

BSES Limited



**FINAL REPORT SRDC PROJECT BSS214
SCREENING OF AUSTRALIAN GERmplasm FOR RESISTANCE TO
SUGARCANE SMUT**

by

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SD04008

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SUMMARY

Sugarcane smut is a destructive disease that has spread to all commercial sugarcane production areas except Fiji, Papua New Guinea and the east coast of Australia. The disease was recorded for the first time in Australia in July 1998 in the Ord River Irrigation Area (ORIA). The objective of this project was to rate Australian commercial cultivars, advanced selections in the BSES/CSIRO and CSR breeding programs and parental clones for resistance to smut. The ratings will be used to provide smut-resistant cultivars to the ORIA and prepare the east coast industry for a possible incursion.

BSES negotiated a contract with the Indonesian Sugar Research Institute (ISRI) to conduct smut resistance screening in Indonesia in 1997 before the incursion in Western Australia. The contract was renegotiated after the incursion to accelerate the testing program. The decision to conduct the testing in Indonesia was made because the quarantine period to move clones to Indonesia was shorter than moving clones to Western Australia. The screening is conducted on Madura Island, which is isolated from commercial cane, and clones can be planted into the smut resistance trials after 1 year in an open quarantine plot. Initially, Indonesia allowed 296 clones that were in the BSES quarantine houses to be screened for resistance with no quarantine period in Indonesia. This allowed BSES to obtain resistance ratings on these clones within 1 year of the incursion of smut into Australia.

The project has obtained smut resistance ratings for 906 clones including over 100 commercial cultivars. Six resistance trials were conducted, and in all but one trial, the disease progression was very similar, with high levels of disease developing in susceptible clones. One trial that was planted at the start of the dry season had much lower disease levels than the other trials and the clones included in this trial were retested in the later trials. The frequency of smut reaction in the Australian germplasm is skewed strongly towards susceptibility with 71% of clones being rated susceptible, 18% intermediate and 11% resistant. The frequency of these reaction types is almost identical in the commercial cultivars tested.

Two rating methods were compared in trials 1 and 2. The percentage of stalks with smut whips and the percentage of infected plants were highly correlated and there was no significant difference between the ratings given with the two methods. Rating infected plants requires less labour and therefore was selected as the rating method for future trials.

The smut resistance ratings of commercial cultivars have been widely distributed to growers in magazine articles, variety guides and newsletters. All districts have some resistant and intermediate cultivars. The Burdekin district currently has 70% of their crop planted to susceptible cultivars. This district has the ideal climate for smut disease development. The ratings have been used to select clones for testing in the ORIA. A number of the smut-resistant cultivars identified in this project are being propagated in the ORIA for possible release to growers.

BSES has set targets to have 50% of crosses each year with either resistant or intermediate parental levels of smut resistance and to have 50% of clones in all stages of the selection programs originating from these crosses. Excellent progress has been made to meet these targets but they have not been achieved to date in all districts. There is a shortage of

smut-resistant parental clones with high breeding value. In response to a specific request for smut-resistant cultivars, BSES/CSIRO has imported 258 clones from 13 overseas countries since 1998. These clones will provide a valuable source of smut-resistant parents in the future.

Barry Croft, BSES Plant Pathologist and Nils Berding, BSES Plant Breeder, have been involved in the planting and rating of most of the trials in Indonesia. This experience will allow the rapid implementation of a smut-screening program in Queensland if a smut incursion occurs on the east coast. A procedure manual for conducting smut trials has been prepared and was used as a guide for the establishment of smut-resistance trials in the ORIA.

Excellent cooperation with the ISRI has allowed the Australian sugar industry to obtain smut ratings on a large number of clones in a short period. The information obtained has allowed BSES/CSIRO to commence breeding and selecting for smut resistance so that the proportion of smut-resistant clones in crop improvement programs will increase significantly. BSES/CSIRO is using the smut ratings to select crosses among smut-resistant parents and to advance smut-resistant clones in selection programs. If sugarcane smut does come to the eastern states, the information obtained in this project, and the actions taken to increase the overall levels of smut resistance in selection populations will reduce the risk of serious yield losses.

1.0 BACKGROUND

Sugarcane smut was first recorded in South Africa in 1877, but has since been recorded in all commercial sugarcane industries except Fiji, Papua New Guinea and the eastern states of Australia (Comstock 2000). The disease is caused by the fungus, *Ustilago scitaminea* H. and P. Sydow. During the 1970s and 1980s, smut spread to Hawaii, the Caribbean, South, Central and North America, and was reported for the first time in 50 years in Indonesia. The first report of smut in Australia occurred in the Ord River Irrigation Area (ORIA) in Western Australia in 1998 (Riley *et al.* 1999). The disease can cause yield losses of greater than 50% in susceptible cultivars and can make ratoon crops unprofitable. Smut can be successfully controlled by resistant cultivars, but the loss of productive susceptible cultivars has caused major disruptions to sugar industries around the world (Lee-Lovick 1978). Previous studies have shown that narrow-sense heritability for smut resistance is moderate to high (Walker 1980; Wu *et al.* 1988; Chao *et al.* 1990).

Sugarcane smut stands out as the greatest exotic disease risk for sugarcane in eastern Australia because of its economic importance, its history of spread and its current close proximity.



Figure 1 Typical smut whip on a thin grassy shoot

Sugarcane smut infects plants when spores come in contact with buds on standing stalks or germinating buds in the soil (Comstock 2000). The fungus penetrates the buds and the fungal hyphae grow in close association with the plant's meristem. Eventually the fungus causes the plant to form a modified floral structure within which the fungus produces masses of brown/black teliospores (Figure 1). 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. Plants often die when ratooned leaving large gaps in ratoon crops.

Resistant cultivars are widely used for control in countries where the disease is present. BSES has maintained a database with the smut ratings of Australian cultivars that had been tested overseas and of important overseas commercial cultivars. However, this database contained few ratings for current Australian cultivars because of the delay in moving clones between countries through quarantine and the lack of a formalised arrangement with other countries to screen Australian clones for smut resistance. BSES previously tested Australian clones for smut resistance in Malaysia but this arrangement lapsed in the mid 1980s.

Strains of *Ustilago scitaminea*, the causal agent of sugarcane smut, have been reported from many countries but a large international project has suggested that differences may not be as great as first reported (Grisham 2001). Recent research by Braithwaite *et al.* (2004) as part of a CRC Tropical Plant Protection project has identified significant diversity at a DNA level in smut from South-East Asia but isolates from other regions show little diversity. She found that smut isolates from Indonesia and Western Australia are identical.

Indonesia is a suitable location for conducting smut resistance screening for the Australian sugar industry because it is the most likely source for spread of the pathogen to Australia. Indonesian plans to establish a sugar industry in West Papua (Irian Jaya) will increase the risk of smut entering Australia. Testing Australian clones in Indonesia ensures they will be tested against the biotypes of the pathogen that are most likely to enter Australia. The ORIA sugar industry has a smut-screening program for introduced clones, but movement of clones to the ORIA is restricted by quarantine regulations.

The aim of this project was to provide the Australian sugar industry with up-to-date information on the smut resistance of current and promising commercial cultivars and parental clones. These ratings will assist the industry to prepare for an incursion of smut and will provide immediate assistance to the industry in the ORIA. In the BSES/CSIRO plant improvement program, a percentage of crosses with resistance to smut will be made each year to increase the frequency of smut resistance genes in the program.

2.0 OBJECTIVES

1. Establish quarantine and testing procedures with the Indonesian Sugar Research Institute to screen Australian sugarcane germplasm for resistance to smut disease.
2. Screen up to 500 clones for resistance to smut disease over 3 years.
3. Provide hands-on training for Australian researchers in conducting smut-resistance trials.
4. Increase knowledge of the smut resistance of current and potential cultivars and parental clones for the Australian sugar industry.
5. Increase the frequency of smut resistance genes in the Australian sugarcane breeding population.

6. Develop and institute an on-going smut resistance screening program in Indonesia or Western Australia.

These objectives were generally met in full (and in some cases exceeded) as summarised below and in more detail in Sections 3-6.

Objectives 1 and 6

- ***Establish quarantine and testing procedures with the Indonesian Sugar Research Institute to screen Australian sugarcane germplasm for resistance to smut disease.***
- ***Develop and institute an on-going smut resistance-screening program in Indonesia or Western Australia.***

BSES negotiated a contract with the Indonesian Sugar Research Institute (ISRI) to conduct smut resistance screening in Indonesia before the incursion in Western Australia. The contract was renegotiated after the incursion to accelerate the testing program. The decision to conduct the testing in Indonesia was made because the quarantine period to move clones to Indonesia was shorter than moving clones to Western Australia. The screening is conducted on Madura Island, which is isolated from commercial cane, and clones can be planted into the smut resistance trials after 1 year in an open quarantine plot. Initially, Indonesia allowed 296 clones that were in the BSES quarantine houses to be screened for resistance with no quarantine period in Indonesia. This allowed BSES to obtain resistance ratings on these clones within 1 year of the incursion of smut into Australia.

Objectives 2 and 4

- ***Screen up to 500 clones for resistance to smut disease over 3 years.***
- ***Increase knowledge of the smut resistance of current and potential cultivars and parental clones for the Australian sugar industry.***

Smut-resistance ratings were obtained for 906 clones including over 100 commercial cultivars. Six resistance trials were conducted, and in all but one trial, the disease progression was very similar, with high levels of disease developing in susceptible clones. One trial that was planted at the start of the dry season had much lower disease levels than the other trials and the clones included in this trial were retested in the later trials. The frequency of smut reaction in the Australian germplasm is skewed strongly towards susceptibility with 71% of clones being rated susceptible, 18% intermediate and 11% resistant. The frequency of these reaction types is almost identical in the commercial cultivars tested.

Two rating methods were compared in trials 1 and 2. The percentage of stalks with smut whips and the percentage of infected plants were highly correlated and there was no significant difference between the ratings given with the two methods. Rating infected plants requires less labour and therefore was selected as the rating method for future trials.

The smut resistance ratings of commercial cultivars have been widely distributed to growers in magazine articles, variety guides and newsletters. All districts have some resistant and intermediate cultivars. The Burdekin district currently has 70% of their crop planted to susceptible cultivars. This district has the ideal climate for smut disease development. The ratings have been used to select clones for testing in the ORIA. A

number of the smut-resistant cultivars identified in this project are being propagated in the ORIA for possible release to growers.

Objective 3

- ***Provide hands-on training for Australian researchers in conducting smut resistance trials.***

Barry Croft, BSES Plant Pathologist and Nils Berding, BSES Plant Breeder, have been involved in the planting and rating of most of the trials in Indonesia. This experience will allow the rapid implementation of a smut-screening program in Queensland if a smut incursion occurs on the east coast. A procedure manual for conducting smut trials has been prepared and was used as a guide for the establishment of smut-resistance trials in the ORIA.

Objective 5

- ***Increase the frequency of smut resistance genes in the Australian sugarcane breeding population.***

BSES has set targets to have 50% of crosses each year with either resistant or intermediate parental levels of smut resistance and to have 50% of clones in all stages of the selection programs originating from these crosses. Excellent progress has been made to meet these targets but they have not been achieved to date in all districts. There is a shortage of smut-resistant parental clones with high breeding value. In response to a specific request for smut-resistant cultivars, BSES/CSIRO has imported 258 clones from 13 overseas countries since 1998. These clones will provide a valuable source of smut-resistant parents in the future.

3.0 ESTABLISHMENT OF SCREENING PROGRAM

In 1997, BSES negotiated a contract with the Indonesian Sugar Research Institute (ISRI) to screen Australian clones for resistance to sugarcane smut as part of the planning for this project. After the identification of sugarcane smut in the ORIA on 20 July 1998, the project was modified to accommodate the increased urgency to obtain ratings for resistance to sugarcane smut for Australian cultivars, breeding clones, and clones in advanced stages of selection. The modified project was prepared and approved by SRDC.

Dr Colin Ryan and Mr Barry Croft travelled to Indonesia in October 1998 to renegotiate the contract with the ISRI to accommodate the increased number of clones to be tested and to discuss the possibility of shortening the quarantine period for the Australian clones. Agreement was reached with the ISRI to test 500 clones over 3 years. ISRI agreed to allow BSES to screen 300 clones that had spent greater than 1 year in quarantine in BSES quarantine facilities in Brisbane at an isolated testing site on Madura (Figure 2) with no quarantine period in Indonesia. This arrangement was subject to approval of the quarantine facilities and procedures by representatives of the ISRI and the Indonesian government quarantine authority. The second part of the agreement was to allow BSES to dispatch 200 clones from the field at Meringa to spend 1 year in the ISRI quarantine facility at Puteran Island, east of Madura. These clones would then be planted directly into a smut resistance trial at the isolated site at Madura in 1999. This arrangement was

subject to inspection of the clones before dispatch by the representatives of ISRI and the government quarantine authority.



Figure 2 East Java and Madura Island. Smut trials are conducted near Sumenep (site arrowed)

Mr Irawan, Senior Pathologist, Indonesian Sugar Research Institute and Dr Suwanda, Indonesian Centre for Agricultural Quarantine, visited Brisbane and Meringa from 12-16 October 1998. They inspected the BSES quarantine facilities and procedures in Brisbane and approved the proposal to plant the clones held at this facility directly into a smut-resistance trial in Indonesia without any quarantine treatments. The BSES Brisbane quarantine facility houses the BSES export collection, which includes most 'Q' cultivars and advanced selections from NSW, southern Queensland, central and northern Queensland. The Indonesians also inspected the fields at Meringa from which we proposed to send parental clones and northern selections to Indonesia. Again, they were happy that the cane at Meringa was free of quarantine diseases and could be exported to their quarantine site on Puteran Island.

These arrangements allowed the project to rapidly obtain information on the resistance of approximately 500 clones. After the establishment of this initial testing program, a review of the project was conducted at SRDC's Brisbane office on 18 April 2000. The options of continuing the testing program in Indonesia or moving to a testing program in the ORIA were considered. A decision was made to continue the testing program in Indonesia.

Some advantages of continuing in Indonesia were:

- The quarantine period for moving clones to Indonesia was shorter than moving clones to the ORIA.

- The cost of conducting the trials was lower than in Australia.
- ISRI staff are experienced with conducting smut trials.
- Supplies of inoculum were available in commercial fields.
- Indonesia was considered to be the greatest risk to eastern Australia as a source of smut by the Smut Incursion Technical Committee. Clones tested in Indonesia would be tested with the isolates of smut most likely to arrive in the eastern states.
- Current trials appeared to be conducted well and good levels of smut were being achieved.

The disadvantage of Indonesia was the possible political instability.

Negotiations with ISRI on a new contract to continue the smut-screening program were finalised in July 2002. This new contract covered the completion of this project and was for the quarantine and smut screening of three batches of 250 clones to be completed by December 2003.

4.0 SCREENING AUSTRALIAN CLONES

4.1 Introduction

BSES had gathered some information on the smut resistance of older commercial cultivars before this project commenced, but there was little information available on the smut resistance of recently released commercial cultivars, the clones in selection trials, and parental collections in Australia. The objective of the project was to screen as many commercial cultivars, advanced selections and parental clones as possible, with a target of 500 clones in 3 years.

4.2 Materials and methods

4.2.1 Plant material and trial design

Trials 1 and 2

Planting material for trials 1 and 2 was cut from the BSES quarantine glasshouses in Brisbane and air freighted to Indonesia. The Indonesian quarantine authorities allowed the clones to be planted directly into a smut-resistance trial in a site isolated from commercial sugarcane on Madura Island on the condition that the clones had been grown in quarantine for at least 12 months in Australia and screened for Fiji leaf gall with a RT-PCR assay. The amount of planting material available was restricted because only one potted plant of each clone was available.

Three Indonesian smut-resistance standard clones were included in the trials; PS79-82 (resistant), PS80-442 (susceptible), and M442-51 (susceptible). In trial 2, eleven 'Q' cultivars and NCo310, which were growing at ISRI, Pasuruan, were included.

Trials 1 and 2 consisted of three replicates in a randomised complete-block design. Each plot consisted of six two-eye setts planted in a single-row 3 m plot. The trials were planted at Braji (near Sumenep), on Madura Island, which is east of Java and has no

commercial sugarcane crops (Figure 2). Trial 1 (137 clones) was planted from 6-8 December 1998 and Trial 2 (159 clones) from 11-15 March 1999. Plant crops were grown for 6 months, and then ratooned for a further 6 months.

Trials 3-6

Clones for trials 3-6 were sourced from BSES Meringa, CSR Macknade, and BSES quarantine, Brisbane. Three 300-400 mm stalk pieces were shipped to Indonesia and were planted in the ISRI quarantine plot on Puteran Island. The clones were pre-germinated and planted into 3-m, single-row plots. The cane was regularly inspected for disease for 12 months as required by Indonesian quarantine authorities. After the 1-year quarantine period that also acted as a propagation phase, the clones were planted into the smut-resistance trial.

Trials 3-6 consisted of four replicates in a randomized complete-block design. Each plot consisted of 10 two-eye setts planted in a 5-m single-row plot. Trial 3 (194 clones) was planted from 2-5 May 2000, trial 4 (289 clones) from 7-13 November 2000, trial 5 (291 clones) from 3-8 November 2001, and trial 6 (259 clones) from 30 October-3 November 2002. Plant crops were grown for 6 months and then ratooned for a further 6 months.

4.2.2 Inoculation

Smut spores were collected for the trials from the Jatitujuh sugarcane plantation, Ceribon (Cheribon) West Java, which has a high incidence of smut infection in commercial fields. Inoculum was collected primarily from the cultivar M442-51. Spores were removed from whips collected from the field by scraping them with a blunt knife. The resulting material was sieved and the spores dried in the sun. Spores were used at 1 g/L of dipping solution to give a concentration of 5×10^6 spores/mL. Two-eye setts were dipped in the spore suspension for 10 min and then covered by plastic fertiliser bags overnight to maintain high humidity to encourage spore germination. The inoculated setts were planted in the field and covered with moist soil.

4.2.3 Rating procedure

The number of stools per plot was recorded at monthly intervals after planting and the number of stools with smut whips was recorded from 2 months after planting. Stools were defined as the plant developing from a single bud. Because smut infects through the bud, each bud is a potential infection site. In trials 1 and 2, the total number of stalks and the number of stalks with whips were recorded at the end of the plant and ratoon crops. The trials were ratooned at 6 months and rating was continued monthly in the first-ratoon crops.

4.2.4 Statistical analyses

Analyses of variance were conducted on the percent-infected plants for all trials. Standard clones were included in all trials and the test clones were rated relative to the standard clones. The ISSCT standard rating system was used with a rating scale of 1 = highly resistant to 9 = highly susceptible. After the first two trials, where only Indonesian standard clones were available, a set of Australian standard clones was included. This set of standards was expanded as more information became available on Australian clones. The standard ratings for these clones initially were taken from the results of smut trials 1 and 2 in Indonesia and observations in Western Australia. As more results are being obtained for the standard clones, the standard ratings are being refined using the results from all trials. Ratings for the test clones were calculated from the regression equation for the log-transformed percent infection for the standards (X) and their standard ratings (\hat{Y}). The standards included in the trials and the mean percent infection and ratings are shown in Table 1.

Table 1 Standard clones, percent infection in all trials and ratings based on the mean of all trials

Clone	Trial						Mean	Rating
	1	2	3	4	5	6		
M442-51	12.2	43.1	7.0	73.2	19.2	43.4	33.0	7.4
NCo310		58.3	14.6	27.5	29.5	55.5	37.1	7.7
PS79-82	0.0	0.0	20.0	68.6	20.0	15.9	20.8	6.2
PS80-442	55.1	47.8	19.7	37.8	46.7	29.7	39.5	7.8
PS84-16029			0.0	2.5	32.6	41.7	19.2	6.1
PS87-10266			0.0	10.9	1.9	29.4	10.6	4.6
Q117		79.6	44.8	66.4	72.6	53.6	63.4	9.0
Q124		17.6	8.8	36.0	14.0	29.3	21.1	6.3
Q155		0.0	0.0	42.3	27.3	23.1	18.5	6.0
Q170 [♢]	2.8		3.6	50.2	31.7	53.0	28.3	7.0
Q171 [♢]		0.0	0.0	9.3	0.0	13.1	4.5	2.7
Q96		12.5	0.0	3.9	1.8	4.0	4.4	2.7
Q99						1.8	1.8	1.0

In trials 1 and 2 the total number of stalks with whips and the percent stalks with whips were recorded. Analyses of variance and covariance were performed for the percent of smut-infected stools and percent smut-infected stalks.

4.3 Results

The development of smut disease in all trials followed a similar pattern except for smut trial 3 (Figure 3) where the disease levels were significantly lower than for all other trials. This trial was planted in May at the commencement of the dry season.

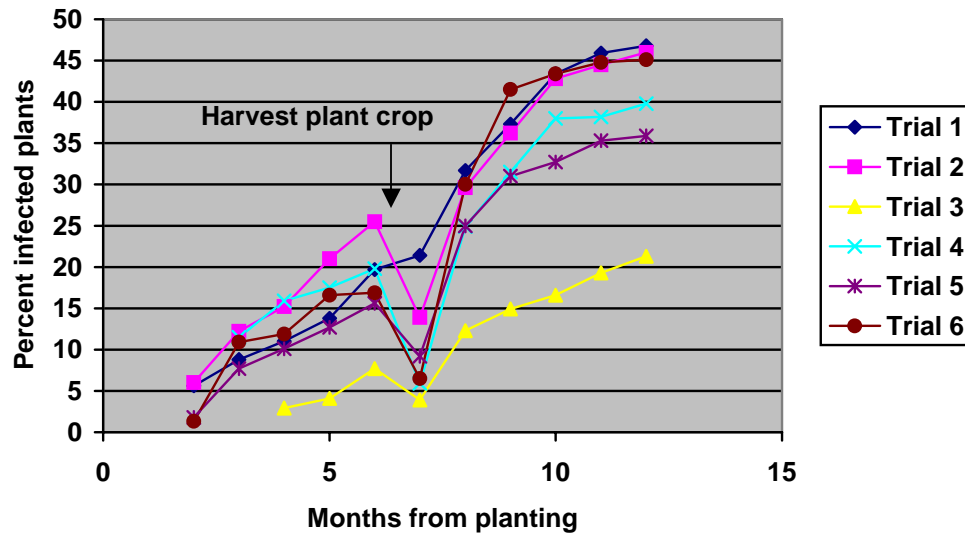


Figure 3 Disease development in trials 1-6 (mean of all clones)

The correlation of the percent-infected plants of the standard clones in each of the six trials relative to the mean from all trials is shown in Table 2. The correlations were all significant, except for trial 1 which only had four standards. Trial 4 had the lowest correlation.

Table 2 Correlation coefficients for the standard clones for their mean percent infection in individual trials versus mean infection over all trials

Trial	Correlation coefficient	Number of clones	P
1	0.868	4	n.s. ^a
2	0.903	9	< 0.01
3	0.863	12	< 0.01
4	0.651	12	< 0.05
5	0.917	12	< 0.01
6	0.746	12	< 0.01

^a n.s. = not significant.

In trials 1-6 906 clones were screened for smut resistance. The percent infection at the end of the plant and ratoon crops and the rating assigned are shown in Appendix 1. The average ratings for clones are shown in Appendix 2. The ratings given for the clones tested in trial 3 were considered unreliable because of the low level of disease in this trial and these ratings were omitted from these appendices. Most clones in trial 3 were retested in trials 4 and 5.

The frequency distribution for the nine rating classes is shown in Figure 4. There is an obvious skew towards susceptibility in the Australian germplasm. 71% of all clones tested ($n = 906$) were classed as susceptible (ratings 7-9). The frequency distribution for commercial cultivars ($n = 107$) was almost identical to the total population.

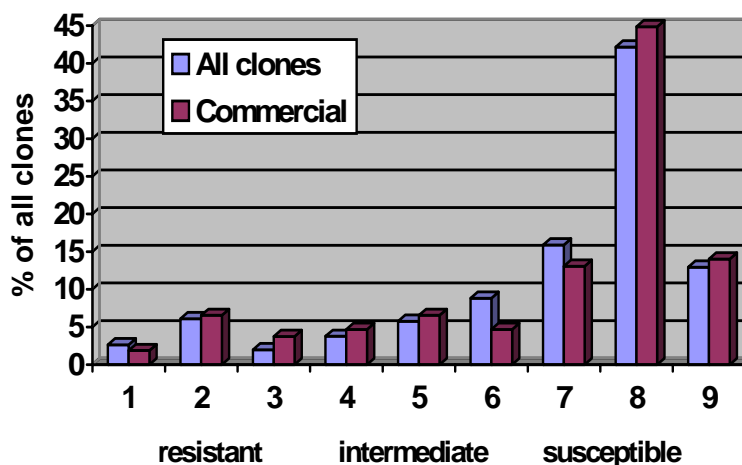


Figure 4 Frequency distribution of smut resistance ratings (Resistant ≤ 3 ; Intermediate = $> 3.0 < 7.0$; and Susceptible ≥ 7.0) of all clones and commercial cultivars

In most overseas countries, trials are assessed on a plant basis (Ladd *et al.* 1974), but some countries make the assessment on a stalk basis (Bailey 1980). These two methods were compared in the final inspections in the plant crops of trials 1 and 2. Phenotypic correlations (r_p) between percent smut-infected plants and percent-infected stalks were 0.86 and 0.94 for trials 1 and 2, respectively. The genotypic correlations (r_G) were 1.0 for both trials and the environmental correlation (r_E) were moderate to high (0.59 trial 1 and 0.73 trial 2). Staff counted up to 67 (mean 29) and 100 (mean 46) stalks per plot in trials 1 and 2, respectively, compared with a maximum possible number of 12 stools. The cost of the extra staff time required to count and assess stalks, rather than plants, cannot be justified because there is no genetic difference between plant- and stalk-based smut assessments.

4.4 Discussion

The objective of screening 500 clones was exceeded and smut ratings are now available for 906 clones. These ratings are stored in the BSES/CSIRO Sugarcane Plant Improvement Database (SPIDS). Growers have been advised of the ratings of commercial cultivars in magazine articles, field days and BSES variety guides. BSES/CSIRO is using the ratings to assist with selection decisions and in identifying smut-resistant crosses.

Australian germplasm has a high proportion of smut susceptible clones. In the past, there has been no emphasis on selection for smut resistance in Australia. If smut arrived in Australia, the disease will cause major disruption to growers and the BSES/CSIRO plant improvement program. This project provides a basis on which the BSES/CSIRO can work towards shifting the breeding population towards a higher frequency of smut resistance genes and the selection populations to having a higher frequency of resistant clones.

The disease development was very similar in all trials except trial 3. Trial 3 was planted at the commencement of the dry season. All other trials were planted during or at the start of the wet season. The reason for the failure of trial 3 is not known, but all future trials will be planted at the commencement of the wet season.

A set of Australian clones that can be used as standards is being developed. These standards, in part, have been selected from commercial cultivars grown in the ORIA district because we know their field reaction. A number of other clones have been selected to give a range of reaction types. There has been some variability in the reaction of the standard clones between trials.

Excellent cooperation with the ISRI has allowed the Australian sugar industry to obtain smut ratings on a large number of clones in a short period. The information obtained will allow BSES/CSIRO to commence breeding and selecting for smut resistance so that the proportion of smut-resistant clones in crop improvement programs will increase significantly. BSES/CSIRO is using the smut ratings to select crosses among smut-resistant parents and to advance smut-resistant clones in selection programs. If sugarcane smut does come to the eastern states, the information obtained in this project, and the actions taken to increase the overall levels of smut resistance in selection populations will reduce the risk of serious yield losses.

The ratings obtained from this project have been used to select clones for dispatch to the ORIA. There has been good agreement between the reaction of clones in the trials in Indonesia and in the ORIA. Some commercial cultivars identified as resistant to smut in Indonesia are being multiplied for possible release in the ORIA. These resistant cultivars should improve the productivity in the ORIA and reduce the reliance of the industry on a small number of clones.

5.0 PROVISION OF TRAINING IN RESISTANCE TRIALS

Barry Croft and Nils Berding have been involved in the planting and inspection of most of the smut trials and Barry Croft has also assisted with inspection of smut trials in the ORIA. A procedure for planting and inspecting smut trials has been written (Appendix 3). The experience gained from these visits will allow the rapid implementation of a smut-screening program in Australia if a smut incursion occurs. The ORIA smut-resistance screening trials are based on the same techniques as used in Indonesia.

Because of the Bali bombing and the war in Iraq in late 2002 and early 2003, travel to Indonesia to inspect smut trial 5 and assist with planting trial 6 was not possible. The travel conditions improved in late 2003, and Barry Croft travelled to assist with the final inspection of smut trial 6 and assisted with planting of a further trial (trial 7) in October 2003.

6.0 INCREASING THE FREQUENCY OF SMUT-RESISTANCE GENES

BSES/CSIRO Plant Improvement staff have set a target that 50% of crosses made in each season should have resistant or intermediate mid-parent rating and that 50% of clones in all selection stages should be derived from these crosses.

Excellent progress has been made in meeting these targets. A computer program (Autosmut) has been developed to assist in selecting smut-resistant crosses and selecting smut-resistant clones in the selection program. This program will allow accurate reporting of progress toward meeting the targets in the crossing and selection programs. In some cases, the ratings of parent clones are not available and Autosmut uses information on grandparents if available. If the rating of one parent is unknown, and there is no information on grandparents, the program uses an estimated rating of 7 (average of all smut ratings obtained to date) for the missing parent rating. This approach is useful, because if one parent is known to be resistant and the rating of the other parent is unknown, the cross at worst would be rated intermediate and has the potential to produce a proportion of smut resistant progeny (worst case is 3 x 9 with 6 mid-parent rating). The following rules are used to obtain the best available estimate of mid-parent rating for crosses:

1. If ratings for both parents are known, the mid-parent rating is calculated as $(FP+MP)/2$, where FP = rating of the female parent and MP = rating of the male parent.
2. If the female parent is known and there is no rating for the male parent but the rating for both grandparents of the male (MGP1 and MGP2) are known, the rating is calculated as $((FP/2)+(MGP1+MGP2)/2)/2$.
3. If the male parent is known and there is no rating for the female parent but the rating for both grandparents of the female (FGP1 and FGP2) are known, the rating is calculated as $((MP/2)+(FGP1+FGP2)/2)/2$.
4. If the rating for one parent is known but the ratings for both grandparents of the missing parent are not known then add 7 (the average rating for all clones tested in Indonesia) as the best estimate of the missing parent, ie $(FP+7)/2$ or $(MP+7)/2$.
5. If no rating is available for either parent, but ratings are available for all grandparents, use the average for all grandparents, ie $(FGP1+FGP2+MGP1+MGP2)/4$.
6. If the above rules are not met, do not assign a rating.

All of the smut-resistance ratings from the Indonesian trials, the ORIA trials and smut ratings supplied by overseas countries for imported clones have been entered into the BSES/CSIRO Sugarcane Plant Improvement Database (SPIDS). The number of smut resistant, intermediate and susceptible crosses made in 2000-2003 is shown in Table 3. The number of crosses in the resistant to intermediate classes increased from 21.9% in 2000 to 72% in 2003.

One of the Meringa photoperiod facilities has been dedicated to making smut-resistant crosses. The success of the photoperiod facility dedicated to making smut resistant crosses (PF-A) can clearly be seen in Table 3 with all of the resistant crosses and two thirds of the intermediate crosses coming from this facility in 2003. The poor flowering in the core Meringa program in 2002 and 2003 and the success of the photoperiod facility biased the results toward resistant to intermediate crosses and in years of better flowering the percentage of crosses in these categories is likely to be closer to the 50% target.

Table 3 Number of crosses, classified by smut-resistance rating, made in the BSES cross-pollination program from 2000 to 2003

Year	Source ¹	Resistant ²		Intermediate ²		Susceptible ²	
		Number	%	Number	%	Number	%
2000	MER – core	3	0.5	136	23.7	436	75.8
	MER – PF-A	0	0	15	11.9	111	88.1
Total		3	0.4	151	21.5	547	78.0
2001	MER - core	25	4.4	156	27.3	390	68.3
	MER – PF-A	64	14.7	255	58.5	117	26.8
	BDB PF	0	0	13	15.3	72	84.7
Total		89	8.2	424	38.8	579	53.0
2002	MER - core	30	11.9	78	30.8	145	57.2
	MER – PF-A	37	10.4	203	57.2	115	32.4
	BDB PF	12	13.5	41	46.1	36	40.4
Total		79	11.3	322	46.2	296	42.5
2003	MER - core	0	0	99	40.7	144	59.3
	MER – PF-A	71	16.7	307	72.2	47	11.1
	BDB PF	0	0	54	78.3	15	21.7
Total		71	9.6	460	62.4	206	28.0

¹ MER = Meringa, BDB = Bundaberg PF = photoperiod facility.

² Determined by Autosmut: R < 3.5; I ≥ 3.5 < 6.5; S ≥ 6.5

Plant Improvement staff within BSES/CSIRO have reviewed the smut resistance of crosses planted in 2002 and 2003 stage 1 trials (Table 4). The Central and Burdekin programs exceeded the target of 50% resistant to intermediate crosses and the Southern and Herbert programs were close to achieving this target. The northern program has the highest percentage of smut susceptible crosses. There has been considerable improvement from the commencement of the project when the percentage of resistant to intermediate crosses in stage 1 trials in most districts was below 30%.

Table 4 Percent of crosses in each smut-resistance class¹ in the seedling populations in stage 1 trials

Region	2002				2003			
	R	I	S	No. crosses rated (Total)	R	I	S	No. crosses rated (Total)
Southern	4	40	56	228 (257)	7	35	58	208 (276)
Central	3	40	56	290 (325)	7	46	46	194 (243)
Burdekin	5	35	60	174 (210)	8	44	49	223 (283)
Herbert	2	42	56	173 (252)	3	44	53	168 (237)
North	2	35	63	113 (237)	1	31	68	151 (232)

¹ Defined as crosses with an AutoSmut score: R < 3.5; I ≥ 3.5 < 6.5; S ≥ 6.5.

Although considerable progress has been made in meeting the targets of 50% crosses made specifically for smut resistance, there remains a shortage of smut-resistant parents with high breeding value. BSES/CSIRO has imported 258 clones from 13 countries since 1999 with an emphasis on clones of known smut resistance. These clones will provide BSES with a valuable source of smut-resistant parents. The imported clones are currently at various stages of quarantine, propagation, and yield assessment. The imported clones are sent directly from the post-entry quarantine facility to the ORIA when they are released from quarantine for assessment for yield and smut resistance.

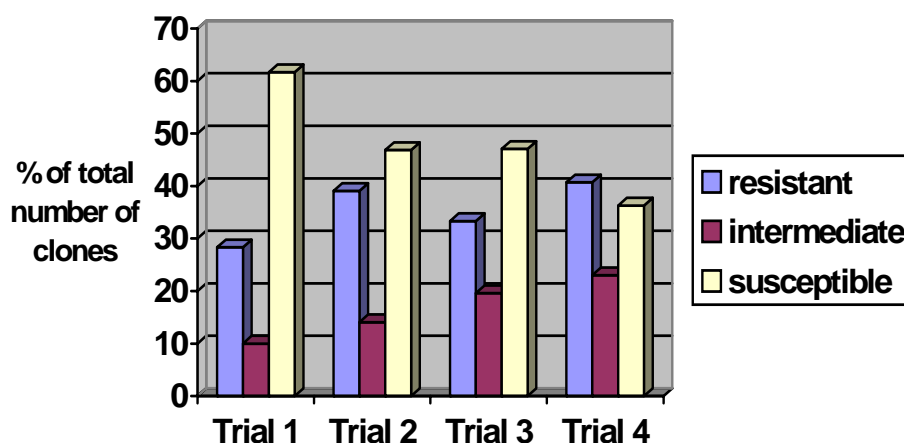


Figure 5 Comparison of resistance levels in four smut trials conducted in the ORIA

The smut-resistance ratings obtained from this project have been used to select clones to be sent from Queensland to the ORIA. The proportion of susceptible clones in smut trials in the ORIA is showing a decreasing trend (Figure 5). This shows the value of the screening conducted in Indonesia, which has been used to select potential clones before shipment to the ORIA. The ORIA screening trials also include clones imported by BSES from overseas. In the ORIA, a number of overseas clones were highly susceptible, even

though they have been reported to be resistant in their country of origin. This may be due to the smut-conducive environment in the ORIA. The cultivars Q133, Q146, Q151, Q171^(b) and Q177^(b) have been propagated for possible distribution to growers in the ORIA in 2004. The provision of smut-resistant cultivars to the ORIA will improve the productivity of the district and will allow growers to plant a wider range of cultivars. This will reduce the over-reliance on Q99, which currently makes up greater than 73% of the crop. BSES has an on-going commitment to provide smut-resistant clones to the ORIA.

Growers have been advised of the smut resistance of current commercial cultivars in Queensland and NSW through BSES variety guides, newsletters, field days and magazine articles. All districts have some commercial cultivars that are rated resistant and a larger number of cultivars rated intermediate (Figure 6). In recent years, promising resistant cultivars have been released, including Q199^(b), Q200^(b) and Q208^(b). The small number of cultivars available to growers in the ORIA is obvious when compared to districts in Queensland and New South Wales.

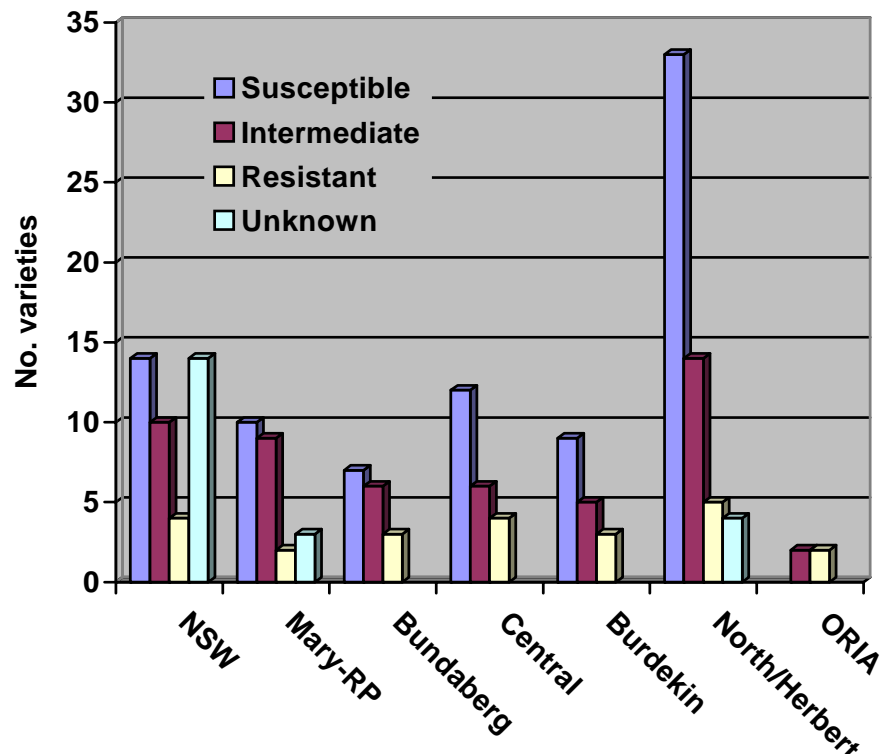


Figure 6 Number of smut-resistant, intermediate, and susceptible cultivars available in each region of Australia

The percentage of the crop (2002) planted to smut resistant, intermediate and susceptible cultivars is shown in Figure 7. The Burdekin is the region most vulnerable to a smut incursion, with 70% of the crop planted to susceptible cultivars. The Burdekin is also the region that has the best environment for development of a smut epidemic. The Central and Bundaberg regions have a high percentage of the crop as intermediate cultivars, but

this is largely due to the area planted to Q124. The area planted to Q124 is decreasing rapidly because of its susceptibility to orange rust.

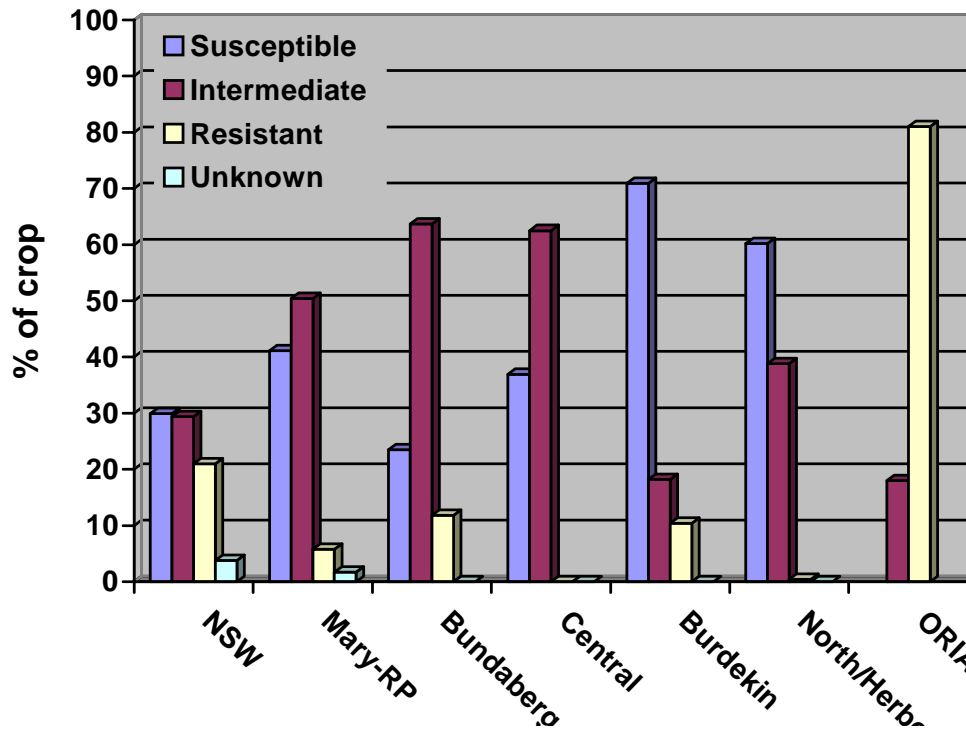


Figure 7 Percentage of the 2002 crop planted to smut resistant, intermediate and susceptible cultivars in each region of Australia

BSES has worked with local Cane Productivity Services to ensure that all districts have access to disease-free planting material of smut-resistant cultivars. Initially BSES provided productivity services with smut-resistant clones from the advanced selection trials and/or obtained planting material of resistant cultivars from other regions. As more information was obtained, some commercial resistant cultivars were identified in all regions. These cultivars provide a buffer for growers if smut arrives in the near future. With the changes in the breeding and selection programs that are now in place, more high-yielding resistant cultivars should become available in the future. High-yielding smut-resistant cultivars will greatly decrease the risk of serious disruption to the east coast industry by a smut incursion.

Economic analyses have shown that growers should continue to grow the most productive cultivars on 88% of their farm even if the clones are susceptible to pests that may enter the region in the future (Glaz *et al.* 1986). The smut-resistance ratings from this project were used in an analysis of the risk of diseases and other variety related causes for the Central district (Willcox and Croft 2004). This analysis identified smut as the greatest disease risk to the central district. The paper recommended that growers plant a mixture of cultivars with a percentage of their farm planted to cultivars resistant to the highest risk diseases.

The BSES/CSIRO strategy for breeding for smut resistance is being reviewed regularly, with a major review in 2002. The main recommendation from the meeting was that clones should be tested earlier in the BSES/CSIRO selection program to reduce the generation time and thereby increase the speed of improvement in smut resistance. This would mean an increase in the number of clones to be tested. The proposal was that selections from the Progeny Assessment Trials (Stage 2) of the BSES/CSIRO Plant Improvement program should be sent to Indonesia from each region (total of 500-600 clones). After the clones spend 1 year in quarantine in Indonesia, the results of the plant crop of the Final Assessment Trials (Stage 3) would be available and the number of clones to be planted in the smut screening trial could be reduced to 250-300. This would reduce the generation time by at least 3 years. The need for quarantine of clones from the Southern and Central regions before shipment to Indonesia would be a limitation to this proposal. The plan involves shortening the quarantine period for these clones by testing them for Fiji leaf gall and mosaic with RT-PCR assays. A proposal to make these changes to the smut-screening program was prepared and a project proposal was submitted to SRDC.

The review also recommended that more plots of smut-resistant parents be planted at Meringa to increase the chances of obtaining flowers from these parents. The planting of parental clones in 2002 was reviewed and increased plots of smut-resistant parents were planted.

7.0 OUTPUTS

The major output from this project is the smut resistance ratings in the BSES Sugarcane Plant Improvement Database (SPIDS). This data is available to all BSES staff and the BSES/CSIRO joint venture in plant breeding. The data is used extensively for decisions on advancement of clones in the selection program and selection of crosses in the breeding program. Extension and variety officers use the data when preparing newsletters, extension material and variety guides. BSES/CSIRO research staff have used the data in research on DNA markers for smut resistance. The ratings are also used when selecting clones for dispatch to the ORIA and are used to support the data collected in the ORIA. The data contained in SPIDS is a valuable resource that will assist the Australian sugar industry to manage the risk from sugarcane smut.

8.0 OUTCOMES

The main outcome from this project has been information on smut resistance of current commercial cultivars and clones in the BSES/CSIRO and CSR breeding and selection programs. Farmers are using the resistance ratings to make decisions on what cultivars to plant on their farm. BSES is using the information extensively in decisions on advancement of clones in the selection program and on crosses in the breeding program. If there is an incursion of smut in the eastern states, the information obtained in this project, and the actions taken to increase the overall levels of smut resistance in selection populations will reduce the risk of serious yield losses.

The information provided by this project has been used to select cultivars and clones for export to the ORIA. A number of smut-resistant cultivars, including Q133, Q146, Q151, Q171^(b) and Q177^(b), have been propagated for distribution to growers in the ORIA in 2004. The provision of smut-resistant cultivars to the ORIA will improve the productivity of the district and will allow growers to plant a wider range of cultivars. This will reduce the over-reliance on Q99, which currently makes up greater than 73% of the crop.

A procedure manual for conducting smut resistance trials has been written based on the experience gained in conducting the resistance trials in Indonesia. Two senior BSES staff, Barry Croft and Nils Berding, have been trained in all aspects of conducting smut resistance trials. This training will allow rapid implementation of smut resistance screening trials in the east coast if smut arrives in the future. The smut resistance screening procedure has been used to assist the ORIA staff in conducting smut trials.

The excellent collaboration between BSES and the ISRI developed during this project has assisted other projects such as the Australian Centre for International Agricultural Research project on germplasm conservation and CRC for Tropical Plant Pathology projects on diversity of sugarcane smut and orange rust. These contacts have also allowed BSES staff to monitor the spread of diseases including smut and leaf scorch in Indonesia. Leaf scorch has recently spread from Sumatra to Java and Sulewasi.

9.0 RECOMMENDATIONS FOR FURTHER WORK

1. Continue screening of Australian germplasm for resistance to smut in Indonesia.
2. Accelerate the rate of progress for breeding for smut resistance by rating clones earlier in the selection program, thereby reducing the generation time for recurrent selection.
3. Continue to maintain quarantine activities to prevent the spread of smut to the east coast. The longer an incursion is delayed, the more prepared the industry will be for an incursion.
4. Continue to promote strategies and awareness of smut incursion management at individual, region and industry levels.
5. Train more staff in the procedures for conducting smut resistance trials.

Project BSS256 'Reducing the Australian sugar industry's genetic vulnerability to sugarcane smut' has built on the findings and aims to breed smut-resistant cultivars for the Australian industry that have high yield potential and are adapted to the industry's environments. The project is funded until December 2006. It will achieve its aim through:

- Making crosses between parent clones that have smut resistance;
- Screening advanced selections for resistance to sugarcane smut in Indonesia;
- Confirming the smut resistance of imported cultivars and using smut-resistant cultivars as parents;
- Using information from the BSES Plant Improvement program to select smut-resistant clones with acceptable yield, agronomic characteristics, and pest and disease resistance for each region;
- Releasing smut-resistant cultivars and advising cane growers of the availability of smut-resistant cultivars.

Some of these recommendations are also captured in the BSES project proposal ‘Smut-proofing the Australian industry - ensuring a reliable cane supply through reduced genetic vulnerability to sugarcane smut’, which has been approved for funding by SRDC from July 2004 as project BSS265. That project aims to provide cultivars that will minimise the impact of a smut incursion, through:

- Reviewing the options for breeding for smut resistance and conducting an analysis of the benefits of the various options.
- Negotiating a new contract with the Indonesia Sugar Research Institute (ISRI) for testing clones for smut resistance based on the recommendations of the review.
- Screening parent clones for resistance to smut and make crosses between resistant parents.
- Screening selections from stage 2 of the BSES-CSIRO Plant Improvement Program for resistance to sugarcane smut in Indonesia.
- Selecting smut-resistant clones with acceptable yield, agronomic characteristics, and pest and disease resistance for each region.
- Releasing high-yielding smut-resistant cultivars to growers.

10.0 PUBLICATIONS AND EXTENSION

10.1 Publications

Croft BJ. 2000. Screening Australian varieties for smut resistance. *BSES Bulletin* 71: 3-5.

Croft BJ, Irawan and Berding N. 2000. Screening Australian sugarcane clones for smut reaction in Indonesia: Initial results. *Proceedings of the Australian Society of Sugar Cane Technologists* 22: 170-177.

Croft BJ, Smith DJ and Magarey RC. 2000. Response of the Australian sugar industry to an incursion of sugarcane smut in Western Australia. *Proceedings of the 6th ISSCT Sugarcane Pathology Workshop, Thailand*.

Croft BJ, Whittle PJJ, Magarey RC and Smith DJ. 1999. Contingency planning for potential sugarcane smut incursion into eastern Australia. *Proceedings of the 12th Australasian Pathology Conference*.

Croft BJ. 2003. Sugarcane smut incursion management in Australia. *Proceedings of the 7th ISSCT Sugarcane Pathology Workshop, Louisiana*.

Croft BJ. 2003. Sugarcane smut incursion management in Australia. *Proceedings of the 8th International Congress of Plant Pathology, Christchurch*.

Willcox T and Croft BJ. 2004. Quantifying risk of loss from sugarcane diseases and other variety related causes. *Proceedings of the Australian Society of Sugar Cane Technologists* 26: 10 pp. (CD-ROM).

10.2 Extension message

Sugarcane smut continues to be a major threat to the future of the sugar industry on the east coast of Australia. Smut can devastate susceptible varieties causing total crop loss. The disease is in the Ord River Irrigation Area (ORIA) of Western Australia and Indonesia as well as nearly every sugarcane industry around the world. The disease has a long history of spread from country to country so there is a high risk that one day it will arrive in Queensland and NSW. The good news is that smut can be controlled by resistant varieties. BSES with funding from SRDC has rated more than 900 Australian varieties for resistance to sugarcane smut. Eleven percent of these clones were resistant to smut and 18% had intermediate resistance. Some resistant commercial varieties are available in all regions of the Australian industry. Growers can obtain a list of smut resistant varieties for their region from their local BSES extension officer. BSES recommends that growers plant at least a small percentage of their farms to these smut resistant varieties. At least a small area of resistant varieties should be maintained on every farm so that they can be multiplied to provide planting material if a smut incursion occurs.

BSES is working hard to provide high yielding smut resistant varieties for the Australian sugar industry. A number of very promising smut resistant varieties have been released in recent years including Q199[Ⓛ], Q200[Ⓛ] and Q208[Ⓛ]. These varieties and others like them will be a valuable resource for the industry in the future. To ensure that BSES continues to improve on these smut resistant varieties it has committed 50% of its breeding program to specifically concentrate on breeding high yielding smut resistant varieties.

Growers and industry personnel should be vigilant to prevent smut coming to the east coast. Strict quarantine regulations in Queensland and New South Wales control the movement of machinery and plant material from the ORIA. Anyone who suspects that these regulations are not being followed should notify their nearest BSES office. When growers or industry personnel travel overseas they should be careful not to carry smut spores back on their clothing, cameras or other equipment. The longer smut is kept out of the east coast sugar industry the better prepared the industry will be for an incursion.

Managing the risk from smut is a high priority for BSES and SRDC.

11.0 REFERENCES

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APPENDIX 1 - RESULTS OF ALL SMUT TRIALS SORTED BY CLONE AND BY TRIAL (TRIAL 3 OMITTED)

Sorted by clone				
Clone	% smut plant	% smut ratoon	Rating	Trial
70C193	19.2	70.3	9	SM4
74N1244	9.2	35.6	7	SM4
75C326	16.6	12.7	4	SM4
75N178	35.7	55.6	9	SM4
77A83	21.3	51.6	9	SM4
77C774	24.1	71.4	9	SM4
77N557	22.6	57.6	8	SM6
77N792	7.1	29.6	7	SM5
77S1300	36.1	72.3	9	SM4
77S1321	21.7	71.5	9	SM4
78N238	24	53	8	SM1
78N379	28.2	67.6	9	SM4
78N881	10.1	18.1	6	SM5
79A362	2.5	10.7	5	SM5
79C116	1.3	34.0	7	SM5
79N1227	1.3	3.6	1	SM4
79N183	18.8	41.3	7	SM5
79N238	8.4	14.6	5	SM5
79N808	22.8	73.7	9	SM4
79S1226	0.0	21.7	6	SM5
80N1042	1.3	14.1	4	SM4
80N314	68.2	57.9	9	SM4
80N314	48.8	73.9	9	SM4
80N3425	5.8	7.3	2	SM4
80N4367	1.3	4.8	1	SM4
80N440	3.1	4.2	1	SM4
80N485	58.3	71.9	9	SM4
80N485	29.1	59.8	8	SM6
80N514	20.2	55.2	9	SM4
80N739	38.2	80.6	9	SM5
80N740	20.6	56.3	9	SM4
80N740	12.0	40.6	7	SM5
80S7031	22.0	37.2	7	SM6
80S7059	27.5	34.1	7	SM4
80S7212	31.7	64.2	9	SM4
80S7253	19.2	30.2	7	SM6
81C558	15.7	22.9	6	SM4
81N289	22.8	36.8	7	SM4
81N289	15.0	41.3	7	SM5
81N315	17.3	42.4	7	SM5
81N374	15.4	30.7	7	SM4
81N82	9.4	45.2	8	SM5
81S2140	13.8	31.1	7	SM6
81S2352	3.8	12.1	4	SM4
82C1047	6.0	33.3	7	SM5
82C11	17.6	36.3	7	SM5
82C1216	10.9	47.0	8	SM4
82C59	21.2	40.0	7	SM5
82C663	24.0	29.4	7	SM4
82C954	4.7	22.7	6	SM4
82N1038	20.7	45.3	8	SM4
82N1525	33.1	49.5	8	SM4
82N238	31	58	8	SM1
82N314	31.5	26.5	6	SM6
82N371	40.3	65.2	9	SM4

Sorted by trial				
Clone	% smut plant	% smut ratoon	Rating	Trial
78N238	24	53	8	SM1
82N238	31	58	8	SM1
82N546	27	28	8	SM1
83N1088	30	62	8	SM1
83N230	39	94	8	SM1
83N925	0	50	8	SM1
85N1802	58	53	8	SM1
85N79	4	0	2	SM1
86N460	32	48	8	SM1
86S108	5	0	2	SM1
86S669	28	73	8	SM1
87N1184	33	47	8	SM1
87N1261	4	55	8	SM1
87N1279	28	70	8	SM1
87N1681	6	68	8	SM1
87N1969	31	68	8	SM1
87S7140	0	0	2	SM1
87S7221	36	69	8	SM1
87S7223	48	81	8	SM1
87S7260	0	6	2	SM1
87S7428	0	0	2	SM1
87S7555	38	82	8	SM1
87S8026	14	50	8	SM1
87S8034	0	10	5	SM1
87S9021	3	0	2	SM1
88N319	0	53	8	SM1
88N836	4	29	8	SM1
88S7161	28	59	8	SM1
88S7189	0	0	2	SM1
88S7199	0	50	8	SM1
88S7205	0	10	5	SM1
88S7276	9	51	8	SM1
88S7336	20	70	8	SM1
88S7337	4	40	8	SM1
88S7341	6	39	8	SM1
88S7397	0	39	8	SM1
88S7403	0	0	2	SM1
88S8224	23	58	8	SM1
88S8307	44	75	8	SM1
89C432	0	4	2	SM1
89W106	11	71	8	SM1
89W119	0	67	8	SM1
89W131	0	0	2	SM1
89W146	7	51	8	SM1
89W148	16	0	5	SM1
89W168	32	52	8	SM1
89W31	11	67	8	SM1
89W61	0	0	2	SM1
89W62	50	75	8	SM1
89W73	38	89	8	SM1
90C215	70	83	8	SM1
90C353	24	44	8	SM1
91S7179	3	12	5	SM1
91S7234	47	88	8	SM1
92C1044	33	98	8	SM1

82N546	27	28	8	SM1
82S1147	9.5	51.8	8	SM6
82S1203	13.2	51.6	8	SM6
82S1399	2.3	23.5	6	SM5
82S1687	16.8	21.5	6	SM5
82S1854	38.8	18.8	5	SM6
82S2214	12.4	41.7	8	SM4
82S2292	7.1	38.6	8	SM4
82S501	11.3	37.0	7	SM6
82S954	36.9	33.3	7	SM5
83C273	35.2	42.1	7	SM5
83C328	8.8	16.2	5	SM4
83C382	14.1	18.7	5	SM4
83C382	13.7	35.9	7	SM6
83C495	2.3	28.7	7	SM5
83C537	8.3	24.9	6	SM5
83C625	6.2	2.1	1	SM4
83C626	1.9	6.1	4	SM5
83C631	0.0	5.9	4	SM5
83N1072	16.4	31.7	7	SM4
83N1082	42.2	85.9	9	SM4
83N1088	30	62	8	SM1
83N1216	6.9	29.6	7	SM4
83N230	39	94	8	SM1
83N399	27.5	65.8	8	SM5
83N660	25.9	72.0	9	SM4
83N925	0	50	8	SM1
83N943	1.3	14.8	4	SM4
83S1051	10.8	35.8	7	SM5
83S1354	8.2	42.0	7	SM5
83S1601	18.5	28.0	7	SM5
83S194	24.3	74.7	9	SM5
83S2070	41.7	61.0	8	SM5
83S2103	10.4	7.9	2	SM4
83S250	34.2	44.7	8	SM5
83S84	49.1	53.8	8	SM5
84A376	12.6	23.8	6	SM5
84A421	64.6	76.0	9	SM5
84C137	29.1	67.0	9	SM4
84C252	36.1	80.0	9	SM4
84C252	32.7	46.6	8	SM6
84C275	17.2	34.2	7	SM5
84C620	13.5	33.9	7	SM4
84C621	11.5	27.3	6	SM4
84C621	0.0	15.2	5	SM6
84N1750	23.0	65.3	9	SM6
84N2436	28.5	59.8	9	SM4
84N2467	18.7	41.2	8	SM4
84N2552	24.5	55.0	9	SM4
84N2552	25.7	57.9	8	SM6
84N2728	39.2	80.7	9	SM4
84N2852	1.3	23.8	6	SM6
84N2865	36.2	67.6	9	SM4
84N2967	23.1	55.1	9	SM4
84N2995	22.1	51.1	9	SM4
84N3672	3.4	22.7	6	SM5
84N3672	7.5	45.0	8	SM6
84N3747	3.0	10.4	3	SM4
84N4014	32.6	30.5	7	SM4
84N4014	3.9	3.6	3	SM5
84N4014	20.6	48.4	8	SM6
84N4221	44.2	87.2	9	SM4
92C1142	16	48	8	SM1
92C12	0	39	8	SM1
92C1227	0	0	2	SM1
92C1287	23	49	8	SM1
92C1404	6	37	8	SM1
92C1459	89	94	8	SM1
92C1473	5	5	2	SM1
92C1496	22	51	8	SM1
92C1585	0	21	8	SM1
92C1594	29	48	8	SM1
92C1644	44	100	8	SM1
92C1649	43	77	8	SM1
92C1685	4	80	8	SM1
92C1717	12	26	8	SM1
92C1719	4	76	8	SM1
92C1738	20	77	8	SM1
92C1743	26	84	8	SM1
92C1815	44	69	8	SM1
92C182	38	70	8	SM1
92C1822	0	29	8	SM1
92C228	8	0	2	SM1
92C244	17	44	8	SM1
92C299	18	75	8	SM1
92C300	39	78	8	SM1
92C320	10	62	8	SM1
92C328	0	0	2	SM1
92C341	5	50	8	SM1
92C37	0	0	2	SM1
92C419	46	93	8	SM1
92C452	67	35	8	SM1
92C581	17	5	5	SM1
92C626	17	50	8	SM1
92C697	12	42	8	SM1
92C712	0	19	5	SM1
92C713	27	79	8	SM1
92C714	44	82	8	SM1
92C768	0	0	2	SM1
92C778	56	85	8	SM1
92C785	0	0	2	SM1
92C803	12	73	8	SM1
92C819	29	83	8	SM1
92C821	4	24	8	SM1
92C823	7	48	8	SM1
92C829	18	50	8	SM1
92C865	27	72	8	SM1
92C907	33	33	8	SM1
92S206	27	75	8	SM1
92S250	0	0	2	SM1
92S50	53	92	8	SM1
92S622	0	9	2	SM1
92S694	47	72	8	SM1
92S929	18	64	8	SM1
93C4	0	0	2	SM1
93C49	18	77	8	SM1
93C5069	46	85	8	SM1
BN82-2324	0	58	8	SM1
BN82-2384	49	100	8	SM1
BN82-2484	28	64	8	SM1
BN89-3022	26	62	8	SM1
BN89-3044	0	35	8	SM1
BN89-3085	67	92	8	SM1
BN893086	0	6	2	SM1

84N4285	34.1	59.4	9	SM4	BN89-3107	0	4	2	SM1
84N4500	26.2	32.2	7	SM4	BN89-6059	14	47	8	SM1
84N4554	33.8	65.0	9	SM4	BN89-6087	71	70	8	SM1
84N4701	44.5	71.6	9	SM4	BN89-6104	29	42	8	SM1
84N94	15.2	53.6	9	SM4	BN89-6144	48	56	8	SM1
84S1225	5.6	23.1	6	SM4	BN89-6152	0	45	8	SM1
84S1263	30	74.9	8	SM2	M442-51	3	12	5	SM1
84S1265	25.5	76.4	9	SM6	MQ84-88	0	0	2	SM1
84S2447	0.0	6.8	2	SM4	PS79-82	3	0	2	SM1
84S2651	35.8	46.6	8	SM5	PS80-442	50	55	8	SM1
84S2735	50.1	73.0	9	SM4	Q137	35	67	8	SM1
84S2905	7.8	38.4	7	SM6	Q157	55	79	8	SM1
84S303	4.4	17.7	6	SM5	Q167	14	39	8	SM1
84S3130	2.1	28.6	7	SM5	Q170	0	3	2	SM1
84S818	31	53.3	8	SM2	Q181	27	62	8	SM1
85A2234	23.8	66.7	9	SM4	Q185	6	79	8	SM1
85A2234	8.3	31.3	7	SM5	Q186	18	40	8	SM1
85A2540	9.0	28.7	6	SM4	Q187	25	46	8	SM1
85A2734	19.6	28.3	6	SM4	Q212	0	0	2	SM1
85A5125	6.4	20.2	5	SM4	Q216	9	40	8	SM1
85A538	35.0	77.8	9	SM5	84S1263	30	74.9	8	SM2
85A572	2.5	9.5	3	SM4	84S818	31	53.3	8	SM2
85C220	17.3	58.0	9	SM4	85S1220	77.9	97.8	8	SM2
85C256	0.0	29.2	7	SM4	85S1420	10.2	33.1	8	SM2
85C478	28.1	63.9	8	SM5	85S1892	75.8	84.7	8	SM2
85C489	14.5	44.1	8	SM4	85S7181	19.4	63.6	8	SM2
85C647	11.3	20.6	6	SM5	85S7325	0	8.6	2	SM2
85C653	26.8	34.0	7	SM4	85S7341	37.5	79.4	8	SM2
85C734	21.4	57.8	9	SM4	85S7807	20	27.8	8	SM2
85C749	17.6	11.8	5	SM5	87C622	66.3	61.9	8	SM2
85C81	25.9	79.2	9	SM4	87C675	43.7	62.5	8	SM2
85C864	17.3	51.3	9	SM4	87S7035	19.4	51.4	8	SM2
85N1167	24.8	40.4	8	SM4	87S7189	13.1	60.8	8	SM2
85N1205	19.1	32.4	7	SM4	87S7212	18.3	56.7	8	SM2
85N1205	13.4	35.9	7	SM5	87S7220	69.9	68.6	8	SM2
85N1276	1.8	4.6	1	SM4	87S7267	41.4	70.5	8	SM2
85N1446	1.5	21.3	5	SM4	87S7368	5	24.9	8	SM2
85N1647	31.6	67.1	9	SM4	87S7404	51.3	87.8	8	SM2
85N1802	58	53	8	SM1	87S7453	0	0	2	SM2
85N1802	18.0	6.5	4	SM5	87S7522	51.4	63.1	8	SM2
85N1819	31.0	53.0	8	SM6	87S7535	21.3	25.3	8	SM2
85N25	14.9	42.9	7	SM6	87S7539	14.6	35.3	8	SM2
85N2770	27.3	42.8	8	SM4	87S7604	32.7	77.4	8	SM2
85N511	43.1	57.6	9	SM4	87S8032	0	0	2	SM2
85N780	21.0	84.8	9	SM4	87S8042	63.8	77.8	8	SM2
85N785	4.4	6.3	1	SM4	87S8090	43.1	66.3	8	SM2
85N79	4	0	2	SM1	87S8091	3.7	20.4	8	SM2
85N79	12.7	20.2	5	SM4	87S8210	9.9	61.7	8	SM2
85N800	14.7	53.5	8	SM6	87S8324	0	6.7	2	SM2
85S1075	18.0	28.5	6	SM4	87S8346	13.9	46.5	8	SM2
85S1220	77.9	97.8	8	SM2	87S8412	29.2	60.7	8	SM2
85S1247	7.9	39.3	7	SM5	87S9030	29.9	69	8	SM2
85S1420	10.2	33.1	8	SM2	87S9045	21.8	78.9	8	SM2
85S1555	26.0	50.6	8	SM6	88C119	36.4	57.1	8	SM2
85S1892	75.8	84.7	8	SM2	88C139	33.3	69.4	8	SM2
85S2162	18.3	62.1	8	SM5	88C23	5.9	0	2	SM2
85S2236	25.0	49.2	8	SM6	88C279	0	0	2	SM2
85S2291	15.2	33.4	7	SM5	88C6017	13.5	65.6	8	SM2
85S7035	28.3	67.2	9	SM4	88C712	32.2	53	8	SM2
85S7102	5.4	37.6	7	SM6	89S7078	40.4	61.6	8	SM2
85S7181	19.4	63.6	8	SM2	89S7651	49	74.6	8	SM2
85S7325	0	8.6	2	SM2	89S7865	6.7	17.2	5	SM2

85S7325	9.9	34.7	7	SM4	89S7902	26.1	72.4	8	SM2
85S7325	0.0	0.0	1	SM5	89S7974	0	0	2	SM2
85S7327	11.1	68.0	8	SM5	89S8099	22.1	76.6	8	SM2
85S7329	20.5	53.3	9	SM4	89S8177	11.7	53.8	8	SM2
85S7329	19.0	71.2	9	SM6	89S8191	30.4	77.8	8	SM2
85S7335	33.2	56.1	8	SM6	89W160	50.9	76.3	8	SM2
85S7341	37.5	79.4	8	SM2	89W169	36.4	70.5	8	SM2
85S7807	20	27.8	8	SM2	90S7022	0	0	2	SM2
85S7877	33.1	47.0	8	SM5	90S7069	49.6	44.8	8	SM2
86A1005	0.0	15.6	5	SM6	90S7146	29.4	83.3	8	SM2
86A148	28.7	59.0	8	SM5	91C2349	23.5	62.6	8	SM2
86A3133	1.4	41.4	7	SM5	91C2836	26.3	43.1	8	SM2
86A3211	24.8	49.4	8	SM4	91C3072	28.1	43.6	8	SM2
86A3850	29.0	49.2	8	SM4	91C315	9.9	33.5	8	SM2
86A4014	19.5	61.2	8	SM6	91C3202	4.2	4.2	2	SM2
86A4174	37.1	60.7	8	SM6	91C3242	0	0	2	SM2
86A679	30.0	41.6	8	SM4	91C3375	39.7	66.5	8	SM2
86A700	19.3	35.0	7	SM4	91C3441	43.3	88.9	8	SM2
86A700	3.7	33.8	7	SM5	91C3452	43.8	100	8	SM2
86C195	17.0	46.7	8	SM6	91C3465	29.7	41.7	8	SM2
86C807	15.4	48.1	8	SM6	91C3476	26.7	46.6	8	SM2
86N139	0.0	4.9	3	SM5	91C3511	0	5.6	2	SM2
86N1581	45.2	69.6	9	SM4	91C3516	30.5	65.3	8	SM2
86N1659	1.3	3.5	3	SM5	91C3517	45.8	72.2	8	SM2
86N1659	12.9	25.3	6	SM5	91C3532	43.6	63.3	8	SM2
86N1659	10.1	39.6	7	SM6	91C3549	29.9	66.7	8	SM2
86N1660	23.5	40.7	8	SM4	91C381	12.2	22.8	8	SM2
86N1660	14.7	32.8	7	SM5	91C392	4.3	29	8	SM2
86N1667	11.4	6.3	1	SM4	91C511	0	0	2	SM2
86N1675	1.3	6.9	2	SM4	91C538	35.4	83.5	8	SM2
86N1833	13.0	25.5	6	SM4	91C580	0	0	2	SM2
86N2124	12.1	24.7	6	SM4	91C982	0	0	2	SM2
86N2139	4.2	21.1	5	SM4	91S7005	0	0	2	SM2
86N2168	42.1	74.5	9	SM4	91S7007	55.1	73.5	8	SM2
86N2195	17.5	68.6	9	SM6	BN83-3068	3.7	0	2	SM2
86N246	16.3	33.5	7	SM4	BN83-3140	17.4	37.1	8	SM2
86N306	0.0	0.0	1	SM6	BN84-4180	0	26.9	8	SM2
86N460	32	48	8	SM1	BN87-3152	0	2.1	2	SM2
86N5279	20.8	50.2	8	SM4	BN87-3165	0	0	2	SM2
86N5441	24.0	47.3	8	SM6	BN87-3185	0	0	2	SM2
86N5689	38.2	50.1	8	SM4	BN88-3109	30.5	40.8	8	SM2
86N874	2.7	7.8	2	SM4	BN88-3116	32.2	67.6	8	SM2
86S108	5	0	2	SM1	BN88-3151	38.3	48.6	8	SM2
86S669	28	73	8	SM1	BN88-3194	0	0	2	SM2
87A1045	12.5	11.3	5	SM5	BN88-3243	12.4	44.2	8	SM2
87A246	36.0	43.8	8	SM4	BN88-3263	0	33.5	8	SM2
87C141	12.7	46.1	8	SM6	BN88-3291	43.6	60.9	8	SM2
87C152	21.2	62.3	8	SM6	BN88-3331	22.6	34.1	8	SM2
87C421	26.2	40.8	7	SM6	BN88-3345	6.7	40.3	8	SM2
87C54	12.9	38.8	7	SM6	BN88-3347	48.8	79	8	SM2
87C622	66.3	61.9	8	SM2	BN89-3038	38.2	56.2	8	SM2
87C632	4.1	16.1	6	SM5	BN89-6109	23.8	28.9	8	SM2
87C675	43.7	62.5	8	SM2	CASSIUS	0	0	2	SM2
87N1117	26.2	46.8	8	SM5	M442-51	39.4	43.1	8	SM2
87N1184	33	47	8	SM1	NC0310	54.7	58.3	8	SM2
87N1184	29.7	57.7	9	SM4	PS79-82	0	0	2	SM2
87N1210	10.0	11.6	3	SM4	PS80-442	17.9	47.8	8	SM2
87N1261	4	55	8	SM1	Q107	8.3	30.6	8	SM2
87N1279	28	70	8	SM1	Q110	27.9	67.6	8	SM2
87N1279	14.0	58.4	8	SM6	Q113	20.4	38.1	8	SM2
87N15	32.7	62.4	9	SM4	Q115	16.1	38.9	8	SM2
87N1681	6	68	8	SM1	Q117	49	79.6	8	SM2

87N1969	31	68	8	SM1
87N1969	53.3	85.4	9	SM4
87N2029	17.2	53.4	8	SM6
87N2105	28.1	39.4	8	SM4
87N479	28.0	49.8	8	SM4
87N481	35.9	56.4	9	SM4
87N79	28.3	47.3	8	SM4
87S7018	34.2	47.5	8	SM5
87S7035	19.4	51.4	8	SM2
87S7095	28.1	59.5	8	SM5
87S7111	13.2	39.5	7	SM5
87S7111	3.8	46.7	8	SM6
87S7121	14.2	23.4	6	SM4
87S7140	0	0	2	SM1
87S7144	19.8	31.9	7	SM5
87S7148	36.1	34.4	7	SM5
87S7148	25.5	52.1	8	SM6
87S7181	33.3	49.2	8	SM4
87S7189	13.1	60.8	8	SM2
87S7199	10.7	16.6	6	SM5
87S7212	18.3	56.7	8	SM2
87S7220	69.9	68.6	8	SM2
87S7221	36	69	8	SM1
87S7221	29.9	63.7	9	SM4
87S7221	15.8	38.7	7	SM5
87S7223	48	81	8	SM1
87S7260	0	6	2	SM1
87S7267	41.4	70.5	8	SM2
87S7268	40.8	64.2	8	SM5
87S7345	21.2	29.4	7	SM5
87S7346	5.0	7.1	4	SM5
87S7368	5	24.9	8	SM2
87S7404	51.3	87.8	8	SM2
87S7428	0	0	2	SM1
87S7453	0	0	2	SM2
87S7522	51.4	63.1	8	SM2
87S7535	21.3	25.3	8	SM2
87S7539	14.6	35.3	8	SM2
87S7555	38	82	8	SM1
87S7563	13.7	71.2	8	SM5
87S7563	4.1	21.4	6	SM6
87S7604	32.7	77.4	8	SM2
87S8026	14	50	8	SM1
87S8032	0	0	2	SM2
87S8034	0	10	5	SM1
87S8040	20.5	32.5	7	SM6
87S8042	63.8	77.8	8	SM2
87S8090	43.1	66.3	8	SM2
87S8091	3.7	20.4	8	SM2
87S8210	9.9	61.7	8	SM2
87S8324	0	6.7	2	SM2
87S8346	13.9	46.5	8	SM2
87S8412	29.2	60.7	8	SM2
87S9021	3	0	2	SM1
87S9030	29.9	69	8	SM2
87S9045	21.8	78.9	8	SM2
88A1085	1.8	30.9	7	SM5
88A1157	17.7	41.3	7	SM5
88A1163	11.5	49.7	8	SM6
88A1399	31.6	75.0	9	SM5
88A1501	18.2	38.0	7	SM5
88A1501	11.4	23.6	6	SM6
Q119	0	52.8	8	SM2
Q120	24.8	60.9	8	SM2
Q121	16.7	53.5	8	SM2
Q122	51.3	59.8	8	SM2
Q122	42.6	54.2	8	SM2
Q124	0	18.5	5	SM2
Q124	0	16.7	5	SM2
Q125	62.4	64.2	8	SM2
Q126	10.7	24.1	8	SM2
Q127	18.6	50.8	8	SM2
Q127	39.4	55.6	8	SM2
Q128	7.9	20.6	8	SM2
Q128	25.4	48.1	8	SM2
Q129	0	4.2	2	SM2
Q130	0	16.7	5	SM2
Q130	0	0	2	SM2
Q132	25.2	74.8	8	SM2
Q133	0	0	2	SM2
Q134	87.3	100	8	SM2
Q135	15.8	28.3	8	SM2
Q136	22.2	74.6	8	SM2
Q138	41	85.2	8	SM2
Q138	45.2	64.1	8	SM2
Q141	38.4	68.8	8	SM2
Q142	0	0	2	SM2
Q142	0	0	2	SM2
Q143	37.4	71.3	8	SM2
Q145	18.4	40.6	8	SM2
Q147	22.2	54.4	8	SM2
Q149	0	0	2	SM2
Q150	33	58.8	8	SM2
Q151	0	22.2	8	SM2
Q152	43.1	69.8	8	SM2
Q153	41.1	78	8	SM2
Q154	28.5	71.2	8	SM2
Q155	0	0	2	SM2
Q158	66.7	83.1	8	SM2
Q159	43.1	73.8	8	SM2
Q160	13.4	53.7	8	SM2
Q161	9.7	43.8	8	SM2
Q162	53.2	69.5	8	SM2
Q163	29.4	59.3	8	SM2
Q164	73	77.8	8	SM2
Q165	61.5	67.5	8	SM2
Q166	66.3	72.2	8	SM2
Q168	10	46.3	8	SM2
Q169	20.8	48.9	8	SM2
Q171	0	0	2	SM2
Q174	85.9	72.9	8	SM2
Q178	68.9	81.1	8	SM2
Q179	44.3	63.6	8	SM2
Q181	52.8	69.7	8	SM2
Q63	28.7	42.4	8	SM2
Q95	4.8	0	2	SM2
Q96	0	12.5	5	SM2
70C193	19.2	70.3	9	SM4
74N1244	9.2	35.6	7	SM4
75C326	16.6	12.7	4	SM4
75N178	35.7	55.6	9	SM4
77A83	21.3	51.6	9	SM4
77C774	24.1	71.4	9	SM4
77S1300	36.1	72.3	9	SM4

88A1968	26.2	74.8	9	SM4	77S1321	21.7	71.5	9	SM4
88A2158	6.0	33.5	7	SM6	78N379	28.2	67.6	9	SM4
88A2290	9.2	26.5	6	SM6	79N1227	1.3	3.6	1	SM4
88A2650	14.7	45.5	8	SM5	79N808	22.8	73.7	9	SM4
88A46	38.4	75.1	9	SM5	80N1042	1.3	14.1	4	SM4
88C119	36.4	57.1	8	SM2	80N314	68.2	57.9	9	SM4
88C139	33.3	69.4	8	SM2	80N314	48.8	73.9	9	SM4
88C23	5.9	0	2	SM2	80N3425	5.8	7.3	2	SM4
88C279	0	0	2	SM2	80N4367	1.3	4.8	1	SM4
88C307	16.2	36.1	7	SM6	80N440	3.1	4.2	1	SM4
88C6006	0.0	3.5	1	SM6	80N485	58.3	71.9	9	SM4
88C6016	32.5	61.8	8	SM6	80N514	20.2	55.2	9	SM4
88C6017	13.5	65.6	8	SM2	80N740	20.6	56.3	9	SM4
88C6019	6.1	1.7	1	SM4	80S7059	27.5	34.1	7	SM4
88C6023	3.1	20.7	6	SM5	80S7212	31.7	64.2	9	SM4
88C6026	10.6	30.8	7	SM5	81C558	15.7	22.9	6	SM4
88C712	32.2	53	8	SM2	81N289	22.8	36.8	7	SM4
88C73	10.7	36.9	7	SM6	81N374	15.4	30.7	7	SM4
88C829	11.3	17.5	5	SM4	81S2352	3.8	12.1	4	SM4
88N1000	13.8	27.7	6	SM4	82C1216	10.9	47.0	8	SM4
88N1000	8.8	49.8	8	SM6	82C663	24.0	29.4	7	SM4
88N1309	18.0	51.0	8	SM6	82C954	4.7	22.7	6	SM4
88N1887	34.5	77.5	9	SM4	82N1038	20.7	45.3	8	SM4
88N1946	23.9	36.5	7	SM4	82N1525	33.1	49.5	8	SM4
88N1973	24.5	46.8	8	SM6	82N371	40.3	65.2	9	SM4
88N319	0	53	8	SM1	82S2214	12.4	41.7	8	SM4
88N410	16.5	32.1	7	SM4	82S2292	7.1	38.6	8	SM4
88N410	19.6	40.0	7	SM6	83C328	8.8	16.2	5	SM4
88N535	38.5	84.8	9	SM4	83C382	14.1	18.7	5	SM4
88N631	25.0	64.7	9	SM4	83C625	6.2	2.1	1	SM4
88N78	35.0	41.6	8	SM4	83N1072	16.4	31.7	7	SM4
88N836	4	29	8	SM1	83N1082	42.2	85.9	9	SM4
88N836	25.5	49.7	8	SM4	83N1216	6.9	29.6	7	SM4
88N853	5.4	20.0	5	SM4	83N660	25.9	72.0	9	SM4
88N912	12.9	39.2	8	SM4	83N943	1.3	14.8	4	SM4
88S6001	11.9	28.8	6	SM6	83S2103	10.4	7.9	2	SM4
88S6002	22.2	33.0	7	SM5	84C137	29.1	67.0	9	SM4
88S6008	29.1	41.2	7	SM5	84C252	36.1	80.0	9	SM4
88S6009	3	17	6	SM5	84C620	13.5	33.9	7	SM4
88S7161	28	59	8	SM1	84C621	11.5	27.3	6	SM4
88S7189	0	0	2	SM1	84N2436	28.5	59.8	9	SM4
88S7199	0	50	8	SM1	84N2467	18.7	41.2	8	SM4
88S7205	0	10	5	SM1	84N2552	24.5	55.0	9	SM4
88S7205	2	16	6	SM5	84N2728	39.2	80.7	9	SM4
88S7276	9	51	8	SM1	84N2865	36.2	67.6	9	SM4
88S7276	32	70	8	SM5	84N2967	23.1	55.1	9	SM4
88S7336	20	70	8	SM1	84N2995	22.1	51.1	9	SM4
88S7337	4	40	8	SM1	84N3747	3.0	10.4	3	SM4
88S7341	6	39	8	SM1	84N4014	32.6	30.5	7	SM4
88S7371	4.4	33.3	7	SM6	84N4221	44.2	87.2	9	SM4
88S7397	0	39	8	SM1	84N4285	34.1	59.4	9	SM4
88S7397	3.0	39.2	8	SM4	84N4500	26.2	32.2	7	SM4
88S7403	0	0	2	SM1	84N4554	33.8	65.0	9	SM4
88S8224	23	58	8	SM1	84N4701	44.5	71.6	9	SM4
88S8307	44	75	8	SM1	84N94	15.2	53.6	9	SM4
88S8307	46	74	9	SM5	84S1225	5.6	23.1	6	SM4
88S9095	13.6	44.1	8	SM6	84S2447	0.0	6.8	2	SM4
88S9322	35.9	58.6	8	SM6	84S2735	50.1	73.0	9	SM4
88S9323	56.4	56.0	9	SM4	85A2234	23.8	66.7	9	SM4
88S9323	20	33	7	SM5	85A2540	9.0	28.7	6	SM4
88S9323	26.8	80.2	9	SM6	85A2734	19.6	28.3	6	SM4
89A1746	18.5	61.2	8	SM6	85A5125	6.4	20.2	5	SM4

89A3055	29	57	8	SM5	85A572	2.5	9.5	3	SM4
89A3057	4	12	5	SM5	85C220	17.3	58.0	9	SM4
89A3305	1.3	23.5	6	SM4	85C256	0.0	29.2	7	SM4
89A3305	3	6	4	SM5	85C489	14.5	44.1	8	SM4
89A3434	21.0	76.5	9	SM6	85C653	26.8	34.0	7	SM4
89A570	8.3	20.5	5	SM4	85C734	21.4	57.8	9	SM4
89A570	5	18	6	SM5	85C81	25.9	79.2	9	SM4
89C432	0	4	2	SM1	85C864	17.3	51.3	9	SM4
89C432	20.2	43.9	8	SM6	85N1167	24.8	40.4	8	SM4
89C6002	10.7	52.5	8	SM6	85N1205	19.1	32.4	7	SM4
89C6019	3.0	7.1	2	SM4	85N1276	1.8	4.6	1	SM4
89C6019	1.3	5.1	2	SM6	85N1446	1.5	21.3	5	SM4
89H116	48.8	43.4	8	SM4	85N1647	31.6	67.1	9	SM4
89H1320	17	49	8	SM5	85N2770	27.3	42.8	8	SM4
89H1357	30.4	49.9	8	SM4	85N511	43.1	57.6	9	SM4
89H1363	27	77	9	SM5	85N780	21.0	84.8	9	SM4
89H1412	4.0	17.4	5	SM6	85N785	4.4	6.3	1	SM4
89H1455	38	84	9	SM5	85N79	12.7	20.2	5	SM4
89H160	3.8	28.2	6	SM4	85S1075	18.0	28.5	6	SM4
89H1670	16	22	6	SM5	85S7035	28.3	67.2	9	SM4
89H1688	9	21	6	SM5	85S7325	9.9	34.7	7	SM4
89H194	23.5	42.2	8	SM4	85S7329	20.5	53.3	9	SM4
89H241	10.7	22.0	6	SM4	86A3211	24.8	49.4	8	SM4
89H424	2.1	7.2	2	SM4	86A3850	29.0	49.2	8	SM4
89N109	5.2	16.5	5	SM4	86A679	30.0	41.6	8	SM4
89N1180	13.9	54.6	8	SM6	86A700	19.3	35.0	7	SM4
89N1246	4	11	5	SM5	86N1581	45.2	69.6	9	SM4
89N1268	6.7	41.6	7	SM6	86N1660	23.5	40.7	8	SM4
89N1381	17.0	45.9	8	SM4	86N1667	11.4	6.3	1	SM4
89N1382	19.7	55.3	9	SM4	86N1675	1.3	6.9	2	SM4
89N1429	21.4	48.0	8	SM4	86N1833	13.0	25.5	6	SM4
89N1492	9	56	8	SM5	86N2124	12.1	24.7	6	SM4
89N1492	7.5	51.8	8	SM6	86N2139	4.2	21.1	5	SM4
89N1567	7.2	11.1	3	SM4	86N2168	42.1	74.5	9	SM4
89N1659	16.2	51.5	9	SM4	86N246	16.3	33.5	7	SM4
89N1659	27	36	7	SM5	86N5279	20.8	50.2	8	SM4
89N1659	5.0	46.8	8	SM6	86N5689	38.2	50.1	8	SM4
89N169	5.1	46.5	8	SM6	86N874	2.7	7.8	2	SM4
89N1734	33.3	45.5	8	SM4	87A246	36.0	43.8	8	SM4
89N1880	13.0	37.3	7	SM6	87N1184	29.7	57.7	9	SM4
89N1902	14.9	61.2	8	SM6	87N1210	10.0	11.6	3	SM4
89N1967	2.8	4.1	1	SM4	87N15	32.7	62.4	9	SM4
89N1967	0	9	5	SM5	87N1969	53.3	85.4	9	SM4
89N2213	6.6	22.5	6	SM4	87N2105	28.1	39.4	8	SM4
89N2349	32.8	63.8	9	SM4	87N479	28.0	49.8	8	SM4
89N452	34.0	73.8	9	SM6	87N481	35.9	56.4	9	SM4
89N512	18	54	8	SM5	87N79	28.3	47.3	8	SM4
89N6002	8.3	47.1	8	SM6	87S7121	14.2	23.4	6	SM4
89N833	37.5	57.0	9	SM4	87S7181	33.3	49.2	8	SM4
89N930	42.3	60.2	9	SM4	87S7221	29.9	63.7	9	SM4
89N936	3.9	25.2	6	SM4	88A1968	26.2	74.8	9	SM4
89N95	3.6	13.3	4	SM4	88C6019	6.1	1.7	1	SM4
89N95	0.0	14.1	4	SM6	88C829	11.3	17.5	5	SM4
89S6001	20	58	8	SM5	88N1000	13.8	27.7	6	SM4
89S6003	2.7	13.6	4	SM6	88N1887	34.5	77.5	9	SM4
89S6005	4	4	3	SM5	88N1946	23.9	36.5	7	SM4
89S7078	40.4	61.6	8	SM2	88N410	16.5	32.1	7	SM4
89S7651	49	74.6	8	SM2	88N535	38.5	84.8	9	SM4
89S7865	6.7	17.2	5	SM2	88N631	25.0	64.7	9	SM4
89S7902	26.1	72.4	8	SM2	88N78	35.0	41.6	8	SM4
89S7974	0	0	2	SM2	88N836	25.5	49.7	8	SM4
89S8099	22.1	76.6	8	SM2	88N853	5.4	20.0	5	SM4

89S8177	11.7	53.8	8	SM2	88N912	12.9	39.2	8	SM4
89S8191	30.4	77.8	8	SM2	88S7397	3.0	39.2	8	SM4
89W106	11	71	8	SM1	88S9323	56.4	56.0	9	SM4
89W108	1.4	22.9	6	SM4	89A3305	1.3	23.5	6	SM4
89W119	0	67	8	SM1	89A570	8.3	20.5	5	SM4
89W131	0	0	2	SM1	89C6019	3.0	7.1	2	SM4
89W146	7	51	8	SM1	89H116	48.8	43.4	8	SM4
89W148	16	0	5	SM1	89H1357	30.4	49.9	8	SM4
89W160	50.9	76.3	8	SM2	89H160	3.8	28.2	6	SM4
89W168	32	52	8	SM1	89H194	23.5	42.2	8	SM4
89W169	36.4	70.5	8	SM2	89H241	10.7	22.0	6	SM4
89W31	11	67	8	SM1	89H424	2.1	7.2	2	SM4
89W61	0	0	2	SM1	89N109	5.2	16.5	5	SM4
89W62	50	75	8	SM1	89N1381	17.0	45.9	8	SM4
89W73	38	89	8	SM1	89N1382	19.7	55.3	9	SM4
90A1227	41	88	9	SM5	89N1429	21.4	48.0	8	SM4
90A1742	6.7	15.8	5	SM6	89N1567	7.2	11.1	3	SM4
90A2343	26.2	56.6	8	SM6	89N1659	16.2	51.5	9	SM4
90A243	8.8	11.7	3	SM4	89N1734	33.3	45.5	8	SM4
90A3231	25	45	8	SM5	89N1967	2.8	4.1	1	SM4
90C215	70	83	8	SM1	89N2213	6.6	22.5	6	SM4
90C289	6	15	5	SM5	89N2349	32.8	63.8	9	SM4
90C289	28.8	51.8	8	SM6	89N833	37.5	57.0	9	SM4
90C353	24	44	8	SM1	89N930	42.3	60.2	9	SM4
90C353	4.2	12.5	4	SM4	89N936	3.9	25.2	6	SM4
90C353	12	0	1	SM5	89N95	3.6	13.3	4	SM4
90C357	20.2	61.1	8	SM6	89W108	1.4	22.9	6	SM4
90C452	24	60	8	SM5	90A243	8.8	11.7	3	SM4
90C6001	10.4	26.1	6	SM6	90C353	4.2	12.5	4	SM4
90C6006	26.6	49.5	8	SM6	90C784	6.5	13.6	4	SM4
90C619	22	48	8	SM5	90C823	16.8	37.5	7	SM4
90C683	13	30	7	SM5	90H1043	22.7	33.1	7	SM4
90C784	6.5	13.6	4	SM4	90H1067	31.0	58.0	9	SM4
90C788	11	21	6	SM5	90H1113	0.0	1.8	1	SM4
90C809	6	58	8	SM5	90H1146	0.0	18.9	5	SM4
90C823	16.8	37.5	7	SM4	90N1849	21.4	38.6	8	SM4
90C823	9.0	41.8	7	SM6	90N350	2.1	6.9	2	SM4
90H1043	22.7	33.1	7	SM4	90N6006	14.9	34.8	7	SM4
90H1067	31.0	58.0	9	SM4	90N803	1.7	3.3	1	SM4
90H1113	0.0	1.8	1	SM4	90N838	39.1	77.1	9	SM4
90H1146	0.0	18.9	5	SM4	90N921	9.1	27.6	6	SM4
90H1150	0	9	5	SM5	91A1165	1.9	6.1	1	SM4
90H1296	10	29	7	SM5	91A1473	23.4	41.4	8	SM4
90H1322	11	7	4	SM5	91A1552	0.0	8.8	2	SM4
90H1322	17.7	42.9	7	SM6	91A3469	0.0	1.5	1	SM4
90H1477	16.8	28.7	6	SM6	91C9	25.5	73.9	9	SM4
90N1604	61	70	8	SM5	91H1113	14.4	32.3	7	SM4
90N1693	20.4	66.1	9	SM6	91N1187	36.2	65.9	9	SM4
90N1788	33	57	8	SM5	91N1188	37.5	67.6	9	SM4
90N1808	9	28	7	SM5	91N1242	12.9	52.3	9	SM4
90N1820	35.0	61.0	8	SM6	91N2976	13.5	42.9	8	SM4
90N1839	30	84	9	SM5	91N3028	12.5	14.0	4	SM4
90N1849	21.4	38.6	8	SM4	91N3322	8.5	35.7	7	SM4
90N252	23	73	8	SM5	91N3381	12.9	26.0	6	SM4
90N350	2.1	6.9	2	SM4	91N3563	33.5	45.9	8	SM4
90N350	2	13	5	SM5	91N3767	31.7	61.8	9	SM4
90N6006	14.9	34.8	7	SM4	92A1707	18.2	44.1	8	SM4
90N6006	26	50	8	SM5	92A9014	39.2	76.9	9	SM4
90N635	11	38	7	SM5	92C1585	25.5	53.6	9	SM4
90N635	1.3	17.9	5	SM6	92H1434	20.1	59.2	9	SM4
90N803	1.7	3.3	1	SM4	ARGOS	48.8	57.6	9	SM4
90N838	39.1	77.1	9	SM4	ARRIS	9.6	24.7	6	SM4

90N838	28	67	8	SM5	BMQ89-14	12.5	37.6	7	SM4
90N876	6	31	7	SM5	BMQ89-15	10.9	46.8	8	SM4
90N921	9.1	27.6	6	SM4	BN73-3416	0.0	6.9	2	SM4
90N959	18	18	6	SM5	BN78-8031	23.6	53.1	9	SM4
90S6002	7.5	39.3	7	SM6	BN81-1394	0.0	1.4	1	SM4
90S6004	18.8	47.1	8	SM6	ENCORE	26.8	55.0	9	SM4
90S6006	0	3	2	SM5	ESK	28.8	58.7	9	SM4
90S6006	6.3	31.4	7	SM6	KQ88-8151	7.7	22.4	6	SM4
90S7022	0	0	2	SM2	KQ91-2616	5.5	5.4	1	SM4
90S7057	21.9	78.4	9	SM6	KQ91-71304	3.0	6.7	2	SM4
90S7063	34.7	63.0	9	SM6	KQ92-11301	23.9	64.2	9	SM4
90S7069	49.6	44.8	8	SM2	KQ92-20111	24.4	35.8	7	SM4
90S7146	29.4	83.3	8	SM2	KQ92-21815	20.7	31.1	7	SM4
91A1125	10	27	7	SM5	KQ92-31017	65.4	73.5	9	SM4
91A1130	13.2	38.7	7	SM6	KQ92-32413	12.5	35.7	7	SM4
91A1135	9.0	63.0	9	SM6	M442-51	34.0	73.2	9	SM4
91A1165	1.9	6.1	1	SM4	MIDA	36.3	71.7	9	SM4
91A1460	16.6	67.3	9	SM6	MQ73-582	47.6	55.6	9	SM4
91A1473	23.4	41.4	8	SM4	MQ74-110	28.3	43.8	8	SM4
91A1549	27	76	9	SM5	MQ76-497	0.0	11.2	3	SM4
91A1549	20.5	63.9	9	SM6	MQ76-534	26.8	44.8	8	SM4
91A1552	0.0	8.8	2	SM4	MQ77-340	15.0	47.8	8	SM4
91A1552	10	13	5	SM5	MQ78-147	27.4	51.2	9	SM4
91A1637	26.8	93.3	9	SM6	MQ78-756	15.1	27.0	6	SM4
91A3469	0.0	1.5	1	SM4	MQ79-1030	36.2	44.3	8	SM4
91C2349	23.5	62.6	8	SM2	MQ79-141	1.8	9.5	3	SM4
91C2836	26.3	43.1	8	SM2	MQ80-805	17.8	33.6	7	SM4
91C3072	28.1	43.6	8	SM2	MQ85-566	47.7	67.1	9	SM4
91C315	9.9	33.5	8	SM2	MQ90-217	4.9	30.9	7	SM4
91C3202	4.2	4.2	2	SM2	MQ91-200	34.3	32.7	7	SM4
91C3242	0	0	2	SM2	NC0310	4.7	27.5	6	SM4
91C3375	39.7	66.5	8	SM2	PS79-82	37.2	68.6	9	SM4
91C3441	43.3	88.9	8	SM2	PS80-442	6.1	37.8	7	SM4
91C3452	43.8	100	8	SM2	PS84-16029	0.0	2.5	1	SM4
91C3465	29.7	41.7	8	SM2	PS87-10266	1.7	10.9	3	SM4
91C3476	26.7	46.6	8	SM2	Q113	41.8	32.7	7	SM4
91C3511	0	5.6	2	SM2	Q114	18.7	35.4	7	SM4
91C3516	30.5	65.3	8	SM2	Q117	31.8	66.4	9	SM4
91C3517	45.8	72.2	8	SM2	Q119	1.8	8.9	3	SM4
91C3532	43.6	63.3	8	SM2	Q120	21.7	24.5	6	SM4
91C3549	29.9	66.7	8	SM2	Q121	28.5	55.6	9	SM4
91C381	12.2	22.8	8	SM2	Q124	39.2	36.0	7	SM4
91C392	4.3	29	8	SM2	Q125	25.6	58.5	9	SM4
91C511	0	0	2	SM2	Q127	11.0	31.6	7	SM4
91C538	35.4	83.5	8	SM2	Q130	11.4	21.5	5	SM4
91C580	0	0	2	SM2	Q132	7.8	69.4	9	SM4
91C9	25.5	73.9	9	SM4	Q133	10.1	19.5	5	SM4
91C982	0	0	2	SM2	Q135	17.3	33.3	7	SM4
91H1113	14.4	32.3	7	SM4	Q142	8.5	33.4	7	SM4
91H1242	8	35	7	SM5	Q145	21.4	48.0	8	SM4
91H1244	7	32	7	SM5	Q146	4.0	4.8	1	SM4
91H1324	6	33	7	SM5	Q147	8.9	29.3	7	SM4
91H1354	10	9	4	SM5	Q149	11.2	12.2	4	SM4
91N1098	30	69	8	SM5	Q151	0.0	3.9	1	SM4
91N1187	36.2	65.9	9	SM4	Q153	40.4	100.0	9	SM4
91N1188	37.5	67.6	9	SM4	Q155	20.1	42.3	8	SM4
91N1223	3	20	6	SM5	Q157	27.1	74.2	9	SM4
91N1242	12.9	52.3	9	SM4	Q161	8.7	25.8	6	SM4
91N1285	25.6	60.7	8	SM6	Q163	18.6	73.1	9	SM4
91N1348	6.7	52.6	8	SM6	Q164	45.3	73.4	9	SM4
91N1358	9	12	5	SM5	Q170	20.8	50.2	8	SM4
91N227	13	24	6	SM5	Q171	2.8	9.3	3	SM4

91N2294	11.8	36.2	7	SM6
91N2422	4	28	7	SM5
91N2976	13.5	42.9	8	SM4
91N2976	17.1	66.6	9	SM6
91N3028	12.5	14.0	4	SM4
91N3307	10.7	31.6	7	SM6
91N3322	8.5	35.7	7	SM4
91N3381	12.9	26.0	6	SM4
91N3381	30.1	54.3	8	SM6
91N3397	0	11	5	SM5
91N3563	33.5	45.9	8	SM4
91N3573	11	29	7	SM5
91N3666	33	50	8	SM5
91N3666	20.1	39.6	7	SM6
91N3738	12	9	4	SM5
91N3767	31.7	61.8	9	SM4
91N406	37	53	8	SM5
91N406	15.8	64.5	9	SM6
91N408	4	0	1	SM5
91N457	31	44	7	SM5
91N457	17.2	40.7	7	SM6
91N561	29	48	8	SM5
91N569	14	2	2	SM5
91N57	33	100	9	SM5
91N91	14	23	6	SM5
91S7005	0	0	2	SM2
91S7007	55.1	73.5	8	SM2
91S7008	15	19	6	SM5
91S7179	3	12	5	SM1
91S7234	47	88	8	SM1
91S7266	11.9	32.9	7	SM6
91S7347	19.5	40.7	7	SM6
92A1156	18	36	7	SM5
92A1156	19.9	31.3	7	SM6
92A1258	25	58	8	SM5
92A1258	18.9	43.3	7	SM6
92A1361	42.3	65.4	9	SM6
92A1431	8.5	37.9	7	SM6
92A1707	18.2	44.1	8	SM4
92A2115	11	26	6	SM5
92A2115	12.5	49.7	8	SM6
92A2275	11	77	9	SM5
92A2275	5.5	42.6	7	SM6
92A2301	23	37	7	SM5
92A2301	18.8	40.1	7	SM6
92A2309	4.3	24.1	6	SM6
92A2395	28	68	8	SM5
92A9003	14	52	8	SM5
92A9003	22.5	55.7	8	SM6
92A9004	17	55	8	SM5
92A9004	27.6	57.7	8	SM6
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92A9014	39.2	76.9	9	SM4
92A9014	21.3	47.8	8	SM6
92A9016	44	59	8	SM5
92A9016	17.3	64.5	9	SM6
92C1044	33	98	8	SM1
92C1142	16	48	8	SM1
92C12	0	39	8	SM1
92C1227	0	0	2	SM1
92C1287	23	49	8	SM1
Q172	5.9	11.4	3	SM4
Q173	18.6	26.4	6	SM4
Q174	44.3	71.0	9	SM4
Q175	8.1	15.7	4	SM4
Q176	15.7	51.9	9	SM4
Q177	2.9	6.3	1	SM4
Q178	32.0	63.1	9	SM4
Q179	43.4	59.0	9	SM4
Q180	39.1	65.3	9	SM4
Q181	23.3	62.3	9	SM4
Q182	0.0	9.7	3	SM4
Q183	5.5	30.3	7	SM4
Q184	38.0	41.8	8	SM4
Q186	11.8	38.2	8	SM4
Q187	34.9	51.7	9	SM4
Q188	17.5	51.1	9	SM4
Q189	26.4	66.3	9	SM4
Q190	0.0	9.5	3	SM4
Q193	45.2	60.6	9	SM4
Q196	27.0	47.5	8	SM4
Q197	25.5	47.3	8	SM4
Q198	12.4	22.9	6	SM4
Q199	3.0	11.3	3	SM4
Q200	5.9	4.9	1	SM4
Q201	31.4	33.8	7	SM4
Q203	1.8	16.1	4	SM4
Q205	16.1	37.0	7	SM4
Q205	13.5	52.1	9	SM4
Q208	0.0	9.5	3	SM4
Q209	26.0	74.3	9	SM4
Q211	8.3	45.8	8	SM4
Q213	4.9	21.6	6	SM4
Q96	0.0	3.9	1	SM4
TELLUS	39.2	46.9	8	SM4
77N792	7.1	29.6	7	SM5
78N881	10.1	18.1	6	SM5
79A362	2.5	10.7	5	SM5
79C116	1.3	34.0	7	SM5
79N183	18.8	41.3	7	SM5
79N238	8.4	14.6	5	SM5
79S1226	0.0	21.7	6	SM5
80N739	38.2	80.6	9	SM5
80N740	12.0	40.6	7	SM5
81N289	15.0	41.3	7	SM5
81N315	17.3	42.4	7	SM5
81N82	9.4	45.2	8	SM5
82C1047	6.0	33.3	7	SM5
82C11	17.6	36.3	7	SM5
82C59	21.2	40.0	7	SM5
82S1399	2.3	23.5	6	SM5
82S1687	16.8	21.5	6	SM5
82S954	36.9	33.3	7	SM5
83C273	35.2	42.1	7	SM5
83C495	2.3	28.7	7	SM5
83C537	8.3	24.9	6	SM5
83C626	1.9	6.1	4	SM5
83C631	0.0	5.9	4	SM5
83N399	27.5	65.8	8	SM5
83S1051	10.8	35.8	7	SM5
83S1354	8.2	42.0	7	SM5
83S1601	18.5	28.0	7	SM5
83S194	24.3	74.7	9	SM5

92C1404	6	37	8	SM1	83S2070	41.7	61.0	8	SM5
92C1459	89	94	8	SM1	83S250	34.2	44.7	8	SM5
92C1459	25.6	65.7	9	SM6	83S84	49.1	53.8	8	SM5
92C1473	5	5	2	SM1	84A376	12.6	23.8	6	SM5
92C1496	22	51	8	SM1	84A421	64.6	76.0	9	SM5
92C1585	0	21	8	SM1	84C275	17.2	34.2	7	SM5
92C1585	25.5	53.6	9	SM4	84N3672	3.4	22.7	6	SM5
92C1594	29	48	8	SM1	84N4014	3.9	3.6	3	SM5
92C1638	43.9	67.3	9	SM6	84S2651	35.8	46.6	8	SM5
92C1644	44	100	8	SM1	84S303	4.4	17.7	6	SM5
92C1644	11.6	38.0	7	SM6	84S3130	2.1	28.6	7	SM5
92C1649	43	77	8	SM1	85A2234	8.3	31.3	7	SM5
92C1685	4	80	8	SM1	85A538	35.0	77.8	9	SM5
92C1717	12	26	8	SM1	85C478	28.1	63.9	8	SM5
92C1719	4	76	8	SM1	85C647	11.3	20.6	6	SM5
92C1738	20	77	8	SM1	85C749	17.6	11.8	5	SM5
92C1743	26	84	8	SM1	85N1205	13.4	35.9	7	SM5
92C1815	44	69	8	SM1	85N1802	18.0	6.5	4	SM5
92C182	38	70	8	SM1	85S1247	7.9	39.3	7	SM5
92C1822	0	29	8	SM1	85S2162	18.3	62.1	8	SM5
92C228	8	0	2	SM1	85S2291	15.2	33.4	7	SM5
92C244	17	44	8	SM1	85S7325	0.0	0.0	1	SM5
92C299	18	75	8	SM1	85S7327	11.1	68.0	8	SM5
92C300	39	78	8	SM1	85S7877	33.1	47.0	8	SM5
92C300	26.0	58.5	8	SM6	86A148	28.7	59.0	8	SM5
92C320	10	62	8	SM1	86A3133	1.4	41.4	7	SM5
92C328	0	0	2	SM1	86A700	3.7	33.8	7	SM5
92C341	5	50	8	SM1	86N139	0.0	4.9	3	SM5
92C369	38.4	70.6	9	SM6	86N1659	1.3	3.5	3	SM5
92C37	0	0	2	SM1	86N1659	12.9	25.3	6	SM5
92C37	20.8	59.5	8	SM6	86N1660	14.7	32.8	7	SM5
92C419	46	93	8	SM1	87A1045	12.5	11.3	5	SM5
92C452	67	35	8	SM1	87C632	4.1	16.1	6	SM5
92C581	17	5	5	SM1	87N1117	26.2	46.8	8	SM5
92C626	17	50	8	SM1	87S7018	34.2	47.5	8	SM5
92C697	12	42	8	SM1	87S7095	28.1	59.5	8	SM5
92C712	0	19	5	SM1	87S7111	13.2	39.5	7	SM5
92C713	27	79	8	SM1	87S7144	19.8	31.9	7	SM5
92C714	44	82	8	SM1	87S7148	36.1	34.4	7	SM5
92C723	6.9	56.4	8	SM6	87S7199	10.7	16.6	6	SM5
92C768	0	0	2	SM1	87S7221	15.8	38.7	7	SM5
92C768	8.4	52.7	8	SM6	87S7268	40.8	64.2	8	SM5
92C778	56	85	8	SM1	87S7345	21.2	29.4	7	SM5
92C785	0	0	2	SM1	87S7346	5.0	7.1	4	SM5
92C803	12	73	8	SM1	87S7563	13.7	71.2	8	SM5
92C819	29	83	8	SM1	88A1085	1.8	30.9	7	SM5
92C821	4	24	8	SM1	88A1157	17.7	41.3	7	SM5
92C823	7	48	8	SM1	88A1399	31.6	75.0	9	SM5
92C829	18	50	8	SM1	88A1501	18.2	38.0	7	SM5
92C865	27	72	8	SM1	88A2650	14.7	45.5	8	SM5
92C907	33	33	8	SM1	88A46	38.4	75.1	9	SM5
92C928	25.1	56.4	8	SM6	88C6023	3.1	20.7	6	SM5
92H1003	41	61	8	SM5	88C6026	10.6	30.8	7	SM5
92H1267	7	5	4	SM5	88S6002	22.2	33.0	7	SM5
92H1426	13	30	7	SM5	88S6008	29.1	41.2	7	SM5
92H1430	5	20	6	SM5	88S6009	3	17	6	SM5
92H1434	20.1	59.2	9	SM4	88S7205	2	16	6	SM5
92H1434	19.7	52.5	8	SM6	88S7276	32	70	8	SM5
92H2023	24	45	8	SM5	88S8307	46	74	9	SM5
92H2023	19.3	59.1	8	SM6	88S9323	20	33	7	SM5
92H2027	15	23	6	SM5	89A3055	29	57	8	SM5
92H2027	11.3	21.9	6	SM6	89A3057	4	12	5	SM5

92H2185	19.7	69.4	9	SM6	89A3305	3	6	4	SM5
92H2243	16	50	8	SM5	89A570	5	18	6	SM5
92H2386	18.1	54.5	8	SM6	89H1320	17	49	8	SM5
92H2429	0	8	4	SM5	89H1363	27	77	9	SM5
92H2457	7	21	6	SM5	89H1455	38	84	9	SM5
92H2676	12	50	8	SM5	89H1670	16	22	6	SM5
92S206	27	75	8	SM1	89H1688	9	21	6	SM5
92S206	38	47	8	SM5	89N1246	4	11	5	SM5
92S250	0	0	2	SM1	89N1492	9	56	8	SM5
92S250	39	41	7	SM5	89N1659	27	36	7	SM5
92S50	53	92	8	SM1	89N1967	0	9	5	SM5
92S50	42	54	8	SM5	89N512	18	54	8	SM5
92S622	0	9	2	SM1	89S6001	20	58	8	SM5
92S694	47	72	8	SM1	89S6005	4	4	3	SM5
92S929	18	64	8	SM1	90A1227	41	88	9	SM5
92S929	28	40	7	SM5	90A3231	25	45	8	SM5
93A1017	15	27	7	SM5	90C289	6	15	5	SM5
93A1098	22	56	8	SM5	90C353	12	0	1	SM5
93A1098	9.3	59.9	8	SM6	90C452	24	60	8	SM5
93A1184	9	37	7	SM5	90C619	22	48	8	SM5
93A1209	22	63	8	SM5	90C683	13	30	7	SM5
93A1395	13.6	37.5	7	SM6	90C788	11	21	6	SM5
93A2795	13.5	61.3	8	SM6	90C809	6	58	8	SM5
93A6008	10	3	3	SM5	90H1150	0	9	5	SM5
93C4	0	0	2	SM1	90H1296	10	29	7	SM5
93C49	18	77	8	SM1	90H1322	11	7	4	SM5
93C5069	46	85	8	SM1	90N1604	61	70	8	SM5
93H1228	8.9	48.4	8	SM6	90N1788	33	57	8	SM5
93H1314	25.4	56.3	8	SM6	90N1808	9	28	7	SM5
93H1406	19.5	48.1	8	SM6	90N1839	30	84	9	SM5
93H1642	30.8	38.2	7	SM6	90N252	23	73	8	SM5
93H1734	30.0	73.2	9	SM6	90N350	2	13	5	SM5
93H1889	7.1	45.0	8	SM6	90N6006	26	50	8	SM5
93H2047	23.8	53.9	8	SM6	90N635	11	38	7	SM5
93H2081	10.8	53.7	8	SM6	90N838	28	67	8	SM5
93H2173	1.4	4.8	2	SM6	90N876	6	31	7	SM5
93H2242	19.0	55.0	8	SM6	90N959	18	18	6	SM5
93H39	35	67	8	SM5	90S6006	0	3	2	SM5
93H39	19.9	68.4	9	SM6	91A1125	10	27	7	SM5
93N1002	16.4	58.6	8	SM6	91A1549	27	76	9	SM5
93N1057	13.2	47.2	8	SM6	91A1552	10	13	5	SM5
93N3515	10.2	11.0	4	SM6	91H1242	8	35	7	SM5
93N4701	16.0	41.1	7	SM6	91H1244	7	32	7	SM5
93N4931	22.7	55.4	8	SM6	91H1324	6	33	7	SM5
93S2440	4.8	36.3	7	SM6	91H1354	10	9	4	SM5
93S2613	4.4	26.1	6	SM6	91N1098	30	69	8	SM5
94A6005	10	14	5	SM5	91N1223	3	20	6	SM5
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95C6009	22.3	58.8	8	SM6	91N227	13	24	6	SM5
95H4030	19.2	16.5	5	SM6	91N2422	4	28	7	SM5
95N1244	5.5	31.9	7	SM6	91N3397	0	11	5	SM5
95N1525	11.8	56.7	8	SM6	91N3573	11	29	7	SM5
95N1645	12.1	28.1	6	SM6	91N3666	33	50	8	SM5
95N1700	2.9	21.4	6	SM6	91N3738	12	9	4	SM5
95N1743	19.2	61.5	8	SM6	91N406	37	53	8	SM5
95N1755	35.3	37.5	7	SM6	91N408	4	0	1	SM5
95N1810	28.0	81.1	9	SM6	91N457	31	44	7	SM5
95N200	16.4	22.1	6	SM6	91N561	29	48	8	SM5
95N234	9.0	37.0	7	SM6	91N569	14	2	2	SM5
95N507	17.0	37.9	7	SM6	91N57	33	100	9	SM5
95N521	13.8	74.8	9	SM6	91N91	14	23	6	SM5
95N707	20.1	66.0	9	SM6	91S7008	15	19	6	SM5

95N87	24.7	50.8	8	SM6
96S6001	10.1	44.5	8	SM6
96S6006	5.9	12.1	4	SM6
96S6008	28.0	46.8	8	SM6
96S6009	28.3	52.9	8	SM6
ARGOS	48.8	57.6	9	SM4
ARGOS	14	31	7	SM5
ARGOS	26.0	34.3	7	SM6
ARRIS	9.6	24.7	6	SM4
BMQ89-14	12.5	37.6	7	SM4
BMQ89-15	10.9	46.8	8	SM4
BMQ89-57	5.6	25.6	6	SM6
BMQ89-645	4	0	1	SM5
BN73-3416	0.0	6.9	2	SM4
BN73-3416	0.0	2.3	0	SM6
BN74-4445	17.3	37.8	7	SM6
BN78-8031	23.6	53.1	9	SM4
BN81-1394	0.0	1.4	1	SM4
BN82-2324	0	58	8	SM1
BN82-2384	49	100	8	SM1
BN82-2484	28	64	8	SM1
BN83-3068	3.7	0	2	SM2
BN83-3120	4	16	6	SM5
BN83-3120	10.1	37.6	7	SM6
BN83-3140	17.4	37.1	8	SM2
BN84-4180	0	26.9	8	SM2
BN87-3152	0	2.1	2	SM2
BN87-3165	0	0	2	SM2
BN87-3185	0	0	2	SM2
BN88-3109	30.5	40.8	8	SM2
BN88-3116	32.2	67.6	8	SM2
BN88-3151	38.3	48.6	8	SM2
BN88-3194	0	0	2	SM2
BN88-3243	12.4	44.2	8	SM2
BN88-3263	0	33.5	8	SM2
BN88-3291	43.6	60.9	8	SM2
BN88-3331	22.6	34.1	8	SM2
BN88-3345	6.7	40.3	8	SM2
BN88-3347	48.8	79	8	SM2
BN89-3022	26	62	8	SM1
BN89-3038	38.2	56.2	8	SM2
BN89-3044	0	35	8	SM1
BN89-3085	67	92	8	SM1
BN893086	0	6	2	SM1
BN89-3107	0	4	2	SM1
BN89-6059	14	47	8	SM1
BN89-6087	71	70	8	SM1
BN89-6104	29	42	8	SM1
BN89-6109	23.8	28.9	8	SM2
BN89-6144	48	56	8	SM1
BN89-6152	0	45	8	SM1
CASSIUS	0	0	2	SM2
CP51-21	13	42	7	SM5
CP51-21	12.5	44.2	8	SM6
CP63-588	2	8	4	SM5
CP70-1133	0	0	1	SM5
CP72-2086	0	22	6	SM5
CP72-356	19	36	7	SM5
CP75-1082	24	63	8	SM5
CP75-1322	0	8	4	SM5
DART	23.6	61.6	8	SM6
ENCORE	26.8	55.0	9	SM4
92A1156	18	36	7	SM5
92A1258	25	58	8	SM5
92A2115	11	26	6	SM5
92A2275	11	77	9	SM5
92A2301	23	37	7	SM5
92A2395	28	68	8	SM5
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92H1003	41	61	8	SM5
92H1267	7	5	4	SM5
92H1426	13	30	7	SM5
92H1430	5	20	6	SM5
92H2023	24	45	8	SM5
92H2027	15	23	6	SM5
92H2243	16	50	8	SM5
92H2429	0	8	4	SM5
92H2457	7	21	6	SM5
92H2676	12	50	8	SM5
92S206	38	47	8	SM5
92S250	39	41	7	SM5
92S50	42	54	8	SM5
92S929	28	40	7	SM5
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93A6008	10	3	3	SM5
93H39	35	67	8	SM5
94A6005	10	14	5	SM5
94A6008	14	50	8	SM5
ARGOS	14	31	7	SM5
BMQ89-645	4	0	1	SM5
BN83-3120	4	16	6	SM5
CP51-21	13	42	7	SM5
CP63-588	2	8	4	SM5
CP70-1133	0	0	1	SM5
CP72-2086	0	22	6	SM5
CP72-356	19	36	7	SM5
CP75-1082	24	63	8	SM5
CP75-1322	0	8	4	SM5
F177	22	55	8	SM5
H52-663	11	22	6	SM5
H56-752	3	16	6	SM5
H60-3802	13	32	7	SM5
H66-8912	0	7	4	SM5
H72-8597	6	11	5	SM5
H73-7324	17	55	8	SM5
H74-0922	2	19	6	SM5
H74-4527	0	15	5	SM5
H74-6418	2	8	4	SM5
H77-0723	3	8	4	SM5
H77-1485	10	29	7	SM5
H83-8856	61	55	8	SM5
H83-8859	0	0	1	SM5
KQ88-8004	9	26	6	SM5
KQ91-0411	22	71	8	SM5
KQ91-0417	15	40	7	SM5
KQ91-2308	13	32	7	SM5
KQ91-2614	16	72	8	SM5
KQ91-31506	10	20	6	SM5

ENCORE	27.0	52.1	8	SM6	KQ92-20518	14	40	7	SM5
ESK	28.8	58.7	9	SM4	KQ93-2348	18	74	9	SM5
ESK	29.9	74.4	9	SM6	KQ95-2283	11	12	5	SM5
F172	7.6	51.1	8	SM6	KQ95-2702	4	18	6	SM5
F177	22	55	8	SM5	KQ95-3254	2	33	7	SM5
F177	6.3	32.8	7	SM6	KQ95-3758	27	40	7	SM5
GEMINI	6.7	27.8	6	SM6	KQ95-3853	5	13	5	SM5
H52-663	11	22	6	SM5	KQ96-1012	37	90	9	SM5
H56-752	3	16	6	SM5	KQ96-1169	26	69	8	SM5
H56-752	3.0	44.2	8	SM6	M442-51	13	19	6	SM5
H60-3802	13	32	7	SM5	MIDA	24	58	8	SM5
H60-3802	22.6	53.1	8	SM6	MQ89-645	0	6	4	SM5
H66-8912	0	7	4	SM5	MQ90-299	0	10	5	SM5
H72-8597	6	11	5	SM5	MQ91-190	2	4	3	SM5
H73-7324	17	55	8	SM5	MQ91-191	2	8	4	SM5
H74-0922	2	19	6	SM5	MQ91-246	16	42	7	SM5
H74-4527	0	15	5	SM5	MQ91-571	17	53	8	SM5
H74-6418	2	8	4	SM5	MQ91-68	25	51	8	SM5
H77-0723	3	8	4	SM5	MQ91-698	8	21	6	SM5
H77-1485	10	29	7	SM5	MQ91-753	7	25	6	SM5
H83-8856	61	55	8	SM5	MQ91-870	38	72	8	SM5
H83-8859	0	0	1	SM5	MQ91-910	2	5	3	SM5
KQ88-8004	9	26	6	SM5	MQ92-255	6	18	6	SM5
KQ88-8151	7.7	22.4	6	SM4	MQ92-405	14	42	7	SM5
KQ91-0411	22	71	8	SM5	MQ92-47	21	52	8	SM5
KQ91-0417	15	40	7	SM5	NC0310	6	29	7	SM5
KQ91-2308	13	32	7	SM5	PS79-82	2	20	6	SM5
KQ91-2614	16	72	8	SM5	PS80-442	18	47	8	SM5
KQ91-2616	5.5	5.4	1	SM4	PS84-16029	17	33	7	SM5
KQ91-31506	10	20	6	SM5	PS87-10266	0	2	2	SM5
KQ91-71304	3.0	6.7	2	SM4	Q114	24	55	8	SM5
KQ92-11301	23.9	64.2	9	SM4	Q117	41	73	8	SM5
KQ92-20111	24.4	35.8	7	SM4	Q124	5	14	5	SM5
KQ92-20518	14	40	7	SM5	Q129	1	0	1	SM5
KQ92-21815	20.7	31.1	7	SM4	Q136	7	91	9	SM5
KQ92-31017	65.4	73.5	9	SM4	Q141	33	84	9	SM5
KQ92-32413	12.5	35.7	7	SM4	Q146	3	2	2	SM5
KQ93-2348	18	74	9	SM5	Q152	22	38	7	SM5
KQ95-2283	11	12	5	SM5	Q154	18	58	8	SM5
KQ95-2283	13.3	23.5	6	SM6	Q155	1	27	7	SM5
KQ95-2702	4	18	6	SM5	Q156	2	13	5	SM5
KQ95-2702	1.8	9.7	3	SM6	Q159	12	23	6	SM5
KQ95-3254	2	33	7	SM5	Q160	6	5	4	SM5
KQ95-3758	27	40	7	SM5	Q165	18	55	8	SM5
KQ95-3853	5	13	5	SM5	Q166	36	69	8	SM5
KQ96-1012	37	90	9	SM5	Q167	7	31	7	SM5
KQ96-1012	42.7	76.8	9	SM6	Q168	16	62	8	SM5
KQ96-1169	26	69	8	SM5	Q169	19	54	8	SM5
KQ96-1169	18.7	74.4	9	SM6	Q170	13	32	7	SM5
M442-51	3	12	5	SM1	Q171	0	0	1	SM5
M442-51	39.4	43.1	8	SM2	Q172	14	23	6	SM5
M442-51	34.0	73.2	9	SM4	Q173	7	5	4	SM5
M442-51	13	19	6	SM5	Q175	15	14	5	SM5
M442-51	19.8	43.4	8	SM6	Q176	3	47	8	SM5
MIDA	36.3	71.7	9	SM4	Q177	4	9	5	SM5
MIDA	24	58	8	SM5	Q179	21	37	7	SM5
MIDA	25.4	61.8	8	SM6	Q180	34	51	8	SM5
MQ73-582	47.6	55.6	9	SM4	Q182	2	7	4	SM5
MQ74-110	28.3	43.8	8	SM4	Q183	0	18	6	SM5
MQ76-497	0.0	11.2	3	SM4	Q183	3	41	7	SM5
MQ76-534	26.8	44.8	8	SM4	Q185	13	47	8	SM5
MQ77-340	15.0	47.8	8	SM4	Q186	10	36	7	SM5

MQ78-147	27.4	51.2	9	SM4
MQ78-756	15.1	27.0	6	SM4
MQ79-1030	36.2	44.3	8	SM4
MQ79-141	1.8	9.5	3	SM4
MQ80-805	17.8	33.6	7	SM4
MQ83-204	16.6	50.9	8	SM6
MQ84-88	0	0	2	SM1
MQ85-566	47.7	67.1	9	SM4
MQ85-918	27.1	41.3	7	SM6
MQ89-645	0	6	4	SM5
MQ90-217	4.9	30.9	7	SM4
MQ90-299	0	10	5	SM5
MQ91-190	2	4	3	SM5
MQ91-191	2	8	4	SM5
MQ91-200	34.3	32.7	7	SM4
MQ91-246	16	42	7	SM5
MQ91-297	24.6	48.6	8	SM6
MQ91-571	17	53	8	SM5
MQ91-68	25	51	8	SM5
MQ91-698	8	21	6	SM5
MQ91-753	7	25	6	SM5
MQ91-870	38	72	8	SM5
MQ91-910	2	5	3	SM5
MQ91-910	32.6	69.6	9	SM6
MQ92-153	26.6	43.5	8	SM6
MQ92-196	23.8	54.7	8	SM6
MQ92-255	6	18	6	SM5
MQ92-348	15.0	56.0	8	SM6
MQ92-402	38.0	43.7	8	SM6
MQ92-405	14	42	7	SM5
MQ92-47	21	52	8	SM5
MQ92-62	28.9	66.8	9	SM6
MQ93-1051	3.0	22.9	6	SM6
MQ93-220	10.0	41.7	7	SM6
MQ93-25	8.8	37.2	7	SM6
MQ93-359	10.9	32.9	7	SM6
MQ93-538	1.3	1.6	1	SM6
MQ93-607	13.3	31.1	7	SM6
MQ93-65	28.0	59.5	8	SM6
MQ93-686	7.2	32.4	7	SM6
MQ93-727	5.6	88.5	9	SM6
MQ93-728	11.7	41.7	7	SM6
MQ93-740	26.3	66.3	9	SM6
MQ95-3046	11.1	50.1	8	SM6
MQ95-3072	17.2	57.0	8	SM6
MQ95-3124	9.4	49.2	8	SM6
NC0310	54.7	58.3	8	SM2
NC0310	4.7	27.5	6	SM4
NC0310	6	29	7	SM5
NC0310	20.8	55.5	8	SM6
PS79-82	3	0	2	SM1
PS79-82	0	0	2	SM2
PS79-82	37.2	68.6	9	SM4
PS79-82	2	20	6	SM5
PS79-82	6.9	15.9	5	SM6
PS80-442	50	55	8	SM1
PS80-442	17.9	47.8	8	SM2
PS80-442	6.1	37.8	7	SM4
PS80-442	18	47	8	SM5
PS80-442	13.6	29.7	6	SM6
PS84-16029	0.0	2.5	1	SM4
PS84-16029	17	33	7	SM5
Q186	27	56	8	SM5
Q187	24	15	6	SM5
Q188	19	57	8	SM5
Q189	28	81	9	SM5
Q190	7	21	6	SM5
Q191	37	51	8	SM5
Q192	31	52	8	SM5
Q193	29	48	8	SM5
Q194	13	81	9	SM5
Q195	23	69	8	SM5
Q206	5	37	7	SM5
Q207	36	85	9	SM5
Q208	0.0	3.1	3	SM5
Q209	19.5	57.9	8	SM5
Q96	0	2	2	SM5
77N557	22.6	57.6	8	SM6
80N485	29.1	59.8	8	SM6
80S7031	22.0	37.2	7	SM6
80S7253	19.2	30.2	7	SM6
81S2140	13.8	31.1	7	SM6
82N314	31.5	26.5	6	SM6
82S1147	9.5	51.8	8	SM6
82S1203	13.2	51.6	8	SM6
82S1854	38.8	18.8	5	SM6
82S501	11.3	37.0	7	SM6
83C382	13.7	35.9	7	SM6
84C252	32.7	46.6	8	SM6
84C621	0.0	15.2	5	SM6
84N1750	23.0	65.3	9	SM6
84N2552	25.7	57.9	8	SM6
84N2852	1.3	23.8	6	SM6
84N3672	7.5	45.0	8	SM6
84N4014	20.6	48.4	8	SM6
84S1265	25.5	76.4	9	SM6
84S2905	7.8	38.4	7	SM6
85N1819	31.0	53.0	8	SM6
85N25	14.9	42.9	7	SM6
85N800	14.7	53.5	8	SM6
85S1555	26.0	50.6	8	SM6
85S2236	25.0	49.2	8	SM6
85S7102	5.4	37.6	7	SM6
85S7329	19.0	71.2	9	SM6
85S7335	33.2	56.1	8	SM6
86A1005	0.0	15.6	5	SM6
86A4014	19.5	61.2	8	SM6
86A4174	37.1	60.7	8	SM6
86C195	17.0	46.7	8	SM6
86C807	15.4	48.1	8	SM6
86N1659	10.1	39.6	7	SM6
86N2195	17.5	68.6	9	SM6
86N306	0.0	0.0	1	SM6
86N5441	24.0	47.3	8	SM6
87C141	12.7	46.1	8	SM6
87C152	21.2	62.3	8	SM6
87C421	26.2	40.8	7	SM6
87C54	12.9	38.8	7	SM6
87N1279	14.0	58.4	8	SM6
87N2029	17.2	53.4	8	SM6
87S7111	3.8	46.7	8	SM6
87S7148	25.5	52.1	8	SM6
87S7563	4.1	21.4	6	SM6
87S8040	20.5	32.5	7	SM6

PS84-16029	15.4	41.7	7	SM6	88A1163	11.5	49.7	8	SM6
PS87-10266	1.7	10.9	3	SM4	88A1501	11.4	23.6	6	SM6
PS87-10266	0	2	2	SM5	88A2158	6.0	33.5	7	SM6
PS87-10266	6.7	29.4	6	SM6	88A2290	9.2	26.5	6	SM6
Q107	8.3	30.6	8	SM2	88C307	16.2	36.1	7	SM6
Q110	27.9	67.6	8	SM2	88C6006	0.0	3.5	1	SM6
Q113	20.4	38.1	8	SM2	88C6016	32.5	61.8	8	SM6
Q113	41.8	32.7	7	SM4	88C73	10.7	36.9	7	SM6
Q114	18.7	35.4	7	SM4	88N1000	8.8	49.8	8	SM6
Q114	24	55	8	SM5	88N1309	18.0	51.0	8	SM6
Q115	16.1	38.9	8	SM2	88N1973	24.5	46.8	8	SM6
Q117	49	79.6	8	SM2	88N410	19.6	40.0	7	SM6
Q117	31.8	66.4	9	SM4	88S6001	11.9	28.8	6	SM6
Q117	41	73	8	SM5	88S7371	4.4	33.3	7	SM6
Q117	24.9	53.6	8	SM6	88S9095	13.6	44.1	8	SM6
Q119	0	52.8	8	SM2	88S9322	35.9	58.6	8	SM6
Q119	1.8	8.9	3	SM4	88S9323	26.8	80.2	9	SM6
Q120	24.8	60.9	8	SM2	89A1746	18.5	61.2	8	SM6
Q120	21.7	24.5	6	SM4	89A3434	21.0	76.5	9	SM6
Q121	16.7	53.5	8	SM2	89C432	20.2	43.9	8	SM6
Q121	28.5	55.6	9	SM4	89C6002	10.7	52.5	8	SM6
Q122	51.3	59.8	8	SM2	89C6019	1.3	5.1	2	SM6
Q122	42.6	54.2	8	SM2	89H1412	4.0	17.4	5	SM6
Q124	0	18.5	5	SM2	89N1180	13.9	54.6	8	SM6
Q124	0	16.7	5	SM2	89N1268	6.7	41.6	7	SM6
Q124	39.2	36.0	7	SM4	89N1492	7.5	51.8	8	SM6
Q124	5	14	5	SM5	89N1659	5.0	46.8	8	SM6
Q124	17.7	29.3	6	SM6	89N169	5.1	46.5	8	SM6
Q125	62.4	64.2	8	SM2	89N1880	13.0	37.3	7	SM6
Q125	25.6	58.5	9	SM4	89N1902	14.9	61.2	8	SM6
Q126	10.7	24.1	8	SM2	89N452	34.0	73.8	9	SM6
Q127	18.6	50.8	8	SM2	89N6002	8.3	47.1	8	SM6
Q127	39.4	55.6	8	SM2	89N95	0.0	14.1	4	SM6
Q127	11.0	31.6	7	SM4	89S6003	2.7	13.6	4	SM6
Q128	7.9	20.6	8	SM2	90A1742	6.7	15.8	5	SM6
Q128	25.4	48.1	8	SM2	90A2343	26.2	56.6	8	SM6
Q129	0	4.2	2	SM2	90C289	28.8	51.8	8	SM6
Q129	1	0	1	SM5	90C357	20.2	61.1	8	SM6
Q130	0	16.7	5	SM2	90C6001	10.4	26.1	6	SM6
Q130	0	0	2	SM2	90C6006	26.6	49.5	8	SM6
Q130	11.4	21.5	5	SM4	90C823	9.0	41.8	7	SM6
Q132	25.2	74.8	8	SM2	90H1322	17.7	42.9	7	SM6
Q132	7.8	69.4	9	SM4	90H1477	16.8	28.7	6	SM6
Q133	0	0	2	SM2	90N1693	20.4	66.1	9	SM6
Q133	10.1	19.5	5	SM4	90N1820	35.0	61.0	8	SM6
Q134	87.3	100	8	SM2	90N635	1.3	17.9	5	SM6
Q135	15.8	28.3	8	SM2	90S6002	7.5	39.3	7	SM6
Q135	17.3	33.3	7	SM4	90S6004	18.8	47.1	8	SM6
Q136	22.2	74.6	8	SM2	90S6006	6.3	31.4	7	SM6
Q136	7	91	9	SM5	90S7057	21.9	78.4	9	SM6
Q137	35	67	8	SM1	90S7063	34.7	63.0	9	SM6
Q138	41	85.2	8	SM2	91A1130	13.2	38.7	7	SM6
Q138	45.2	64.1	8	SM2	91A1135	9.0	63.0	9	SM6
Q141	38.4	68.8	8	SM2	91A1460	16.6	67.3	9	SM6
Q141	33	84	9	SM5	91A1549	20.5	63.9	9	SM6
Q142	0	0	2	SM2	91A1637	26.8	93.3	9	SM6
Q142	0	0	2	SM2	91N1285	25.6	60.7	8	SM6
Q142	8.5	33.4	7	SM4	91N1348	6.7	52.6	8	SM6
Q143	37.4	71.3	8	SM2	91N2294	11.8	36.2	7	SM6
Q145	18.4	40.6	8	SM2	91N2976	17.1	66.6	9	SM6
Q145	21.4	48.0	8	SM4	91N3307	10.7	31.6	7	SM6
Q146	4.0	4.8	1	SM4	91N3381	30.1	54.3	8	SM6

Q146	3	2	2	SM5
Q147	22.2	54.4	8	SM2
Q147	8.9	29.3	7	SM4
Q149	0	0	2	SM2
Q149	11.2	12.2	4	SM4
Q150	33	58.8	8	SM2
Q151	0	22.2	8	SM2
Q151	0.0	3.9	1	SM4
Q152	43.1	69.8	8	SM2
Q152	22	38	7	SM5
Q153	41.1	78	8	SM2
Q153	40.4	100.0	9	SM4
Q154	28.5	71.2	8	SM2
Q154	18	58	8	SM5
Q155	0	0	2	SM2
Q155	20.1	42.3	8	SM4
Q155	1	27	7	SM5
Q155	13.8	23.1	6	SM6
Q156	2	13	5	SM5
Q157	55	79	8	SM1
Q157	27.1	74.2	9	SM4
Q158	66.7	83.1	8	SM2
Q159	43.1	73.8	8	SM2
Q159	12	23	6	SM5
Q160	13.4	53.7	8	SM2
Q160	6	5	4	SM5
Q161	9.7	43.8	8	SM2
Q161	8.7	25.8	6	SM4
Q162	53.2	69.5	8	SM2
Q163	29.4	59.3	8	SM2
Q163	18.6	73.1	9	SM4
Q164	73	77.8	8	SM2
Q164	45.3	73.4	9	SM4
Q165	61.5	67.5	8	SM2
Q165	18	55	8	SM5
Q166	66.3	72.2	8	SM2
Q166	36	69	8	SM5
Q167	14	39	8	SM1
Q167	7	31	7	SM5
Q168	10	46.3	8	SM2
Q168	16	62	8	SM5
Q169	20.8	48.9	8	SM2
Q169	19	54	8	SM5
Q170	0	3	2	SM1
Q170	20.8	50.2	8	SM4
Q170	13	32	7	SM5
Q170	36.3	64.7	9	SM6
Q170	35.0	53.0	8	SM6
Q171	0	0	2	SM2
Q171	2.8	9.3	3	SM4
Q171	0	0	1	SM5
Q171	6.4	13.1	4	SM6
Q172	5.9	11.4	3	SM4
Q172	14	23	6	SM5
Q173	18.6	26.4	6	SM4
Q173	7	5	4	SM5
Q174	85.9	72.9	8	SM2
Q174	44.3	71.0	9	SM4
Q175	8.1	15.7	4	SM4
Q175	15	14	5	SM5
Q176	15.7	51.9	9	SM4
Q176	3	47	8	SM5
91N3666	20.1	39.6	7	SM6
91N406	15.8	64.5	9	SM6
91N457	17.2	40.7	7	SM6
91S7266	11.9	32.9	7	SM6
91S7347	19.5	40.7	7	SM6
92A1156	19.9	31.3	7	SM6
92A1258	18.9	43.3	7	SM6
92A1361	42.3	65.4	9	SM6
92A1431	8.5	37.9	7	SM6
92A2115	12.5	49.7	8	SM6
92A2275	5.5	42.6	7	SM6
92A2301	18.8	40.1	7	SM6
92A2309	4.3	24.1	6	SM6
92A9003	22.5	55.7	8	SM6
92A9004	27.6	57.7	8	SM6
92A9004	24.2	52.8	8	SM6
92A9014	21.3	47.8	8	SM6
92A9016	17.3	64.5	9	SM6
92C1459	25.6	65.7	9	SM6
92C1638	43.9	67.3	9	SM6
92C1644	11.6	38.0	7	SM6
92C300	26.0	58.5	8	SM6
92C369	38.4	70.6	9	SM6
92C37	20.8	59.5	8	SM6
92C723	6.9	56.4	8	SM6
92C768	8.4	52.7	8	SM6
92C928	25.1	56.4	8	SM6
92H1434	19.7	52.5	8	SM6
92H2023	19.3	59.1	8	SM6
92H2027	11.3	21.9	6	SM6
92H2185	19.7	69.4	9	SM6
92H2386	18.1	54.5	8	SM6
93A1098	9.3	59.9	8	SM6
93A1395	13.6	37.5	7	SM6
93A2795	13.5	61.3	8	SM6
93H1228	8.9	48.4	8	SM6
93H1314	25.4	56.3	8	SM6
93H1406	19.5	48.1	8	SM6
93H1642	30.8	38.2	7	SM6
93H1734	30.0	73.2	9	SM6
93H1889	7.1	45.0	8	SM6
93H2047	23.8	53.9	8	SM6
93H2081	10.8	53.7	8	SM6
93H2173	1.4	4.8	2	SM6
93H2242	19.0	55.0	8	SM6
93H39	19.9	68.4	9	SM6
93N1002	16.4	58.6	8	SM6
93N1057	13.2	47.2	8	SM6
93N3515	10.2	11.0	4	SM6
93N4701	16.0	41.1	7	SM6
93N4931	22.7	55.4	8	SM6
93S2440	4.8	36.3	7	SM6
93S2613	4.4	26.1	6	SM6
95C6009	22.3	58.8	8	SM6
95H4030	19.2	16.5	5	SM6
95N1244	5.5	31.9	7	SM6
95N1525	11.8	56.7	8	SM6
95N1645	12.1	28.1	6	SM6
95N1700	2.9	21.4	6	SM6
95N1743	19.2	61.5	8	SM6
95N1755	35.3	37.5	7	SM6
95N1810	28.0	81.1	9	SM6

Q177	2.9	6.3	1	SM4
Q177	4	9	5	SM5
Q177	11.2	20.0	5	SM6
Q178	68.9	81.1	8	SM2
Q178	32.0	63.1	9	SM4
Q179	44.3	63.6	8	SM2
Q179	43.4	59.0	9	SM4
Q179	21	37	7	SM5
Q180	39.1	65.3	9	SM4
Q180	34	51	8	SM5
Q181	27	62	8	SM1
Q181	52.8	69.7	8	SM2
Q181	23.3	62.3	9	SM4
Q182	0.0	9.7	3	SM4
Q182	2	7	4	SM5
Q183	5.5	30.3	7	SM4
Q183	0	18	6	SM5
Q183	3	41	7	SM5
Q184	38.0	41.8	8	SM4
Q184	13.5	45.3	8	SM6
Q185	6	79	8	SM1
Q185	13	47	8	SM5
Q186	18	40	8	SM1
Q186	11.8	38.2	8	SM4
Q186	10	36	7	SM5
Q186	27	56	8	SM5
Q187	25	46	8	SM1
Q187	34.9	51.7	9	SM4
Q187	24	15	6	SM5
Q187	19.9	48.2	8	SM6
Q188	17.5	51.1	9	SM4
Q188	19	57	8	SM5
Q188	5.0	45.6	8	SM6
Q189	26.4	66.3	9	SM4
Q189	28	81	9	SM5
Q189	7.3	70.6	9	SM6
Q190	0.0	9.5	3	SM4
Q190	7	21	6	SM5
Q190	4.5	31.4	7	SM6
Q191	37	51	8	SM5
Q191	23.4	56.3	8	SM6
Q192	31	52	8	SM5
Q192	31.3	67.9	9	SM6
Q193	45.2	60.6	9	SM4
Q193	29	48	8	SM5
Q194	13	81	9	SM5
Q195	23	69	8	SM5
Q196	27.0	47.5	8	SM4
Q197	25.5	47.3	8	SM4
Q197	11.3	47.9	8	SM6
Q198	12.4	22.9	6	SM4
Q199	3.0	11.3	3	SM4
Q200	5.9	4.9	1	SM4
Q200	2.5	6.3	2	SM6
Q201	31.4	33.8	7	SM4
Q201	32.5	30.1	7	SM6
Q203	1.8	16.1	4	SM4
Q205	16.1	37.0	7	SM4
Q205	13.5	52.1	9	SM4
Q205	25.3	50.2	8	SM6
Q206	5	37	7	SM5
Q206	34.4	71.7	9	SM6
95N200	16.4	22.1	6	SM6
95N234	9.0	37.0	7	SM6
95N507	17.0	37.9	7	SM6
95N521	13.8	74.8	9	SM6
95N707	20.1	66.0	9	SM6
95N87	24.7	50.8	8	SM6
96S6001	10.1	44.5	8	SM6
96S6006	5.9	12.1	4	SM6
96S6008	28.0	46.8	8	SM6
96S6009	28.3	52.9	8	SM6
ARGOS	26.0	34.3	7	SM6
BMQ89-57	5.6	25.6	6	SM6
BN73-3416	0.0	2.3	0	SM6
BN74-4445	17.3	37.8	7	SM6
BN83-3120	10.1	37.6	7	SM6
CP51-21	12.5	44.2	8	SM6
DART	23.6	61.6	8	SM6
ENCORE	27.0	52.1	8	SM6
ESK	29.9	74.4	9	SM6
F172	7.6	51.1	8	SM6
F177	6.3	32.8	7	SM6
GEMINI	6.7	27.8	6	SM6
H56-752	3.0	44.2	8	SM6
H60-3802	22.6	53.1	8	SM6
KQ95-2283	13.3	23.5	6	SM6
KQ95-2702	1.8	9.7	3	SM6
KQ96-1012	42.7	76.8	9	SM6
KQ96-1169	18.7	74.4	9	SM6
M442-51	19.8	43.4	8	SM6
MIDA	25.4	61.8	8	SM6
MQ83-204	16.6	50.9	8	SM6
MQ85-918	27.1	41.3	7	SM6
MQ91-297	24.6	48.6	8	SM6
MQ91-910	32.6	69.6	9	SM6
MQ92-153	26.6	43.5	8	SM6
MQ92-196	23.8	54.7	8	SM6
MQ92-348	15.0	56.0	8	SM6
MQ92-402	38.0	43.7	8	SM6
MQ92-62	28.9	66.8	9	SM6
MQ93-1051	3.0	22.9	6	SM6
MQ93-220	10.0	41.7	7	SM6
MQ93-25	8.8	37.2	7	SM6
MQ93-359	10.9	32.9	7	SM6
MQ93-538	1.3	1.6	1	SM6
MQ93-607	13.3	31.1	7	SM6
MQ93-65	28.0	59.5	8	SM6
MQ93-686	7.2	32.4	7	SM6
MQ93-727	5.6	88.5	9	SM6
MQ93-728	11.7	41.7	7	SM6
MQ93-740	26.3	66.3	9	SM6
MQ95-3046	11.1	50.1	8	SM6
MQ95-3072	17.2	57.0	8	SM6
MQ95-3124	9.4	49.2	8	SM6
NC _o 310	20.8	55.5	8	SM6
PS79-82	6.9	15.9	5	SM6
PS80-442	13.6	29.7	6	SM6
PS84-16029	15.4	41.7	7	SM6
PS87-10266	6.7	29.4	6	SM6
Q117	24.9	53.6	8	SM6
Q124	17.7	29.3	6	SM6
Q155	13.8	23.1	6	SM6
Q170	36.3	64.7	9	SM6

Q207	36	85	9	SM5
Q207	23.5	43.9	8	SM6
Q208	0.0	9.5	3	SM4
Q208	0.0	3.1	3	SM5
Q209	26.0	74.3	9	SM4
Q209	19.5	57.9	8	SM5
Q211	8.3	45.8	8	SM4
Q212	0	0	2	SM1
Q213	4.9	21.6	6	SM4
Q215	9.2	23.2	6	SM6
Q216	9	40	8	SM1
Q63	28.7	42.4	8	SM2
Q95	4.8	0	2	SM2
Q96	0	12.5	5	SM2
Q96	0.0	3.9	1	SM4
Q96	0	2	2	SM5
Q96	0.0	4.0	1	SM6
Q99	1.8	1.8	1	SM6
R574	8.8	35.2	7	SM6
R75-70	24.2	29.2	6	SM6
RB72-454	6.2	39.7	7	SM6
RB76-5418	12.9	44.0	8	SM6
SP78-3137	5.6	27.7	6	SM6
SP79-2313	7.2	45.3	8	SM6
TELLUS	39.2	46.9	8	SM4
TS65-28	18.8	35.0	7	SM6

Q170	35.0	53.0	8	SM6
Q171	6.4	13.1	4	SM6
Q177	11.2	20.0	5	SM6
Q184	13.5	45.3	8	SM6
Q187	19.9	48.2	8	SM6
Q188	5.0	45.6	8	SM6
Q189	7.3	70.6	9	SM6
Q190	4.5	31.4	7	SM6
Q191	23.4	56.3	8	SM6
Q192	31.3	67.9	9	SM6
Q197	11.3	47.9	8	SM6
Q200	2.5	6.3	2	SM6
Q201	32.5	30.1	7	SM6
Q205	25.3	50.2	8	SM6
Q206	34.4	71.7	9	SM6
Q207	23.5	43.9	8	SM6
Q215	9.2	23.2	6	SM6
Q96	0.0	4.0	1	SM6
Q99	1.8	1.8	1	SM6
R574	8.8	35.2	7	SM6
R75-70	24.2	29.2	6	SM6
RB72-454	6.2	39.7	7	SM6
RB76-5418	12.9	44.0	8	SM6
SP78-3137	5.6	27.7	6	SM6
SP79-2313	7.2	45.3	8	SM6
TS65-28	18.8	35.0	7	SM6

APPENDIX 2 - MEAN RATING FOR CLONES FROM ALL TRIALS AND THE NUMBER OF TRIALS IN WHICH THE CLONE HAS BEEN TESTED (TRIAL 3 OMITTED)

Sorted by Clone			Sorted by rating		
Clone	Rating	No. Trials	Clone	Rating	No. Trials
70C193	9	1	79N1227	1	1
74N1244	7	1	80N4367	1	1
75C326	4	1	80N440	1	1
75N178	9	1	83C625	1	1
77A83	9	1	85N1276	1	1
77C774	9	1	85N785	1	1
77N557	8	1	86N1667	1	1
77N792	7	1	86N306	1	1
77S1300	9	1	88C6006	1	1
77S1321	9	1	88C6019	1	1
78N238	8	1	90H1113	1	1
78N379	9	1	90N803	1	1
78N881	6	1	91A1165	1	1
79A362	5	1	91A3469	1	1
79C116	7	1	91N408	1	1
79N1227	1	1	BMQ89-645	1	1
79N183	7	1	BN73-3416	1	2
79N238	5	1	BN81-1394	1	1
79N808	9	1	CP70-1133	1	1
79S1226	6	1	H83-8859	1	1
80N1042	4	1	KQ91-2616	1	1
80N314	9	2	MQ93-538	1	1
80N3425	2	1	Q146	1	2
80N4367	1	1	Q99	1	1
80N440	1	1	80N3425	2	1
80N485	9	2	83S2103	2	1
80N514	9	1	84S2447	2	1
80N739	9	1	86N1675	2	1
80N740	8	2	86N874	2	1
80S7031	7	1	86S108	2	1
80S7059	7	1	87S7140	2	1
80S7212	9	1	87S7260	2	1
80S7253	7	1	87S7428	2	1
81C558	6	1	87S7453	2	1
81N289	7	2	87S8032	2	1
81N315	7	1	87S8324	2	1
81N374	7	1	87S9021	2	1
81N82	8	1	88C23	2	1
81S2140	7	1	88C279	2	1
81S2352	4	1	88S7189	2	1
82C1047	7	1	88S7403	2	1
82C11	7	1	89C6019	2	2
82C1216	8	1	89H424	2	1
82C59	7	1	89S7974	2	1
82C663	7	1	89W131	2	1
82C954	6	1	89W61	2	1
82N1038	8	1	90S7022	2	1
82N1525	8	1	91C3202	2	1
82N238	8	1	91C3242	2	1
82N314	6	1	91C3511	2	1
82N371	9	1	91C511	2	1
82N546	8	1	91C580	2	1
82S1147	8	1	91C982	2	1
82S1203	8	1	91N569	2	1
82S1399	6	1	91S7005	2	1

82S1687	6	1	92C1227	2	1
82S1854	5	1	92C1473	2	1
82S2214	8	1	92C228	2	1
82S2292	8	1	92C328	2	1
82S501	7	1	92C785	2	1
82S954	7	1	92S622	2	1
83C273	7	1	93C4	2	1
83C328	5	1	93H2173	2	1
83C382	6	2	BN83-3068	2	1
83C495	7	1	BN87-3152	2	1
83C537	6	1	BN87-3165	2	1
83C625	1	1	BN87-3185	2	1
83C626	4	1	BN88-3194	2	1
83C631	4	1	BN893086	2	1
83N1072	7	1	BN89-3107	2	1
83N1082	9	1	CASSIUS	2	1
83N1088	8	1	KQ91-71304	2	1
83N1216	7	1	MQ84-88	2	1
83N230	8	1	Q129	2	2
83N399	8	1	Q171	2	4
83N660	9	1	Q200	2	2
83N925	8	1	Q212	2	1
83N943	4	1	Q95	2	1
83S1051	7	1	Q96	2	4
83S1354	7	1	84N3747	3	1
83S1601	7	1	85A572	3	1
83S194	9	1	85S7325	3	3
83S2070	8	1	86N139	3	1
83S2103	2	1	87N1210	3	1
83S250	8	1	89N1567	3	1
83S84	8	1	89N1967	3	2
84A376	6	1	89S6005	3	1
84A421	9	1	90A243	3	1
84C137	9	1	90N350	3	2
84C252	8	2	93A6008	3	1
84C275	7	1	MQ76-497	3	1
84C620	7	1	MQ79-141	3	1
84C621	5	2	MQ91-190	3	1
84N1750	9	1	Q149	3	2
84N2436	9	1	Q182	3	2
84N2467	8	1	Q199	3	1
84N2552	9	2	Q208	3	2
84N2728	9	1	75C326	4	1
84N2852	6	1	80N1042	4	1
84N2865	9	1	81S2352	4	1
84N2967	9	1	83C626	4	1
84N2995	9	1	83C631	4	1
84N3672	7	2	83N943	4	1
84N3747	3	1	85N79	4	2
84N4014	6	3	87S7346	4	1
84N4221	9	1	89N95	4	2
84N4285	9	1	89S6003	4	1
84N4500	7	1	90C353	4	3
84N4554	9	1	90C784	4	1
84N4701	9	1	91A1552	4	2
84N94	9	1	91H1354	4	1
84S1225	6	1	91N3028	4	1
84S1263	8	1	91N3738	4	1
84S1265	9	1	92A9006	4	1
84S2447	2	1	92H1267	4	1
84S2651	8	1	92H2429	4	1
84S2735	9	1	93N3515	4	1

84S2905	7	1
84S303	6	1
84S3130	7	1
84S818	8	1
85A2234	8	2
85A2540	6	1
85A2734	6	1
85A5125	5	1
85A538	9	1
85A572	3	1
85C220	9	1
85C256	7	1
85C478	8	1
85C489	8	1
85C647	6	1
85C653	7	1
85C734	9	1
85C749	5	1
85C81	9	1
85C864	9	1
85N1167	8	1
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85N511	9	1
85N780	9	1
85N785	1	1
85N79	4	2
85N800	8	1
85S1075	6	1
85S1220	8	1
85S1247	7	1
85S1420	8	1
85S1555	8	1
85S1892	8	1
85S2162	8	1
85S2236	8	1
85S2291	7	1
85S7035	9	1
85S7102	7	1
85S7181	8	1
85S7325	3	3
85S7327	8	1
85S7329	9	2
85S7335	8	1
85S7341	8	1
85S7807	8	1
85S7877	8	1
86A1005	5	1
86A148	8	1
86A3133	7	1
86A3211	8	1
86A3850	8	1
86A4014	8	1
86A4174	8	1
86A679	8	1
86A700	7	2

96S6006	4	1
CP63-588	4	1
CP75-1322	4	1
H66-8912	4	1
H74-6418	4	1
H77-0723	4	1
MQ89-645	4	1
MQ91-191	4	1
PS87-10266	4	3
Q130	4	3
Q133	4	2
Q142	4	3
Q177	4	3
Q203	4	1
79A362	5	1
79N238	5	1
82S1854	5	1
83C328	5	1
84C621	5	2
85A5125	5	1
85C749	5	1
85N1446	5	1
86A1005	5	1
86N2139	5	1
87A1045	5	1
87S8034	5	1
88C829	5	1
88N853	5	1
88S7205	5	2
89A3057	5	1
89A3305	5	2
89C432	5	2
89H1412	5	1
89N109	5	1
89N1246	5	1
89S7865	5	1
89W148	5	1
90A1742	5	1
90H1146	5	1
90H1150	5	1
90S6006	5	2
91N1358	5	1
91N3397	5	1
91S7179	5	1
92C37	5	2
92C581	5	1
92C712	5	1
92C768	5	2
92S250	5	2
94A6005	5	1
95H4030	5	1
H72-8597	5	1
H74-4527	5	1
KQ95-2283	5	2
KQ95-2702	5	2
KQ95-3853	5	1
MQ90-299	5	1
PS79-82	5	5
PS84-16029	5	3
Q119	5	2
Q151	5	2
Q156	5	1

86C195	8	1
86C807	8	1
86N139	3	1
86N1581	9	1
86N1659	6	3
86N1660	7	2
86N1667	1	1
86N1675	2	1
86N1833	6	1
86N2124	6	1
86N2139	5	1
86N2168	9	1
86N2195	9	1
86N246	7	1
86N306	1	1
86N460	8	1
86N5279	8	1
86N5441	8	1
86N5689	8	1
86N874	2	1
86S108	2	1
86S669	8	1
87A1045	5	1
87A246	8	1
87C141	8	1
87C152	8	1
87C421	7	1
87C54	7	1
87C622	8	1
87C632	6	1
87C675	8	1
87N1117	8	1
87N1184	8	2
87N1210	3	1
87N1261	8	1
87N1279	8	2
87N15	9	1
87N1681	8	1
87N1969	9	2
87N2029	8	1
87N2105	8	1
87N479	8	1
87N481	9	1
87N79	8	1
87S7018	8	1
87S7035	8	1
87S7095	8	1
87S7111	8	2
87S7121	6	1
87S7140	2	1
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87S7148	8	2
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87S7189	8	1
87S7199	6	1
87S7212	8	1
87S7220	8	1
87S7221	8	3
87S7223	8	1
87S7260	2	1
87S7267	8	1
87S7268	8	1

Q172	5	2
Q173	5	2
Q175	5	2
Q190	5	3
78N881	6	1
79S1226	6	1
81C558	6	1
82C954	6	1
82N314	6	1
82S1399	6	1
82S1687	6	1
83C382	6	2
83C537	6	1
84A376	6	1
84N2852	6	1
84N4014	6	3
84S1225	6	1
84S303	6	1
85A2540	6	1
85A2734	6	1
85C647	6	1
85N1802	6	2
85S1075	6	1
86N1659	6	3
86N1833	6	1
86N2124	6	1
87C632	6	1
87S7121	6	1
87S7199	6	1
88A2290	6	1
88C6023	6	1
88S6001	6	1
88S6009	6	1
89A570	6	2
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90H1322	6	2
90H1477	6	1
90N635	6	2
90N921	6	1
90N959	6	1
91N1223	6	1
91N227	6	1
91N91	6	1
91S7008	6	1
92A2309	6	1
92H1430	6	1
92H2027	6	2
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BN88-3331	8	1	93N1057	8	1
BN88-3345	8	1	93N4931	8	1
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BN89-3038	8	1	95N1525	8	1
BN89-3044	8	1	95N1743	8	1
BN89-3085	8	1	95N87	8	1
BN893086	2	1	96S6001	8	1
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BN89-6059	8	1	96S6009	8	1
BN89-6087	8	1	ARGOS	8	3
BN89-6104	8	1	BMQ89-15	8	1
BN89-6109	8	1	BN82-2324	8	1
BN89-6144	8	1	BN82-2384	8	1
BN89-6152	8	1	BN82-2484	8	1
CASSIUS	2	1	BN83-3140	8	1
CP51-21	7	2	BN84-4180	8	1
CP63-588	4	1	BN88-3109	8	1
CP70-1133	1	1	BN88-3116	8	1
CP72-2086	6	1	BN88-3151	8	1
CP72-356	7	1	BN88-3243	8	1
CP75-1082	8	1	BN88-3263	8	1
CP75-1322	4	1	BN88-3291	8	1
DART	8	1	BN88-3331	8	1
ENCORE	8	2	BN88-3345	8	1
ESK	9	2	BN88-3347	8	1
F172	8	1	BN89-3022	8	1
F177	7	2	BN89-3038	8	1
GEMINI	6	1	BN89-3044	8	1
H52-663	6	1	BN89-3085	8	1
H56-752	7	2	BN89-6059	8	1
H60-3802	7	2	BN89-6087	8	1
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H72-8597	5	1	BN89-6109	8	1
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H74-0922	6	1	BN89-6152	8	1
H74-4527	5	1	CP75-1082	8	1
H74-6418	4	1	DART	8	1
H77-0723	4	1	ENCORE	8	2
H77-1485	7	1	F172	8	1
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KQ88-8151	6	1	KQ91-2614	8	1
KQ91-0411	8	1	MQ74-110	8	1
KQ91-0417	7	1	MQ76-534	8	1
KQ91-2308	7	1	MQ77-340	8	1
KQ91-2614	8	1	MQ79-1030	8	1
KQ91-2616	1	1	MQ83-204	8	1
KQ91-31506	6	1	MQ91-297	8	1
KQ91-71304	2	1	MQ91-571	8	1
KQ92-11301	9	1	MQ91-68	8	1
KQ92-20111	7	1	MQ91-870	8	1
KQ92-20518	7	1	MQ92-153	8	1
KQ92-21815	7	1	MQ92-196	8	1
KQ92-31017	9	1	MQ92-348	8	1
KQ92-32413	7	1	MQ92-402	8	1
KQ93-2348	9	1	MQ92-47	8	1
KQ95-2283	5	2	MQ93-65	8	1

KQ95-2702	5	2	MQ95-3046	8	1
KQ95-3254	7	1	MQ95-3072	8	1
KQ95-3758	7	1	MQ95-3124	8	1
KQ95-3853	5	1	PS80-442	8	5
KQ96-1012	9	2	Q107	8	1
KQ96-1169	9	2	Q110	8	1
M442-51	7	5	Q114	8	2
MIDA	9	3	Q115	8	1
MQ73-582	9	1	Q121	8	2
MQ74-110	8	1	Q122	8	2
MQ76-497	3	1	Q126	8	1
MQ76-534	8	1	Q127	8	3
MQ77-340	8	1	Q128	8	2
MQ78-147	9	1	Q134	8	1
MQ78-756	6	1	Q135	8	2
MQ79-1030	8	1	Q136	8	2
MQ79-141	3	1	Q137	8	1
MQ80-805	7	1	Q138	8	2
MQ83-204	8	1	Q141	8	2
MQ84-88	2	1	Q143	8	1
MQ85-566	9	1	Q145	8	2
MQ85-918	7	1	Q150	8	1
MQ89-645	4	1	Q152	8	2
MQ90-217	7	1	Q154	8	2
MQ90-299	5	1	Q158	8	1
MQ91-190	3	1	Q162	8	1
MQ91-191	4	1	Q165	8	2
MQ91-200	7	1	Q166	8	2
MQ91-246	7	1	Q168	8	2
MQ91-297	8	1	Q169	8	2
MQ91-571	8	1	Q176	8	2
MQ91-68	8	1	Q179	8	3
MQ91-698	6	1	Q181	8	3
MQ91-753	6	1	Q184	8	2
MQ91-870	8	1	Q185	8	2
MQ91-910	6	2	Q186	8	4
MQ92-153	8	1	Q188	8	3
MQ92-196	8	1	Q191	8	2
MQ92-255	6	1	Q192	8	2
MQ92-348	8	1	Q193	8	2
MQ92-402	8	1	Q195	8	1
MQ92-405	7	1	Q196	8	1
MQ92-47	8	1	Q197	8	2
MQ92-62	9	1	Q205	8	3
MQ93-1051	6	1	Q206	8	2
MQ93-220	7	1	Q207	8	2
MQ93-25	7	1	Q211	8	1
MQ93-359	7	1	Q216	8	1
MQ93-538	1	1	Q63	8	1
MQ93-607	7	1	RB76-5418	8	1
MQ93-65	8	1	SP79-2313	8	1
MQ93-686	7	1	TELLUS	8	1
MQ93-727	9	1	70C193	9	1
MQ93-728	7	1	75N178	9	1
MQ93-740	9	1	77A83	9	1
MQ95-3046	8	1	77C774	9	1
MQ95-3072	8	1	77S1300	9	1
MQ95-3124	8	1	77S1321	9	1
NC0310	7	4	78N379	9	1
PS79-82	5	5	79N808	9	1
PS80-442	8	5	80N314	9	2
PS84-16029	5	3	80N485	9	2

PS87-10266	4	3	80N514	9	1
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Q110	8	1	80S7212	9	1
Q113	7	2	82N371	9	1
Q114	8	2	83N1082	9	1
Q115	8	1	83N660	9	1
Q117	9	4	83S194	9	1
Q119	5	2	84A421	9	1
Q120	7	2	84C137	9	1
Q121	8	2	84N1750	9	1
Q122	8	2	84N2436	9	1
Q124	6	5	84N2552	9	2
Q125	9	2	84N2728	9	1
Q126	8	1	84N2865	9	1
Q127	8	3	84N2967	9	1
Q128	8	2	84N2995	9	1
Q129	2	2	84N4221	9	1
Q130	4	3	84N4285	9	1
Q132	9	2	84N4554	9	1
Q133	4	2	84N4701	9	1
Q134	8	1	84N94	9	1
Q135	8	2	84S1265	9	1
Q136	8	2	84S2735	9	1
Q137	8	1	85A538	9	1
Q138	8	2	85C220	9	1
Q141	8	2	85C734	9	1
Q142	4	3	85C81	9	1
Q143	8	1	85C864	9	1
Q145	8	2	85N1647	9	1
Q146	1	2	85N511	9	1
Q147	7	2	85N780	9	1
Q149	3	2	85S7035	9	1
Q150	8	1	85S7329	9	2
Q151	5	2	86N1581	9	1
Q152	8	2	86N2168	9	1
Q153	9	2	86N2195	9	1
Q154	8	2	87N15	9	1
Q155	6	4	87N1969	9	2
Q156	5	1	87N481	9	1
Q157	9	2	88A1399	9	1
Q158	8	1	88A1968	9	1
Q159	7	2	88A46	9	1
Q160	6	2	88N1887	9	1
Q161	7	2	88N535	9	1
Q162	8	1	88N631	9	1
Q163	9	2	89A3434	9	1
Q164	9	2	89H1363	9	1
Q165	8	2	89H1455	9	1
Q166	8	2	89N1382	9	1
Q167	7	2	89N2349	9	1
Q168	8	2	89N452	9	1
Q169	8	2	89N833	9	1
Q170	7	5	89N930	9	1
Q171	2	4	90A1227	9	1
Q172	5	2	90H1067	9	1
Q173	5	2	90N1693	9	1
Q174	9	2	90N1839	9	1
Q175	5	2	90N838	9	2
Q176	8	2	90S7057	9	1
Q177	4	3	90S7063	9	1
Q178	9	2	91A1135	9	1
Q179	8	3	91A1460	9	1

Q180	9	2
Q181	8	3
Q182	3	2
Q183	7	3
Q184	8	2
Q185	8	2
Q186	8	4
Q187	7	4
Q188	8	3
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Q205	8	3
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Q207	8	2
Q208	3	2
Q209	9	2
Q211	8	1
Q212	2	1
Q213	6	1
Q215	6	1
Q216	8	1
Q63	8	1
Q95	2	1
Q96	2	4
Q99	1	1
R574	7	1
R75-70	6	1
RB72-454	7	1
RB76-5418	8	1
SP78-3137	6	1
SP79-2313	8	1
TELLUS	8	1
TS65-28	7	1

91A1549	9	2
91A1637	9	1
91C9	9	1
91N1187	9	1
91N1188	9	1
91N1242	9	1
91N3767	9	1
91N57	9	1
92A1361	9	1
92C1638	9	1
92C369	9	1
92H1434	9	2
92H2185	9	1
93H1734	9	1
93H39	9	2
95N1810	9	1
95N521	9	1
95N707	9	1
BN78-8031	9	1
ESK	9	2
KQ92-11301	9	1
KQ92-31017	9	1
KQ93-2348	9	1
KQ96-1012	9	2
KQ96-1169	9	2
MIDA	9	3
MQ73-582	9	1
MQ78-147	9	1
MQ85-566	9	1
MQ92-62	9	1
MQ93-727	9	1
MQ93-740	9	1
Q117	9	4
Q125	9	2
Q132	9	2
Q153	9	2
Q157	9	2
Q163	9	2
Q164	9	2
Q174	9	2
Q178	9	2
Q180	9	2
Q189	9	3
Q194	9	1
Q209	9	2

APPENDIX 3 - PROCEDURE FOR CONDUCTING SMUT TRIALS

Spore Collection

- Collect whips, cut whips off 10-20 cm below exposed whip and peel off green leaves. Place in bag. Collect only fresh whips with lots of black spores.
- Spread whips out in a relatively cool, dry place, free of breezes. Place on plastic or wax paper.
- Allow to dry for 1-2 weeks until completely dry. This is essential to maintain spore viability. Spores must be maintained at low humidity.
- Collect spores which have fallen onto paper/plastic, rub whips over sieve to remove remaining spores, collect spores in tray under sieve. (Use a coarse 20 mesh sieve).
- Weigh total spores collected, place in paper bag in a large jar containing some silica gel desiccant. Seal lid of jar with vaseline.
- Conduct a viability test on the spores a couple of weeks before you intend to plant trial. Take a small sample 2-3 g and count spores – mix 0.1 g in 100 mL of sterile distilled water (Add 0.05% Tween 20 to disperse spores, dilution may need to be adjusted to give the correct number of spores in the counting chamber to allow accurate counting), count spores in haemocytometer, calculate spores per g. Viability – spread 0.5 mL of spore suspension on water agar, incubate overnight and calculate % germinated spores.

Inoculation of setts

- Cut 4 bundles of 10 setts of each clone, 20-30 cm long or at least two (2) eyes. Remove all leaf sheaths. Tie and label each bundle of 10 setts – one for each of four (4) reps. Place bundles for each replicate together.
- Prepare inoculum by calculating the weight of spores required to give 5×10^6 viable spores/mL in final dipping tank.
- Place spores in 800 mL of water in a blender and mix for 20-30 sec (Figure 1). Add this suspension to water in dipping tank and mix well, leave for 20-30 minutes.



Figure 1 **Mixing smut spores in a blender**

- Dip setts in tank for 10 min (Figure 2), drain and place in cool place under plastic sheeting – must stay moist overnight (Figure 3). Repeat until all setts are dipped. Dip a replicate at a time eg 10 clones in each dip repeat six (6) times for one replicate, then proceed to replicate two (2).



Figure 2 **Dipping setts in the smut spore suspension**



Figure 3 **Covering inoculated setts before storage overnight**

- If water level drops below level necessary to cover setts, mix up a few buckets of spore suspension as above to replenish tank.

Standard varieties

Include at least two highly resistant, two intermediate and two resistant varieties in every trial.

Planting

Plant the setts the day after dipping, into moist soil, cover and irrigate (Figure 4). Plant a replicate at a time. Keep setts out of direct sunlight while waiting to plant.

Plant in a randomised complete blocks design. 5 m plots, 10 setts/plot.

Rating

In the plant crop count total stools and infected stools in each plot. Rate at 5-6 months.

Ratoon crop after rating the plant crop and rate ratoon crop at 5-6 months.

Count total stools and infected stools in each plot (Figure 5).



Figure 4 Planting a smut-resistance trial



Figure 5 Counting smut-infected stools

Analysis

Analyses of variance are conducted on the percent-infected plants. Ratings for the test clones are calculated from the regression equation for the log-transformed percent infection for the standards (X) and their standard ratings (\hat{Y}). The standards included in the trials and the mean percent infection and ratings are shown in Table 1. As more results are being obtained for the standard varieties, the standard ratings are being refined using the results from all trials.

Table 1 Standard clones, percent infection in all trials and ratings based on the mean of all trials

Clone	Trial						Mean	Rating
	1	2	3	4	5	6		
M442-51	12.2	43.1	7.0	73.2	19.2	43.4	33.0	7.4
NCo310		58.3	14.6	27.5	29.5	55.5	37.1	7.7
PS79-82	0.0	0.0	20.0	68.6	20.0	15.9	20.8	6.2
PS80-442	55.1	47.8	19.7	37.8	46.7	29.7	39.5	7.8
PS84-16029			0.0	2.5	32.6	41.7	19.2	6.1
PS87-10266			0.0	10.9	1.9	29.4	10.6	4.6
Q117		79.6	44.8	66.4	72.6	53.6	63.4	9.0
Q124		17.6	8.8	36.0	14.0	29.3	21.1	6.3
Q155		0.0	0.0	42.3	27.3	23.1	18.5	6.0
Q170 [♠]	2.8		3.6	50.2	31.7	53.0	28.3	7.0
Q171 [♠]		0.0	0.0	9.3	0.0	13.1	4.5	2.7
Q96		12.5	0.0	3.9	1.8	4.0	4.4	2.7
Q99						1.8	1.8	1.0