SUGARCANE SMUT IN AUSTRALIA: HISTORY, RESPONSE AND BREEDING STRATEGIES

By

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Abstract

ALTHOUGH sugarcane smut was first detected in the Ord River Irrigation Area of West Australia in 1998, the major sugarcane areas along the east coast of Queensland and northern New South Wales were not affected by the disease until it was found near Childers in June 2006. Since then there has been a rapid disease escalation and smut has now been found in most sugarcane regions of Queensland, but not in New South Wales. It is estimated that smut will be found on every farm in the Bundaberg-Childers, Mackay and Herbert regions in 2009 and economic losses will be recorded in some crops of susceptible varieties. This paper documents the development of the smut epidemic in Queensland, the strategy now in place to replace smut-susceptible varieties and the breeding approaches adopted pre- and post-incursion. A key feature was the screening of varieties, advanced clones and parents in Indonesia from 1998 onwards. Breeding strategies aim to minimise industry economic losses and maintain the rate of genetic gain. This should result in a high proportion of resistant and intermediate varieties being harvested by 2012 and the on-going release of new, highly productive, smut-resistant varieties to the Australian sugarcane industry.

Introduction

The Australian sugar industry is spread along a narrow 2500 km coastal strip of eastern Australia from Grafton in northern New South Wales (latitude 29.7°S) to Mossman in Queensland (latitude 16.5°S). The major cane growing regions are separated by cattle pasture or natural vegetation and these provide natural barriers to pest and disease spread. The Australian sugar industry has a well established internal quarantine system, supported by State Government legislation, and the alignment of quarantine boundaries with these natural barriers has limited the spread of serious pests and diseases such Fiji leaf gall, mosaic and cane weevil borers.

Sugarcane smut (*Ustilago scitaminea* Sydow syn. *Sporisorium scitaminea*) was found for the first time in Australia in July 1998 in the Ord River Irrigation Area (ORIA) of Western Australia (Riley *et al.*, 1999), more than 2000 km from the main production areas on the east coast. Western Australian and the east coast sugarcane production areas are separated by tropical savannah with very sparse population. The Western Australian sugar industry had one small sugar mill with 4000 ha of commercial cane, and strict quarantine restrictions governed movement of machinery and cane from Western Australia to the eastern states to prevent human-assisted smut spread. The industry in Western Australia ceased production in 2007.

The smut resistance of Australian varieties was largely unknown in 1998 when smut was found in Western Australia. Limited information was available from overseas countries, but this was mainly for older varieties and there was disparity between ratings obtained from different countries. BSES established a testing program in Indonesia within months of the incursion in

Western Australia (Croft *et al.* 2000) and information on the resistance of some Australian varieties became available from Western Australia (Engelke *et al.* 2001) with time.

Smut was found on the east coast of Australia in the variety Q205[Φ] in the Childers district in June 2006 (Croft *et al.,* 2008b). This paper describes the spread of smut throughout Queensland, the response of the industry to the incursion, the impact of the disease on the industry and pre- and post-incursion strategies used in the BSES-CSIRO Variety Improvement program.

Smut spread within Queensland

Smut was found near Childers in June 2006 and intensive surveys showed the disease was already widespread in the Bundaberg-Childers region (Figure 1). Only a small number of farms were heavily infested and these were mainly in the Redridge area. The initial finding triggered a search for smut in other major cane growing regions. In November 2006, the disease was found in the Mackay region approximately 600 km north of Childers and, in December 2006, in the Ingham region a further 600 km north (Figure 2). In both the Mackay and Ingham regions, the disease was also well established and appeared to have been present for a number of years. It is possible that the three regions became infested at the same time, possibly from the same weather event that carried spores from the original source (Western Australia or overseas). The Mackay and Ingham findings meant there was no chance of containing smut within the southern region.

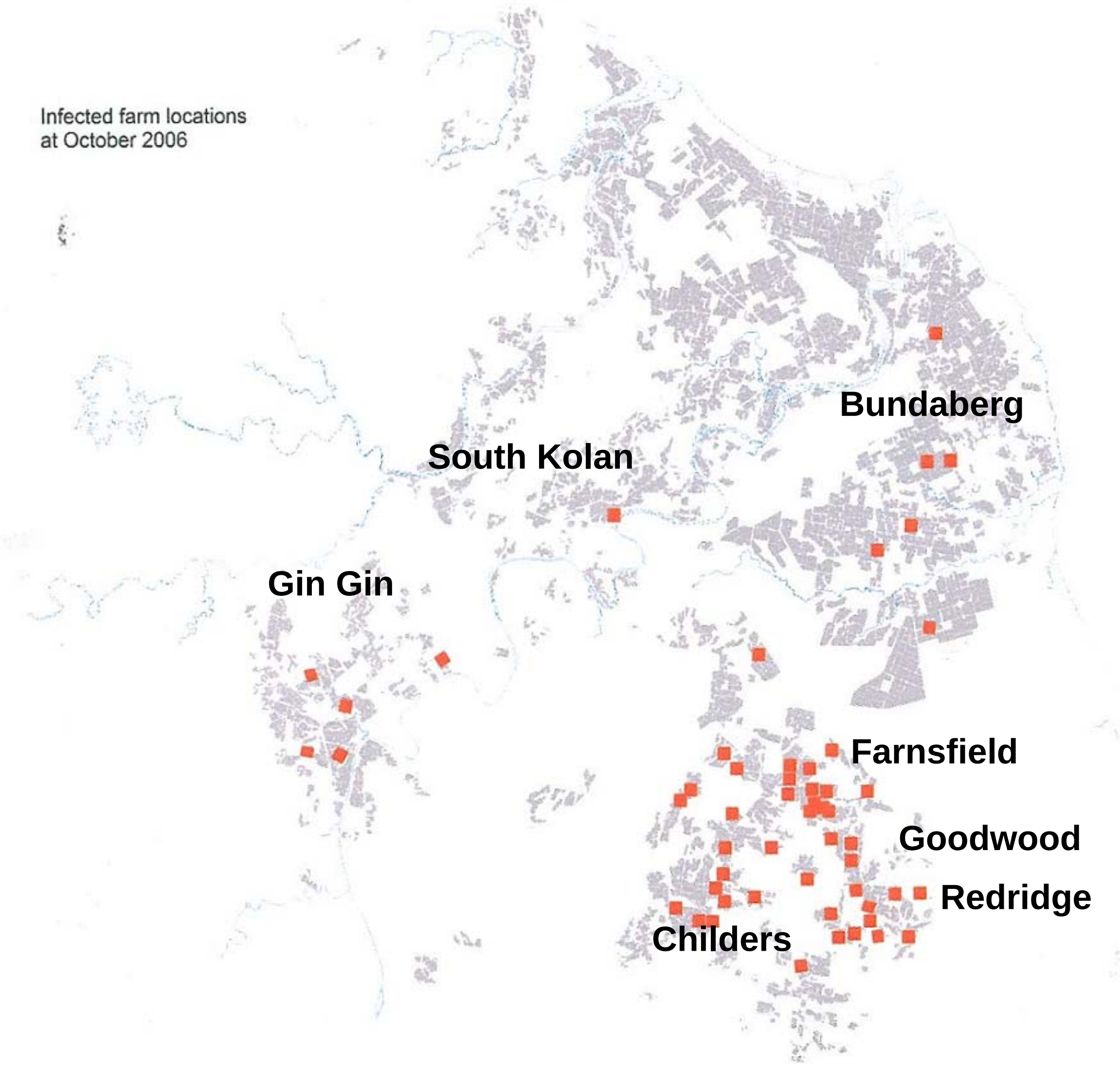

Fig. 1—Location of smut infested farms in the Bundaberg-Childers region of Queensland in October 2006. Infested farms are marked in red and the cane growing properties are highlighted in grey.

After the Ingham finding, nearly 12 months elapsed before the next two regional smut detections; these were in Maryborough, only a short distance south of Childers, and in Proserpine, a short distance north of Mackay (Figure 2). By the end of 2008, smut was found in all the remaining major cane growing regions. Smut detections in 2007 and 2008 probably represented spread from the three initially-infested regions. Only the most southerly sugar mills in the Australian industry remain free of smut (southern Queensland and New South Wales). However, it is highly probable that the disease is already present in some of these areas. Initial detections have been quickly followed by rapid local disease spread.

Spore trapping provided early warning of smut spread into new regions (Magarey *et al.,* 2009a). Traps consistently detected smut spores 12–18 months before symptoms were detected in the field.

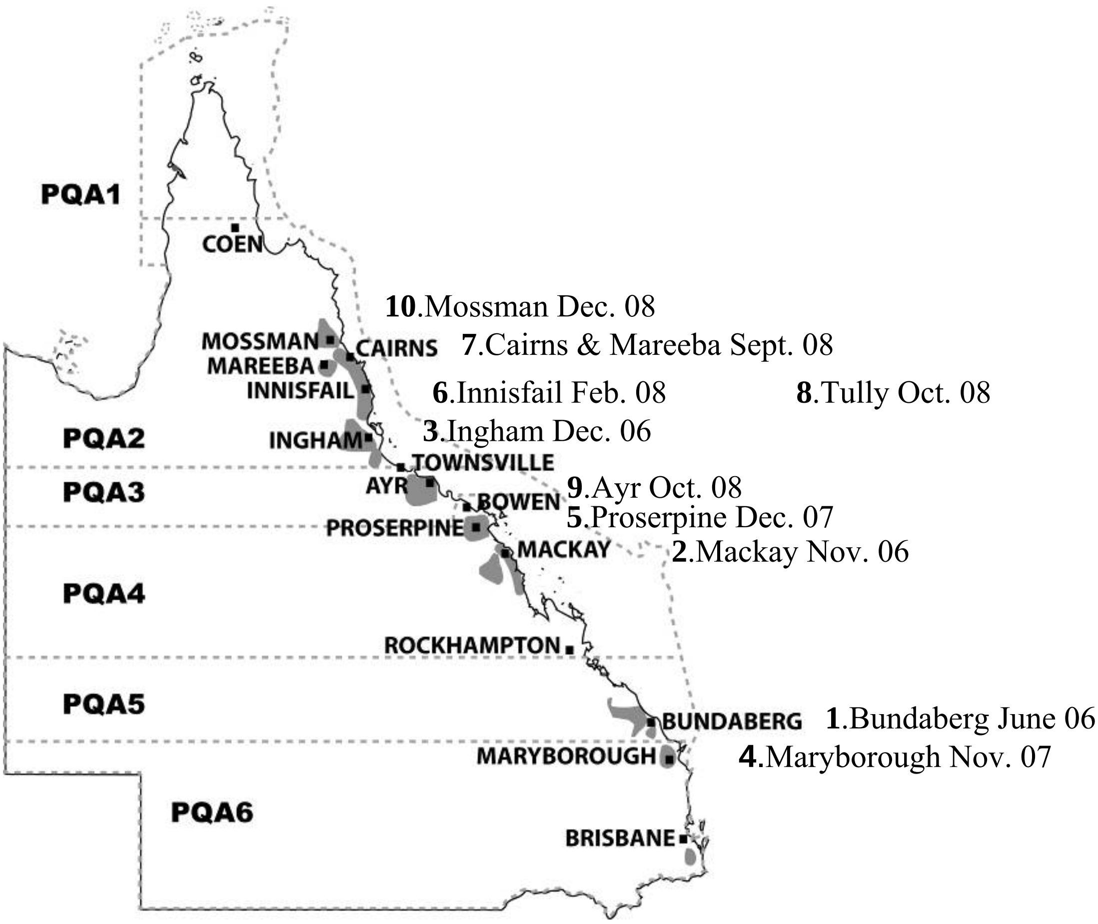

Fig. 2—Smut findings in Queensland.

Spread within infested districts

When smut was found in the Bundaberg-Childers region in 2006, susceptible varieties accounted for 78% of the crop with the two most widely grown varieties, Q188[⊕] and Q205[⊕], being rated susceptible.

An intensive surveillance program was conducted in the Bundaberg-Childers region between June-November 2006 (Croft *et al.,* 2008b). A total of 8649 blocks on 1052 properties were inspected and 2.2% of the blocks and 7.4% of the properties inspected were smut-infested. The highest incidence was in the variety Q205[⊕], with 8.3% of blocks infested. No disease was found in resistant crops, but some was found in crops of intermediate varieties. Trace back on one of the most heavily infested farms in the region suggested the disease had been present at least since the 2003/04 crop.

Monitoring of a series of farms within the district in 2007 and 2008 (Magarey *et al.* 2009b) provided information on disease spread; from this it was estimated that by mid-2009 all farms would become infested (Figure 3).

The planting of smut susceptible varieties was banned in the Bundaberg-Childers region in September 2006. Over 3750 t of seed cane of resistant varieties was transported 600–1200 km into the area to assist growers to transition to resistant varieties. The proportion of smut-susceptible varieties had fallen below 50% by 2009 and it is predicted that none will remain by 2011 or 2012.

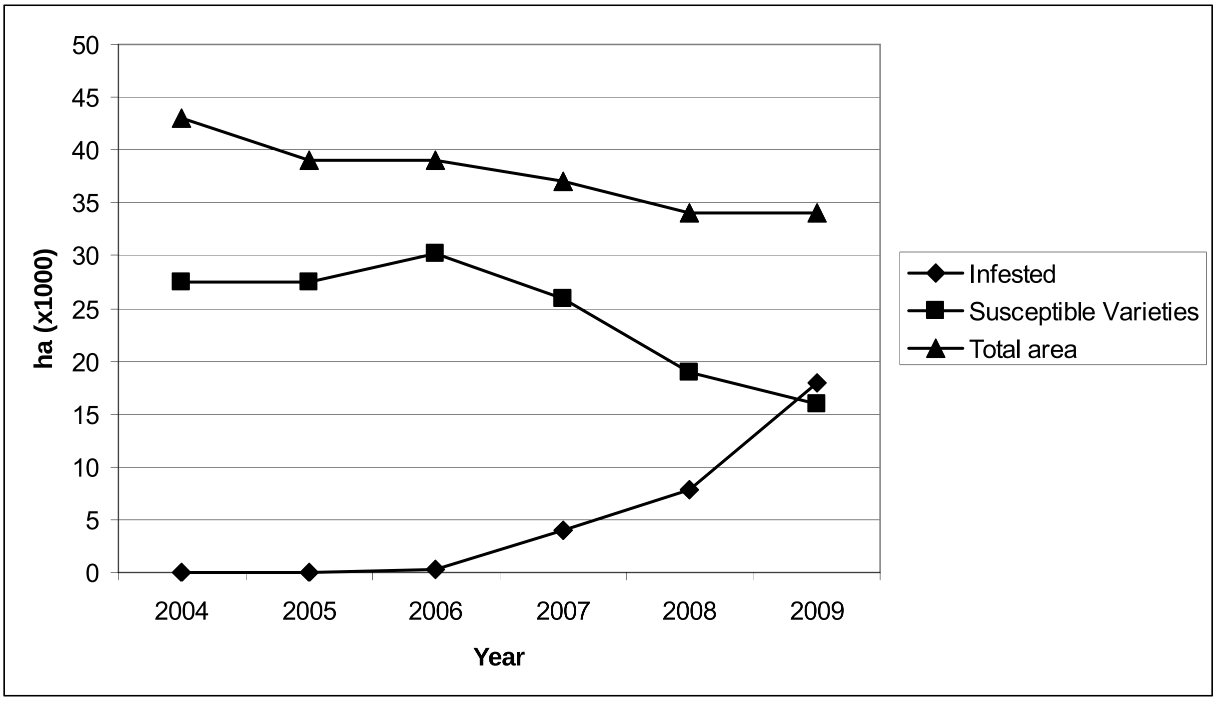

Fig. 3—Estimated spread of smut in the Bundaberg-Childers region from 2004 to 2009 and the total area planted and the area of susceptible varieties. A field was considered to be infested if it had one smut whip.

Smut spread and variety replacement has progressed at similar rates in the Ingham and Mackay regions (Figure 4) where the most susceptible varieties are Q157, Q158, Q174$^{\phi}$ and Q207$^{\phi}$. Disease spread has been faster in the Ingham region relative to Bundaberg-Childers (Magarey *et al.*, 2009b). Higher temperatures are likely to be favouring pathogen activity and varietal susceptibility.

Industry impact

Direct yield losses from smut have been minimal because the disease was detected before it had spread widely, smut response plans were quickly implemented in each region, smut resistant varieties were available from pre-emptive screening in Indonesia/Western Australia and growers have rapidly transitioned to resistant varieties.

Smut detection in a region was accompanied by virtually no further planting of susceptible varieties; this led to only isolated cases of primary infection (infection from infected seed cane) in susceptible crops–thus lowering direct yield losses.

Growers also have removed many smut-infested crops before disease levels have escalated, again reducing direct losses and slowing disease spread / buildup by minimising inoculum production.

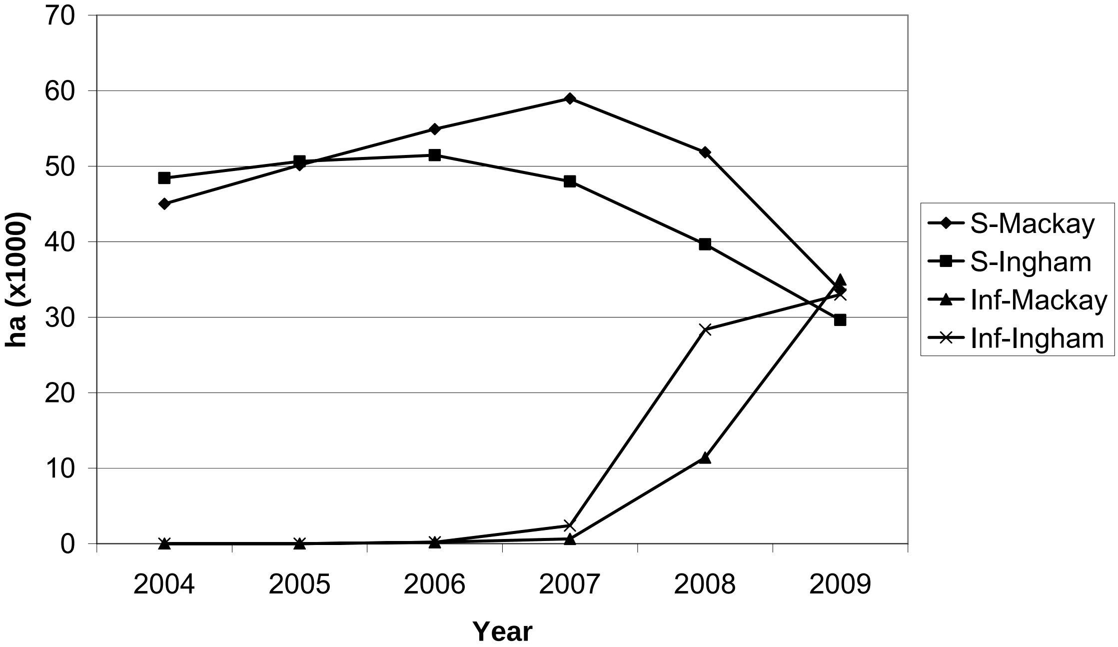

Fig. 4—Estimated smut spread in the Mackay and Ingham regions (Inf) from 2004 to 2009 and the area of susceptible (S) varieties. A field was considered to be infested if it had one smut whip.

However, smut has had a significant financial impact via increased costs from premature ploughout of infested fields and shortened crop cycles. In most cases, growers have been able to plant resistant varieties with equal or better yield potential compared with the susceptible varieties they replaced. However, on occasions, a limited choice of resistant varieties has meant that some indirect losses have resulted.

The variety Q208$^{\Phi}$ is high yielding, intermediate-resistant to smut and is likely to be the major variety in coming years. It has excellent yield and sugar content over a wide range of environments. A number of new high yielding smut resistant or intermediate varieties have been released since the smut incursion and these have good yield potential, including KQ228$^{\Phi}$, Q232$^{\Phi}$, Q238$^{\Phi}$ and Q240$^{\Phi}$.

Smut strategies used in the BSES-CSIRO Variety Improvement program

Pre-incursion screening

In preparation for a smut incursion, BSES negotiated a contract in 1997 with the Indonesian Sugar Research Institute to screen Australian varieties for resistance to the disease (Croft *et al.*, 2000). In 1998, another program was established by CSIRO, WA Agriculture and BSES to screen varieties for resistance in Western Australia (Engelke *et al.*, 2001). Initial studies showed that a high percentage of Australian varieties were susceptible to the disease.

Eleven smut trials were conducted in Indonesia from 1998–2008 (Croft *et al.,* 2008a). Varieties were shipped to Indonesia and planted in an open quarantine plot on Puteran Island, a site isolated from commercial sugarcane fields. After one year in quarantine, the varieties were planted in smut resistance trials on Madura Island to the east of Java. The standard smut dip inoculation method was used (Ferreira *et al.*, 1980). A set of 10–12 standard varieties was included in all trials. All trials consisted of four replicates with 10 two-eye-setts per replication, except for trials 1 and 2 which had three replications of six two-eye-setts per replicate. The resistance ratings were based on the ISSCT scale of 1 to 9 (Hutchinson, 1970), where 1 = highly resistant and 9 = highly susceptible.

Eight smut resistance trials were conducted in the ORIA of Western Australia using the same techniques used in Indonesia, except that the trials consisted of only three replicates and four standard varieties.

Indonesian smut trials included a total of 2035 varieties with many varieties being tested in two or more trials. The distribution of resistance classes is shown in Figure 1. The predominantly Australian varieties screened in Indonesia have a strong bias towards susceptibility, with 66% of varieties in the susceptible range (rating 7–9). In contrast, in the ORIA only 43% of varieties were rated susceptible (Figure 5). Only varieties imported from overseas (with reputed smut resistance) and varieties from the Australian breeding programs that were already identified as intermediate to resistant in Indonesia were included in smut trials in the ORIA (except for the first two trials).

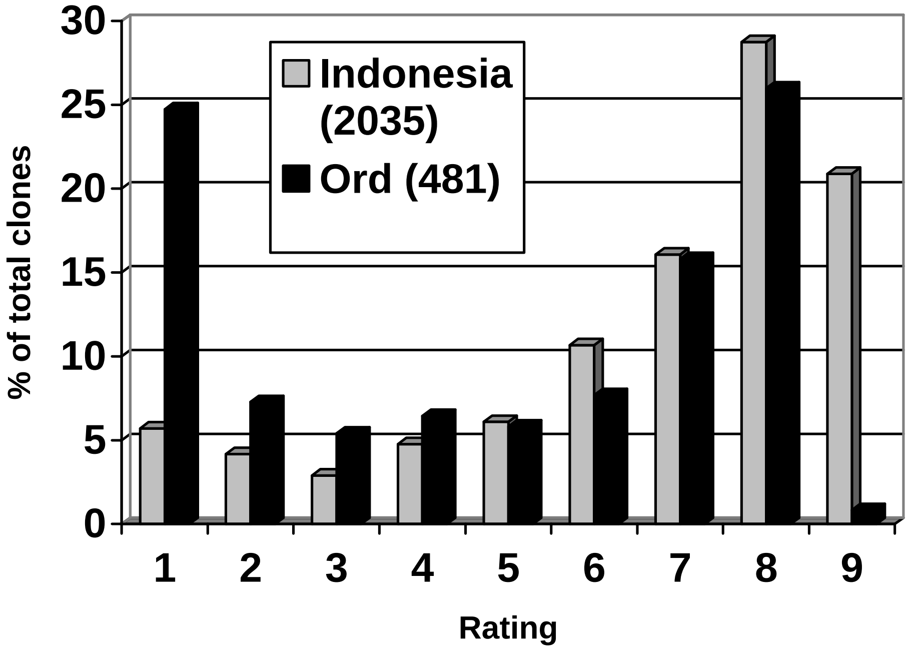

Fig. 5—Frequency distribution of smut resistance classes of 2035 varieties screened in Indonesia and 481 varieties screened in the ORIA.

The proportion of the 2006 crop (tonnes harvested) produced by resistant, intermediate and susceptible varieties in each east-coast region is shown in Figure 6.

Susceptible varieties (rating 7–9) contributed more than 65% of the crop in all regions except the Burdekin and New South Wales, while in the Herbert the figure was more than 80%.

The Indonesian and ORIA screening trials provided information on varietal resistance allowing the east-coast industry to minimise losses from the smut incursion.

Smut-resistant varieties were rapidly propagated in all regions and planting of susceptible varieties was banned. Resistant or intermediate-resistant varieties such as Q177[ϕ], Q200[ϕ], Q208[ϕ], KQ228[ϕ] and Q232[ϕ] were propagated using traditional methods, spaced one-eye setts or tissue culture for rapid distribution to growers.

Pre-incursion breeding strategy

In 2001, when information became available from the Indonesian and ORIA resistance trials, a strategy was adopted that 50% of the crosses made in the BSES-CSIRO Variety Improvement Program would have an average smut rating for the parents (mid-parent rating) < 6.5.

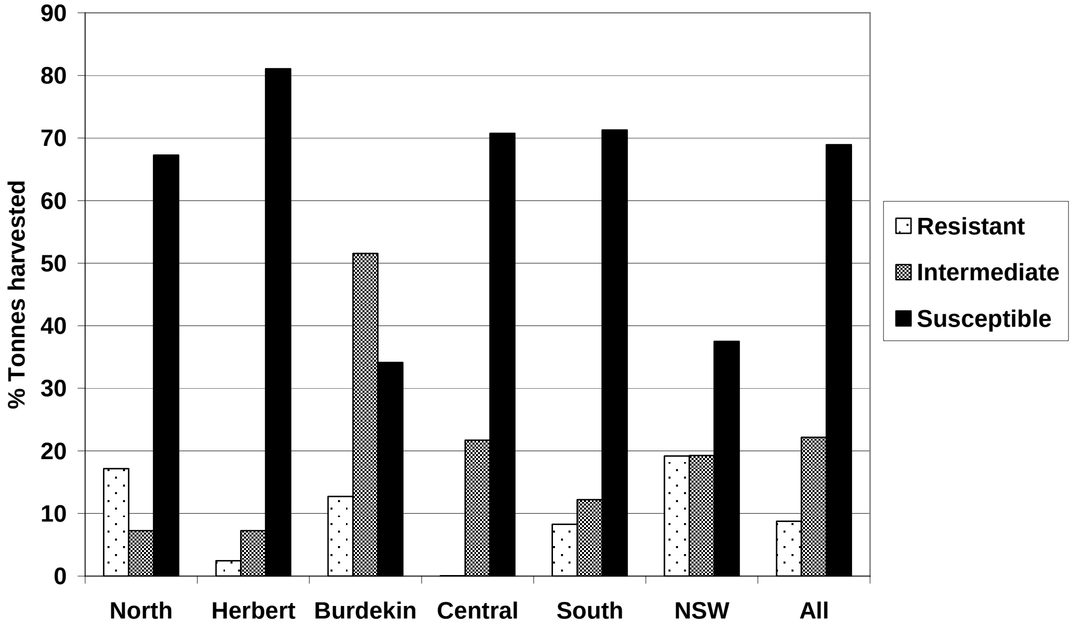

Fig. 6—Proportion of the 2006 crop (tonnes harvested) planted to smut-resistant, intermediate and susceptible varieties in the 6 production regions on the east coast of Australia.

When information was available for only one parent, further information was sourced for grandparents, providing a better estimate of the resistance of a cross. The initial data showed that, in 2000, only 20% of crosses had an intermediate smut mid-parent rating (≥ 3.5 and < 6.5) and there were virtually no resistant crosses (< 3.5) (Figure 7).

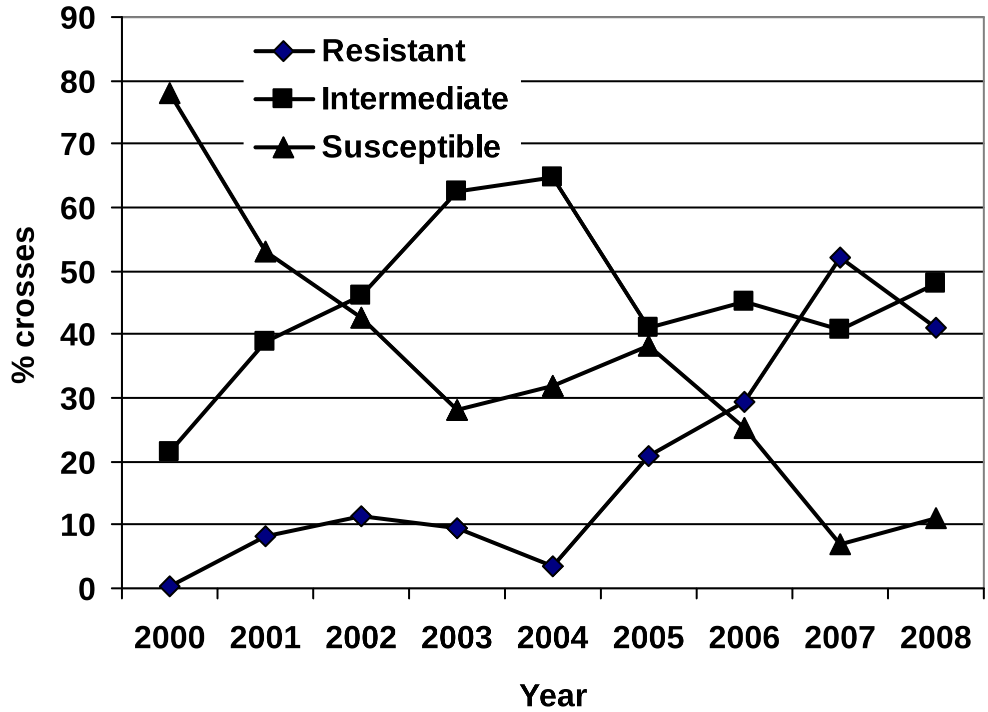

Fig. 7—Mid-parent smut rating of crosses made in the BSES-CSIRO Variety Improvement Program 2000–2008 (Resistant = average of parent smut ratings < 3.5, intermediate ≥ 3.5 and < 6.5 and susceptible ≥ 6.5).

From 2000 to 2004 the proportion of crosses with intermediate mid-parent rating steadily increased as a result of this strategy but the proportion with resistant mid-parent rating remained at or below 10%. To improve the situation, one of the BSES photoperiod facilities was dedicated specifically to making smut-resistant crosses, supplementing the crosses made from field grown flowers. In 2004, the smut breeding strategy was again reviewed and modified to embrace a target of 25% crosses with mid-parent ratings in the resistant range and at least 25% in the intermediate range.

These goals were almost achieved in 2005 and were exceeded in 2006. After the 2006 smut incursion, only a small number of susceptible crosses with high breeding value were made, and in 2007 and 2008 approximately 10% of crosses were rated susceptible.

Post-incursion screening

BSES commenced screening trials in Bundaberg in August 2006. At this time, the quantity of available smut spores was limited so varieties were inoculated by painting a spore paste (0.1 g spores (approximately 1 x 10^8 spores)/mL in distilled water with 0.05% Tween 20) onto each bud. Whole stalks were used and the inoculated stalks were incubated overnight at 31°C and 100% relative humidity before planting into the field. The trials consisted of two replicates, and three stalks were planted per replication. Results were obtained for 1007 varieties and 10 standard varieties.

In 2007 and 2008, 1591 and 2257 varieties (respectively) were screened with the standard dip inoculation method. A similar number are planned for 2009. Four hundred tentative selections from stage 2 from each of the 4 regional selection programs, advanced selections from the final selection stage and parent clones were included in these trials. After dip inoculation, the inoculated one-eye setts were planted in trays of vermiculite and incubated in a chamber at 31°C for 7–10 days. These were transferred to a screen house for a further 7–10 days, potted out into peat pots and placed on outside benches for 3–6 weeks before being transplanted to the field.

Eight one-eye-setts from each variety were planted per replicate. Trials consisted of two or three replicates, depending on the selection stage of the test clones. Advanced parents or foreign clones were planted in three replicates, and clones from the early stages of the breeding programs (tentative selections from stage 2) were planted in two replicates. The plants were rated for percent smut infection and disease severity 3–4 months after transplanting, then ratooned and rated again when the ratoon crop was 5–6 months old.

The 2007 and 2008 Bundaberg smut screening trials had high levels of smut infection; 54% of clones had greater than 30% smut infected plants in 2007 and 63% in 2008 (Figure 8). Further effort is required to reduce the proportion of smut susceptible clones in the Australian breeding program.

Following the smut incursion in 2006, a strategy was developed to minimise the impact of smut in the breeding program. The effective size of the program was dramatically reduced by the high frequency of smut susceptibility in breeding and selection populations; this inevitably impacted on the rate of genetic gain. In addition, many of the high breeding value parent varieties were susceptible to smut. To overcome this, a dual approach was adopted.

The smut strategy for the **Core** Variety Improvement Program is to only plant seedlings from crosses with a mid-parent rating <5. Similar strategies have been successfully followed for many years for other major diseases in Australia including Fiji leaf gall, leaf scald and pachymetra root rot.

The core program has been described elsewhere, but briefly it incorporates three selection stages, with family and individual selection in stage 1 (true seedlings) with stages 2 and 3 involving clonal selection. There are four regional programs.

However, a strategy needed to be developed to exploit high breeding value but smut-susceptible parents. This has been called the **SmutBuster** program and is basically designed to select and exploit the low frequency of smut resistance in susceptible crosses (eg S*S, S*I). Each year approximately 40 000 seedlings from these crosses are planted at Bundaberg. This population is screened for smut resistance in a two-phase program, first as seedlings and then as clones.

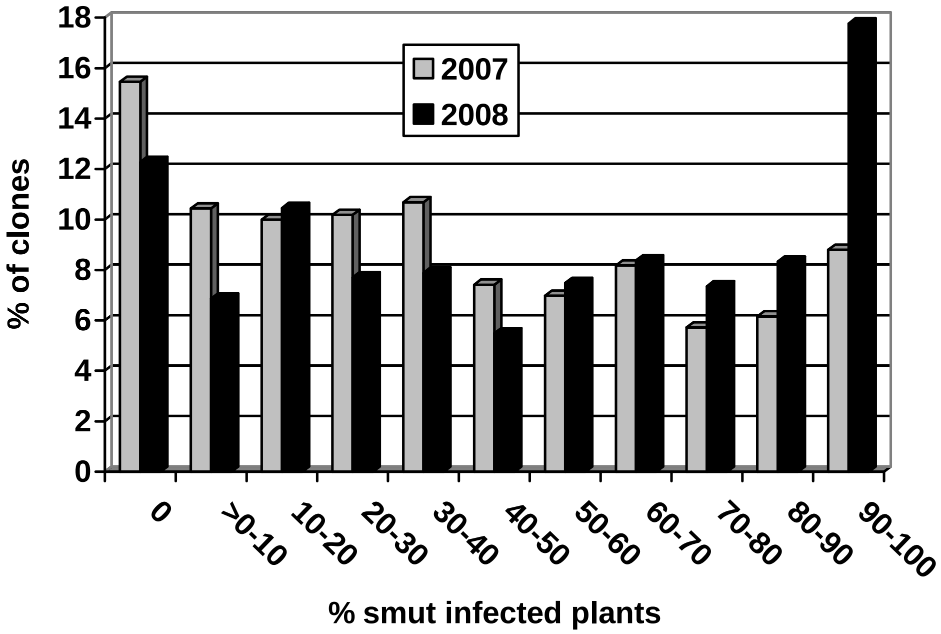

Fig. 8—Frequency distribution of classes of percent smut infected plants for clones screened for smut resistance in Bundaberg in 2007 (1591 clones) and 2008 (2257 clones).

Post-incursion breeding strategy

There is no generally acceptable method for screening original seedlings. In 2006, original seedlings were planted directly to the field in November-December and a paste of smut spores was painted onto the buds of two decapitated standing stalks of each seedling in April 2007. This inoculation failed, with no smut infection developing. In 2007, seedlings at the 3–6 leaf stage, six weeks after transplanting, were trimmed to approximately 20–30 mm above the growing point and then sprayed with a suspension of approximately 1 x 10^6 viable smut spores per mL onto seedlings. The inoculated seedlings were placed in an incubation chamber at 31°C overnight and then planted to the field.

An experiment was established to examine three methods for inoculating original seedlings:

1. Dip inoculation of four week old seedlings. The seedlings were teased from the germination medium, washed in water and dipped in a spore suspension of 1 x 10^6 viable smut spores per mL for 10 min. The seedlings were then planted into potting mix in 90 mm peat pots and placed in an incubation chamber at 31°C overnight. The pots were planted to the field 4–6 weeks later.
2. Trimming and spray inoculation of seedlings at the 3–6 leaf stage, six weeks after transplanting from the germination trays. Plants were trimmed to approximately 20–30 mm above the growing point and then sprayed with a suspension of approximately 1 x 10^6 viable smut spores per mL onto seedlings before planting to the field
3. Natural spread by planting the seedlings between smut-infected spreader rows.

In this experiment, 50 seedlings from 12 families with varying smut resistance were included in each treatment. An un-inoculated batch of seedlings was planted in a low smut risk area.

The un-inoculated seedlings were grown to maturity and then screened for smut resistance using the standard dip-inoculation method to estimate the resistance in each of the families.

The results indicate that dip inoculation when transplanting seedlings into peat pots is an effective method for screening true seedlings (Figure 9) and this practice was adopted in 2008. Natural spread was also effective but this method requires considerably more area to allow for spreader rows. The dip inoculation method allowed 23% of seedlings that develop smut whips to be discarded; however, the data from the control (34%) indicated 11% of susceptible clones may escape using this method. A second screening using normal clonal inoculation methods is required to adequately screen this population. About 10 000 seedlings with no smut and good visual appearance are selected and a 3-eye sett of each is cut. These are inoculated in family groups, incubated overnight at 31ºC and planted to the field as spaced plants. Again, plants with no smut and good visual appearance are selected and about 2500 of these clones are propagated for stage 2 trials in each region.

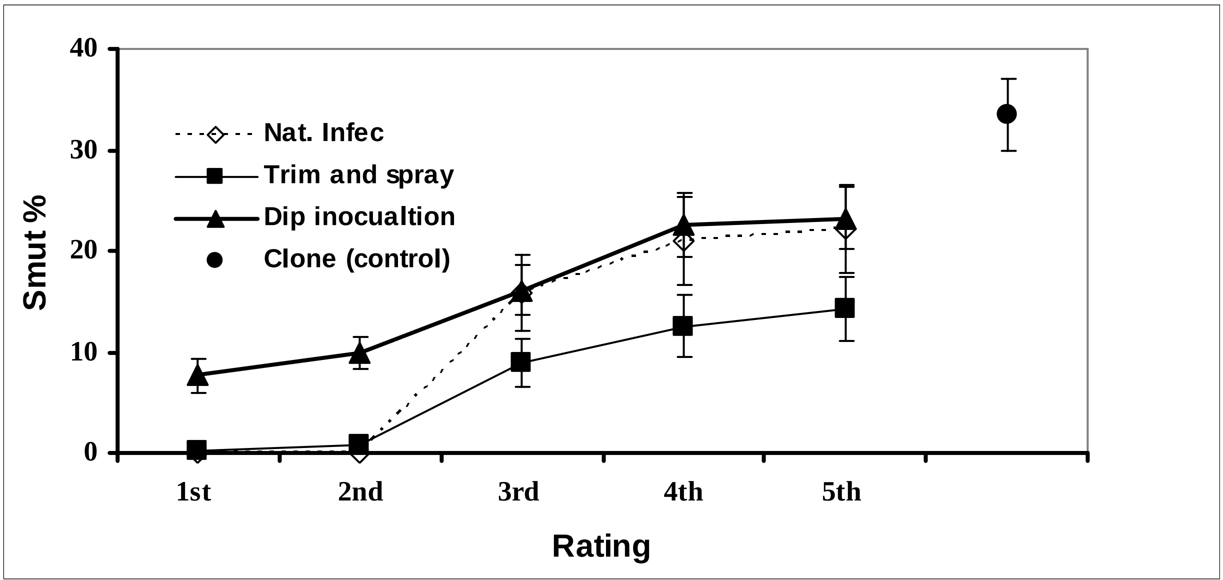

Fig. 9—Smut expression over time on sugarcane true seedlings inoculated using various methods. Clones (control) were planted separately and assessed once on plant crop. Error bars indicate standard error of means.

The core program will provide 2500 clones with a high frequency of resistant and intermediate types that will be combined with the 2500 smut-resistant clones selected from more susceptible crosses, effectively doubling the size of the stage 2 clonal assessment trials (CAT).

This expanded program is critical to maintaining breeding progress for improved productivity, while ensuring that all new varieties have sufficient smut resistance. The program is summarised in Figure 10.

Conclusions

Sugarcane smut has spread rapidly throughout the Queensland sugarcane industry since it was first detected in 2006. The preparations for a smut incursion prior to its arrival allowed the Queensland and New South Wales industries to minimise losses and to quickly start the replacement of smut-susceptible varieties with resistant or intermediate-resistant varieties.

The BSES-CSIRO Variety Improvement Program commenced breeding for smut resistance in 2000 and the benefits of this pre-emptive breeding program, ultimately, will provide more highly-productive smut-resistant varieties and improved profitability of the Australian sugarcane industry.

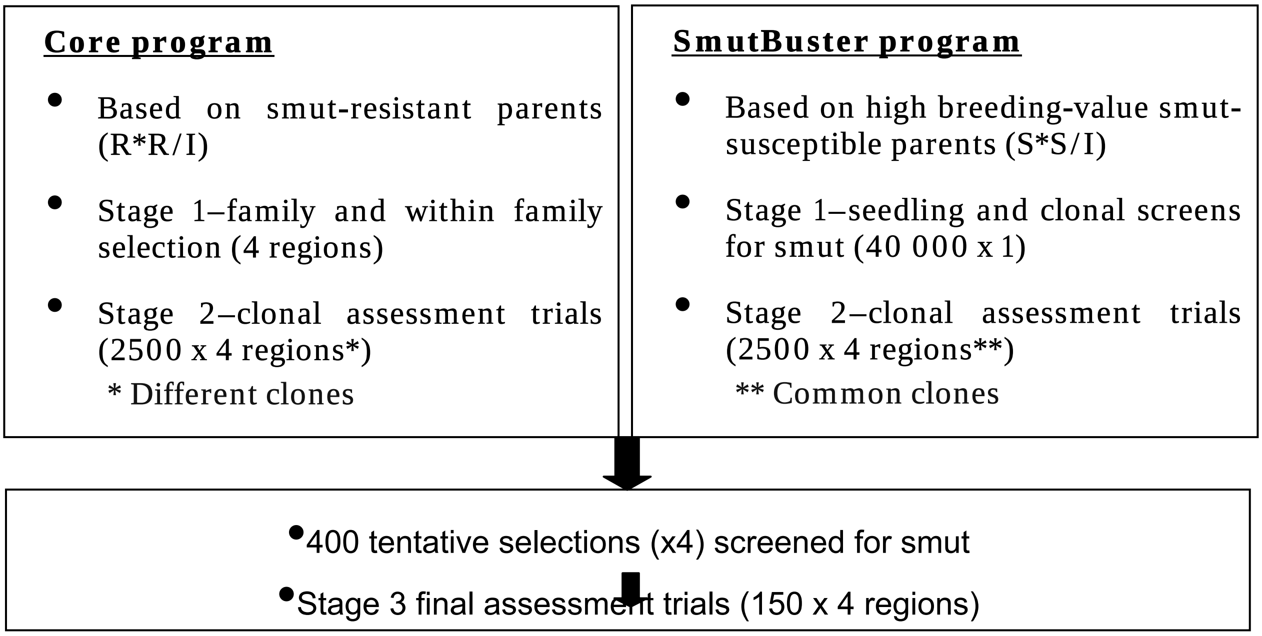

Fig. 10—Outline of Core and SmutBuster programs.

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REFERENCES

Croft, B.J., Irawan and Berding, N. (2000). Screening Australian sugarcane clones for smut reaction in Indonesia: initial results. Proc. Aust. Soc. Sugar Cane Technol., 22: 170–177.

Croft, B.J., Berding, N., Cox, M.C. and Bhuiyan, S. (2008a). Breeding smut-resistant sugarcane varieties in Australia–progress and future directions. Proc. Aust. Soc. Sugar Cane Technol., 30: 125–134.

Croft, B.J., Magarey, R.C., Allsopp, P.G., Cox, M.C., Willcox, T.G., Milford, B.J. and Wallis, E.S. (2008b). Sugarcane smut in Queensland: arrival and emergency response. Aust. Plant Path., 37: 26–34.

Engelke, J.H., Egan, B.T., Sherrard, J.H., Triglone, T. and Jackson, P.A. (2001). Sugarcane smut: successful management in the Ord. Proc. Aust. Soc. Sugar Cane Technol., 23: 268–273.

Ferreira, S.A., Comstock, J.C. and Wu, K.K. (1980). Evaluating sugarcane smut resistance. Proc. Int. Soc. Sugar Cane Technol., 17: 1463–1476.

Hutchinson, P.B. (1970). A standardised rating system for recording varietal resistance to sugarcane diseases. ISSCT Sugarcane Path. Newsl., 5: 7.

Magarey, R.C., Bade, G., Braithwaite, K.S., Croft, B.J. and Lonie, K.J. (2009a). Smut spore trapping studies conducted in Australian east coast production areas in late 2007–2008. Proc. Aust. Soc. Sugar Cane Technol., 30: 158–165.

Magarey, R.C., Denney, D., Sheahan, T., Fowell, L., Croft, B.J., Lonie, K.J., Bull, J.I., Bhuiyan, S. and Willcox, T.G. (2009). Results from smut epidemiology studies in the Herbert, Mackay and Bundaberg-Isis areas in 2007–2008. Proc. Aust. Soc. Sugar Cane Technol., 30: 145–157.

Riley, I.T., Jubb, T.F., Egan, B.T. and Croft B.J. (1999). First outbreak of sugarcane smut in Australia. Proc. Int. Soc. of Sugar Cane Technol., 23**:** 333–337.

LE CHARBON EN AUSTRALIE: HISTORIQUE, DÉCISION ET CHOIX DES STRATÉGIES D'AMÉLIORATION GÉNÉTIQUE

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MOTS CLÈS: Canne à Sucre, Charbon, Incursion,
Criblage aux Maladies, Stratégies d'Hybridation.

Résumé

MALGRÉ que la maladie du charbon avait été observée pour la première fois dans la zone du 'Ord River Irrigation Area' dans le secteur Ouest de l'Australie en 1998, la région principale de canne à sucre au long de la côte Est du Queensland et la partie Nord du New South Wales n'étaient pas affectées par la maladie jusqu'à son apparition près de Childers en juin 2006. Depuis cela, une progression rapide de la maladie a été observée dans la plus part des régions du Queensland, mais pas au New South Wales. Il est estimé que le charbon sera éventuellement observé sur chaque ferme dans les régions du Bundaberg-Childers, Mackay et Herbert en 2009 et des pertes économiques seront ressenties chez variétés sensibles. Cet article décrit le développement de l'épidémie du charbon au Queensland, la stratégie mise en place pour le remplacement des variétés sensibles, et la méthodologie d'hybridation et de sélection adoptée avant et après l'incursion de la maladie. Un évènement clé a été le criblage des variétés, des clones à un stade avancé de la sélection, et les parents en Indonésie à partir de 1998. Les stratégies d'hybridation de la canne ont pour objectifs de réduire les pertes économiques de l'industrie et maintenir le gain génétique. Ceci devrait aboutir à une plus grande proportion de variétés résistantes ou à résistance intermédiaire pour la récolte d'ici 2012, ainsi que l'homologation de nouvelles variétés très productives, résistantes au charbon pour l'industrie sucrière australienne.

EL CARBÓN DE LA CAÑADE AZÚCAR EN AUSTRALIA: HISTORIA, RESPUESTA Y ESTARATEGIAS DE MEJOPRAMIENTO GENÉTICO

Por

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PALABRAS CLAVE: Carbón de la Caña de Azúcar, Incursión, Evaluación de la Enfermedad, Estrategias de Fitomejoramiento.

Abstract

AUNQUE el carbón de la caña de azúcar fue detectado por primera vez en el área del Río Ord del Oeste de Australia en 1998, las principales aéreas de caña de azúcar a lo largo de la costa este de Queensland y Norte de New South Wales no fueron afectadas por la enfermedad hasta que fue encontrada cerca de Childers en Junio de 2006. Desde entonces, ha habido una rápida escalada de la enfermedad y el carbón se encuentra ahora en la mayoría de regiones cañeras de Queensland, pero no en New South Wales. Se estima que el carbón se encontrará en todas las unidades de producción en las regiones de Bundaberg-Childers, Mackay y Herbert en 2009, esto provocará pérdidas económicas en algunos campos con variedades susceptible. Este artículo documenta el desarrollo epidémico de la enfermedad en Queensland, la estrategia que hoy se dispone para reemplazar variedades susceptibles a carbón y los programas de fitomejoramiento adoptados en pre- y pos-entrada de la enfermedad. La clave del proceso fue el inicio de ensayos desde 1998 en adelante, para evaluación de variedades, clones avanzado y parentales en Indonesia. Las estrategias de mejoramiento buscan minimizar las pérdidas económicas de la industria y mantener la tasa de ganancias genéticas. Esto daría como resultado una alta proporción de variedades resistentes e intermedias cosechadas para el 2012 así como las nuevas variedades que están siendo entregadas que son altamente productivas y resistentes al carbón para la industria azucarera Australiana.