriate control measures can be commenced if it is present, or strict quarantine can be enforced if the disease is not present. Systematic surveys were planned for all districts in Queensland and New South Wales to inspect high risk sugarcane crops and a random selection of other crops. Crops were considered to be high risk if the assignment had brought machinery from the ORIA, the grower had visited the ORIA, or the crop was of a susceptible variety. A coordinator was appointed to train the Cane Protection and Productivity Board and Bureau of Sugar Experiment Stations staff in the identification sugarcane smut, assist with the survey and to collate the results of the survey. He also conducted media campaigns and spoke at industry meetings to inform canegrowers and industry personnel of the risks of an incursion of sugarcane smut and to enlist their assistance in locating possible incursions.

Over the two years of the survey, 44,415 ha in 12,535 fields were inspected, which represents approximately 10% of the crop in Queensland and New South Wales. Within fields an average of 20% of the crop was inspected. The survey gave a 99.8% probability of detecting one infected field in 2,000 fields (0.05%) and 98% probability of detecting one infected plant in 1,000 plants within a field (0.1%). In the first year, 1,083 assignments were visited and in the second year 1,671 assignments were visited. This represents about 20% of the sugarcane assignments in the eastern states. No sugarcane smut was found.

During the survey, the incidence of serious endemic diseases was recorded. Sugarcane mosaic disease was found to be widespread in the variety Q124 in the Isis and Moreton districts. Mosaic was also reported in the Bingera and Fairymead districts. Fiji disease was noted in Rocky Point, Broadwater and Harwood in Q124 and other intermediate to susceptible varieties. A few isolated Fiji diseased plants were also found in Maryborough and Moreton. Chlorotic streak was widespread in many districts but was of greatest concern in the Burdekin where it is increasing. The sugarcane smut surveys gave many areas an opportunity to monitor the incidence of other diseases and will assist them in planning future disease control activities. The use of four-wheel bikes for surveying diseases was a new innovation introduced to the industry by the smut survey. This equipment greatly improved the working conditions for the survey teams.

BSES Bulletin articles, presentations at shed meetings, field days and other industry meetings, and newspaper, radio and television articles were used to promote sugarcane smut awareness. There is a high degree of awareness in the industry of the sugarcane smut threat.

The smut survey coordinator assisted with inspections in a field in the Plane Creek area, which was planted with forage sorghum seed that had originated from the ORIA. This seed was under quarantine restrictions, which prohibited its planting on sugarcane assignments. No sugarcane smut was detected in the volunteer sugarcane growing in the field. The field was ploughed to destroy the plants and left fallow to ensure no sugarcane smut spores could survive.

The sugarcane smut survey of Australia's eastern coast did not find sugarcane smut in cane growing in Queensland and New South Wales. The absence of sugarcane smut has reinforced the need for continued quarantine and action to reduce the area planted to smut susceptible varieties in the ORIA to reduce the risk of spread of the disease.

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 the 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. Travel by canegrowers to the ORIA and movement of machinery from the ORIA to eastern states prior to the discovery of smut had created opportunities for the disease to enter Queensland and New South Wales. There was also the possibility that the atmospheric conditions that facilitated the incursion into the ORIA, may have carried the disease to the eastern states. The status of sugarcane smut in the eastern states was uncertain at the commencement of the current survey.

Sugarcane smut infects plants when spores come in contact with buds on standing stalks or germinating buds in the soil. The fungus penetrates the buds and the fungal hyphae grow in close association with the plants' meristems. It can be 6-12 months before any symptoms develop after the spores penetrate the bud. Eventually the fungus causes the plant to form a modified floral structure within which the fungus produces masses of brown/black teliospores. The sorus, or fruiting structure of the fungus, is known as a whip and can be from a few centimetres to 1.5 m long. The spores initially are enclosed in a thin silvery membrane, which ruptures and releases the spores to be spread by the wind. Infected plants are generally stunted and may produce many thin, grassy tillers.

Detection of sugarcane smut as early as possible will allow actions to be taken 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 the eastern states is known.

The major benefit from the project will be a better indication as to whether smut is in the eastern states. Preventing entry of smut will save the sugar industry in the eastern states an estimated \$200M for every year it is kept out. Early detection will allow the speedy implementation of control procedures and the minimisation of losses.

This report describes the results of a two-year sugarcane smut survey carried out by Cane Protection and Productivity Board (CPPB) and Bureau of Sugar Experiment Stations (BSES) staff in Queensland and New South Wales between the 10 November 1998 and the 17 March 2000.

2.0 OBJECTIVES

The objectives were to:

- Conduct specific smut surveys to determine whether sugarcane smut is present in eastern Australia.

- Through publicity campaigns encourage canegrowers to inspect their assignments 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 east Australian industry.

3.0 METHODS

3.1 Training

Daniel Smith was appointed by BSES in October 1998 as a research assistant to coordinate the Queensland and New South Wales sugarcane smut surveys. He was contracted for two years to coordinate the sugarcane smut surveys.

In October 1998, Daniel travelled to the ORIA and received training in identification of sugarcane smut from Roger Bailey (South African Sugar Association Experiment Station) and Brian Egan (BTE Consultant Pathologist). In August 1999, Daniel visited the ORIA again to see how the smut situation had changed over 10 months since his previous visit and to refresh himself with sugarcane smut symptoms.

Before the commencement of the survey in each district, Daniel trained the local CPPB and BSES staff in the identification of sugarcane smut and conducted training in the use of the survey equipment and disinfection procedures if smut was found.

3.2 Survey equipment

3.2.1 Four-wheel motorbikes

Inspections within the cane blocks were carried out in number of ways to maximise the area covered and the probability of detecting sugarcane smut. Four modes of infield transport were used to inspect the cane for smut.

The most efficient transport used was four-wheel motorbikes. Four-wheel motorbikes are used extensively by farmers for application of pesticides and for general transport around farms, particularly to manage irrigation. Two Yamaha Timberwolves (250cc 2wd) were purchased by BSES and used extensively by the smut survey coordinator and CPPB staff during the smut surveys. The use of the four-wheel bikes was very successful and a number of CPPBs purchased bikes for use in disease surveys and for maintenance of Approved Seed plots as a result of the sugarcane smut survey.

Daniel Smith instructed many CPPBs in the use of the four-wheel motorbikes. The conditions in some mill areas were unsuitable for the four-wheel motorbike because of row profile, row spacing and waterlogged soil. However, bikes were used in Mossman, Atherton Tableland, Mulgrave, Babinda, Mourilyan, South Johnstone, Tully, Herbert, Ayr, Invicta, Inkerman, Proserpine, Mackay, Plane Creek, Millaquin-Qunaba,

Maryborough, Rocky Point and Broadwater mill areas. The bikes allowed large areas to be covered in a short time. The Tully, Herbert, Mackay, Ayr, and Inkerman CPPBs have purchased four-wheel bikes as a result of the smut survey.

3.2.2 Walking

Traditionally disease inspections have taken place by walking through the interspaces of cane blocks. In some districts, part of the survey was conducted by this method. Plant source inspections were included as part of the survey. Plant source inspections are usually conducted by walking every interspace and inspecting 100% of the rows nominated as the plant source.

3.2.3 Over-row spray machine

Over-row spray machines were used by Mulgrave, Mourilyan and Tully CPPBs to inspect cane from above the crop. These machines were useful in mill areas where blocks to be inspected were in close proximity to each other and were not broken up by major roads.

3.2.4 Inspections from a vehicle

The presence of winch tracks at frequent intervals allowed inspections in the Bundaberg and Childers regions to be conducted from a conventional four-wheel drive vehicle. Large areas were inspected in the Isis, Bingera, Millaquin-Qunaba and Fairymead mill areas from the window of a vehicle. Headlands and winch tracks were driven down while inspecting cane on either side of the vehicle. In these inspections it was estimated that between, one and five percent of the block was effectively surveyed. The larger the cane the lower the effective area of inspection for every pass of the vehicle.

3.3 Disinfection equipment

As a contingency in case smut was found, a trailer with protective clothing and disinfection equipment accompanied Daniel Smith to each mill area.

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
- 5 litre container of Chemtech CT – 18 concentrate truck wash
- Box of 20 Kimberly-Clark Heavy duty Kleenguard disposable overalls

The washing equipment was used by the team to wash all dirt, mud and seeds from the four-wheel motorbikes, vehicles and trailer between mill areas. If the bikes became very muddy, or the blocks within an assignment had heavy weed infestations, the bikes were washed thoroughly at the growers shed before moving to another assignment.

Personal disinfection equipment was placed in a backpack as a precautionary measure in case smut was found. 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
- Screwdriver 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. Details of personal disinfection procedures were circulated in the BSES Smut Survey Fortnightly Report (25/01/1999) during the first smut survey and a glove box guide was prepared and circulated to all industry field staff (Appendix 1).

3.4 Survey method

The aim of the survey was to determine if sugarcane smut was present in Queensland and New South Wales with a high degree of confidence. The sampling strategy was based on a number of assumptions to determine the sample units and the number of samples to be taken during the survey. For the purposes of the survey the sugar production area of Queensland and New South Wales was assumed to be 400,000 ha with an average block size of 4 ha. The total number of blocks was therefore 100,000. Each block was considered a sample unit.

It was assumed that the incidence of smut would be low. To increase the chances of detecting the disease, the plan was to survey as many blocks as possible and to concentrate on high risk blocks containing susceptible varieties and blocks on assignments that had contact with the ORIA. The target number of blocks to survey listed in the SRDC project proposal was 3,750. This would give a total of 15,000 ha to be inspected each year. As a guide for the CPPBs they were asked to inspect 10% of blocks in their district and 10% of the area in each block.

The binomial distribution is used to estimate the number of samples required to detect disease at different levels of incidence (Cannon and Roe, 1982). To have a 99% probability of detecting a 0.1% infection, 4,603 samples should be taken. The surveys aimed to achieve approximately this order of confidence. Within each block, it was suggested that 10% of the block area should be inspected for smut. This would give a 99% probability of detecting 0.2% infection level within a block.

3.5 Selection of crops to survey

3.5.1 Crop class

Inspections concentrated on ratoon crops because they had been growing for longer and therefore exposed to the risk of infection for a greater period. Where no suitable ratoon crops were available plant crops were selected.

3.5.2 Varieties

Susceptible varieties were inspected first. However, intermediate and resistant varieties, and varieties where the smut resistance was unknown, were included in the random selection of other blocks after the high risk blocks had been surveyed.

3.5.3 Contact with the ORIA

Assignments that had a connection to the ORIA were inspected extensively. The types of contact included:

- The grower had visited the ORIA.
- The assignment had purchased second-hand machinery from the ORIA.
- The harvesting contractor in the ORIA also contracted to harvest cane on assignments in the eastern states.
- Family connections between owners of assignments in the ORIA and in the eastern states, or growers owned or had owned farms in the ORIA and in the eastern states.

3.5.4 Age/size of cane

Blocks of cane were inspected if they were between waist and shoulder height (2-6 months old). Cane at 6 months of age was preferable because smut whips are reported to peak in 6-7 month old cane. Cane at this stage of growth is also ideal for inspection because the cane can be surveyed visually from vehicles or from walking height.

3.5.5 Geographic region

Fields that fitted the criteria listed above were selected in geographic sub-districts to give coverage of the whole district.

3.5.6 Routine plant source inspections and disease surveys

CPPB staff conduct routine plant source inspections and some conduct surveys for diseases and pests such as Fiji disease, mosaic, leaf scald, chlorotic streak, canegrubs and itch grass. While conducting these surveys, CPPB staff also inspected for smut and these results were included in the smut survey data. The smut survey allowed other important diseases and pests to be recorded over large areas of the industry.

3.6 Database

A smut survey form was enclosed with the guidelines for conducting smut surveys before the first survey was initiated. The guidelines included block inspection information to be recorded in the database. Before the commencement of the second survey a revised set of guidelines was distributed in the Queensland and New South Wales Smut Survey Update (6/10/1999). Required inspection details for the database included:

CPPB Name	Block Number	Variety
Assignment Name	Area of Block	ORIA Contact
Assignment Number	Actual Area Inspected	Diseases Noted
Inspection Date	Crop Class	

Mill maps were used to provide details of varieties, assignment numbers, block numbers and crop class. Inspection results were recorded on disk by CPPB staff in Microsoft Excel® or Microsoft Access® under the above field names. On completion of the surveys in the two seasons the results were sent to the survey coordinator on disk or by e-mail to be compiled.

3.7 Smut survey reports and updates

Smut survey reports were distributed to CPPBs, BSES stations and centres and other concerned parties detailing fortnightly and monthly progress during the survey periods. Survey updates were distributed to communicate housekeeping matters.

3.8 Publicity and awareness

Publicity was carried out during each visit to all mill areas through local papers, television, radio, grower meetings and BSES field days. Information given in the media releases included the symptoms of smut, when to look for smut, the methodology of the smut survey, and the current smut situation in the ORIA. Articles were also prepared for inclusion in the *BSES Bulletin*, which is sent to every canegrower in Queensland and New South Wales. A glove box guide to the identification of sugarcane smut was included in one issue of the *BSES Bulletin*.

Posters and pamphlets on sugarcane smut quarantine were prepared and placed at strategic places such as sugar industry offices, airports, transport agents and second-hand machinery dealers in Queensland, New South Wales and Western Australia. Roadside billboards were placed on the main roads out of Kununurra to advise travellers of the sugarcane smut quarantine.

3.9 Quarantine inspections

During 1999, seed produced in the ORIA that was likely to be planted in fallow sugarcane fields was identified as a potential risk for introducing sugarcane smut. Forage sorghum, Lab Lab, cowpea and soybeans were identified as the high risks. Under the Sugarcane Smut Proclamation and the Plant Protection Act in Queensland, seed of these crops from the ORIA was prohibited from planting on cane assignments in Queensland. Bags containing seed from the ORIA are labelled that the seed is not to be planted on a parcel of land in Queensland with a cane assignment.

On the 5 March 2000, BSES was notified of a planting of forage sorghum from the ORIA on assigned land in the Plane Creek mill area. Daniel Smith flew to Mackay on the 6 March 2000 to inspect volunteer cane in the forage sorghum field for symptoms of smut. All volunteer sugarcane plants in the sorghum, and in a fallow section of this block, were thoroughly inspected. Inspections were also carried out in immediately adjacent blocks containing Q124, Q138 and Q136.

4.0 RESULTS

4.1 Area inspected

In the first year of the smut survey (10 November 1998 – 17 March 1999) a total of 4,774 blocks on 1,083 assignments was inspected. The area covered by the survey teams was 16,041 ha (Table 1). The second year of the smut survey (6 September 1999 – 17 March 2000) covered an area of 28,375 ha with a total of 7,761 blocks inspected over 1,671 assignments.

No sugarcane smut was found in Queensland or New South Wales during the 1998-1999 and 1999-2000 survey periods.

TABLE 1

**Total area inspected in each CPPB district during the Queensland
and New South Wales smut survey**

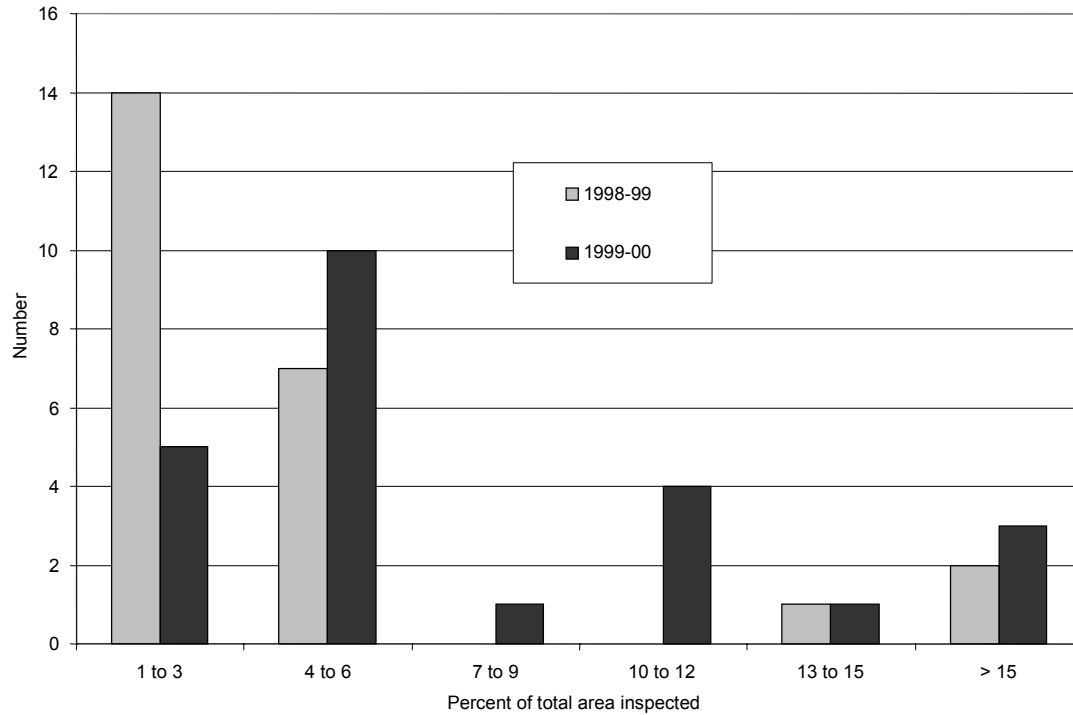
CANE PROTECTION AND PRODUCTIVITY BOARD	1998-1999				1999-2000			
	Area of blocks inspected (ha)	Mean % inspected within blocks	Area of cane in district (ha)	% of total area in district	Area of blocks inspected (ha)	Mean % inspected within blocks	Area of cane in district (ha)	% of total area in district
AYR	650	33	29,662	2	2,572	14	30,622	8
BABINDA	664	10	10,496	6	297	19	10,622	3
BINGERA	257	54	12,537	2	502	63	12,967	4
BROADWATER	222	93	7,288	3	408	65	7,443	5
CONDONG	206	11	5,817	4	315	15	5,790	5
FAIRYMEAD	2,713	6	14,087	19	3,116	5	14,110	22
HARWOOD	216	100	6,343	3	855	36	6,343	13
HERBERT	557	66	60,476	1	860	48	61,088	1
INKERMAN	282	25	16,190	2	749	23	16,512	5
INVICTA	1,673	12	26,376	6	2,962	10	27,778	11
ISIS	2,920	12	13,039	22	2,283	10	13,641	17
MACKAY	956	19	81,775	1	2,113	18	83,299	3
MARYBOROUGH	170	19	10,871	2	725	15	11,368	6
MILLAQUIN-QUNABA	641	14	11,742	5	1,905	10	11,504	17
MORETON	975	24	7,470	13	774	100	7,513	10
MOSSMAN	317	10	12,407	3	614	11	12,586	5
MOURILYAN	138	100	12,028	1	782	13	12,164	6
MULGRAVE	631	14	13,900	5	787	20	14,317	5
PLANE CREEK	448	71	20,564	2	683	20	20,469	3
PROSERPINE	885	19	22,226	4	1,210	18	22,861	5
ROCKY POINT	204	14	5,003	4	113	20	4,990	2
SOUTH JOHNSTONE	102	37	14,844	1	721	20	15,549	5
TABLELAND	17	25	2,170	1	488	11	4,108	12
TULLY	198	32	23,684	1	2,541	16	24,313	10
TOTAL/MEAN	16,041	21 ^a	440,995	4	28,375	19 ^a	451,955	6

^a weighted mean percent of area within fields inspected

The survey covered 4% of the total area under crop in the 1998-1999 season and 6% of the crop in the 1999-2000 season. The targets in the SRDC proposal were exceeded in both years and the target set for the CPPBs to inspect 10% of blocks was achieved on a combined basis. Only ten CPPBs achieved the 10% target, but some CPPBs far exceeded the target. The survey methods varied considerably between districts. The Fairymead, Millaquin-Qunaba and Isis districts covered large areas in their surveys because they used conventional vehicles and inspected winch paths that are regularly placed in fields in their district. The Moreton, Harwood and Broadwater CPPBs covered relatively large areas at high intensity within blocks. These CPPBs regularly conduct surveys for Fiji disease and the smut survey was conducted in conjunction with their Fiji disease survey using the protocol for the Fiji disease survey. In 1998-1999, weather conditions and the late start to the survey restricted the survey teams,

particularly in northern districts. The percentage of the total area covered by the CPPBs increased significantly in 1999/2000 (Fig. 1). Overall the survey gave a reasonable coverage in most districts and exceeded the number of fields required to give a high degree of confidence that smut was not present at the time of the survey.

Figure 1. Number of CPPBs in different ranges of percentage area covered in the survey in 1998-1999 and 1999-2000



4.2 Crop class

During the 1998-1999 survey period, 62% of the total area inspected was ratoon crops (see Table 2). Plant crop inspections contributed 8% to the total area inspected and the remaining 30% were unspecified. The large percentage of unspecified crops resulted from the failure of some CPPBs to record these data. This was remedied in the second year of the survey.

In the 1999-2000 survey period, approximately 84% of the total area inspected was ratoon crops. The plant crop accounted for 16% of the area inspected in the 1999-2000 survey.

TABLE 2

Percentage of ratoon and plant crops inspected during the 1998-1999 and 1999-2000 surveys

Crop class	% of total area inspected	
	1998-1999	1999-2000
Ratoon	62	84
Plant	8	16
Unspecified	30	0

4.3 Varieties

A total of 64 varieties was inspected during the first year of the smut survey (Table 3 and Appendix 2). Susceptible varieties accounted for 33 of the 64 varieties inspected and 45% of the area inspected during the first year of the survey. Varieties with unknown smut resistance made up 17% of the total area surveyed and were mainly varieties grown in New South Wales. In the resistant group, four varieties were inspected which made up 2% of the area surveyed. The intermediate category included two varieties, Q124 and Q96. Together these varieties made up 36% of the total area inspected during the first survey period. The domination of Q124 in many districts meant that this variety made up a significant proportion of the area surveyed. The total area of Q124 inspected during the first smut survey period was 5,491 ha. The next highest area inspected was for the highly susceptible variety Q117 with 2,441 ha inspected.

During the second survey, period a total of 89 varieties was inspected, including experimental and commercial varieties (Appendix 2). Of these 89 varieties, 38 (56% of the area surveyed) were susceptible, two (32% of the area surveyed) were intermediate, seven (2% of the area surveyed) were resistant and 42 (10% of the area surveyed) were of unknown smut reaction (Table 3).

The variety Q124 accounted for the largest area inspected with 8,666 ha or 30% of the total. The next most common varieties inspected were the susceptible varieties Q117 (3,256 ha), Q127 (2,032 ha) and Q138 (1,600 ha).

TABLE 3

**Number of varieties inspected in each smut resistance category
(ratings were based on the BSES Indonesian smut resistance trials)
during 1998-1999 and 1999-2000**

Smut Rating ^a	1998-1999			1999-2000		
	Number of varieties inspected per rating	Area of blocks inspected (ha)	% of Total	Number of varieties inspected per rating	Area of blocks inspected (ha)	% of Total
R	4	397	2	7	654	2
I	2	5,714	36	2	8,998	32
S	33	7,226	45	38	15,771	56
U	25	2,704	17	42	2,952	10
Total	64	16,041	100	89	28,375	100

^a R – Resistant, I – Intermediate, S – Susceptible, U – Unknown

4.4 Assignments with ORIA connection

During the course of the survey, 102 assignments were identified as having some connection with the ORIA. Approximately 2,394 ha were surveyed from inspections in 594 blocks on these farms in year two. In year one, the inspections that were made specifically because of a connection to the ORIA were not noted on the records received from the CPPBs.

4.5 Quarantine inspections

Inspections of volunteer sugarcane in a field in Plane Creek mill area planted with forage sorghum seed from the ORIA, and adjacent sugarcane fields, failed to detect any sugarcane smut. The sorghum crop and the volunteer sugarcane were destroyed and the field was left fallow until any chance of sugarcane smut spores surviving had passed.

4.6 Other diseases

During the survey the incidence of serious endemic diseases was recorded. Sugarcane mosaic disease was found to be widespread in the variety Q124 in the Isis district and in Q124 and Q137 in the Moreton district (Table 4). Mosaic was also reported in the Bingera and Fairymead districts. Under favourable conditions for the aphid vectors of this disease, the disease can spread rapidly and cause losses of 10-30%. Control strategies were developed to limit further spread of this disease. Fiji disease was noted in Rocky Point, Broadwater and Harwood in Q124 and other intermediate to susceptible varieties. These areas are aware of the risk of this devastating disease and have programs in place to limit future spread. A few isolated diseased plants were also found in Maryborough and Moreton and these were destroyed. Chlorotic streak was

widespread in many districts but was of greatest concern in the Burdekin where it is increasing in incidence, particularly in association with the use of recycled irrigation water. The sugarcane smut survey gave many areas an opportunity to monitor the incidence of other diseases and pests and will assist them in planning disease and pest control activities in the future.

TABLE 4

The number of blocks and the percentage of the blocks surveyed that were infected with sugarcane mosaic in the Moreton and Isis districts

Infection level	Moreton				Isis	
	Q124		Q137		Q124	
	Number of assignments	% of total	Number of assignments	% of total	Number of assignments	% of total
0	49	64	11	26	136	52
<5%	27	36	29	67	92	35
5-10%	0	0	0	0	8	3
>10%	0	0	3	7	24	9

5.0 DISCUSSION

No sugarcane smut was detected during the two years of the survey. The overall inspection target of 15,000 ha per year was well exceeded in both years of the survey (16,041 ha in 1998-1999 and 28,375 ha in 1999-2000). The total number of fields inspected was 12,535 and the average sampling intensity within fields was 20%. This level of sampling would give a 99.8% probability of detecting one infected field in 2,000 fields and 98% probability of detecting one infected plant in 1,000 plants within a field. In 1998-1999, at least one block was inspected on 1,083 assignments and in 1999-2000 at least one block was inspected on 1,671 assignments. The survey provided a high degree of confidence that sugarcane smut was not present during the survey period.

The operational target set for CPPBs of inspecting 10% of the total area in their district over the two years was achieved or exceeded by ten CPPBs, with six CPPBs just short of the target with 9% of their district inspected. Wet weather and a late start to the survey restricted the area inspected in 1998-1999.

Over the two years of the smut survey, inspections were targeted at ratoon crops, because they had longer exposure to possible wind-borne and mechanical infection. Over 75% of the area inspected during the survey was ratoon crops.

Plant source inspections and surveys for other diseases and pests, were carried out by CPPBs in some mill areas as part of their routine programs. Plant source inspections and disease and pest surveys carried out within or between the two survey periods were included in the smut survey. These inspections increased the plant cane inspected during the second year of the survey.

To increase the chances of detecting a smut infection, inspections were targeted toward smut susceptible varieties. Smut resistance ratings for the varieties growing in the commercial sugar production areas of Queensland and New South Wales were largely unknown at the beginning of the survey. Information from the ORIA and from overseas was available for some 'Q' varieties and these ratings were used until ratings from the BSES smut resistance trials in Indonesia became available.

Most of the varieties inspected in both survey periods were susceptible to smut and these varieties accounted for a large proportion of the area inspected. The variety Q124 accounted for the largest area inspected for a single variety (14,166 ha). Q124 is rated as intermediate and is the most common variety grown in eastern Australian. In mill areas such as Mackay, Q124 accounts for over 85% of the area under cane. Other varieties that contributed large areas to the survey were Q117 (5,700 ha), Q151 (2,254 ha), Q127 (2,221 ha), Q158 (2,181 ha) and Q138 (2,180 ha).

The smut survey endeavoured to inspect as many assignments with ORIA contact as possible. One hundred and two assignments (3.7%) were identified that had some connection with the ORIA. These connections included purchase of second-hand machinery, grower had visited the ORIA or a family connection with the ORIA. These assignments were targeted in the survey but no smut was found on any of these assignments.

Daniel Smith assisted with inspections in a fallow sugarcane field planted with seed of forage sorghum originating from the ORIA. This seed was prohibited from planting in this situation under the Sugarcane Smut Proclamation. No sugarcane smut was detected in volunteer sugarcane plants or surrounding sugarcane fields.

Canegrowers throughout Queensland and New South Wales are well informed on the symptoms, production losses and transmission of sugarcane smut from publicity and awareness carried out by the BSES survey coordinator, BSES extension officers and CPPB staff during the survey. BSES and CPPBs have encouraged growers to inspect their own assignments during daily farm operations as part of the awareness and publicity program. As a result of the smut awareness, many growers informed CPPBs and the survey coordinator during the survey that their assignments are free of smut from inspections they carried out during weed control and fertilising.

At the state level a series of 12 reports and updates was compiled to communicate the findings of the survey at regular intervals. These reports were distributed to CPPBs, BSES stations and centres, government and sugar industry representatives during the survey.

At the local level, a number of media were used to communicate the smut survey's progress throughout Queensland and New South Wales. In particular, news articles were placed in local papers to promote the need to look for smut whips during daily farm operations and to highlight the progress of the smut survey. A number of interviews on ABC radio were conducted by BSES staff to highlight the smut threat, the quarantine regulations and the need for growers to report any suspected smut infected

plants. In Mackay, Channel Seven televised an interview with Daniel Smith on the smut survey program, and Mackay CPPB produced an advertisement on sugarcane smut awareness which was televised during the evening news.

To reach other personnel in the sugar industry, several articles have appeared in the *BSES Bulletin*, *Australian Sugarcane* and *Australian Canegrower* magazines addressing different aspects of sugarcane smut.

Although no sugarcane smut was found during the survey, other important endemic diseases were noted. Of particular concern was the incidence of sugarcane mosaic in Isis, Bingera and Moreton, and Fiji disease in Broadwater and Harwood. Careful management is required to prevent these diseases from increasing further and causing yield losses in these districts, and providing a source of inoculum for spread to other districts. The increased incidence of chlorotic streak associated with recycled irrigation water in the Burdekin is also of concern.

6.0 RECOMMENDATIONS

6.1 Continued vigilance

Continued vigilance within the sugar industry is necessary to prevent production losses from a sugarcane smut incursion. It is recommended that canegrowers, CPPB staff, BSES employees and other sugar industry personnel remain alert to detect any sugarcane smut in commercial and experimental cane in Queensland and New South Wales. CPPBs will continue to inspect for sugarcane smut during their routine plant source inspections and surveys for other diseases and pests. Early detection is the most effective way of reducing production losses.

6.2 Quarantine

The current survey has provided strong evidence that sugarcane smut is not in the eastern states. It is therefore essential to maintain strict quarantine regulations to prevent spread of the disease from the ORIA or overseas. It also increases the need to reduce the source of inoculum in the ORIA by replacing susceptible varieties as quickly as possible.

6.3 Sugarcane smut awareness

There is a need to continue publicising the threat of sugarcane smut, so that farmers are vigilant to report possible future incursions. Articles should be published in future editions of the *BSES Bulletin* and other industry magazines.

6.4 Availability of resistant varieties

Continued programs to breed, select and make sugarcane smut resistant varieties available to growers are essential. Smut resistant varieties are the only long-term insurance against future smut incursions.

7.0 ACKNOWLEDGMENTS

This survey was conducted primarily by CPPB staff in Queensland and New South Wales. We would like to thank the CPPB staff and the CPPB boards for supporting the survey. We also thank the BSES extension staff who assisted with coordination of the survey and in preparation of the media campaign. We also acknowledge Peter Whittle, BSES quarantine pathologist, who assisted with producing quarantine pamphlets and signs, and providing in training in the quarantine regulations.

8.0 REFERENCE

Cannon, R M and Roe, R T 1982. *Livestock Disease Surveys: A field manual for Veterinarians.*

APPENDIX 1

Personal cleaning procedure

1. Remove bag containing smut incursion kit (SIN kit) from vehicle - touching as little inside the vehicle as possible.
2. Remove spray bottle and fill with 70% alcohol. Spray hands and surfaces in vehicle that were touched when removing the SIN kit. Shut any open doors.
3. Set out contents of SIN kit on the back of the vehicle.
4. Clean boots. Scrape all mud off boots. Then spray all over with steriliser (70% alcohol). Use spray packs to drench boots, concentrating on the seams and soles of the boots.
5. Place groundsheet (garbage bag) on the ground then remove boots while stepping onto the garbage bag. Place shoes near the garbage bag but not on it. Remove outer layer of clothing. Try at all times to turn clothes inside out when removing. Place clothes in another heavy duty garbage bag on the vehicle.
6. Spray all exposed body parts (hands, arms and legs) using the spray bottles.
7. Redress with clean or uncontaminated clothing without letting clothes touch the ground.
8. Step back into boots before packing up ground sheet and place in garbage bag with contaminated clothes. Tie off bag securely with the tie provided on the bag.

APPENDIX 2

Varieties inspected for sugarcane smut in both years of the survey and their smut resistance rating

Variety	Smut Rating	Area inspected (ha)		Variety	Smut Rating	Area inspected (ha)	
		Year 1	Year 2			Year 1	Year 2
75C326	U	0	36	Q125	S	18	0
77N557	U	0	30	Q127	S	190	2,032
78S383	U	0	0	Q130	R	2	16
82S1608	U	0	5	Q133	R	28	13
83S1825	U	4	0	Q135	S	224	481
85S1863	U	0	0	Q136	S	207	592
85S7308	U	0	0	Q137	S	112	58
85S7807	U	0	0	Q138	S	584	1,596
86C451	U	0	1	Q140	U	3	0
Apollo	U	0	9	Q141	S	679	803
ARRIS	U	66	89	Q143	S	7	0
BN1064	U	1	0	Q145	S	9	22
BN1394	U	0	22	Q146	U	267	277
BN3087	U	0	2	Q150	S	99	131
BN3120	U	0	4	Q151	S	1,111	1,143
BN332H	U	4	2	Q152	S	20	1,163
BN73-3416	U	22	55	Q153	S	2	7
BN74-4445	U	2	0	Q154	S	86	135
BN81-1394	U	3	13	Q155	R	280	446
BN83-3087	U	0	6	Q157	S	0	122
BN83-3646	U	0	3	Q158	S	7	1,197
BN9113	U	0	10	Q159	S	3	62
BN9442H	U	0	0	Q160	S	0	67
CASSIUS	R	0	7	Q161	S	0	21
CO-740	U	0	31	Q162	S	0	25
CONCORD	U	11	22	Q163 ^b	S	14	67
CP44-101	U	66	39	Q164	S	30	57
CP51-21	U	422	247	Q165 ^b	S	141	436
CP75-1082	U	0	2	Q166 ^b	S	0	156
DART	U	16	14	Q167 ^b	S	1	22
DELTA	U	6	24	Q168 ^b	S	0	1
ENCORE	U	13	10	Q169 ^b	S	1	3
EOS	U	1	0	Q170 ^b	R	88	164
ESK	U	12	108	Q171 ^b	R	0	6
H56-752	U	8	66	Q172 ^b	U	0	15
LOUISIANA	U	0	6	Q173 ^b	U	0	46
(L62-96)				Q174 ^b	S	3	267
MIXED	U	1,732	1,492	Q176 ^b	U	0	2
PINDAR	U	4	5	Q177 ^b	U	0	16
Q107	S	23	87	Q178 ^b	S	0	0
Q110	S	120	14	Q179 ^b	S	0	1
Q113	S	38	136	Q181 ^b	S	0	15
Q115	S	2	146	Q182 ^b	U	0	93
Q117	S	2,445	3,256	Q68	U	1	0
Q119	S	8	11	Q96	I	223	332
Q120	S	972	1,313	Q99	R	0	2
Q121	S	39	70	RB72-454	U	6	69
Q122	S	17	59	TRIAL	U	35	46
Q124	I	5,500	8,666	TS65-28	U	2	32

^a R – Resistant, I – Intermediate, S – Susceptible, U – Unknown

APPENDIX 3

Publications

BSES Bulletin, Number 66, April 1999. *Smut Survey Update.*

BSES Bulletin, Number 68, October 1999. *Round two of Sugarcane Smut.*

BSES Bulletin, Number 71, July 2000. *No smut in sight.*

Australian Sugarcane, Volume 2, Number 3, August-September 1998. *Breeding sugarcane varieties resistant to smut.*

Australian Canegrower, Volume 22, Number 6, 27 March 2000. *Smut Scare in Sarina.*

Australian Canegrower, Volume 22, Number 7, 10 April 2000. *Ord seed should never get to Queensland.*