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SMUT-PROOFING THE AUSTRALIAN INDUSTRY – ENSURING A RELIABLE CANE SUPPLY THROUGH REDUCED GENETIC VULNERABILITY TO SUGARCANE SMUT

by

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SD09002

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CONTENTS

SUMMARY

Sugarcane smut has spread throughout Queensland since it was first reported in the Bundaberg/Isis, Central and Herbert regions of Queensland in 2006. This serious disease can cause losses from 30-100% in susceptible varieties. The smut-resistant varieties identified by this and earlier projects have been the basis of the response to the sugarcane smut epidemic, and losses from the epidemic will be substantially reduced by the provision of high-yielding smut-resistant varieties. The information obtained from the project was used to commence breeding for smut resistance well before the smut incursion was identified and the benefits of this pre-emptive breeding will flow through to industry in coming years as more high-yielding smut-resistant varieties are released.

This project continues the work commenced in the SRDC projects BSS214 Screening of Australian Germplasm for Resistance to Sugarcane Smut and BSS256 Reducing the Australian sugar industry's genetic vulnerability to sugarcane smut. The smut-screening trials were conducted on Madura Island by the Indonesian Sugar Research Institute (ISRI) under contract to BSES.

The project was terminated 12 months earlier than was planned after smut was found in Queensland. Research has continued at smut resistance screening facilities in Bundaberg with funding from BSES, CSIRO, SRDC and QDPI&F.

Two smut-resistance screening trials were conducted and smut ratings were obtained for 695 clones. The clones were from the later stages of the BSES selection programs or were selected parent clones. A set of 12 standard varieties were included in the trials, and the disease reaction of the standard varieties in the trials was highly correlated with their long-term ratings. There has been a consistent trend toward higher levels of resistance in the populations screened during the 10 years that trials have been conducted in Indonesia. In the first six trials, the percentage of clones rated resistant or intermediate was 29%, in the next three trials the percentage was 36% and in the last two trials the percentage was 42%. This change shows that the BSES strategy for increasing the levels of smut resistance in selection populations has worked. The smut-resistance ratings obtained in this project have been stored in the BSES' plant improvement database, SPIDNet, and have been used extensively in the BSES-CSIRO selection program when considering the advancement of varieties and in the breeding program when selecting crosses. Six new smut-resistant commercial varieties, Q235$^{\phi}$, KQ236$^{\phi}$, Q237$^{\phi}$, Q238, MQ239 and Q240, were released to growers in 2008 and 2009 based on their smut resistance identified in these trials.

Since the smut incursion and subsequent spread of the disease breeding for smut resistance has become an essential priority for the BSES-CSIRO Variety Improvement program. The strategy that has been adopted includes the SmutBuster program and this program has been funded by special grants from SRDC and QDPI&F. The SmutBuster program aims to maintain advances in breeding for productivity while ensuring that all new varieties have adequate smut resistance. A key component of this program is an effort to recover genes for high yield and sugar content from the best parent varieties by screening progeny from crosses between susceptible parents and identifying the small percentage of smut-resistant progeny. These smut-resistant progeny from high value

parents will be tested as potential new varieties and will be used as parents for breeding for high-yielding smut-resistant varieties for the future.

There has been extensive coverage of the smut epidemic in radio interviews, magazine articles, media releases, variety guides and newsletters. Growers in the Herbert and Central regions have requested that the QDPI&F remove all smut-susceptible varieties from their approved variety lists. Surveys have shown that almost all growers are now aware of the smut resistance of commercial varieties in their region. The percentage of the crop planted to smut-susceptible varieties has fallen in all regions and it is estimated that over the next 5 years only a small proportion of commercial crops of smut-susceptible varieties will remain in Queensland.

1.0 BACKGROUND

Sugarcane smut has a history of spread around the world. Since the 1970s, it has spread to Hawaii (1971), the Caribbean (1974), Central, South and North America (1978), Indonesia (1979) and Western Australia (1998). Smut was identified for the first time in Queensland in the Childers district in June 2006 and has subsequently been found in all districts in Queensland except Nambour and Rocky Point. The disease has not been found in New South Wales; however, smut spores have been detected with spore traps in the Condong mill area. It has been estimated that all farms in the Bundaberg/Isis, Mackay and Herbert regions will be infested with smut by the end of 2009. Significant losses have been recorded in a few fields, but many infested fields have been removed before losses have occurred. By removing heavily infested fields and replacing susceptible varieties, the industry should be able to avoid serious direct losses from the disease. The accelerated replacement of smut-susceptible varieties and the loss of productive susceptible varieties will result in significant indirect losses to growers.

Sugarcane smut is caused by the fungus, *Ustilago scitaminea* H. and P. Sydow (syn. *Sporisorium scitaminea*). The disease can cause yield losses of 30-100% in susceptible varieties and can make ratoon crops unprofitable. Smut can be successfully controlled by resistant varieties, but the loss of productive susceptible varieties 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 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 plants' meristems. 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.

Figure 1 Typical smut whips on Q117 in the Burdekin

In the Ord River Irrigation Area (ORIA) in Western Australia, surveys initially identified relatively low-level infestations in crops concentrated at the northern end of the production area. Within 12 months of being discovered, the disease had spread throughout the ORIA production area and many fields of susceptible varieties were heavily infested. Susceptible varieties (NCo310 and Q117) made up 30% of the crop when the disease was discovered and would have suffered complete crop loss after first or second ratoon if they had not been replaced.

Overseas research has shown that smut resistance is moderately heritable and all overseas breeding programs have successfully bred smut-resistant varieties. BSES commenced breeding for smut resistance when the first results from the Indonesian smut-resistance screening trials were obtained.

Research funded by a CRC for Tropical Plant Protection project and SRDC found that in most countries around the world the smut isolates showed very low variability. The sugarcane smut isolates in Western Australia were identical to isolates from Indonesia and to the dominant world-wide genotype. The isolates of smut in Queensland were identical to those found in Western Australia, Indonesia and the dominant world-wide genotype. SRDC has funded two previous projects (BSS214 and BSS256), starting in 1998, to screen Australian clones for resistance to smut in Indonesia through a contract with the Indonesian Sugar Research Institute (ISRI). Screening of varieties for resistance to smut in Western Australia as part of SRDC project CTA043 gave ratings, which agree well with ratings from Indonesia. BSES has cooperative exchange programs with international sugarcane-breeding programs and BSES has exchanged varieties with the specific aim of obtaining varieties with smut resistance. In the last 10 years, over 300 varieties have been imported from overseas. These varieties are being used as parents to increase the level of smut resistance in Australian breeding programs.

2.0 OBJECTIVES

This project aimed to provide varieties that will minimise the impact of the 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 varieties to growers.

3.0 METHODS, RESULTS AND DISCUSSION

3.1 Objective 1: Reviewing the options for breeding for smut resistance and conducting an analysis of the benefits of the various options

In 1998, after the incursion of smut into the ORIA, smut-resistance screening trials commenced and a strategy was adopted that 50% of the crosses made in the BSES-CSIRO Variety Improvement Program would have an average smut rating for the parents (mid-parent rating) < 6.5. Where there was no information for one parent but information was available for grandparents, this information was used to provide an estimate of the resistance of a cross. The initial data showed that in 2000 only 20% of crosses had an intermediate smut mid-parent rating (≥ 3.5 and < 6.5) and there were virtually no resistant crosses (< 3.5) (Figure 2). From 2000 to 2004 the initial plan was implemented and the proportion of crosses with intermediate mid-parent rating steadily increased, but the proportion of crosses with resistant mid-parent rating remained at or below 10%. One of the BSES photoperiod facilities was dedicated specifically to making smut-resistant crosses to supplement the crosses from field-grown flowers. In 2004, the smut breeding strategy was reviewed and a new strategy was developed that targeted 25% crosses with mid-parent ratings in the resistant range and 50% in the intermediate range. This new strategy was almost achieved in 2005 and was exceeded in 2006. After the smut incursion in 2006, the decision was made that susceptible crosses with high breeding value would be made only for a separate sub-program referred to as SmutBuster and in 2007 and 2008 the proportion of susceptible crosses was about 10%.

In the most recent cross-pollination season (2008), approximately 88% of crosses are rated intermediate or resistant for smut (Table 1).

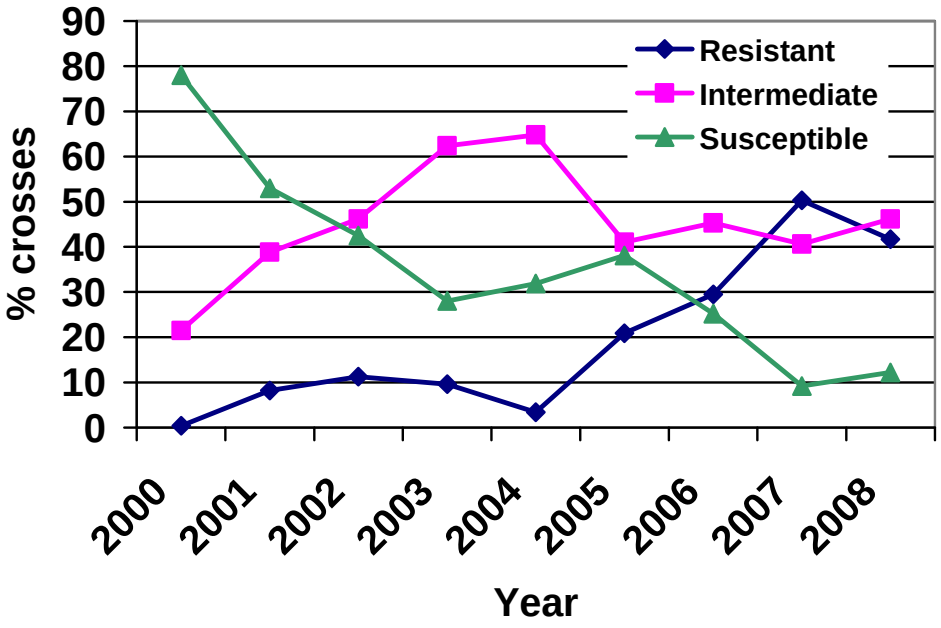

Figure 2 Proportion of crosses in different resistance classes from 2000-2006

The BSES-CSIRO Variety Improvement Program is faced with a major challenge to maintain progress in breeding for improved productivity at the same time as ensuring that all new varieties are resistant to smut. Many of the parent clones that are producing the highly productive new varieties that have been released to industry in recent years are also highly susceptible to smut. In an attempt to recover the genes in these parents that instil the characteristics of high yield and sugar content, the SmutBuster sub-program was developed to screen large populations from crosses between these parents in an attempt to select the smut-resistant clones that will be present at low frequency. Overseas research has shown that, even in crosses between two highly susceptible parents, between 6-20% of progeny will be smut-resistant (Chao *et al.,* 1990, Wu *et al.,* 1983). These resistant progeny from susceptible crosses will be assessed as potential varieties and will be used as parents.

There are no commonly accepted methods for screening true seedlings for smut resistance. A number of methods have been published but none have been widely adopted. Research is underway in the SmutBuster project (BSS325) to develop effective methods to screen original seedlings. The SmutBuster program aims to screen 30,000 true seedlings each year for smut resistance (Table 2). After an initial screen, 5000-10,000 clones will be selected for a second stage of smut resistance screening by inoculating one three-eye sett from the selected clones. Approximately 2,500 clones that do not show smut after the initial two smut resistance screens will be selected for advancement and will be distributed to Northern, Burdekin, Central and Southern selection programs for yield trials after appropriate quarantine.

The plan is that the SmutBuster program will be followed for 5 years until smut-resistant clones with high productivity can be identified from the susceptible crosses.

Table 1 **Average smut rating of crosses made in the Meringa core program, photoperiod facilities, and SmutBuster programs in 2008. The best estimate refers to ratings using the best available estimate of the parents smut resistance including actual ratings, ratings of grandparents or, if no information was available for one parent, a default value of rating 7**

Source	Mid-parent rating	Resistance class	No.	%
Meringa (Core)	Resistant	1-3	878	44.4
	Intermediate	4-6	951	48.1
	Susceptible	7-9	147	7.4
	Total		1976	
Photoperiod Facilities	Resistant	1-3	512	42.8
	Intermediate	4-6	516	43.2
	Susceptible	7-9	167	14.0
	Total		1195	
SmutBuster	Resistant	1-3	12	6.2
	Intermediate	4-6	88	45.1
	Susceptible	7-9	95	48.7
	Total		195	
Total	Resistant	1-3	1402	41.7
	Intermediate	4-6	1555	46.2
	Susceptible	7-9	409	12.2
	Total		3366	

The strategy for addressing smut in the core Variety Improvement Program is to only plant seedlings from crosses with a mid-parent rating <5. Similar strategies have been successfully followed for many years for other major diseases in Australia such as Fiji leaf gall, leaf scald and pachymetra root rot. This core program will provide 2,500 clones with a high frequency of resistant and intermediate types that will be combined with the 2,500 smut-resistant clones selected from the SmutBuster program, effectively doubling the size of the CAT trials. This expanded program aims to maintain progress for breeding for improved productivity, while ensuring that all new varieties have sufficient smut resistance.

The SmutBuster strategy was recently reviewed by a panel of external experts and the reviewers fully endorsed the proposed strategy.

Table 2 **Outline of the proposed BSES-CSIRO SmutBuster and core Variety Improvement Program with changes made in response to the smut incursion. The core program is duplicated in the four selection regions**

Core program			*Smut Program*		
Year	**Stage**	**Description**	**Year**	**Stage**	**Description**
1	**1**	Plant seedlings crosses with mid-parent < 5 (30K)	**1**	**1**	Plant seedlings & inoculate with smut, crosses with mid-parent rating >5 (30K)
2	**1**	Harvest families – select high yield families	**2**	**1**	Select 5000 resistant seedlings and inoculate 3 eye sett with smut
3	**1**	Select clones 2500 from high yielding families	**3**	**1**	Select 2500 smut-resistant seedlings
3	**2**	Plant 2500 clones from core and 2500 clones from smut programs in CAT[a] trial	**3**	**1**	Propagate 2500 clones
4	**2**	Harvest P crop CAT			
5	**2**	Harvest 1R crop CAT			
6		Propagate 400 clones for FAT[b]	**6**	**2**	Screen 400 tentative selections for smut resistance
7	**3**	Plant 150 smut-resistant clones in FAT trial			
8	**3**	Harvest P crop FAT			
9	**3**	Harvest 1R crop FAT	**9**	**3**	Screen 25 tentative selections for smut resistance
10		Propagate varieties for release	**10**	**3**	Retest 5

[a] CAT = clonal assessment trial
[b] FAT = final assessment trial

3.2 Objective 2: Negotiating a new contract with the Indonesia Sugar Research Institute for testing clones for smut resistance based on the recommendations of the review

Nils Berding and Barry Croft visited the Director and staff of the Indonesian Sugar Research Institute (ISRI) on the 25 October 2004 to discuss a new contract for this project (BSS265). The new contract involved sending 550 clones to the Indonesian quarantine. Data from Australian final assessment trials harvested during the year that the clones were in Indonesian quarantine would be used to select 250 clones to be planted in a smut trial after the quarantine period. This new contract would provide smut ratings 2-3 years

earlier than was possible with earlier contracts. The new contract was successfully negotiated within the budget allowed in the project.

Before the first trial in this project was planted, smut was found in Queensland. Initially, there was uncertainty about whether smut-resistance screening trials could be conducted in Queensland because the initial emergency response was focused on eradicating or containing smut. During this period of uncertainty, the second batch of clones was dispatched to Indonesia. Further negotiations were conducted with the ISRI, and it was agreed that the number of clones to be screened in the trials would be increased to 350 in the first two trials and that the future of the contract would be reassessed at the end of 2006. At the end of 2006, smut was found in Mackay and the Herbert and smut was declared widespread and established. This allowed smut-screening facilities to be established in Bundaberg. It was decided to complete the two series of trials that were in progress in Indonesia but to terminate the contract after these two trials. The ISRI was informed of these decisions.

In recognition of the importance of the series of projects which have screened Australian varieties for resistance to sugarcane smut, Irawan the ISRI plant pathologist who supervised the trials was awarded the SRDC Service Award in 2008.

The completion of smut trial 11 marked the end of the 10-year collaboration with ISRI. All trials were successful in giving accurate smut resistance ratings for Australian clones. In recognition of the outstanding contribution of the ISRI to the Australian sugar industry, Barry Croft and Nils Berding made a presentation of a plaque to the ISRI during their visit to Indonesia in November 2008 (Figure 3).

Figure 3 **Presentation of a plaque to Dr Mirzawan, Acting Director of the ISRI, expressing the appreciation of the Australian sugar industry for the 10-year collaborative program conducted by ISRI**

3.3 Objectives 3 and 4: Screening parent clones for resistance to smut and make crosses between resistant parents and Screening selections from stage 2 of the BSES-CSIRO Plant Improvement Program for resistance to sugarcane smut in Indonesia

3.3.1 Introduction

This project conducted two smut-resistance screening trials in Indonesia. The trials included 690 clones selected from the final stages of the BSES/CSIRO selection programs, commercial varieties and parent clones.

3.3.2 Materials and methods

Plant material and trial design

The intention of this project was to send 500 clones selected for the final assessment trials (FATs) from the five BSES-CSIRO regional programs to Indonesia. The tentative selections from the FATs (200), based on plant crop results, were to be planted into a smut trial after 1 year of quarantine in Indonesia. Fifty clones comprising untested parents, Q varieties requiring a second rating and special-interest clones were to be tested each year. As mentioned above, after the finding of smut in Queensland the number of clones included in each trial was increased to 350.

The trials were given the code numbers 10 and 11 to continue the numbering system commenced in project BSS214 and BSS256. Clones from Fiji leaf gall-infested regions in Australia were quarantined in BSES' quarantine facilities in Brisbane for 1 year and screened for Fiji leaf gall with a PCR-DNA assay before dispatch to Indonesia. Clones from Fiji leaf gall-free regions were dispatched directly to Indonesia from BSES-CSIRO approved propagation plots. Three, 300-400 mm stalk pieces were shipped to Indonesia and were planted in the ISRI quarantine plot on Puteran Island (Figure 4). The clones were pre-germinated and planted into 3 m, single-row plots. The cane was regularly inspected for disease for 12 months. After the 1-year quarantine period, that also acted as a propagation phase, the clones were planted into the smut resistance trial at a site near Sumanep on Madura Island (Figure 4). This protocol was approved by the Indonesian Government quarantine authority.

Figure 4 Map of East Java, Madura and Puteran Islands

Trials 10 and 11 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 10 contained 352 test clones and 12 standards and was planted on 22-25 November 2006. Trial 11 contained 340 test clones and 12 standards and was planted on 14-17 November 2007. Plant crops were grown for 6 months and then ratooned, these being grown for a further 6 months.

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. Whips were collected from the field and the spores were removed by scraping the whips with a blunt knife. The resulting material was sieved and the spores dried in the sun. The spore viability was checked by germinating spores on water agar at 28°C overnight. Spores were used at 1 g/L of dipping solution to give a concentration of 5 x 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.

Rating

The number of stools per plot was recorded at monthly intervals after planting and the number of stools with smut whips was recorded from two months after planting. Stools were defined as the plant developing from a single bud. The trials were ratooned at six months and rating was continued monthly in the first ratoon crops.

Statistical analyses

Analyses of variance were conducted on the percent-infected plants for all trials. Standard clones/varieties 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. The standard ratings were based on the long-term reaction of standards in all trials. Ratings for the test clones were calculated from the regression equation for the log 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 3.

Table 3 Standard varieties, percent infection in trials 10 and 11, mean percent infection for all trials (1-11) and ratings based on the mean of all trials

Clone	% infected plants			Rating
	Trial		Mean trials 1-11	
	10	11		
PS79-82	12.7	10.2	10.86	1
Q171[ф]	11.4	23.5	11.72	1
PS87-10266	18.7	23.7	17.96	3
Q124	18.3	14.5	19.91	4
Q155	15.6	24.7	21.27	4
M442-51	31.1	23.4	34.69	6
PS80-442	28.1	20.3	33.98	6
PS84-16029	40.7	25.1	37.88	6
NCo310	53.2	49.5	47.32	8
Q117	76.4	57.6	67.57	9
Q170[ф]	47.2	50.3	42.53	9

3.3.3 Results

The development of smut symptoms in trials 10 and 11 was similar to the mean for trials 1-11 (Figure 5). Trial 11 developed slightly less disease than other trials. The average percent infection increased to 19% at the end of the plant crop in trial 10 and 13% in trial 11. At the end of the ratoon crop, the average infection was 45% in trial 10 and 33% in trial 11.

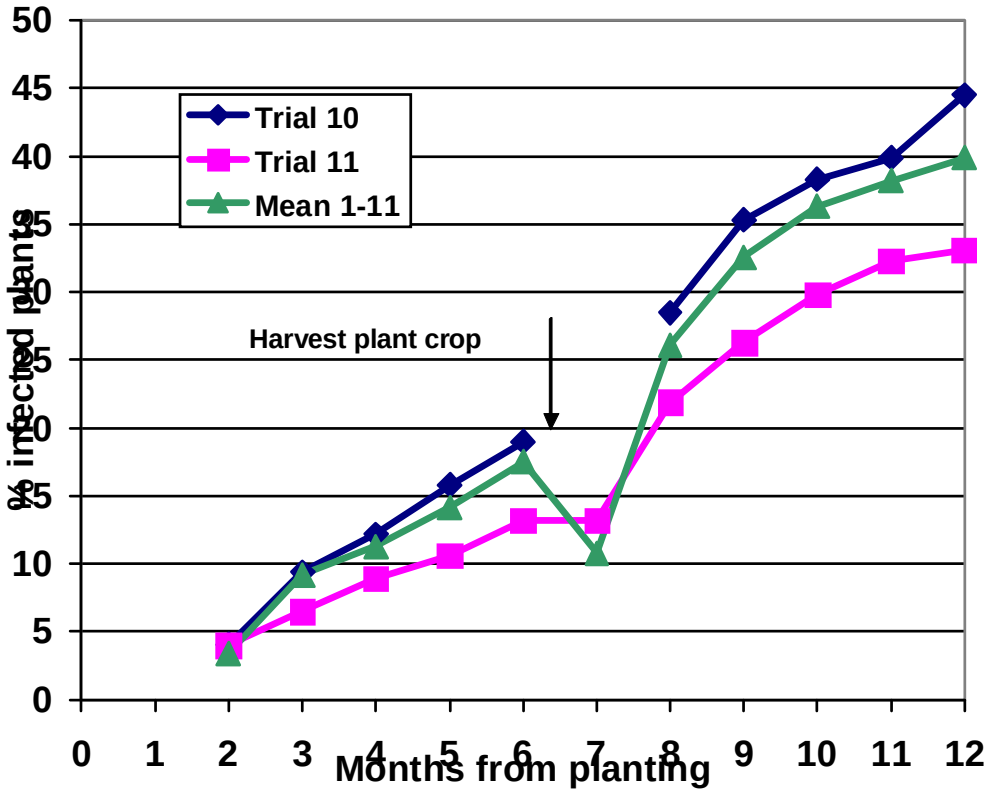

Figure 5 **Disease development in trials 10 and 11 (mean of all clones) and the mean for trials 1-11**

The correlation of the percent-infected plants of the standard varieties in trials 10 and 11 relative to the long term average from all trials is shown in Table 4 and the percent infection for the individual standards in the two trials are shown in Table 3. The correlations were both highly significant.

Table 4 **Correlation coefficients for the percent infection of standard varieties in trials 10 and 11 and the long-term average from all trials.**

Trial	Correlation coefficient (*r*)	No. varieties	P
10	0.95	12	<0.01
11	0.80	12	<0.01

We screened 695 clones including the 12 standards for smut resistance in trials 10 and 11. Some clones were repeated to provide a greater confidence in the rating. The percent infection at the end of the plant and ratoon crops and the ratings assigned to clones in trials 10 and 11 are shown in Appendix 1. The average ratings of the 695 clones are shown in Appendix 2.

The frequency distribution for the nine rating classes for trials 10 and 11 are shown in Figure 6. In trial 10, there were 10.5% resistant clones, 25% intermediate and 64.5% susceptible clones. Trial 11 had 25% resistant clones, 24% intermediate clones and 51% susceptible clones.

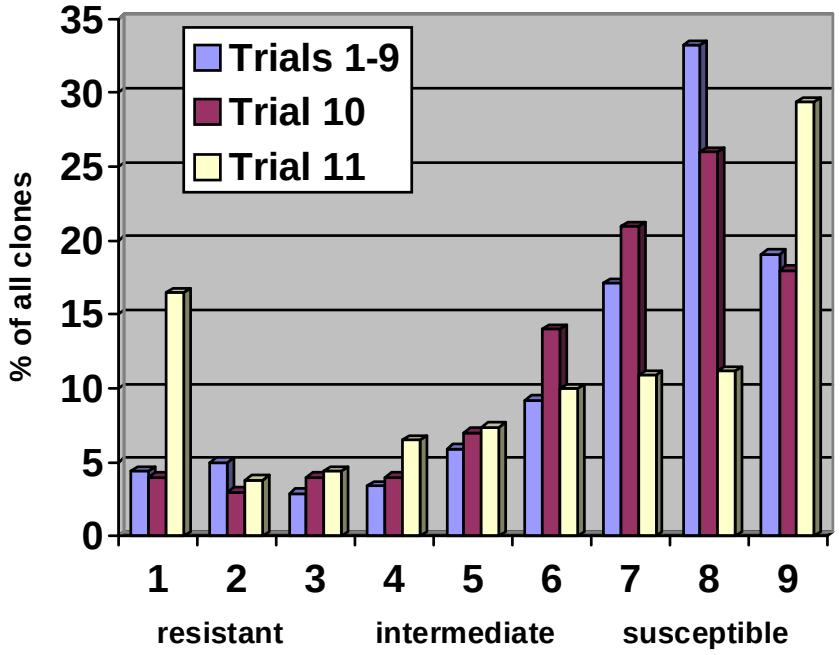

Figure 6 **Frequency distribution of smut resistance ratings[1] of clones in trials 1-6 (project BSS214 and BSS256, 1504 clones) and in trials 10-11 (project BSS265, 695 clones)**
[1]R ≤ 3; I = > 3.0 < 7.0; and S ≥ 7.0.

3.3.4 Discussion

The ratings of 695 clones screened in smut trials 10 and 11 have been stored in the BSES' Sugarcane Plant Improvement Database (SPIDNet). Growers have been advised of the ratings of commercial varieties in smut response plans, magazine articles, field days, BSES Limited's variety guides and via the web on QCANESelect™.

The smut-resistance ratings from this project and the previous projects (BSS214 and BSS256) have played a key role in the response to the incursion of sugarcane smut in Queensland. BSES has used the data extensively in selecting parent clones in the breeding program.

There has been a consistent trend toward higher levels of resistance in the populations screened during the 10-year period trials have been conducted in Indonesia. In the first six trials, the percentage of clones rated resistant or intermediate was 29%, in the next three trials the percentage was 36%, and in the last two trials the percentage was 42%.

The strategy for increasing the levels of smut resistance in selection populations has worked.

The susceptible varieties identified in these projects are showing the highest levels of smut in commercial fields. The knowledge of the resistance of varieties has allowed growers to move quickly to minimise direct losses from the smut epidemic.

Table 5 Commercial varieties that are rated intermediate (I = 3-6) or resistant (R = 1-3) to smut.

Smut rating	
Intermediate	**Resistant**
ARRIS	BN73-3416
MIDA(ф)	BN81-1394
Q119	CASSIUS
Q120	CP63-588
Q124	CP74-2005
Q130	KQ228(ф)
Q135	KQ236(ф)
Q142	MQ239
Q145	Q129
Q155	Q133
Q156	Q146
Q160	Q149
Q161	Q151
Q172(ф)	Q171(ф)
Q173(ф)	Q177(ф)
Q175(ф)	Q182(ф)
Q176(ф)	Q199(ф)
Q183(ф)	Q200(ф)
Q190(ф)	Q212(ф)
Q203(ф)	Q219(ф)
Q208(ф)	Q232(ф)
Q213(ф)	Q235(ф)
Q215(ф)	Q238
Q220(ф)	Q240
Q226(ф)	Q99
Q229(ф)	
Q230(ф)	
Q231(ф)	
Q233(ф)	
Q234(ф)	
Q237(ф)	
Q96	
QC75-326	
RB76-5418	
SP79-2313	

The results of this project and the previous smut-resistance screening projects will affect every farm in the Australian sugar industry. Already, almost all growers have selected smut-resistant or intermediate varieties to propagate on their farm. The Burdekin region has less than 20% of their crop planted to susceptible varieties in 2009 and the Bundaberg/Isis region has moved from 80% susceptible to below 50% susceptible varieties since 2006. The Bundaberg/Isis, Central and Herbert regions have removed all susceptible varieties from the lists of varieties approved for planting in these regions. The proportion of the crop planted to smut-resistant or intermediate varieties will increase significantly in all regions in the next few years and we estimate that susceptible varieties will be completely replaced or reduced to a low percentage of the crop by 2014. This rate of variety replacement is close to that proposed in the smut emergency response plans formulated in 2006.

The resistant and intermediate approved varieties available in Queensland and New South Wales are listed in table 5. Six new smut resistant commercial varieties; Q235$^{\Phi}$, KQ236$^{\Phi}$, Q237$^{\Phi}$, Q238, MQ239 and Q240, were released to growers in 2008 and 2009 based on their smut resistance identified in these trials.

4.0 INTELLECTUAL PROPERTY

Most of the sugarcane varieties and clones used in this project are the property of BSES. Many of the commercial varieties are protected by PBR rights under Australian legislation.

Use of the smut-resistance ratings in this report in any other research project should acknowledge the source of the ratings and the authors of this report.

5.0 ENVIRONMENTAL AND SOCIAL IMPACTS

This project will have significant social benefits to regional communities in eastern Australia which rely on the sugar industry. The finding of sugarcane smut in Queensland in 2006 could have resulted in a dramatic reduction in yields and major disruption to regional communities. The information and varieties identified by these projects have minimised this impact.

An orderly transition from smut-susceptible to smut-resistant varieties will reduce the need for premature plough out of infected fields and will, therefore, benefit the environment by reducing the soil degradation associated with increased cultivation.

6.0 OUTPUTS

The major output from this project is the smut-resistance ratings which have been entered into the BSES' Sugarcane Plant Improvement Database (SPIDNet). These data are

available to all BSES staff and the BSES-CSIRO joint venture. The smut-resistance ratings of commercial varieties have played a key role in the response to the sugarcane smut incursion in Queensland. Growers have been advised of these ratings in the *BSES Bulletin*, newsletters, variety guides, and numerous communications from BSES, productivity groups, and industry organisations and on the web via QCANESelect™. The data have been used extensively for decisions on selection of clones in the BSES-CSIRO selection programs and for making crosses in the breeding program. Extension and variety officers have used the data when preparing newsletters, extension material and variety guides and when providing advice to growers. BSES-CSIRO research staff have used the data in research on DNA markers for smut resistance. The data contained in SPIDNet are a valuable resource that will assist the Australian sugar industry manage the sugarcane smut epidemic.

Publications and extension material produced from the project are listed below.

7.0 EXPECTED OUTCOMES

The smut resistance ratings provided by this and the two early smut-resistance screening projects will be adopted by greater than 90% of growers in Queensland and New South Wales over the next 5 years. Already the Bundaberg/Isis, Central and Herbert regions have used the ratings to remove all smut-susceptible varieties from their lists of approved varieties. This will mean that all growers in these regions can only plant the smut-resistant or intermediate varieties identified by this project. Other regions are expected to make similar decisions in coming years. Smut has spread rapidly in the Bundaberg/Isis, Central and Herbert regions and growers have commenced to plough out any field with high levels of disease. The smut emergency response plans formulated in each region using the ratings from these projects will minimise the direct impacts of smut losses.

Highly productive smut resistant varieties have been identified by these projects and these varieties have been widely planted by growers. The smut intermediate to resistant variety Q208$^{\phi}$ has shown wide adaptability and excellent yield and sugar content. Q208$^{\phi}$ will be the major variety harvested in 2009 and will continue to increase in popularity in coming years. Other popular smut resistant varieties that have shown good productivity are Q200$^{\phi}$ and KQ228$^{\phi}$. A number of new smut resistant or intermediate varieties have been released in the last few years, including Q232$^{\phi}$, Q235$^{\phi}$, KQ236$^{\phi}$, Q237$^{\phi}$, Q238, MQ239 and Q240.

BSES-CSIRO are using the ratings obtained from these projects extensively in decisions on advancement of varieties in the selection program and on crosses in the breeding program. Breeding for smut resistance commenced in 2002 and the crosses made from smut resistant parents will provide the new varieties for the future. There has been a consistent trend in increasing levels of smut resistance in clones screened over the 10 years of the smut-screening trials in Indonesia. This trend will increase in coming years as the enhanced smut-breeding strategy that commenced after smut arrived in Queensland will provide the clones for the BSES-CSIRO selection programs.

The experience gained by staff in conducting smut-resistance screening trials in Indonesia has allowed BSES-CSIRO to rapidly establish smut-screening trials in Bundaberg. These trials will greatly increase the efficiency of screening for smut resistance in the future.

The excellent cooperation with the ISRI has been acknowledged by presentation of the SRDC Service Award for 2008 to Irawan, ISRI pathologist.

8.0 FUTURE NEEDS AND RECOMMENDATIONS

1. 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.

2. Screen original seedlings from crosses between high-value but smut susceptible parents and select any resistant progeny to combine the genes for high yield and smut resistance.

3. Conduct field surveys and experiments to determine the rate of natural infection in commercial varieties to ensure that the resistance ratings obtained from this project are correlated with field reaction under the various environmental conditions in the Australian sugar industry.

4. Develop extension and communication programs to assist growers to change to smut-resistant varieties while maintaining productivity and managing risks from other pests and diseases.

9.0 EXTENSION MESSAGE

Sugarcane smut is spreading rapidly throughout Queensland and has now been found in all cane-growing regions north of Brisbane. Smut is particularly bad in the highly smut susceptible varieties such as Q117, Q166$^{\Phi}$, Q157, Q158, Q174$^{\Phi}$ and Q205$^{\Phi}$. These smut susceptible varieties were identified by BSES during a SRDC-funded smut-screening project in Indonesia. Smut is a serious disease that can cause complete crop loss in highly susceptible varieties. The disease causes severe stunting, thin grassy shoots and a whip-like structure is formed from the heart of the stalk. The Australian sugar industry was well prepared for the smut incursion because BSES with funding from SRDC had a contingency plan and had already identified some high yielding smut resistant varieties.

The highly productive smut resistant to intermediate varieties Q200$^{\Phi}$, Q208$^{\Phi}$, KQ228$^{\Phi}$, Q232$^{\Phi}$ Q235$^{\Phi}$, KQ236$^{\Phi}$, Q237$^{\Phi}$, Q238, MQ239, and Q240 are being widely adopted by growers and in most regions and these new smut resistant varieties will replace the smut susceptible varieties within a few years.

A large new program has been commenced by BSES-CSIRO with funding from SRDC and QDPI&F to expand on the effort for breeding smut resistant sugarcane varieties. This

new program is known as SmutBuster and the funding from the three groups is in excess of $6 m over 3 years. SmutBuster aims to recover the genes for high yield and CCS and transfer them to smut resistant varieties through conventional breeding. The combined efforts of the work conducted in Indonesia and the new SmutBuster program should see the sugar industry smoothly transition to smut resistant varieties over the next 3-5 years.

Growers who want assistance with developing a plan to transition to smut resistant varieties should contact their local BSES extension officer or visit the new QCANESelect™ web (www.bses.org.au/QCANESelect). QCANESelect™ is a web-based decision support tool for varieties that has been developed by BSES with SRDC support. It provides live up-to-date information on varieties and allows growers to obtain specific recommendations for individual blocks or for their whole farm. The system is interactive and growers can select the soil type and specific issues that affect their blocks and set their own risk management rules so they can get the best mix of varieties for their farm.

10.0 PUBLICATIONS

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APPENDIX 1 - Results for all clones entered in smut trials 7-9, sorted by clone and by trial.

Sorted by clone:

Clone	% smut plant	% smut ratoon	Rating	Trial
CL73-239	6.8	36.6	6	SM10
CL73-792	22.2	39.0	7	SM10
CP70-1547	28.3	54.5	8	SM10
IJ76-514	34.3	33.4	6	SM10
KQ02-1244	15.8	26.1	5	SM11
KQ02-1847	13.2	28.3	6	SM11
KQ02-2026	0.0	26.1	5	SM11
KQ02-2083	5.5	35.7	7	SM11
KQ02-2093	8.3	34.4	7	SM11
KQ02-2114	10.9	36.0	7	SM11
KQ02-2178	30.4	64.4	9	SM11
KQ97-4514	8.6	36.0	6	SM10
KQ97-5020	19.0	48.1	7	SM10
KQ97-5020	11.9	34.4	6	SM10
KQ97-8438	32.5	63.8	9	SM10
KQ97-8438	34.4	51.8	8	SM10
KQ97-9300	8.4	39.6	7	SM10
KQ98-416	25.6	41.1	7	SM10
KQ98-604	1.3	5.0	1	SM10
KQ99-2751	9.8	26.8	5	SM11
M442-51	6.1	31.1	6	SM10
M442-51	11.2	23.4	4	SM11
MQ82-558	1.7	18.4	3	SM11
MQ93-356	11.8	48.6	7	SM10
MQ94-156	40.3	66.0	9	SM10
MQ94-266	18.7	31.3	6	SM10
MQ94-435	15.5	40.3	7	SM10
MQ96-1033	30.9	70.6	9	SM10
MQ96-25	1.3	3.5	1	SM11
MQ96-675	20.9	57.1	8	SM10
MQ96-687	14.8	31.8	6	SM10
MQ96-810	4.2	17.3	3	SM10
N14	19.6	53.4	8	SM10
NCo310	25.6	53.2	8	SM10
NCo310	20.5	49.5	9	SM11
PS01-121	0.0	0.0	1	SM11
PS79-82	1.8	12.7	2	SM10
PS79-82	0.0	10.2	1	SM11
PS80-442	12.7	28.1	5	SM10
PS80-442	7.5	20.3	3	SM11
PS84-16029	23.7	40.7	7	SM10
PS84-16029	18.4	25.1	5	SM11
PS87-10266	0.0	18.7	3	SM10
PS87-10266	3.8	23.7	4	SM11
PS97-545	2.5	35.9	7	SM11
PS98-118	7.3	22.5	4	SM11
PS98-126	0.0	2.8	1	SM11
PS98-136	0.0	0.0	1	SM11
PS98-140	0.0	0.0	1	SM11
Q117	53.6	76.5	9	SM10

Sorted by trial:

Clone	% smut plant	% smut ratoon	Rating	Trial
CL73-239	6.8	36.6	6	SM10
CL73-792	22.2	39.0	7	SM10
CP70-1547	28.3	54.5	8	SM10
IJ76-514	34.3	33.4	6	SM10
KQ97-4514	8.6	36.0	6	SM10
KQ97-5020	19.0	48.1	7	SM10
KQ97-5020	11.9	34.4	6	SM10
KQ97-8438	32.5	63.8	9	SM10
KQ97-8438	34.4	51.8	8	SM10
KQ97-9300	8.4	39.6	7	SM10
KQ98-416	25.6	41.1	7	SM10
KQ98-604	1.3	5.0	1	SM10
M442-51	6.1	31.1	6	SM10
MQ93-356	11.8	48.6	7	SM10
MQ94-156	40.3	66.0	9	SM10
MQ94-266	18.7	31.3	6	SM10
MQ94-435	15.5	40.3	7	SM10
MQ96-1033	30.9	70.6	9	SM10
MQ96-675	20.9	57.1	8	SM10
MQ96-687	14.8	31.8	6	SM10
MQ96-810	4.2	17.3	3	SM10
N14	19.6	53.4	8	SM10
NCo310	25.6	53.2	8	SM10
PS79-82	1.8	12.7	2	SM10
PS80-442	12.7	28.1	5	SM10
PS84-16029	23.7	40.7	7	SM10
PS87-10266	0.0	18.7	3	SM10
Q117	53.6	76.5	9	SM10
Q124	1.4	18.3	3	SM10
Q155	5.0	15.6	3	SM10
Q170	31.0	47.2	7	SM10
Q171	6.4	11.4	1	SM10
Q96	6.2	28.8	5	SM10
QA00-1013	2.5	63.6	9	SM10
QA00-1015	21.5	59.7	8	SM10
QA00-1056	7.8	49.8	8	SM10
QA00-1057	48.8	84.3	9	SM10
QA00-1070	6.7	57.5	8	SM10
QA00-1130	16.5	40.3	7	SM10
QA00-2015	52.7	78.3	9	SM10
QA00-2021	10.2	71.8	9	SM10
QA00-2105	11.8	44.7	7	SM10
QA00-2123	17.9	62.7	9	SM10
QA00-2137	11.1	36.9	6	SM10
QA00-2182	7.2	29.3	5	SM10
QA00-2264	42.4	65.2	9	SM10
QA00-2283	36.6	64.9	9	SM10
QA00-2306	27.8	40.0	7	SM10
QA00-2335	8.6	46.9	7	SM10
QA00-2367	37.4	59.9	8	SM10

Q117	25.6	57.6	9	SM11
Q124	1.4	18.3	3	SM10
Q124	7.5	14.5	1	SM11
Q155	5.0	15.6	3	SM10
Q155	3.6	24.7	5	SM11
Q170	31.0	47.2	7	SM10
Q170	20.3	50.3	9	SM11
Q171	6.4	11.4	1	SM10
Q171	7.4	23.5	4	SM11
Q233	18.4	34.2	7	SM11
Q237	1.3	19.8	3	SM11
Q96	6.2	28.8	5	SM10
Q96	5.4	30.8	6	SM11
QA00-1013	2.5	63.6	9	SM10
QA00-1015	21.5	59.7	8	SM10
QA00-1056	7.8	49.8	8	SM10
QA00-1057	48.8	84.3	9	SM10
QA00-1070	6.7	57.5	8	SM10
QA00-1130	16.5	40.3	7	SM10
QA00-2015	52.7	78.3	9	SM10
QA00-2021	10.2	71.8	9	SM10
QA00-2105	11.8	44.7	7	SM10
QA00-2123	17.9	62.7	9	SM10
QA00-2137	11.1	36.9	6	SM10
QA00-2182	7.2	29.3	5	SM10
QA00-2264	42.4	65.2	9	SM10
QA00-2283	36.6	64.9	9	SM10
QA00-2306	27.8	40.0	7	SM10
QA00-2335	8.6	46.9	7	SM10
QA00-2367	37.4	59.9	8	SM10
QA00-2408	7.5	49.4	8	SM10
QA00-2409	26.0	58.0	8	SM10
QA00-2414	21.9	60.2	8	SM10
QA00-2433	17.1	49.0	8	SM10
QA00-2540	22.1	47.8	7	SM10
QA00-2607	11.5	32.9	6	SM10
QA00-2650	6.7	39.6	7	SM10
QA00-2663	50.1	72.1	9	SM10
QA00-2718	36.4	65.4	9	SM10
QA00-2803	35.9	52.7	8	SM10
QA00-2908	14.1	38.9	7	SM10
QA00-2933	15.6	40.3	7	SM10
QA00-2973	13.2	32.5	6	SM10
QA00-3093	6.9	33.4	6	SM10
QA00-3203	9.2	51.0	8	SM10
QA00-3207	10.2	57.8	8	SM10
QA00-4066	0.0	19.2	3	SM10
QA00-6015	28.7	43.3	7	SM10
QA00-6095	33.2	70.3	9	SM10
QA00-6136	15.4	35.7	6	SM10
QA00-6139	12.1	54.3	8	SM10
QA00-6178	24.2	55.2	8	SM10
QA00-6184	21.0	63.5	9	SM10
QA00-6207	20.9	38.6	6	SM10
QA00-6226	10.8	39.5	7	SM10
QA00-6235	25.6	35.7	6	SM10
QA00-6353	14.0	68.0	9	SM10

QA00-2408	7.5	49.4	8	SM10
QA00-2409	26.0	58.0	8	SM10
QA00-2414	21.9	60.2	8	SM10
QA00-2433	17.1	49.0	8	SM10
QA00-2540	22.1	47.8	7	SM10
QA00-2607	11.5	32.9	6	SM10
QA00-2650	6.7	39.6	7	SM10
QA00-2663	50.1	72.1	9	SM10
QA00-2718	36.4	65.4	9	SM10
QA00-2803	35.9	52.7	8	SM10
QA00-2908	14.1	38.9	7	SM10
QA00-2933	15.6	40.3	7	SM10
QA00-2973	13.2	32.5	6	SM10
QA00-3093	6.9	33.4	6	SM10
QA00-3203	9.2	51.0	8	SM10
QA00-3207	10.2	57.8	8	SM10
QA00-4066	0.0	19.2	3	SM10
QA00-6015	28.7	43.3	7	SM10
QA00-6095	33.2	70.3	9	SM10
QA00-6136	15.4	35.7	6	SM10
QA00-6139	12.1	54.3	8	SM10
QA00-6178	24.2	55.2	8	SM10
QA00-6184	21.0	63.5	9	SM10
QA00-6207	20.9	38.6	6	SM10
QA00-6226	10.8	39.5	7	SM10
QA00-6235	25.6	35.7	6	SM10
QA00-6353	14.0	68.0	9	SM10
QA00-6355	14.4	32.3	6	SM10
QA00-6386	9.0	52.9	8	SM10
QA00-6402	3.8	32.1	6	SM10
QA00-6405	13.9	61.3	9	SM10
QA00-6469	38.1	80.8	9	SM10
QA00-6472	27.4	73.4	9	SM10
QA00-6499	40.7	72.7	9	SM10
QA00-6521	14.0	22.6	4	SM10
QA00-6579	14.4	49.9	8	SM10
QA00-6625	5.8	27.4	5	SM10
QA00-6718	22.2	77.5	9	SM10
QA00-6810	31.3	62.2	9	SM10
QA00-6814	14.0	45.4	7	SM10
QA00-6817	16.7	42.9	7	SM10
QA00-6822	50.5	71.5	9	SM10
QA00-6844	7.6	34.3	6	SM10
QA00-6849	18.3	89.9	9	SM10
QA00-6860	3.9	14.1	2	SM10
QA00-6876	4.9	16.9	3	SM10
QA00-6887	17.9	27.3	5	SM10
QA93-1780	25.3	58.9	8	SM10
QA94-6128	22.0	56.5	8	SM10
QA94-6257	7.9	42.8	7	SM10
QA96-1340	28.1	72.4	9	SM10
QA96-1492	15.4	55.4	8	SM10
QA96-1749	9.3	34.9	6	SM10
QA97-1580	11.6	26.7	5	SM10
QA97-3235	26.8	62.9	9	SM10
QA97-3379	10.9	32.3	6	SM10
QA98-6169	3.1	14.7	2	SM10

QA00-6355	14.4	32.3	6	SM10
QA00-6386	9.0	52.9	8	SM10
QA00-6402	3.8	32.1	6	SM10
QA00-6405	13.9	61.3	9	SM10
QA00-6469	38.1	80.8	9	SM10
QA00-6472	27.4	73.4	9	SM10
QA00-6499	40.7	72.7	9	SM10
QA00-6521	14.0	22.6	4	SM10
QA00-6579	14.4	49.9	8	SM10
QA00-6625	5.8	27.4	5	SM10
QA00-6718	22.2	77.5	9	SM10
QA00-6810	31.3	62.2	9	SM10
QA00-6814	14.0	45.4	7	SM10
QA00-6817	16.7	42.9	7	SM10
QA00-6822	50.5	71.5	9	SM10
QA00-6844	7.6	34.3	6	SM10
QA00-6849	18.3	89.9	9	SM10
QA00-6860	3.9	14.1	2	SM10
QA00-6876	4.9	16.9	3	SM10
QA00-6887	17.9	27.3	5	SM10
QA01-1011	5.0	18.2	3	SM11
QA01-1062	0.0	7.4	1	SM11
QA01-1103	13.4	38.0	8	SM11
QA01-2059	2.5	6.7	1	SM11
QA01-2133	0.0	3.8	1	SM11
QA01-2156	0.0	12.5	1	SM11
QA01-2358	28.8	50.6	9	SM11
QA01-2421	13.4	38.1	8	SM11
QA01-2580	8.5	44.2	9	SM11
QA01-2602	14.8	31.6	6	SM11
QA01-2603	14.3	29.9	6	SM11
QA01-2701	15.6	25.4	5	SM11
QA01-2707	7.5	46.0	9	SM11
QA01-2738	0.0	2.1	1	SM11
QA01-2863	9.5	19.8	3	SM11
QA01-5037	20.7	52.0	9	SM11
QA01-5151	0.0	3.8	1	SM11
QA01-5153	0.0	10.0	1	SM11
QA01-5204	27.2	46.2	9	SM11
QA01-5228	25.5	53.8	9	SM11
QA01-5267	2.6	29.4	6	SM11
QA01-6035	21.3	43.1	8	SM11
QA01-6050	19.4	37.5	8	SM11
QA01-6087	36.6	66.1	9	SM11
QA01-6141	0.0	25.0	5	SM11
QA01-6287	30.3	71.0	9	SM11
QA01-6361	21.1	18.9	3	SM11
QA01-6442	4.6	40.9	8	SM11
QA01-6585	3.6	5.4	1	SM11
QA01-6654	19.9	40.5	8	SM11
QA01-6730	1.9	14.5	1	SM11
QA01-6773	42.1	58.6	9	SM11
QA01-6829	2.1	7.6	1	SM11
QA01-6918	10.7	29.5	6	SM11
QA01-7059	18.2	43.2	8	SM11
QA86-855	9.8	34.6	7	SM11
QA86-979	6.7	13.0	1	SM11

QA98-6189	7.8	49.0	8	SM10
QA98-6353	3.8	27.5	5	SM10
QA99-1032	25.6	32.5	6	SM10
QA99-1046	23.6	37.3	6	SM10
QA99-1338	26.6	48.5	7	SM10
QA99-1690	24.8	56.6	8	SM10
QA99-1714	1.3	19.1	3	SM10
QA99-1815	0.0	2.3	1	SM10
QA99-1903	22.5	54.8	8	SM10
QC00-1020	33.6	65.2	9	SM10
QC00-1043	11.1	51.2	8	SM10
QC00-1149	35.8	56.4	8	SM10
QC00-1151	32.9	47.6	7	SM10
QC00-1168	27.3	39.5	7	SM10
QC00-1201	7.1	39.6	7	SM10
QC00-1299	26.6	57.0	8	SM10
QC00-1369	31.8	43.7	7	SM10
QC00-1374	17.4	45.0	7	SM10
QC00-1400	35.6	47.3	7	SM10
QC00-1415	37.4	60.8	8	SM10
QC00-1436	25.2	47.7	7	SM10
QC00-1452	10.4	8.5	1	SM10
QC00-1463	19.7	36.8	6	SM10
QC00-1464	26.0	50.4	8	SM10
QC00-1557	7.7	45.2	7	SM10
QC00-1569	27.6	50.9	8	SM10
QC00-1570	10.6	51.3	8	SM10
QC00-1572	3.3	29.3	5	SM10
QC00-1573	0.0	13.0	2	SM10
QC00-1585	14.0	46.0	7	SM10
QC00-1632	22.5	34.8	6	SM10
QC00-1644	44.0	63.0	9	SM10
QC00-1651	20.8	35.4	6	SM10
QC00-1659	32.2	47.5	7	SM10
QC00-1668	13.6	31.5	6	SM10
QC00-1693	27.5	65.4	9	SM10
QC00-1714	27.1	49.4	8	SM10
QC00-1716	39.5	73.1	9	SM10
QC00-1789	19.5	42.6	7	SM10
QC00-1794	21.7	49.3	8	SM10
QC00-1817	14.4	57.1	8	SM10
QC00-1823	15.0	66.5	9	SM10
QC00-6230	31.6	69.4	9	SM10
QC00-6294	0.0	6.9	1	SM10
QC00-6375	29.6	50.0	8	SM10
QC00-6376	15.0	31.5	6	SM10
QC00-6500	41.3	53.1	8	SM10
QC00-6621	9.6	29.3	5	SM10
QC00-6632	20.6	46.5	7	SM10
QC00-6686	23.8	55.4	8	SM10
QC00-6760	7.3	26.6	5	SM10
QC00-6761	10.1	35.7	6	SM10
QC00-6764	14.6	39.8	7	SM10
QC00-6803	1.4	20.5	4	SM10
QC00-6859	36.2	58.2	8	SM10
QC00-919	52.7	75.0	9	SM10
QC00-921	24.2	61.1	8	SM10

QA87-1622	26.3	72.9	9	SM11
QA92-1880	7.0	18.3	3	SM11
QA93-1780	25.3	58.9	8	SM10
QA94-6003	8.5	48.2	9	SM11
QA94-6128	22.0	56.5	8	SM10
QA94-6128	9.5	21.9	4	SM11
QA94-6257	7.9	42.8	7	SM10
QA95-2182	14.7	24.7	5	SM11
QA96-1333	27.8	45.4	9	SM11
QA96-1340	28.1	72.4	9	SM10
QA96-1492	15.4	55.4	8	SM10
QA96-1749	9.3	34.9	6	SM10
QA96-1749	0.0	10.6	1	SM11
QA97-1026	21.5	62.9	9	SM11
QA97-1031	4.5	21.4	4	SM11
QA97-1578	9.5	43.5	9	SM11
QA97-1580	11.6	26.7	5	SM10
QA97-3235	26.8	62.9	9	SM10
QA97-3298	1.5	12.0	1	SM11
QA97-3379	10.9	32.3	6	SM10
QA97-6102	16.5	17.6	2	SM11
QA97-6146	34.6	62.6	9	SM11
QA98-1055	12.5	33.0	7	SM11
QA98-1221	19.5	40.5	8	SM11
QA98-6169	3.1	14.7	2	SM10
QA98-6189	7.8	49.0	8	SM10
QA98-6353	3.8	27.5	5	SM10
QA99-1032	25.6	32.5	6	SM10
QA99-1046	23.6	37.3	6	SM10
QA99-1338	26.6	48.5	7	SM10
QA99-1549	8.3	30.7	6	SM11
QA99-1690	24.8	56.6	8	SM10
QA99-1714	1.3	19.1	3	SM10
QA99-1815	0.0	2.3	1	SM10
QA99-1903	22.5	54.8	8	SM10
QA99-2163	47.2	74.0	9	SM11
QA99-6178	26.1	29.6	6	SM11
QC00-1020	33.6	65.2	9	SM10
QC00-1043	11.1	51.2	8	SM10
QC00-1149	35.8	56.4	8	SM10
QC00-1151	32.9	47.6	7	SM10
QC00-1168	27.3	39.5	7	SM10
QC00-1201	7.1	39.6	7	SM10
QC00-1299	26.6	57.0	8	SM10
QC00-1327	21.9	29.6	6	SM11
QC00-1369	31.8	43.7	7	SM10
QC00-1374	17.4	45.0	7	SM10
QC00-1400	35.6	47.3	7	SM10
QC00-1413	6.1	45.1	9	SM11
QC00-1415	37.4	60.8	8	SM10
QC00-1436	25.2	47.7	7	SM10
QC00-1452	10.4	8.5	1	SM10
QC00-1463	19.7	36.8	6	SM10
QC00-1464	26.0	50.4	8	SM10
QC00-1520	12.8	16.9	2	SM11
QC00-1557	7.7	45.2	7	SM10
QC00-1569	27.6	50.9	8	SM10

QC00-926	29.8	65.3	9	SM10
QC00-956	18.5	45.5	7	SM10
QC82-693	0.0	7.6	1	SM10
QC93-1140	23.7	65.0	9	SM10
QC93-1952	32.0	82.3	9	SM10
QC93-724	45.1	76.3	9	SM10
QC93-896	29.3	45.2	7	SM10
QC93-993	13.5	55.6	8	SM10
QC97-2372	25.6	41.7	7	SM10
QC97-2432	11.6	28.1	5	SM10
QC97-2469	30.1	69.6	9	SM10
QC98-2203	12.5	28.5	5	SM10
QC98-3314	34.6	62.1	9	SM10
QC98-363	4.7	22.5	4	SM10
QC98-6109	32.3	61.7	9	SM10
QH00-6055	27.7	48.0	7	SM10
QH00-6144	0.0	2.3	1	SM10
QH00-6177	9.8	32.6	6	SM10
QH00-6178	3.1	27.8	5	SM10
QH00-6238	37.1	76.5	9	SM10
QH00-6295	26.1	51.2	8	SM10
QH00-6315	18.5	42.0	7	SM10
QH00-6319	9.5	36.2	6	SM10
QH00-6403	49.8	82.3	9	SM10
QH00-6425	7.3	24.0	4	SM10
QH00-6449	14.5	39.5	7	SM10
QH00-6469	9.7	22.8	4	SM10
QH00-6480	8.4	46.9	7	SM10
QH89-108	12.6	56.5	8	SM10
QH89-264	5.8	53.5	8	SM10
QH94-2458	30.8	64.0	9	SM10
QH98-6030	21.8	67.3	9	SM10
QH98-6057	33.3	56.1	8	SM10
QH98-6062	34.0	48.4	7	SM10
QH98-6065	31.2	38.1	6	SM10
QH98-6094	36.4	67.8	9	SM10
QH98-6095	25.0	61.3	9	SM10
QH98-6107	27.0	51.2	8	SM10
QH98-6112	0.0	25.8	5	SM10
QH98-6143	5.4	42.1	7	SM10
QH98-6145	41.1	75.0	9	SM10
QH98-6176	4.9	15.4	2	SM10
QH98-6183	12.4	26.5	5	SM10
QH99-4003	6.0	20.0	4	SM10
QH99-4425	6.4	31.4	6	SM10
QH99-4508	4.5	17.5	3	SM10
QH99-4700	6.2	36.0	6	SM10
QH99-4719	0.0	9.1	1	SM10
QH99-4798	14.3	37.3	6	SM10
QH99-4832	0.0	11.3	1	SM10
QH99-5070	17.1	42.3	7	SM10
QH99-5211	28.6	9.7	1	SM10
QH99-5250	21.4	72.8	9	SM10
QH99-5281	9.9	46.8	7	SM10
QH99-6015	11.3	40.9	7	SM10
QH99-6018	9.2	35.2	6	SM10
QH99-6038	0.0	17.4	3	SM10

QC00-1570	10.6	51.3	8	SM10
QC00-1572	3.3	29.3	5	SM10
QC00-1573	0.0	13.0	2	SM10
QC00-1578	10.5	27.2	5	SM11
QC00-1585	14.0	46.0	7	SM10
QC00-1632	22.5	34.8	6	SM10
QC00-1644	44.0	63.0	9	SM10
QC00-1651	20.8	35.4	6	SM10
QC00-1659	32.2	47.5	7	SM10
QC00-1668	13.6	31.5	6	SM10
QC00-1693	27.5	65.4	9	SM10
QC00-1714	27.1	49.4	8	SM10
QC00-1716	39.5	73.1	9	SM10
QC00-1789	19.5	42.6	7	SM10
QC00-1794	21.7	49.3	8	SM10
QC00-1817	14.4	57.1	8	SM10
QC00-1823	15.0	66.5	9	SM10
QC00-6012	5.9	12.0	1	SM11
QC00-6210	17.2	51.3	9	SM11
QC00-6227	15.7	35.0	7	SM11
QC00-6230	31.6	69.4	9	SM10
QC00-6294	0.0	6.9	1	SM10
QC00-6297	23.1	45.8	9	SM11
QC00-6375	29.6	50.0	8	SM10
QC00-6376	15.0	31.5	6	SM10
QC00-6382	7.4	21.0	4	SM11
QC00-6413	20.6	30.4	6	SM11
QC00-6461	4.5	31.3	6	SM11
QC00-6475	19.6	51.9	9	SM11
QC00-6500	41.3	53.1	8	SM10
QC00-6559	19.8	36.0	7	SM11
QC00-6588	13.2	51.8	9	SM11
QC00-6604	13.2	51.0	9	SM11
QC00-6621	9.6	29.3	5	SM10
QC00-6632	20.6	46.5	7	SM10
QC00-6667	20.2	29.8	6	SM11
QC00-6686	23.8	55.4	8	SM10
QC00-6718	3.9	23.6	4	SM11
QC00-6719	1.6	9.8	1	SM11
QC00-6760	7.3	26.6	5	SM10
QC00-6761	10.1	35.7	6	SM10
QC00-6764	14.6	39.8	7	SM10
QC00-6803	1.4	20.5	4	SM10
QC00-6859	36.2	58.2	8	SM10
QC00-876	0.0	4.4	1	SM11
QC00-919	52.7	75.0	9	SM10
QC00-921	24.2	61.1	8	SM10
QC00-926	29.8	65.3	9	SM10
QC00-956	18.5	45.5	7	SM10
QC00-958	3.2	15.2	1	SM11
QC81-337	7.0	34.7	7	SM11
QC82-693	0.0	7.6	1	SM10
QC89-748	6.1	31.6	6	SM11
QC93-1140	23.7	65.0	9	SM10
QC93-1952	32.0	82.3	9	SM10
QC93-6003	12.9	35.7	7	SM11
QC93-724	45.1	76.3	9	SM10

QH99-6064	21.8	27.6	5	SM10
QH99-6085	55.1	60.7	8	SM10
QH99-6101	7.7	36.7	6	SM10
QH99-6109	9.2	21.2	4	SM10
QH99-6130	5.0	49.1	8	SM10
QH99-6134	18.5	63.1	9	SM10
QN80-605	1.3	5.7	1	SM10
QN83-1175	19.9	60.8	8	SM10
QN89-1043	7.3	40.3	7	SM10
QN91-274	31.6	49.8	8	SM10
QN91-2967	29.5	36.6	6	SM10
QN95-289	15.3	53.4	8	SM10
QN96-1232	39.5	91.7	9	SM10
QN96-1418	42.5	55.4	8	SM10
QN96-1771	23.5	49.9	8	SM10
QN97-1022	11.9	53.8	8	SM10
QN97-1168	8.5	22.4	4	SM10
QN97-1229	20.7	58.8	8	SM10
QN97-123	5.6	15.4	2	SM10
QN97-1881	38.5	41.4	7	SM10
QN97-1972	24.9	51.0	8	SM10
QN97-2024	5.8	65.6	9	SM10
QN97-2122	22.6	72.4	9	SM10
QN97-2170	5.0	27.9	5	SM10
QN97-2173	13.8	43.8	7	SM10
QN97-23	5.6	25.8	5	SM10
QN97-2353	3.3	12.5	2	SM10
QN97-2468	15.3	58.9	8	SM10
QN97-315	7.9	25.1	5	SM10
QN97-387	36.3	48.9	8	SM10
QN97-599	34.6	57.7	8	SM10
QN97-633	19.3	29.0	5	SM10
QN99-1065	23.2	55.2	8	SM10
QN99-1108	7.4	41.6	7	SM10
QN99-1111	15.3	32.3	6	SM10
QN99-1146	13.7	26.0	5	SM10
QN99-1209	29.1	67.0	9	SM10
QN99-1258	20.2	44.2	7	SM10
QN99-1292	3.3	19.9	4	SM10
QN99-1350	44.8	69.2	9	SM10
QN99-145	15.0	32.0	6	SM10
QN99-1514	5.1	25.0	5	SM10
QN99-1563	5.0	47.5	7	SM10
QN99-1592	26.4	60.3	8	SM10
QN99-1593	35.6	53.8	8	SM10
QN99-1632	16.0	28.7	5	SM10
QN99-1633	8.7	52.8	8	SM10
QN99-1646	27.5	53.0	8	SM10
QN99-1683	16.2	13.4	2	SM10
QN99-1705	17.8	55.6	8	SM10
QN99-1709	43.6	57.1	8	SM10
QN99-1769	27.0	51.7	8	SM10
QN99-1785	20.2	37.5	6	SM10
QN99-1914	10.4	39.7	7	SM10
QN99-1936	12.6	54.6	8	SM10
QN99-1954	18.3	39.4	7	SM10
QN99-2265	1.9	13.0	2	SM10

QC93-896	29.3	45.2	7	SM10
QC93-993	13.5	55.6	8	SM10
QC94-2649	20.5	17.0	2	SM11
QC97-2372	25.6	41.7	7	SM10
QC97-2432	11.6	28.1	5	SM10
QC97-2469	30.1	69.6	9	SM10
QC98-2203	12.5	28.5	5	SM10
QC98-3314	34.6	62.1	9	SM10
QC98-363	4.7	22.5	4	SM10
QC98-363	6.2	17.7	2	SM11
QC98-6109	32.3	61.7	9	SM10
QC99-1062	5.4	22.0	4	SM11
QC99-1156	0.0	25.8	5	SM11
QC99-1160	30.6	51.0	9	SM11
QC99-1172	18.1	39.7	8	SM11
QC99-1176	9.6	47.4	9	SM11
QC99-1182	17.5	49.5	9	SM11
QC99-1198	4.7	32.1	6	SM11
QC99-1292	8.9	30.8	6	SM11
QC99-1298	11.1	36.5	7	SM11
QC99-1308	24.4	35.3	7	SM11
QC99-1509	21.2	61.9	9	SM11
QC99-1520	4.6	7.9	1	SM11
QC99-1528	15.0	58.3	9	SM11
QC99-1781	9.2	21.8	4	SM11
QC99-179	20.3	35.4	7	SM11
QC99-1870	33.1	36.7	7	SM11
QC99-1921	4.7	28.2	6	SM11
QC99-194	15.4	29.1	6	SM11
QC99-1940	25.9	51.9	9	SM11
QC99-1958	24.3	32.6	7	SM11
QC99-2005	8.2	21.1	4	SM11
QC99-2035	0.0	1.8	1	SM11
QC99-2293	32.5	52.0	9	SM11
QC99-2314	1.8	28.1	6	SM11
QC99-2374	3.6	8.5	1	SM11
QC99-2386	35.1	59.0	9	SM11
QC99-289	13.0	34.5	7	SM11
QC99-402	0.0	13.3	1	SM11
QC99-608	1.3	7.6	1	SM11
QC99-651	0.0	7.7	1	SM11
QC99-66	3.6	22.3	4	SM11
QC99-684	22.6	42.9	8	SM11
QC99-710	0.0	14.8	1	SM11
QC99-749	12.5	37.8	8	SM11
QC99-914	1.3	25.0	5	SM11
QC99-931	18.1	36.6	7	SM11
QC99-933	19.1	38.9	8	SM11
QC99-955	5.1	45.5	9	SM11
QC99-973	13.4	29.6	6	SM11
QC99-985	9.8	18.9	3	SM11
QH00-2001	31.9	48.5	9	SM11
QH00-2027	6.7	16.3	2	SM11
QH00-2069	8.4	32.4	6	SM11
QH00-2074	13.1	46.3	9	SM11
QH00-2088	13.3	28.8	6	SM11
QH00-2103	13.5	42.9	8	SM11

QN99-2382	8.4	45.0	7	SM10
QN99-2387	13.4	54.2	8	SM10
QN99-2400	26.9	51.4	8	SM10
QN99-241	16.1	54.2	8	SM10
QN99-2468	37.2	86.7	9	SM10
QN99-2480	20.7	38.4	6	SM10
QN99-2482	7.5	38.3	6	SM10
QN99-2502	32.9	50.7	8	SM10
QN99-2506	39.4	52.2	8	SM10
QN99-2514	23.7	39.3	7	SM10
QN99-399	21.9	43.8	7	SM10
QN99-436	25.4	45.9	7	SM10
QN99-511	15.7	46.4	7	SM10
QN99-546	55.9	75.0	9	SM10
QN99-635	22.2	56.6	8	SM10
QN99-646	13.1	50.4	8	SM10
QN99-703	32.5	56.4	8	SM10
QN99-712	16.4	54.3	8	SM10
QN99-770	5.2	21.9	4	SM10
QN99-815	8.8	21.4	4	SM10
QN99-895	19.1	54.0	8	SM10
QN99-905	20.8	51.1	8	SM10
QN99-911	8.5	39.5	7	SM10
QN99-961	20.5	47.2	7	SM10
QN99-968	3.1	40.6	7	SM10
QN99-997	43.4	63.6	9	SM10
QS84-35	6.9	45.1	7	SM10
QS88-7178	15.3	66.6	9	SM10
QS94-2641	4.8	36.1	6	SM10
QS94-930	13.9	35.9	6	SM10
QS96-392	19.5	39.9	7	SM10
QS96-850	7.0	39.0	7	SM10
QS97-12	40.2	56.8	8	SM10
QS97-2038	16.6	27.0	5	SM10
QS99-1038	6.3	50.9	8	SM10
QS99-1059	0.0	8.6	1	SM10
QS99-1229	12.7	41.4	7	SM10
QS99-1315	5.4	31.6	6	SM10
QS99-1404	60.2	81.6	9	SM10
QS99-1484	20.5	49.8	8	SM10
QS99-1495	19.9	39.4	7	SM10
QS99-1572	26.2	57.1	8	SM10
QS99-2007	13.0	42.9	7	SM10
QS99-2014	17.5	17.1	3	SM10
QS99-2071	13.5	41.2	7	SM10
QS99-2078	5.2	12.8	2	SM10
QS99-2084	43.6	70.6	9	SM10
QS99-2111	8.6	34.8	6	SM10
QS99-2182	13.2	29.8	5	SM10
QS99-2200	7.4	24.5	4	SM10
QS99-2247	46.5	65.0	9	SM10
QS99-2612	34.4	69.3	9	SM10
QS99-2637	6.9	41.3	7	SM10
QS99-2642	27.5	50.2	8	SM10
QS99-2648	22.0	54.0	8	SM10
QS99-2656	5.0	20.6	4	SM10
QS99-2687	12.8	39.4	7	SM10

QH00-2133	11.2	32.6	7	SM11
QH00-2169	7.5	25.4	5	SM11
QH00-2187	12.3	32.6	7	SM11
QH00-2196	10.1	14.5	1	SM11
QH00-2202	30.3	41.5	8	SM11
QH00-2206	18.6	58.9	9	SM11
QH00-2240	9.2	14.6	1	SM11
QH00-2258	5.2	21.0	4	SM11
QH00-2291	50.4	66.0	9	SM11
QH00-2321	37.5	56.3	9	SM11
QH00-2325	14.8	22.4	4	SM11
QH00-2328	22.2	58.8	9	SM11
QH00-2372	45.4	82.1	9	SM11
QH00-2447	19.6	42.6	8	SM11
QH00-2487	16.4	45.4	9	SM11
QH00-2506	4.8	28.1	6	SM11
QH00-2507	25.0	26.4	5	SM11
QH00-2509	32.3	44.3	9	SM11
QH00-2519	17.1	31.9	6	SM11
QH00-2546	14.7	23.8	4	SM11
QH00-2583	5.3	11.3	1	SM11
QH00-2594	16.7	39.9	8	SM11
QH00-2596	12.1	38.8	8	SM11
QH00-2616	28.5	60.5	9	SM11
QH00-2623	20.9	47.9	9	SM11
QH00-2632	15.4	30.3	6	SM11
QH00-6055	27.7	48.0	7	SM10
QH00-6144	0.0	2.3	1	SM10
QH00-6177	9.8	32.6	6	SM10
QH00-6178	3.1	27.8	5	SM10
QH00-6238	37.1	76.5	9	SM10
QH00-6295	26.1	51.2	8	SM10
QH00-6315	18.5	42.0	7	SM10
QH00-6319	9.5	36.2	6	SM10
QH00-6403	49.8	82.3	9	SM10
QH00-6425	7.3	24.0	4	SM10
QH00-6449	14.5	39.5	7	SM10
QH00-6469	9.7	22.8	4	SM10
QH00-6480	8.4	46.9	7	SM10
QH01-105	12.4	32.5	7	SM11
QH01-115	15.4	46.9	9	SM11
QH01-147	10.8	44.1	9	SM11
QH01-152	17.5	25.9	5	SM11
QH01-3	13.1	23.6	4	SM11
QH01-4	6.5	29.5	6	SM11
QH01-63	13.1	27.0	5	SM11
QH01-7	0.0	7.7	1	SM11
QH02-1041	8.5	12.3	1	SM11
QH02-1084	33.0	48.9	9	SM11
QH02-1132	24.7	71.4	9	SM11
QH02-1140	1.9	31.6	6	SM11
QH02-1174	0.0	15.9	2	SM11
QH02-1431	4.3	7.6	1	SM11
QH02-6051	0.0	4.1	1	SM11
QH02-6073	19.1	30.4	6	SM11
QH02-6160	8.3	46.3	9	SM11
QH02-6177	8.8	51.2	9	SM11

QS99-2729	16.3	49.5	8	SM10
QS99-2750	5.0	23.8	4	SM10
QS99-368	5.1	31.7	6	SM10
QS99-482	0.0	6.3	1	SM10
QS99-501	28.1	51.3	8	SM10
QS99-6018	11.6	13.1	2	SM10
QS99-6032	44.9	67.1	9	SM10
QS99-6035	33.1	52.3	8	SM10
QS99-6037	0.0	16.5	3	SM10
QS99-6090	22.2	46.9	7	SM10
QS99-6092	7.0	34.7	6	SM10
QS99-6135	19.4	46.7	7	SM10
QS99-6151	23.5	35.1	6	SM10
QS99-666	14.1	17.1	3	SM10
QS99-672	18.3	37.7	6	SM10
QS99-675	26.2	55.8	8	SM10
QS99-678	30.9	43.8	7	SM10
QS99-714	3.3	38.6	6	SM10
QS99-723	10.8	39.7	7	SM10
QS99-743	40.5	80.6	9	SM10
QS99-759	33.8	57.8	8	SM10
QS99-826	36.7	44.0	7	SM10
QS99-909	32.6	57.9	8	SM10
SP77-5181	16.6	32.3	6	SM10
SP80-1816	5.0	26.6	5	SM10
TCP87-3388	0.0	0.0	1	SM10
VMC67-315	21.3	49.2	8	SM10
VMC71-39	6.7	19.3	3	SM10
KQ02-1244	15.8	26.1	5	SM11
KQ02-1847	13.2	28.3	6	SM11
KQ02-2026	0.0	26.1	5	SM11
KQ02-2083	5.5	35.7	7	SM11
KQ02-2093	8.3	34.4	7	SM11
KQ02-2114	10.9	36.0	7	SM11
KQ02-2178	30.4	64.4	9	SM11
KQ99-2751	9.8	26.8	5	SM11
M442-51	11.2	23.4	4	SM11
MQ82-558	1.7	18.4	3	SM11
MQ96-25	1.3	3.5	1	SM11
NCo310	20.5	49.5	9	SM11
PS01-121	0.0	0.0	1	SM11
PS79-82	0.0	10.2	1	SM11
PS80-442	7.5	20.3	3	SM11
PS84-16029	18.4	25.1	5	SM11
PS87-10266	3.8	23.7	4	SM11
PS97-545	2.5	35.9	7	SM11
PS98-118	7.3	22.5	4	SM11
PS98-126	0.0	2.8	1	SM11
PS98-136	0.0	0.0	1	SM11
PS98-140	0.0	0.0	1	SM11
Q117	25.6	57.6	9	SM11
Q124	7.5	14.5	1	SM11
Q155	3.6	24.7	5	SM11
Q170	20.3	50.3	9	SM11
Q171	7.4	23.5	4	SM11
Q233	18.4	34.2	7	SM11
Q237	1.3	19.8	3	SM11

QH02-6243	20.4	71.8	9	SM11
QH02-6252	16.4	45.1	9	SM11
QH89-108	12.6	56.5	8	SM10
QH89-264	5.8	53.5	8	SM10
QH94-2458	30.8	64.0	9	SM10
QH97-2327	13.7	21.0	4	SM11
QH97-2512	10.0	14.2	1	SM11
QH97-2610	16.8	51.5	9	SM11
QH97-2641	13.1	48.6	9	SM11
QH98-6030	21.8	67.3	9	SM10
QH98-6057	33.3	56.1	8	SM10
QH98-6062	34.0	48.4	7	SM10
QH98-6065	31.2	38.1	6	SM10
QH98-6094	36.4	67.8	9	SM10
QH98-6095	25.0	61.3	9	SM10
QH98-6107	27.0	51.2	8	SM10
QH98-6112	0.0	25.8	5	SM10
QH98-6143	5.4	42.1	7	SM10
QH98-6145	41.1	75.0	9	SM10
QH98-6176	4.9	15.4	2	SM10
QH98-6183	12.4	26.5	5	SM10
QH99-4003	6.0	20.0	4	SM10
QH99-4425	6.4	31.4	6	SM10
QH99-4508	4.5	17.5	3	SM10
QH99-4700	6.2	36.0	6	SM10
QH99-4719	0.0	9.1	1	SM10
QH99-4798	14.3	37.3	6	SM10
QH99-4832	0.0	11.3	1	SM10
QH99-5070	17.1	42.3	7	SM10
QH99-5211	28.6	9.7	1	SM10
QH99-5250	21.4	72.8	9	SM10
QH99-5281	9.9	46.8	7	SM10
QH99-6015	11.3	40.9	7	SM10
QH99-6018	9.2	35.2	6	SM10
QH99-6038	0.0	17.4	3	SM10
QH99-6064	21.8	27.6	5	SM10
QH99-6085	55.1	60.7	8	SM10
QH99-6101	7.7	36.7	6	SM10
QH99-6109	9.2	21.2	4	SM10
QH99-6130	5.0	49.1	8	SM10
QH99-6134	18.5	63.1	9	SM10
QH99-9010	6.0	40.0	8	SM11
QN00-1033	4.8	25.4	5	SM11
QN00-1096	18.3	23.4	4	SM11
QN00-1174	3.6	13.7	1	SM11
QN00-1235	26.1	44.0	9	SM11
QN00-1247	7.2	19.7	3	SM11
QN00-1248	18.1	41.4	8	SM11
QN00-1260	23.5	22.0	4	SM11
QN00-1279	8.6	17.4	2	SM11
QN00-1309	17.5	57.6	9	SM11
QN00-1330	19.2	63.7	9	SM11
QN00-1381	10.7	36.4	7	SM11
QN00-1413	3.1	16.9	2	SM11
QN00-1430	0.0	37.1	7	SM11
QN00-1511	7.9	22.8	4	SM11
QN00-1516	9.8	44.7	9	SM11

Q96	5.4	30.8	6	SM11
QA01-1011	5.0	18.2	3	SM11
QA01-1062	0.0	7.4	1	SM11
QA01-1103	13.4	38.0	8	SM11
QA01-2059	2.5	6.7	1	SM11
QA01-2133	0.0	3.8	1	SM11
QA01-2156	0.0	12.5	1	SM11
QA01-2358	28.8	50.6	9	SM11
QA01-2421	13.4	38.1	8	SM11
QA01-2580	8.5	44.2	9	SM11
QA01-2602	14.8	31.6	6	SM11
QA01-2603	14.3	29.9	6	SM11
QA01-2701	15.6	25.4	5	SM11
QA01-2707	7.5	46.0	9	SM11
QA01-2738	0.0	2.1	1	SM11
QA01-2863	9.5	19.8	3	SM11
QA01-5037	20.7	52.0	9	SM11
QA01-5151	0.0	3.8	1	SM11
QA01-5153	0.0	10.0	1	SM11
QA01-5204	27.2	46.2	9	SM11
QA01-5228	25.5	53.8	9	SM11
QA01-5267	2.6	29.4	6	SM11
QA01-6035	21.3	43.1	8	SM11
QA01-6050	19.4	37.5	8	SM11
QA01-6087	36.6	66.1	9	SM11
QA01-6141	0.0	25.0	5	SM11
QA01-6287	30.3	71.0	9	SM11
QA01-6361	21.1	18.9	3	SM11
QA01-6442	4.6	40.9	8	SM11
QA01-6585	3.6	5.4	1	SM11
QA01-6654	19.9	40.5	8	SM11
QA01-6730	1.9	14.5	1	SM11
QA01-6773	42.1	58.6	9	SM11
QA01-6829	2.1	7.6	1	SM11
QA01-6918	10.7	29.5	6	SM11
QA01-7059	18.2	43.2	8	SM11
QA86-855	9.8	34.6	7	SM11
QA86-979	6.7	13.0	1	SM11
QA87-1622	26.3	72.9	9	SM11
QA92-1880	7.0	18.3	3	SM11
QA94-6003	8.5	48.2	9	SM11
QA94-6128	9.5	21.9	4	SM11
QA95-2182	14.7	24.7	5	SM11
QA96-1333	27.8	45.4	9	SM11
QA96-1749	0.0	10.6	1	SM11
QA97-1026	21.5	62.9	9	SM11
QA97-1031	4.5	21.4	4	SM11
QA97-1578	9.5	43.5	9	SM11
QA97-3298	1.5	12.0	1	SM11
QA97-6102	16.5	17.6	2	SM11
QA97-6146	34.6	62.6	9	SM11
QA98-1055	12.5	33.0	7	SM11
QA98-1221	19.5	40.5	8	SM11
QA99-1549	8.3	30.7	6	SM11
QA99-2163	47.2	74.0	9	SM11
QA99-6178	26.1	29.6	6	SM11
QC00-1327	21.9	29.6	6	SM11

QN00-1590	12.8	25.8	5	SM11
QN00-1715	10.5	22.8	4	SM11
QN00-1720	7.2	23.4	4	SM11
QN00-1738	23.7	62.6	9	SM11
QN00-1742	24.6	38.7	8	SM11
QN00-1752	11.1	37.9	8	SM11
QN00-1781	24.2	62.9	9	SM11
QN00-1809	12.0	14.9	1	SM11
QN00-1813	5.4	28.9	6	SM11
QN00-240	11.0	38.3	8	SM11
QN00-248	11.6	16.1	2	SM11
QN00-261	15.0	26.4	5	SM11
QN00-262	26.4	54.9	9	SM11
QN00-272	20.7	41.1	8	SM11
QN00-28	4.7	5.0	1	SM11
QN00-307	14.7	34.7	7	SM11
QN00-351	15.0	42.2	8	SM11
QN00-37	7.8	30.4	6	SM11
QN00-385	17.5	69.0	9	SM11
QN00-44	11.1	42.3	8	SM11
QN00-468	21.1	45.7	9	SM11
QN00-507	0.0	4.1	1	SM11
QN00-515	18.1	51.5	9	SM11
QN00-522	11.1	27.7	5	SM11
QN00-549	3.8	40.0	8	SM11
QN00-557	18.3	56.6	9	SM11
QN00-583	29.6	39.1	8	SM11
QN00-605	23.7	33.3	7	SM11
QN00-630	7.8	14.8	1	SM11
QN00-636	35.2	70.7	9	SM11
QN00-644	39.9	62.2	9	SM11
QN00-646	16.8	40.5	8	SM11
QN00-652	13.0	17.8	2	SM11
QN00-668	12.9	35.9	7	SM11
QN00-727	11.2	39.4	8	SM11
QN00-728	1.3	1.6	1	SM11
QN00-730	31.2	59.3	9	SM11
QN00-761	25.3	69.9	9	SM11
QN00-840	12.8	50.8	9	SM11
QN00-919	0.0	0.0	1	SM11
QN00-932	19.7	59.4	9	SM11
QN00-936	5.0	7.5	1	SM11
QN00-95	20.3	42.2	8	SM11
QN00-956	9.7	24.8	5	SM11
QN00-98	4.6	3.3	1	SM11
QN00-988	20.7	26.5	5	SM11
QN01-3379	38.4	73.4	9	SM11
QN01-3641	21.3	34.8	7	SM11
QN78-430	43.1	30.2	6	SM11
QN80-605	1.3	5.7	1	SM10
QN82-1241	14.7	54.2	9	SM11
QN83-1175	19.9	60.8	8	SM10
QN84-2969	8.9	43.1	8	SM11
QN85-1271	4.1	15.2	1	SM11
QN89-1043	7.3	40.3	7	SM10
QN91-274	31.6	49.8	8	SM10
QN91-2967	29.5	36.6	6	SM10

QC00-1413	6.1	45.1	9	SM11
QC00-1520	12.8	16.9	2	SM11
QC00-1578	10.5	27.2	5	SM11
QC00-6012	5.9	12.0	1	SM11
QC00-6210	17.2	51.3	9	SM11
QC00-6227	15.7	35.0	7	SM11
QC00-6297	23.1	45.8	9	SM11
QC00-6382	7.4	21.0	4	SM11
QC00-6413	20.6	30.4	6	SM11
QC00-6461	4.5	31.3	6	SM11
QC00-6475	19.6	51.9	9	SM11
QC00-6559	19.8	36.0	7	SM11
QC00-6588	13.2	51.8	9	SM11
QC00-6604	13.2	51.0	9	SM11
QC00-6667	20.2	29.8	6	SM11
QC00-6718	3.9	23.6	4	SM11
QC00-6719	1.6	9.8	1	SM11
QC00-876	0.0	4.4	1	SM11
QC00-958	3.2	15.2	1	SM11
QC81-337	7.0	34.7	7	SM11
QC89-748	6.1	31.6	6	SM11
QC93-6003	12.9	35.7	7	SM11
QC94-2649	20.5	17.0	2	SM11
QC98-363	6.2	17.7	2	SM11
QC99-1062	5.4	22.0	4	SM11
QC99-1156	0.0	25.8	5	SM11
QC99-1160	30.6	51.0	9	SM11
QC99-1172	18.1	39.7	8	SM11
QC99-1176	9.6	47.4	9	SM11
QC99-1182	17.5	49.5	9	SM11
QC99-1198	4.7	32.1	6	SM11
QC99-1292	8.9	30.8	6	SM11
QC99-1298	11.1	36.5	7	SM11
QC99-1308	24.4	35.3	7	SM11
QC99-1509	21.2	61.9	9	SM11
QC99-1520	4.6	7.9	1	SM11
QC99-1528	15.0	58.3	9	SM11
QC99-1781	9.2	21.8	4	SM11
QC99-179	20.3	35.4	7	SM11
QC99-1870	33.1	36.7	7	SM11
QC99-1921	4.7	28.2	6	SM11
QC99-194	15.4	29.1	6	SM11
QC99-1940	25.9	51.9	9	SM11
QC99-1958	24.3	32.6	7	SM11
QC99-2005	8.2	21.1	4	SM11
QC99-2035	0.0	1.8	1	SM11
QC99-2293	32.5	52.0	9	SM11
QC99-2314	1.8	28.1	6	SM11
QC99-2374	3.6	8.5	1	SM11
QC99-2386	35.1	59.0	9	SM11
QC99-289	13.0	34.5	7	SM11
QC99-402	0.0	13.3	1	SM11
QC99-608	1.3	7.6	1	SM11
QC99-651	0.0	7.7	1	SM11
QC99-66	3.6	22.3	4	SM11
QC99-684	22.6	42.9	8	SM11
QC99-710	0.0	14.8	1	SM11

QN95-289	15.3	53.4	8	SM10
QN95-766	10.8	36.9	7	SM11
QN96-1232	39.5	91.7	9	SM10
QN96-1418	42.5	55.4	8	SM10
QN96-1771	23.5	49.9	8	SM10
QN97-1022	11.9	53.8	8	SM10
QN97-1168	8.5	22.4	4	SM10
QN97-1229	20.7	58.8	8	SM10
QN97-123	5.6	15.4	2	SM10
QN97-1881	38.5	41.4	7	SM10
QN97-1972	24.9	51.0	8	SM10
QN97-2024	5.8	65.6	9	SM10
QN97-2122	22.6	72.4	9	SM10
QN97-2170	5.0	27.9	5	SM10
QN97-2173	13.8	43.8	7	SM10
QN97-23	5.6	25.8	5	SM10
QN97-2353	3.3	12.5	2	SM10
QN97-2468	15.3	58.9	8	SM10
QN97-315	7.9	25.1	5	SM10
QN97-387	36.3	48.9	8	SM10
QN97-599	34.6	57.7	8	SM10
QN97-633	19.3	29.0	5	SM10
QN98-1104	12.0	20.8	3	SM11
QN98-1384	25.7	52.1	9	SM11
QN98-1449	29.0	46.8	9	SM11
QN98-1453	9.4	44.5	9	SM11
QN98-165	16.5	19.3	3	SM11
QN98-175	14.9	47.1	9	SM11
QN98-184	11.3	36.2	7	SM11
QN98-1947	0.0	14.1	1	SM11
QN98-1962	13.4	20.8	3	SM11
QN98-320	0.0	13.1	1	SM11
QN98-44	15.9	40.2	8	SM11
QN98-994	8.9	43.3	9	SM11
QN98-998	14.1	46.4	9	SM11
QN99-100	16.9	34.9	7	SM11
QN99-1065	23.2	55.2	8	SM10
QN99-1108	7.4	41.6	7	SM10
QN99-1111	15.3	32.3	6	SM10
QN99-1146	13.7	26.0	5	SM10
QN99-1209	29.1	67.0	9	SM10
QN99-1258	20.2	44.2	7	SM10
QN99-1292	3.3	19.9	4	SM10
QN99-1350	44.8	69.2	9	SM10
QN99-145	15.0	32.0	6	SM10
QN99-1514	5.1	25.0	5	SM10
QN99-1563	5.0	47.5	7	SM10
QN99-1592	26.4	60.3	8	SM10
QN99-1593	35.6	53.8	8	SM10
QN99-1632	16.0	28.7	5	SM10
QN99-1633	8.7	52.8	8	SM10
QN99-1646	27.5	53.0	8	SM10
QN99-1683	16.2	13.4	2	SM10
QN99-1705	17.8	55.6	8	SM10
QN99-1709	43.6	57.1	8	SM10
QN99-1769	27.0	51.7	8	SM10
QN99-1785	20.2	37.5	6	SM10

QC99-749	12.5	37.8	8	SM11
QC99-914	1.3	25.0	5	SM11
QC99-931	18.1	36.6	7	SM11
QC99-933	19.1	38.9	8	SM11
QC99-955	5.1	45.5	9	SM11
QC99-973	13.4	29.6	6	SM11
QC99-985	9.8	18.9	3	SM11
QH00-2001	31.9	48.5	9	SM11
QH00-2027	6.7	16.3	2	SM11
QH00-2069	8.4	32.4	6	SM11
QH00-2074	13.1	46.3	9	SM11
QH00-2088	13.3	28.8	6	SM11
QH00-2103	13.5	42.9	8	SM11
QH00-2133	11.2	32.6	7	SM11
QH00-2169	7.5	25.4	5	SM11
QH00-2187	12.3	32.6	7	SM11
QH00-2196	10.1	14.5	1	SM11
QH00-2202	30.3	41.5	8	SM11
QH00-2206	18.6	58.9	9	SM11
QH00-2240	9.2	14.6	1	SM11
QH00-2258	5.2	21.0	4	SM11
QH00-2291	50.4	66.0	9	SM11
QH00-2321	37.5	56.3	9	SM11
QH00-2325	14.8	22.4	4	SM11
QH00-2328	22.2	58.8	9	SM11
QH00-2372	45.4	82.1	9	SM11
QH00-2447	19.6	42.6	8	SM11
QH00-2487	16.4	45.4	9	SM11
QH00-2506	4.8	28.1	6	SM11
QH00-2507	25.0	26.4	5	SM11
QH00-2509	32.3	44.3	9	SM11
QH00-2519	17.1	31.9	6	SM11
QH00-2546	14.7	23.8	4	SM11
QH00-2583	5.3	11.3	1	SM11
QH00-2594	16.7	39.9	8	SM11
QH00-2596	12.1	38.8	8	SM11
QH00-2616	28.5	60.5	9	SM11
QH00-2623	20.9	47.9	9	SM11
QH00-2632	15.4	30.3	6	SM11
QH01-105	12.4	32.5	7	SM11
QH01-115	15.4	46.9	9	SM11
QH01-147	10.8	44.1	9	SM11
QH01-152	17.5	25.9	5	SM11
QH01-3	13.1	23.6	4	SM11
QH01-4	6.5	29.5	6	SM11
QH01-63	13.1	27.0	5	SM11
QH01-7	0.0	7.7	1	SM11
QH02-1041	8.5	12.3	1	SM11
QH02-1084	33.0	48.9	9	SM11
QH02-1132	24.7	71.4	9	SM11
QH02-1140	1.9	31.6	6	SM11
QH02-1174	0.0	15.9	2	SM11
QH02-1431	4.3	7.6	1	SM11
QH02-6051	0.0	4.1	1	SM11
QH02-6073	19.1	30.4	6	SM11
QH02-6160	8.3	46.3	9	SM11
QH02-6177	8.8	51.2	9	SM11

QN99-1914	10.4	39.7	7	SM10
QN99-1936	12.6	54.6	8	SM10
QN99-1954	18.3	39.4	7	SM10
QN99-2265	1.9	13.0	2	SM10
QN99-2382	8.4	45.0	7	SM10
QN99-2387	13.4	54.2	8	SM10
QN99-2400	26.9	51.4	8	SM10
QN99-241	16.1	54.2	8	SM10
QN99-2468	37.2	86.7	9	SM10
QN99-2480	20.7	38.4	6	SM10
QN99-2482	7.5	38.3	6	SM10
QN99-2502	32.9	50.7	8	SM10
QN99-2506	39.4	52.2	8	SM10
QN99-2514	23.7	39.3	7	SM10
QN99-399	21.9	43.8	7	SM10
QN99-436	25.4	45.9	7	SM10
QN99-511	15.7	46.4	7	SM10
QN99-546	55.9	75.0	9	SM10
QN99-635	22.2	56.6	8	SM10
QN99-646	13.1	50.4	8	SM10
QN99-703	32.5	56.4	8	SM10
QN99-712	16.4	54.3	8	SM10
QN99-770	5.2	21.9	4	SM10
QN99-815	8.8	21.4	4	SM10
QN99-895	19.1	54.0	8	SM10
QN99-905	20.8	51.1	8	SM10
QN99-911	8.5	39.5	7	SM10
QN99-961	20.5	47.2	7	SM10
QN99-968	3.1	40.6	7	SM10
QN99-997	43.4	63.6	9	SM10
QS00-1043	10.1	22.2	4	SM11
QS00-182	7.5	50.2	9	SM11
QS00-191	7.2	44.8	9	SM11
QS00-2072	32.8	40.0	8	SM11
QS00-2182	4.8	31.0	6	SM11
QS00-2191	6.3	22.1	4	SM11
QS00-2197	8.9	13.4	1	SM11
QS00-2233	21.9	36.7	7	SM11
QS00-228	16.9	36.2	7	SM11
QS00-2312	1.5	26.6	5	SM11
QS00-2318	15.0	36.5	7	SM11
QS00-2319	4.3	24.0	4	SM11
QS00-2472	13.2	35.7	7	SM11
QS00-256	0.0	6.7	1	SM11
QS00-29	13.3	36.7	7	SM11
QS00-314	5.0	20.1	3	SM11
QS00-317	27.8	54.2	9	SM11
QS00-318	28.8	64.9	9	SM11
QS00-32	0.0	0.0	1	SM11
QS00-365	13.0	54.9	9	SM11
QS00-369	0.0	13.6	1	SM11
QS00-405	1.3	6.6	1	SM11
QS00-418	31.1	59.1	9	SM11
QS00-473	10.4	45.9	9	SM11
QS00-48	21.6	50.6	9	SM11
QS00-484	5.1	15.0	1	SM11
QS00-486	1.9	5.9	1	SM11

QH02-6243	20.4	71.8	9	SM11
QH02-6252	16.4	45.1	9	SM11
QH97-2327	13.7	21.0	4	SM11
QH97-2512	10.0	14.2	1	SM11
QH97-2610	16.8	51.5	9	SM11
QH97-2641	13.1	48.6	9	SM11
QH99-9010	6.0	40.0	8	SM11
QN00-1033	4.8	25.4	5	SM11
QN00-1096	18.3	23.4	4	SM11
QN00-1174	3.6	13.7	1	SM11
QN00-1235	26.1	44.0	9	SM11
QN00-1247	7.2	19.7	3	SM11
QN00-1248	18.1	41.4	8	SM11
QN00-1260	23.5	22.0	4	SM11
QN00-1279	8.6	17.4	2	SM11
QN00-1309	17.5	57.6	9	SM11
QN00-1330	19.2	63.7	9	SM11
QN00-1381	10.7	36.4	7	SM11
QN00-1413	3.1	16.9	2	SM11
QN00-1430	0.0	37.1	7	SM11
QN00-1511	7.9	22.8	4	SM11
QN00-1516	9.8	44.7	9	SM11
QN00-1590	12.8	25.8	5	SM11
QN00-1715	10.5	22.8	4	SM11
QN00-1720	7.2	23.4	4	SM11
QN00-1738	23.7	62.6	9	SM11
QN00-1742	24.6	38.7	8	SM11
QN00-1752	11.1	37.9	8	SM11
QN00-1781	24.2	62.9	9	SM11
QN00-1809	12.0	14.9	1	SM11
QN00-1813	5.4	28.9	6	SM11
QN00-240	11.0	38.3	8	SM11
QN00-248	11.6	16.1	2	SM11
QN00-261	15.0	26.4	5	SM11
QN00-262	26.4	54.9	9	SM11
QN00-272	20.7	41.1	8	SM11
QN00-28	4.7	5.0	1	SM11
QN00-307	14.7	34.7	7	SM11
QN00-351	15.0	42.2	8	SM11
QN00-37	7.8	30.4	6	SM11
QN00-385	17.5	69.0	9	SM11
QN00-44	11.1	42.3	8	SM11
QN00-468	21.1	45.7	9	SM11
QN00-507	0.0	4.1	1	SM11
QN00-515	18.1	51.5	9	SM11
QN00-522	11.1	27.7	5	SM11
QN00-549	3.8	40.0	8	SM11
QN00-557	18.3	56.6	9	SM11
QN00-583	29.6	39.1	8	SM11
QN00-605	23.7	33.3	7	SM11
QN00-630	7.8	14.8	1	SM11
QN00-636	35.2	70.7	9	SM11
QN00-644	39.9	62.2	9	SM11
QN00-646	16.8	40.5	8	SM11
QN00-652	13.0	17.8	2	SM11
QN00-668	12.9	35.9	7	SM11
QN00-727	11.2	39.4	8	SM11

QS00-51	5.3	30.8	6	SM11
QS00-6116	14.8	40.6	8	SM11
QS00-6149	28.4	57.6	9	SM11
QS00-6173	11.4	30.9	6	SM11
QS00-618	12.1	39.9	8	SM11
QS00-6181	8.7	42.6	8	SM11
QS00-6217	6.9	40.5	8	SM11
QS00-6225	32.8	47.1	9	SM11
QS00-645	0.0	36.3	7	SM11
QS00-648	17.6	30.3	6	SM11
QS00-66	6.1	37.3	7	SM11
QS00-669	9.0	24.8	5	SM11
QS00-784	10.4	15.6	2	SM11
QS00-800	24.8	53.5	9	SM11
QS00-814	10.8	59.0	9	SM11
QS00-819	22.8	33.1	7	SM11
QS00-905	16.7	45.7	9	SM11
QS00-908	29.4	49.1	9	SM11
QS00-923	10.0	14.3	1	SM11
QS00-954	35.0	53.4	9	SM11
QS00-970	21.9	56.3	9	SM11
QS00-992	24.4	52.2	9	SM11
QS84-35	6.9	45.1	7	SM10
QS88-7178	15.3	66.6	9	SM10
QS93-451	12.3	30.5	6	SM11
QS94-2641	4.8	36.1	6	SM10
QS94-930	13.9	35.9	6	SM10
QS96-392	19.5	39.9	7	SM10
QS96-429	2.8	6.0	1	SM11
QS96-434 (Q240)	4.6	18.8	3	SM11
QS96-73	6.4	52.7	9	SM11
QS96-850	7.0	39.0	7	SM10
QS97-12	40.2	56.8	8	SM10
QS97-12	1.5	10.5	1	SM11
QS97-2038	16.6	27.0	5	SM10
QS97-2038	4.8	37.8	8	SM11
QS97-2067	0.0	19.7	3	SM11
QS97-6127	8.2	21.5	4	SM11
QS97-6152	4.5	17.2	2	SM11
QS98-105	22.4	50.0	9	SM11
QS98-118	17.9	26.2	5	SM11
QS98-151	10.0	28.0	5	SM11
QS98-155	2.8	45.4	9	SM11
QS98-192	8.5	27.7	5	SM11
QS98-2052	10.6	16.3	2	SM11
QS98-61	8.0	12.5	1	SM11
QS99-1038	6.3	50.9	8	SM10
QS99-1059	0.0	8.6	1	SM10
QS99-1229	12.7	41.4	7	SM10
QS99-1315	5.4	31.6	6	SM10
QS99-1404	60.2	81.6	9	SM10
QS99-1484	20.5	49.8	8	SM10
QS99-1495	19.9	39.4	7	SM10
QS99-1572	26.2	57.1	8	SM10
QS99-2007	13.0	42.9	7	SM10
QS99-2014	17.5	17.1	3	SM10

QN00-728	1.3	1.6	1	SM11
QN00-730	31.2	59.3	9	SM11
QN00-761	25.3	69.9	9	SM11
QN00-840	12.8	50.8	9	SM11
QN00-919	0.0	0.0	1	SM11
QN00-932	19.7	59.4	9	SM11
QN00-936	5.0	7.5	1	SM11
QN00-95	20.3	42.2	8	SM11
QN00-956	9.7	24.8	5	SM11
QN00-98	4.6	3.3	1	SM11
QN00-988	20.7	26.5	5	SM11
QN01-3379	38.4	73.4	9	SM11
QN01-3641	21.3	34.8	7	SM11
QN78-430	43.1	30.2	6	SM11
QN82-1241	14.7	54.2	9	SM11
QN84-2969	8.9	43.1	8	SM11
QN85-1271	4.1	15.2	1	SM11
QN95-766	10.8	36.9	7	SM11
QN98-1104	12.0	20.8	3	SM11
QN98-1384	25.7	52.1	9	SM11
QN98-1449	29.0	46.8	9	SM11
QN98-1453	9.4	44.5	9	SM11
QN98-165	16.5	19.3	3	SM11
QN98-175	14.9	47.1	9	SM11
QN98-184	11.3	36.2	7	SM11
QN98-1947	0.0	14.1	1	SM11
QN98-1962	13.4	20.8	3	SM11
QN98-320	0.0	13.1	1	SM11
QN98-44	15.9	40.2	8	SM11
QN98-994	8.9	43.3	9	SM11
QN98-998	14.1	46.4	9	SM11
QN99-100	16.9	34.9	7	SM11
QS00-1043	10.1	22.2	4	SM11
QS00-182	7.5	50.2	9	SM11
QS00-191	7.2	44.8	9	SM11
QS00-2072	32.8	40.0	8	SM11
QS00-2182	4.8	31.0	6	SM11
QS00-2191	6.3	22.1	4	SM11
QS00-2197	8.9	13.4	1	SM11
QS00-2233	21.9	36.7	7	SM11
QS00-228	16.9	36.2	7	SM11
QS00-2312	1.5	26.6	5	SM11
QS00-2318	15.0	36.5	7	SM11
QS00-2319	4.3	24.0	4	SM11
QS00-2472	13.2	35.7	7	SM11
QS00-256	0.0	6.7	1	SM11
QS00-29	13.3	36.7	7	SM11
QS00-314	5.0	20.1	3	SM11
QS00-317	27.8	54.2	9	SM11
QS00-318	28.8	64.9	9	SM11
QS00-32	0.0	0.0	1	SM11
QS00-365	13.0	54.9	9	SM11
QS00-369	0.0	13.6	1	SM11
QS00-405	1.3	6.6	1	SM11
QS00-418	31.1	59.1	9	SM11
QS00-473	10.4	45.9	9	SM11

QS99-2071	13.5	41.2	7	SM10
QS99-2078	5.2	12.8	2	SM10
QS99-2084	43.6	70.6	9	SM10
QS99-2111	8.6	34.8	6	SM10
QS99-2182	13.2	29.8	5	SM10
QS99-2200	7.4	24.5	4	SM10
QS99-2247	46.5	65.0	9	SM10
QS99-2446	7.0	45.3	9	SM11
QS99-2612	34.4	69.3	9	SM10
QS99-2637	6.9	41.3	7	SM10
QS99-2642	27.5	50.2	8	SM10
QS99-2648	22.0	54.0	8	SM10
QS99-2656	5.0	20.6	4	SM10
QS99-2687	12.8	39.4	7	SM10
QS99-2729	16.3	49.5	8	SM10
QS99-2750	5.0	23.8	4	SM10
QS99-368	5.1	31.7	6	SM10
QS99-482	0.0	6.3	1	SM10
QS99-501	28.1	51.3	8	SM10
QS99-6018	11.6	13.1	2	SM10
QS99-6032	44.9	67.1	9	SM10
QS99-6035	33.1	52.3	8	SM10
QS99-6037	0.0	16.5	3	SM10
QS99-6090	22.2	46.9	7	SM10
QS99-6092	7.0	34.7	6	SM10
QS99-6135	19.4	46.7	7	SM10
QS99-6151	23.5	35.1	6	SM10
QS99-666	14.1	17.1	3	SM10
QS99-672	18.3	37.7	6	SM10
QS99-675	26.2	55.8	8	SM10
QS99-678	30.9	43.8	7	SM10
QS99-714	3.3	38.6	6	SM10
QS99-715	31.9	58.2	9	SM11
QS99-723	10.8	39.7	7	SM10
QS99-743	40.5	80.6	9	SM10
QS99-759	33.8	57.8	8	SM10
QS99-826	36.7	44.0	7	SM10
QS99-909	32.6	57.9	8	SM10
ROC12	2.6	19.7	3	SM11
SP70-3370	6.1	27.4	5	SM11
SP77-5181	16.6	32.3	6	SM10
SP80-1816	5.0	26.6	5	SM10
TCP87-3388	0.0	0.0	1	SM10
VMC67-315	21.3	49.2	8	SM10
VMC71-39	6.7	19.3	3	SM10

QS00-48	21.6	50.6	9	SM11
QS00-484	5.1	15.0	1	SM11
QS00-486	1.9	5.9	1	SM11
QS00-51	5.3	30.8	6	SM11
QS00-6116	14.8	40.6	8	SM11
QS00-6149	28.4	57.6	9	SM11
QS00-6173	11.4	30.9	6	SM11
QS00-618	12.1	39.9	8	SM11
QS00-6181	8.7	42.6	8	SM11
QS00-6217	6.9	40.5	8	SM11
QS00-6225	32.8	47.1	9	SM11
QS00-645	0.0	36.3	7	SM11
QS00-648	17.6	30.3	6	SM11
QS00-66	6.1	37.3	7	SM11
QS00-669	9.0	24.8	5	SM11
QS00-784	10.4	15.6	2	SM11
QS00-800	24.8	53.5	9	SM11
QS00-814	10.8	59.0	9	SM11
QS00-819	22.8	33.1	7	SM11
QS00-905	16.7	45.7	9	SM11
QS00-908	29.4	49.1	9	SM11
QS00-923	10.0	14.3	1	SM11
QS00-954	35.0	53.4	9	SM11
QS00-970	21.9	56.3	9	SM11
QS00-992	24.4	52.2	9	SM11
QS93-451	12.3	30.5	6	SM11
QS96-429	2.8	6.0	1	SM11
QS96-434 (Q240)	4.6	18.8	3	SM11
QS96-73	6.4	52.7	9	SM11
QS97-12	1.5	10.5	1	SM11
QS97-2038	4.8	37.8	8	SM11
QS97-2067	0.0	19.7	3	SM11
QS97-6127	8.2	21.5	4	SM11
QS97-6152	4.5	17.2	2	SM11
QS98-105	22.4	50.0	9	SM11
QS98-118	17.9	26.2	5	SM11
QS98-151	10.0	28.0	5	SM11
QS98-155	2.8	45.4	9	SM11
QS98-192	8.5	27.7	5	SM11
QS98-2052	10.6	16.3	2	SM11
QS98-61	8.0	12.5	1	SM11
QS99-2446	7.0	45.3	9	SM11
QS99-715	31.9	58.2	9	SM11
ROC12	2.6	19.7	3	SM11
SP70-3370	6.1	27.4	5	SM11

APPENDIX 2 - Mean rating for clones in smut trials 10 and 11 and the number of trials in which the clone has been tested

Sorted by Clone:		
Clone	**Rating**	**No. Trials**
CL73-239	6	1
CL73-792	7	1
CP70-1547	8	1
IJ76-514	6	1
KQ02-1244	5	1
KQ02-1847	6	1
KQ02-2026	5	1
KQ02-2083	7	1
KQ02-2093	7	1
KQ02-2114	7	1
KQ02-2178	9	1
KQ97-4514	6	1
KQ97-5020	7	1
KQ97-8438	8	1
KQ97-9300	7	1
KQ98-416	7	1
KQ98-604	1	1
KQ99-2751	5	1
M442/51*	5	2
MQ82-558	3	1
MQ93-356	7	1
MQ94-156	9	1
MQ94-266	6	1
MQ94-435	7	1
MQ96-1033	9	1
MQ96-25	1	1
MQ96-675	8	1
MQ96-687	6	1
MQ96-810	3	1
N14	8	1
NCo310*	9	2
PS79-82*	2	2
PS80-442*	4	2
PS84-16029*	6	2
PS87-10266*	4	2
Q117*	9	2
Q124*	2	2
Q155*	4	2
Q170*	8	2
Q171*	3	2
Q233	7	1
Q237	4	2
Q96*	6	2
QA00-1013	9	1
QA00-1015	8	1
QA00-1056	8	1
QA00-1057	9	1
QA00-1070	8	1
QA00-1130	7	1
QA00-2015	9	1

Sorted by rating:		
Clone	**Rating**	**No. Trials**
KQ98-604	1	1
MQ96-25	1	1
QA01-1062	1	1
QA01-2059	1	1
QA01-2133	1	1
QA01-2156	1	1
QA01-2738	1	1
QA01-5151	1	1
QA01-5153	1	1
QA01-6585	1	1
QA01-6730	1	1
QA01-6829	1	1
QA86-979	1	1
QA97-3298	1	1
QA99-1815	1	1
QC00-1452	1	1
QC00-6012	1	1
QC00-6294	1	1
QC00-6719	1	1
QC00-876	1	1
QC00-958	1	1
QC82-693	1	1
QC99-1520	1	1
QC99-2035	1	1
QC99-2374	1	1
QC99-402	1	1
QC99-608	1	1
QC99-651	1	1
QC99-710	1	1
QH00-2196	1	1
QH00-2240	1	1
QH00-2583	1	1
QH00-6144	1	1
QH01-7	1	1
QH02-1041	1	1
QH02-1431	1	1
QH02-6051	1	1
QH97-2512	1	1
QH99-4719	1	1
QH99-4832	1	1
QH99-5211	1	1
QN00-1174	1	1
QN00-1809	1	1
QN00-28	1	1
QN00-507	1	1
QN00-630	1	1
QN00-728	1	1
QN00-919	1	1
QN00-936	1	1
QN00-98	1	1

QA00-2021	9	1
QA00-2105	7	1
QA00-2123	9	1
QA00-2137	6	1
QA00-2182	5	1
QA00-2264	9	1
QA00-2283	9	1
QA00-2306	7	1
QA00-2335	7	1
QA00-2367	8	1
QA00-2408	8	1
QA00-2409	8	1
QA00-2414	8	1
QA00-2433	8	1
QA00-2540	7	1
QA00-2607	6	1
QA00-2650	7	1
QA00-2663	9	1
QA00-2718	9	1
QA00-2803	8	1
QA00-2908	7	1
QA00-2933	7	1
QA00-2973	6	1
QA00-3093	6	1
QA00-3203	8	1
QA00-3207	8	1
QA00-4066	3	1
QA00-6015	7	1
QA00-6095	9	1
QA00-6136	6	1
QA00-6139	8	1
QA00-6178	8	1
QA00-6184	9	1
QA00-6207	6	1
QA00-6226	7	1
QA00-6235	6	1
QA00-6353	9	1
QA00-6355	6	1
QA00-6386	8	1
QA00-6402	6	1
QA00-6405	9	1
QA00-6469	9	1
QA00-6472	9	1
QA00-6499	9	1
QA00-6521	4	1
QA00-6579	8	1
QA00-6625	5	1
QA00-6718	9	1
QA00-6810	9	1
QA00-6814	7	1
QA00-6817	7	1
QA00-6822	9	1
QA00-6844	6	1
QA00-6849	9	1
QA00-6860	2	1
QA00-6876	3	1

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