ANNUAL REPORT
COMPREHENSIVE RESEARCH ON RICE

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PROJECT TITLE: Rice Disease Research and Management

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OBJECTIVES AND EXPERIMENTS CONDUCTED, BY LOCATION, TO ACCOMPLISH OBJECTIVES:

The overall objective of the proposed research was to increase understanding of the biology of California rice diseases and use this knowledge to develop economically viable management practices for these diseases.

Specific objectives of the proposed research were:

1) Aggregate sheath spot disease
   a. To develop a better understanding of aggregate sheath spot disease and pathogen biology.
   b. To develop a better understanding of yield and quality loss potential due to aggregate sheath spot disease.
   c. To develop a better understanding of fungicide activity on aggregate sheath spot and design better management strategies for this disease.

2) Evaluate the need and potential for fungicide applications targeted at kernel smut disease management in seed fields.

3) Monitoring false smut disease to evaluate risk and extent of disease and evaluate fungicides for management.

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Objective 1: Aggregate Sheath Spot

To develop a better understanding of aggregate sheath spot disease and pathogen biology, artificial inoculation studies were established in two commercial field locations. Nine individual plots, 10'x10' in size, were constructed using wood stakes and surrounded by plastic sheeting to prevent inoculums movement between plots. Fields were seeded with M-206 and all agronomic operations were performed by the grower as per the normal routine. *Rhizoctonia oryzae-sativae* was grown in the lab on an artificial growth medium to produce sclerotial inoculum. Experimental treatments were replicated and included three plots receiving no artificially produced inoculum, three plots receiving inoculum 30 days after seeding, three plots receiving inoculum 45 days after seeding, and three plots receiving inoculum 60 days after seeding. Plants were observed weekly for disease incidence and severity throughout the season.

In addition to the above study, tiller tagging was conducted in conjunction with the small plot fungicide trials (described below) to measure aggregate sheath spot lesion development over time. Plants were examined weekly in each of the treatments and tillers were marked with flagging tape at the first sign of aggregate sheath spot development. Lesions were measured weekly to allow comparison of individual lesion development or the mean lesion development on tillers subjected to a specific fungicide treatment.

Two large-scale field experiments were established in Colusa and Glenn Counties in collaboration with J. Cook and V. Rose from Wilbur-Ellis Company to evaluate Quadris and Stratego fungicides for aggregate sheath spot management and to develop a better understanding of the yield and quality loss potential due to this disease. Each of these experiments (Location A - M-206 and Location B – M-205) consisted of commercial fields that were split into areas that received no fungicide treatment, 19 oz/A Stratego at full boot, or 9-12 oz/A Quadris at full boot. All treatments were applied by air. Samples were randomly collected from each treatment three to four weeks prior to harvest and rated for aggregate sheath spot incidence and severity as well as for stem rot incidence. Visual ratings were conducted to divide tillers into different severity categories based upon the movement of the disease up the tiller.

- Category 1 = no disease
- Category 2 = disease affecting second leaf below flag leaf or lower
- Category 3 = disease affecting leaf below flag leaf
- Category 4 = disease affecting flag leaf
- Category 5 = disease affecting panicle

- Category ratings were used to calculate:
    - Disease incidence = (# of tillers in categories 2-5) / Total tillers
    - Disease severity = [(#tillers in cat. 1 X 1) + (#tillers in cat. 2 X 2) + (#tillers in cat. 3 X 3) + (#tillers in cat. 4 X 4) + (#tillers in cat. 5 X 5) / Total # of tillers

Yield was estimated for treatment areas using a commercial combine to cut a subplot from each treatment to calculate yield and a subsample was collected for milling quality determination.

Two small plot fungicide trials were established in M-401 commercial rice fields (Glenn and Colusa Counties) in 2008 to evaluate different application timings and rates for Quadris (22.9% Azoxystrobin), Stratego (11.4% Trifloxystrobin + 11.4% Propiconazole), and Quilt (7% Azoxystrobin +11.7% Propiconazole) fungicides and combinations. Treatments were applied to 10' x 20' plots with a CO_2-powered backpack sprayer. Treatments were replicated four times at each location. Disease incidence and severity were evaluated throughout the season by lesion measurement and by a final evaluation, as described for the large scale trials, of 50 tillers per plot prior to harvesting. Plots were harvested with the UC research combine to determine yield and collect samples for milling quality analysis.

Objectives 2 and 3: Kernel Smut and False Smut

Fungicide trials for kernel smut and false smut could not be conducted in 2008 as no large amounts of Stratego or Quilt were available for research purposes because there was a shortage of supplies due to large corn plantings in the mid-west and extensive use of these products.

Objective 3: False Smut

False smut disease distribution was evaluated by scouting individual fields in Glenn County in conjunction with a red rice survey. The survey closely inspected fields radiating out for the original infestation of red rice in Glenn County. In addition, Greer discussed this issue and presented photos of the disease at many rice meetings throughout the year in order to raise awareness in encourage farmers and pest control adviser to be on the lookout for false smut.

SUMMARY OF 2008 RESEARCH BY OBJECTIVE:

Objective 1: Aggregate Sheath Spot

Artificial field inoculation with *Rhizoctonia oryzae-sativae* successfully resulted in diseased plants in the 30, 45 and 60 das inoculations. Disease incidence in inoculated treatments ranged from 40-80% infected tillers. Nevertheless, disease severity did not progress to a level that was adequate for effectively studying disease progress. Visible aggregate sheath spot lesions did not developed on tillers under any of the treatments until approximately 60 days after seeding. Regrettably, the majority of these lesions expanded at a very slow rate and reached a maximum length of approximately 1". These lesions did not progress up the plant from the waterline and the initial site of infection as we would like to see when measuring disease progress. Aggregate sheath spot disease conditions in 2008 were generally unfavorable due to cool conditions and slow plant growth. High humidity and long dew periods are essential for the movement of aggregate sheath spot lesions up the plant and these conditions were not present in 2008. In future inoculation experiments we will experiment with manipulating the microclimate to increase favorable conditions by increasing plant density and/or lengthening dew periods by other means.

Both large scale fungicide trials yielded low disease incidences and very low disease severities. Disease severity at Location A ranged from 5.5-16% aggregate sheath spot with only a few diseased tillers classified in any class above the lowest severity. Disease severity at Location B ranged from 6-18% aggregate sheath spot with only a few diseased tillers classified in any class above the lowest severity. Yield estimates for all treatments were over 10,000 lb/ac.

In general, the large-scale field experiments were disappointing due to the low incidence and severity of aggregate sheath spot disease. The disease levels in these treated fields should be considered when evaluating the effectiveness of these fungicides to protect against yield and quality losses due to disease. More severe disease severity in the form of aggregate sheath spot lesions affecting the upper part of the tiller, particularly the flag leaf, is thought to have a more significant impact on yield and quality. In addition, harvest conditions in 2008 were generally favorable for milling quality and significant differences in this parameter due to fungicide applications were not be realized under these conditions. We will continue large-scale field testing with more intensive sampling to help elucidate the potential benefits of fungicide applications for aggregate sheath spot management. In addition, we will re-visit the utility of fungicide applications for stem rot management, especially at the propanil application timing.

Results of the two small plot fungicide trials are presented in Tables 1 and 2. Results differed between the two locations. At the Glenn County trial, overall aggregate sheath spot disease incidence was moderate and severity was fairly mild while stem rot disease incidence was high but severity very mild as lesions were mostly confined to the outer leaf sheaths. All fungicide treatments resulted in lower mean aggregate sheath spot incidence and severity ratings as compared to the untreated plots, however, these differences were not statistically significant. Yield estimates for all fungicide treatments at the Glenn County trial were appreciably higher (400-1,300 lb/A) than yield estimates for the untreated areas. There were two non-treated control treatments included in this study. All fungicide treatments had a statistically significant yield advantage over one of the non-treated controls (900-1,300 lb/A), whereas, only the Quadris @ 10 oz, Quilt @ 32 oz, and Stratego @ 19 oz, had a significant yield advantage over the other non-treated control. Milling quality data is still outstanding for this trial.

At the Yuba County small plot fungicide trial, overall aggregate sheath spot disease incidence was very high and severity was moderate while stem rot disease incidence was very low and severity very mild as lesions were confined to the outer leaf sheaths. The purpose of this trial was to evaluate Quadris at commonly used rates and reduced rates for aggregate sheath spot management. Both the 12 oz and 6 oz Quadris rate treatments had significantly lower mean aggregate sheath spot incidence and severity ratings as compared to the control treatment. Yield estimates for both fungicide treatments were not significantly different than yield estimates for the untreated areas. The yield potential of this trial was high as all three treatments yielded 10,236-10,622 lb/A. Milling quality data is still outstanding for this trial.

Table 1. Results of Aggregate Sheath Spot Small Plot Fungicide Trial (Glenn Co.)

Treatment	# Samples for Disease Evaluation	AGSS Incidence	AGSS Severity	Stem Rot Incidence	Estimated Yield
1. Not Treated #1	4	0.60	1.68	0.66	8832 ab
2. Not Treated #2	4	0.51	1.56	0.80	8306 a
3. Quadris @ 10 oz	4	0.29	1.30	0.72	9481 c
4. Quilt @ 32 oz	4	0.35	1.35	0.66	9679 c
5. Quilt @ 18 oz + Quadris @ 4.5 oz	4	0.32	1.32	0.50	9240 bc
6. Stratego @ 19 oz	4	0.48	1.49	0.62	9693 c
7. Stratego @ 19 oz + Quadris @ 3 oz	4	0.43	1.56	0.68	9454 bc
P-Value		0.1715	0.0811		0.0012*

* There is not a statistically significant difference between the means followed by the same letter within a column.

Table 2. Results of Aggregate Sheath Spot Small Plot Fungicide Trial (Yuba Co.)

Treatment	# Samples for Disease Evaluation	AGSS Incidence	AGSS Severity	Stem Rot Incidence	Estimated Yield
1. Not Treated #1	4	0.94 a	2.05 a	0.15	10236
3. Quadris @ 12 oz	4	0.84 b	1.85 b	0.12	10337
4. Quadris @ 6 oz	4	0.82 b	1.83 b	0.17	10622
P-Value		0.0292*	0.0045*		0.7374

* There is not a statistically significant difference between the means followed by the same letter within a column

At both small plot fungicide trial locations, tiller tagging was conducted to measure aggregate sheath spot lesion development over time. At least 10 diseased tillers per treatment were tagged and lesions were measured on a weekly basis. Figures 1 and 2 present data associated with the different fungicide treatments at each location. Each data point is the mean lesion length calculated from at least 10 tillers. The data show that generally, conditions for aggregate sheath spot lesion development were not optimal and overall, lesions did not progress up the tiller as we would see in the case of severe disease development.

However, if we look at the data from individual tillers, we start to get a better picture of the affect of fungicide treatments on aggregate sheath spot lesion development. Figures 3 and 4 compare aggregate sheath spot lesion development between non-treated tillers and tillers treated with 12 oz of Quadris at boot split. A small percentage of the lesions from the non-treated plots continued to expand following the date of fungicide treatment, whereas those treated with Quadris were restricted in their growth.

<u>Objective 3: False Smut</u>

Several weeks were spent on intensive field scouting in Glenn County in conjunction with a weedy red rice survey. The presence of false smut was again confirmed in the same field it was first identified in 2006. Incidence and severity of false smut in this field was much lower than in 2006 or 2007. No other fields were visually confirmed with false smut disease in 2008. However, Greer was contacted by a couple of growers and pest control advisers who stated they had seen this disease in more than one of their fields in Colusa and Glenn Counties.

All false smut affected growers have expressed an interest in possible fungicide trials for 2008. We are currently making arrangements with product registrants to ensure fungicide product availability and planning for these trials. Field monitoring and false smut education and awareness programs will continue throughout the year to help growers and pest control advisers identify false smut.

PUBLICATIONS OR REPORTS:

No formal publications or reports. Greer presented information on aggregate sheath spot and false smut at more than ten educational meetings in 2007 and 2008.

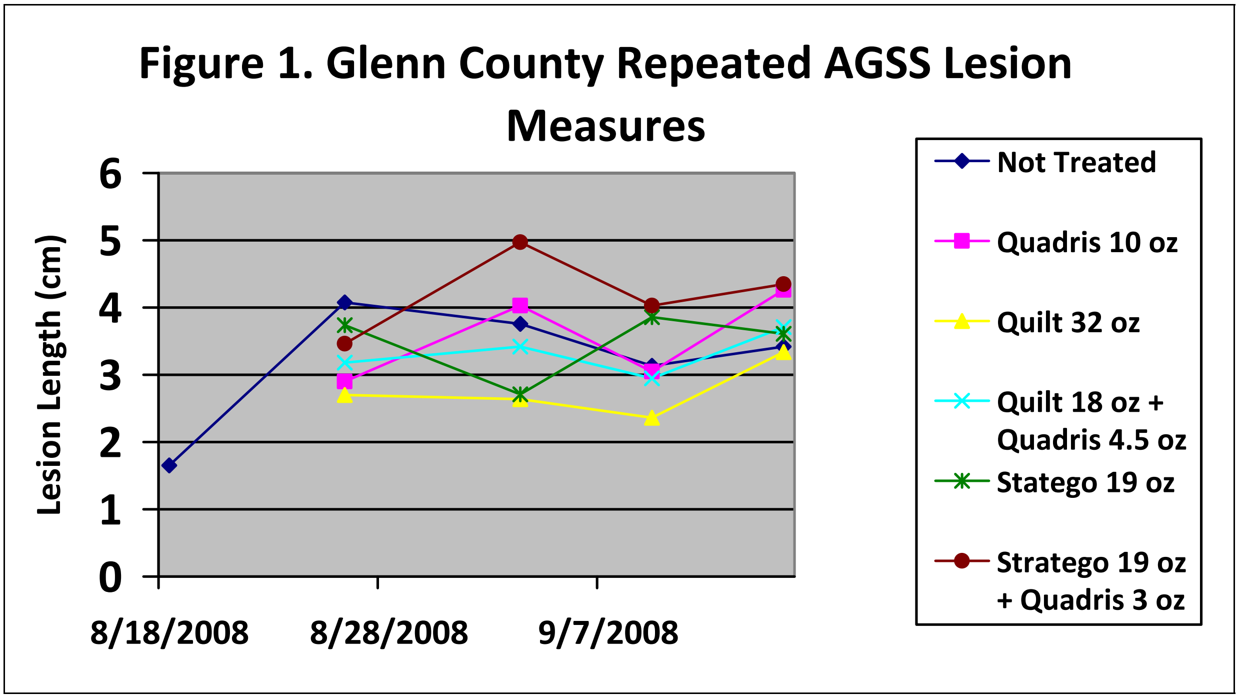


Figure 1. Glenn County Repeated AGSS Lesion Measures
Lesion Length (cm)
0
1
2
3
4
5
6
8/18/2008
8/28/2008
9/7/2008
Not Treated
Quadris 10 oz
Quilt 32 oz
Quilt 18 oz + Quadris 4.5 oz
Statego 19 oz
Stratego 19 oz + Quadris 3 oz

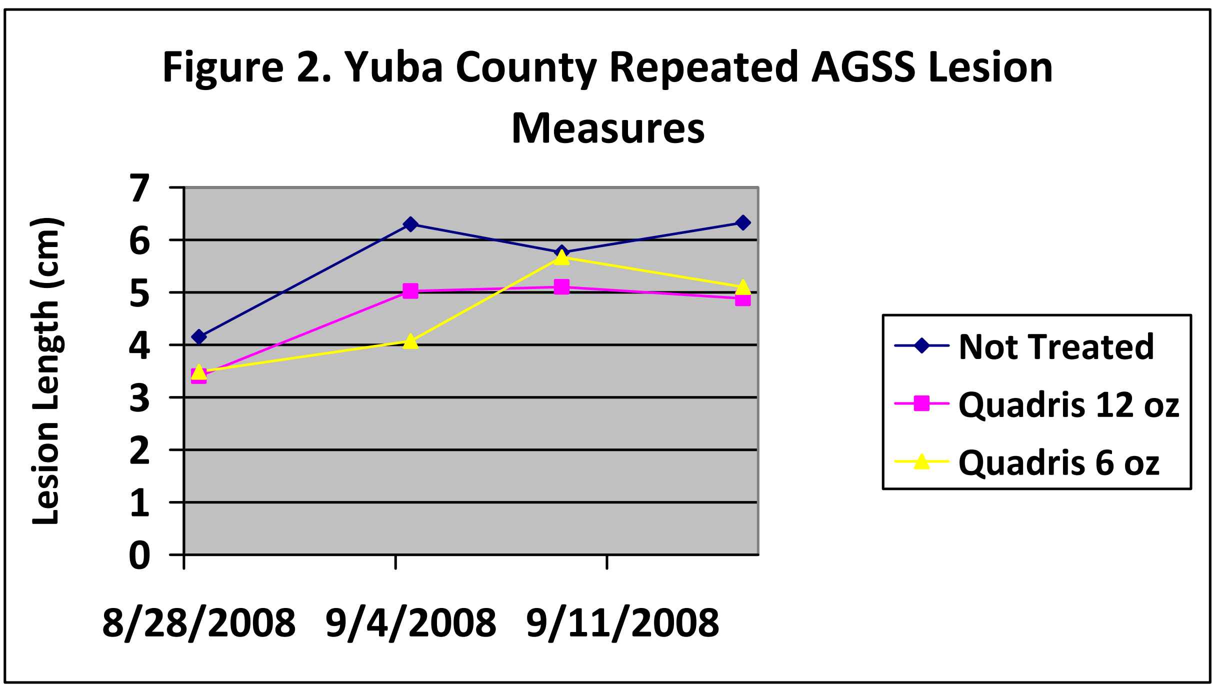


Figure 2. Yuba County Repeated AGSS Lesion Measures
Lesion Length (cm)
0
1
2
3
4
5
6
7
8/28/2008
9/4/2008
9/11/2008
Not Treated
Quadris 12 oz
Quadris 6 oz

Figure 3. Yuba County - AGSS lesion development on individual control tillers

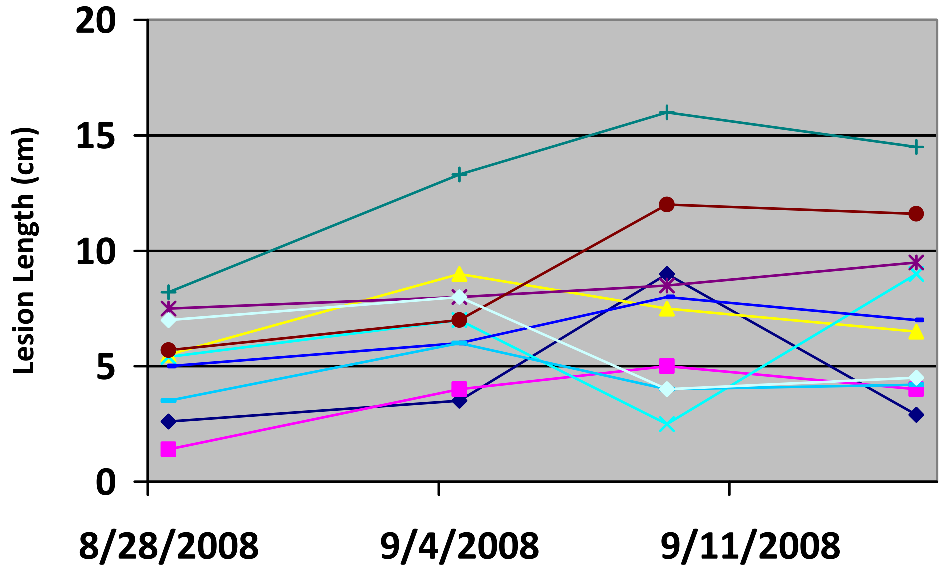
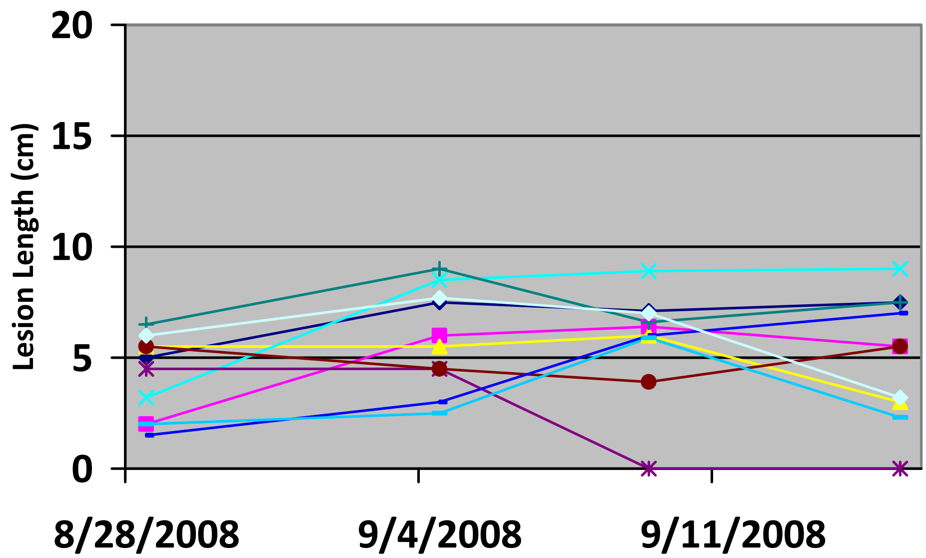


Figure 4. Yuba County - AGSS lesion development on individual tillers treated with 12 oz Quadris



CONCISE GENERAL SUMMARY OF CURRENT YEAR'S RESULTS:

Experiments in artificially inoculated plots resulted in successful infections of rice plants by the aggregate sheath spot pathogen. However, unfavorable conditions, including low humidity and short dew periods, conducive to severe disease development did not allow aggregate sheath spot disease development to severe levels. Large scale commercial field fungicide trials to evaluate Quadris and Stratego were also compromised by low levels of aggregate sheath spot disease incidence and severity. Small plot fungicide trials were quite successful for aggregate sheath spot management in reducing disease incidence and severity and increasing yields in the trial where yields were constrained. Evaluation of milling quality in these trials is still in process and results will be made available when completed. False smut disease was observed again in 2008 after being identified in California for the first time in recent history in 2006. There have been reports from growers in Colusa and Glenn Counties that they also had fields infested with false smut in 2007 and 2008. Future research will continue to elucidate the biology of California rice pathogens to assist in developing effective management practices for these pests. This ultimate goal is to develop an integrated rice disease management program for California growers based on sound fungicide efficacy data and pathogen biology to define the conditions under which a fungicide application is beneficial and economical.