ANNUAL REPORT
COMPREHENSIVE RESEARCH ON RICE
January 1, 2022 – December 31, 2022

PROJECT TITLE: Rice Disease Research and Management

PROJECT LEADER: Luis Espino
Rice Farming Systems Advisor
Butte and Glenn Counties
UC Cooperative Extension
5 County Center Drive
Oroville, CA 9565
(530) 635-6234

PRINCIPAL UC INVESTIGATORS:
Whitney Brim-DeForest, UCCE Rice Farm Advisor, Sutter, Yuba, Placer and Sacramento Counties

COOPERATORS:
Ray Stogsdill, Staff Research Associate, UC Davis
Troy Clark, Junior Specialist, UCCE
Marco Giron, Junior Specialist, UCCE
Consuelo Baez, Field Assistant, UCCE

LEVEL OF 2022 FUNDING: $27,866

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

OBJECIVE 1) Determine the susceptibility of California varieties to stem rot, aggregate sheath spot, and kernel smut and explore their effect on yield and quality.

For this objective, two trials were established in fields with a history of stem rot and aggregate sheath spot (AGSS) (table 1). As in previous years, the Statewide Variety Trials were monitored for the presence of kernel smut; however, kernel smut was not observed in any of the trials.

Methods

The stem rot variety trial was established in a basin with a history of stem rot at the Rice Experiment Station in Biggs. The AGSS variety trial was established in a commercial field near Richvale. Important dates are presented in table 1. Plots were seeded at a rate of 180 lbs/acre. Trials were managed following typical recommended practices for rice in California. At the stem rot location, the N rate was increased to promote the development of stem rot. Varieties tested in both trials and their characteristics are presented in table 2.

In each trial, two plots were established for each variety, one was left untreated and the other was treated with Quadris at 15.5 oz/a at the late boot to early heading stage. Because of the differences in days to heading for the varieties, treatments were made in two dates, grouping varieties that were in similar developmental stages. This resulted in applications made between 78 and 94 days after seeding. To rate disease incidence and severity, tiller samples were taken when approximately 50% of kernels in panicles turned yellow. These ratings were accomplished in two dates, grouping varieties in the same way as for fungicide application, resulting in samples taken between 114 and 127 days after seeding. Tiller samples consisted of tillers cut below the water level randomly from the front, middle, and back of each plot. A subset of 50 tillers per sample were used to rate stem rot or AGSS incidence and severity using the scale presented in table 3.

To calculate disease incidence and severity, the following formulas were used:

- % disease incidence = (number of tillers in categories 1-4) / total tillers*100
- Disease severity = [∑(number of tillers per category*category)] / total tillers

Plots were harvested using a small plot combine and yields converted to lbs/a at 14% moisture content (MC). A 1 lb sample of rough rice was obtained from each plot and air dried to 14% MC. A sub-sample of 200 g was hulled with a McGill sheller and milled with a Yamamoto Ricepal 32. Next, whole kernels were separated using a Satake drum whole kernel separator. Whole kernels are unbroken kernels of rice and broken kernels of rice which are at least three-fourths of an unbroken kernel. With this information, the following parameters were determined:

- Milled rice yield = (milled rice weight (whole + broken)/rough rice weight)*100%
- Head rice yield = (whole kernels weight/rough rice weight)*100%

The trial was conducted as a factorial experiment, with variety and fungicide treatment as factors, with four replications for the stem rot trial and six for the AGSS trial. Analysis of variance was used to detect differences among treatment means for parameters evaluated. When significant differences were detected, the Least Significant Difference test was used to compare treatment means. The level of α used was 0.05.

Results

Stem rot

Stem rot levels in the trial area reached moderate to high levels, with samples from untreated plots averaging a severity of 97% and severity of 2.2. For incidence, the interaction between variety and treatment was not significant. The variety main effect was not significant either, indicating that incidence was similar for all varieties, averaging 94% for the trial (table 4). The treatment effect was significant (F=15.419; df=1, 45; P<0.001), resulting in a 6% reduction in treated plots (91%) compared to untreated plots (97%).

For severity, the interaction between variety and treatment was not significant, but the main effects were (F=10.076; df=7, 45; P<0.001 for variety and F=36.593; df=1, 45; P<0.001 for treatment). Varieties S-102, CM-101, and M-105 had the highest severity levels, while varieties

M-209 and M-211 had the lowest (table 4). Treatment with azoxystrobin reduced severity from 2.2 in untreated plots to 1.8 in treated plots, an 18% reduction.

The interaction between variety and treatment was not significant for yield. The treatment main effect was not significant either, but the variety main effect was (*F*=38.583; df=7, 45; *P*<0.001). Medium grains had similar yields, with M-211 having slightly higher yield than M-105. The two short grain had similar yields, while L-208 had the highest yield of all varieties (table 4).

Milling yield was not affected by the interaction between variety and treatment or treatment main effect, but it was significantly (*F*=34.590; df=7, 45; *P*<0.001) affected by the variety main effect. Among the medium grains, M-105 had the highest milling yield and M-211 had the lowest; for medium grains, CM-101 had higher milling yield than S-102; and for long grains, L-208 had higher milling yield than CJ-201 (table 4). For head rice yield, the interaction between treatment and variety was not significant, but both main effects were (*F*=20.601; df=7, 45; *P*<0.001 for variety and *F*=6.120; df=1, 45; *P*=0.017 for treatment). Trends in head rice yield were similar to trends in milling yield (table 4). Averaging across varieties, treatment with azoxystrobin resulted in a 3% increase in head rice yield when compared with untreated plots (50.34%).

Results of this trial show that there are differences on how the varieties respond to stem rot. Similar to 2021, symptoms observed were more severe on varieties with a shorter period of development than varieties with longer periods of development (fig. 1). In 2022, disease ratings were made when plots were at a similar stage of development, eliminating the possibility that the differences observed were due to more disease development in early varieties because these varieties matured earlier compared to later varieties, giving the disease more time to develop. However, this year we did not see an effect of treatment on yield even though treatment resulted in an 18% reduction on average stem rot severity. This could indicate that all varieties are capable of overcoming the negative effects of stem rot at the severity levels observed. In 2021, disease levels were similar than in 2022, but treatment with azoxystrobin resulted in a 30% severity reduction. Weather was unfavorable in 2022, with a cold spell early in the season and hot temperatures during heading and grain fill. These anomalies in weather may have resulted in less disease control and lack of yield increase.

Application of azoxystrobin resulted in an increase in head rice yield. In previous year’s trials, positive effects of azoxystrobin application on milling quality have been rare. It is likely than in a year with unfavorable conditions for milling quality, the effect fungicide may have become more evident.

Aggregate sheath spot

Aggregate sheath spot levels in the trial were low. Average incidence and severity in untreated plots were 53% and 0.6, respectively. Incidence was significantly affected by the variety (*F*=4.748; df=7, 75; *P*<0.001) and treatment (*F*=165.019; df=1, 75; *P*<0.001) main effects, but not by their interaction. Similarly, severity was affected by the variety (*F*=4.300; df=7, 75; *P*<0.001) and treatment (*F*=169.160; df=1, 75; *P*<0.001) main effects but not their interaction. Incidence and severity were significantly lower in variety L-208 (table 5). All other varieties did not differed significantly among each other. On average, disease levels in L-208 were half of what they were in other varieties. Treatment with azoxystrobin resulted in a 61% incidence reduction in treated plots versus untreated plots (20.14%) and a 63% severity reduction in treated plots versus untreated plots (0.56).

For yield, the interaction between variety and treatment was not significant, but the main effects were (F=96.039; df=7,75; P<0.001 for variety and F=34.946; df=1, 75; P<0.001 for treatment). L-208 had the highest yields, followed by M-105 and M-206 (table 5). Lowest yields were obtained with M-211 and the short grains. The trial was conducted in an M-105 field and it was drained to maximize yield for this variety. Longer season varieties like M-211, M-209, and CJ-201 may have been drained too early. Treatment with azoxystrobin increased yield for all varieties an average of 366 lbs/a, or 4% from untreated plots (9,142 lbs/a).

Milling yield was only significantly affected by variety (F=108.816; df=7, 75; P<0.001). Among medium grains, milling yield was higher with M-105 and M-206 (table 5). For longer season varieties, the early drain may have resulted in reduced milling yield. Small differences were observed between short or long grain varieties.

For head rice yield, the interaction between variety and treatment was significant (F=2.842; df=7, 75; P=0.011), indicating that the effect of the treatment was different among the varieties. For all varieties, except CJ-201, treatment with azoxystrobin resulted in an increase in milling yield (fig. 2). These increases were significant for varieties M-211 and M-209, which saw a head rice yield increase of 10 and 17%, respectively. When considering all varieties, except CJ-201, the average increase was 6%.

Results of this trial show that variety L-208 had the lowest levels of AGSS. In 2021, varieties L-208 and A-202 had the lowest AGSS levels. We did not include A-202 this year because of lack of seed; however, we included another aromatic long grain variety, CJ-201. These results seem to indicate that some long grain varieties may be less susceptible to the development of AGSS. Nevertheless, these results need to be considered carefully because disease levels in this year’s trial were very low.

The trial shows that reducing AGSS levels by applying azoxystrobin resulted in a yield benefit, even though disease levels were low. Using AGSS severity as covariate (fig. 3), analysis of covariance indicates that for a one unit increase in disease severity, yield decreased 1,350 lbs/a. This estimate is much higher than what we have seen in the past in other AGSS trials. Part of the increase may be due to the “greening” effect of azoxystrobin. This may also explain the higher milling quality obtained in treated plots. The benefits of azoxystrobin in yield and quality may be evident because of the unfavorable weather conditions in 2022.

OBJECTIVE 2) Investigate the relationship between disease ratings at drain time and ratings before heading for stem rot and aggregate sheath spot.

Methods

Only stem rot was investigated for this objective; aggregate sheath spot levels were too low to be included. Five trials conducted during 2022 at the Rice Experiment Station in Biggs, Butte County, were used to collect data (table 6). In each trial, 10x20 ft fungicide-untreated plots were sampled before heading and at drain time. Before heading, samples were taken at the mid to late boot stage (4-6 inch panicle inside the main tiller). Drain time was when up to 50% of the kernels in panicles had turned yellow. For each sampling time, tiller samples consisted of tillers cut below the water level randomly from the front, middle, and back of each plot. A subset of 50 tillers per sample were used to rate stem rot incidence and severity using the scale presented in table 3.

To calculate disease incidence and severity, the following formulas were used:

- % disease incidence = (number of tillers in categories 1-4) / total tillers*100
- Disease severity = [∑(number of tillers per category*category)] / total tillers

Trial 1 consisted of 4 plots of each of the following varieites: S-102, M-211, CM-101, M-209, M-105, CJ-201, L-208, and M-206. Trial 6 consisted of 12 plots of each of the following varieties: M-211, M-206, and CH-202. Trials 3, 4, and 5 were all M-206.

Scatter plots of incidence or severity at the first sampling time versus incidence or severity at the second sampling time were used to explore the data and determine if disease levels before heading could predict disease levels near maturity.

Results

Incidence and severity were related at each of the sampling times (fig. 4). For the mid to late boot stage, incidence and severity were linearly related and incidence approached 100% when disease severity was close to 1. At grain maturity, severity increased linearly with incidence until reaching a rating of 2.

Incidence at boot was linearly predictive of incidence at maturity until it reached approximately 30%. After 30%, there is quite a bit of variability in the data (fig. 5). Similarly, low levels of incidence at boot seemed to be linearly predictive of severity at maturity, but when incidence at boot was higher than 30%, the variability in the data made any prediction of severity at maturity difficult.

There are several sources of variability in the data. Trial and variety are the main ones. Close examination of the data seems to indicate that variety did not produce high variability in disease scores. However, most trials used seemed to have levels of disease that did not have a wide range. In the future, fungicide applications at the tillering stage could be used to produce a wider range of disease levels in the same trial or field.

Preliminary, the data indicates that stem rot incidence of 30 to 40% at the boot stage is predictive of > 60% incidence or > 1.5 severity at maturity.

OBJECTIVE 3) Investigate the effect of reduced water flow during heading and grain fill on stem rot development.

Methods

On 8/19, metal rings 5-ft in diameter were placed over the canopy of a M-206 field and pushed into the soil so that the ring would limit water flow inside the ring. When the rings were established, the field was at full flowering. Temperature loggers were put into the water inside one of the rings and in an area near one of the rings but where water flowed normally. Loggers were removed at drain time on 9/16. Tiller samples were taken from inside and outside each ring on 8/19 and soon after drain time on 9/20. Tiller samples consisted of tillers cut below the water level randomly on three areas inside and outside each ring. A subset of 50 tillers per sample were used to rate stem rot incidence and severity using the scale presented in table 3.

To calculate disease incidence and severity, the following formulas were used:

- % disease incidence = (number of tillers in categories 1-4) / total tillers*100
- Disease severity = [∑(number of tillers per category*category)] / total tillers

The trial was established as a complete randomized complete block, with treatments “ring” and “no ring” and replicated four times. Analysis of variance was used to detect differences between treatment means for stem rot incidence and severity. The level of α used was 0.05.

Results

Water temperature inside and outside the rings was very similar. On average, hourly water temperature was 0.1 ^{o}F warmer inside the rings than outside. No significant differences were observed in stem rot incidence or severity between samples taken from inside and outside the rings at heading or drain time (fig. 6). On average, incidence increased from 68% at heading to 91% at drain time, while severity increased from 0.8 to 2.1.

These results indicate that holding water after heading, instead of maintaining a continuous water flow until drain time, may not result in increased stem rot levels. It is important to note that in our trial, we did not manipulate water depth. At the start of the trial, water depth was similar inside and outside the rings, averaging 4.3 inches. Growers may increase their water level at heading and hold the water until it subsides, instead of draining the field by removing boards at drain time. In this case, water depth will be larger and may affect water temperature and stem rot differently than in our trial.

OBJECTIVE 4) Monitor the response of M-210, a blast resistant variety, to blast epidemics in the field.

M-210 is a new medium grain variety resistant to blast. There are some reports that blast can develop in M-210; however, these reports have not been confirmed. Similar to 2021, very little blast developed in the Sacramento Valley in 2022. Unfortunately, no reports of blast were received until after harvest, when there was one report of blast (not on M-210).

Of notice this year was the identification of blast in the San Joaquin Valley. Two M-206 fields was affected with panicle blast, and samples sent to the UC Davis Plant Pathology lab (Swett Lab) by Advisor Leinfelder-Miles confirmed the identification. Samples from these field were collected and are currently being stored for later isolation.

To our knowledge, this is the first identification of blast in the San Joaquin Valley. Cooler summer temperatures there do not provide the best conditions for blast development. However, rice in the San Joaquin Delta is drill seeded, making plants more susceptible. Additionally, 2022 was a warm year and this may have provided good conditions for blast.

Other developments of notice in 2022 relates to different pathogens. A report of possible blast in M-211 was received in late summer form a PCA in Butte County. Inspection of the field revealed only a few plants affected with symptoms that looked like collar blast (fig. 7). Samples were submitted to the Swett Lab and the identification came back as *Nigrospora oryzae.* Interestingly, this pathogen was also identified in the blast affected field and another nearby field in the San Joaquin Valley casing panicle branch rot. This pathogen had also been identified from samples with symptoms similar to stem rot in 2017 and 2021 and in a field with heavy discoloration of rice panicles in 2021 (fig. 7).

The Compendium of Rice Diseases and Pests (2018, APS Press) indicates that *Nigrospora* species are common and occur in senescing plant tissue, and may cause lesions in plants weakened by diseases, insects, or poor nutrition. This fungus is reported to cause an ear blight and blackening of rice kernels. These descriptions fit the symptoms caused by *Nigrospora oryzae* in California (fig. 7). Addtionally, *Nigrospora oryzae* has recently been identified as the causal agent of panicle branch rot disease in China (Liu et al., 2021, Plant Disease 105 (9): 2724), with reported yield and quality losses.

Given the information in the literature, at this point the identification of *Nigrospora oryzae* from California rice samples is not cause of concern but warrants vigilance from the industry. It is possible that *Nigrospora* was able to cause disease in plants that were weakened due to other factors. In 2022, hot weather may have resulted in stressed plants that were more likely to develop *Nigrospora* disease symptoms.

Another identification of interest came from one of the San Joaquin Valley fields where *Nigrospora* was identified in 2021. The bacterium *Pantoea ananatis* was isolated from plant samples with symptoms that resembled stem rot. The Compendium of Rice Diseases and Pests states that this bacterium is the causal agent of a palea browning in some Asian countries and Italy (2007). More recently, articles on the journal Plant Disease report that this bacterium has been found to cause leaf blight in India (2011), Togo (2016), Benin (2016), Malaysia (2019), and China (2021, 2022). Symptoms described in these articles are yellow stripes on leaves that later turn brown, water-soaked lesions on the tips of leaves, and dark green to yellow water-soaked thin streaks on leaves (fig. 8). While these symptoms were not observed in the California field where the pathogen was identified, it is important to continue to monitor fields in case the pathogen surfaces again. *Pantoea ananatis* is currently considered an emerging plant pathogen worldwide.

CONCISE GENERAL SUMMARY OF CURRENT YEAR'S RESULTS

OBJECIVE 1) Determine the susceptibility of California varieties to stem rot, aggregate sheath spot, and kernel smut and explore their effect on yield and quality.

Variety trials were conducted against stem rot and aggregate sheath spot. Similar to 2021, varieties with longer periods of development showed lower levels of stem rot severity. Application with azoxystrobin reduced stem rot severity by 20%, did not increase yield but it did increase heard rice yield an average of 3%. The long grain variety L-208 showed significantly lower levels of aggregate sheath spot than the other varieties tested. Azoxystrobin reduced disease severity by 63% and resulted in a yield increase of 4% and head rice yield increase of 6%.

OBJECTIVE 2) Investigate the relationship between disease ratings at drain time and ratings before heading for stem rot and aggregate sheath spot.

Data on aggregate sheath spot was not collected due to low disese levels. For stem rot, disease incidence taken at mid to late boot may predict disease incidence or severity at late maturity. Disease incidence and severity at maturity is linearly related to disease incidence at the boot stage until this reaches 30%. However, at higher levels, the variability in the data makes prediction difficult. When disease incidence reaches 30% at boot, disease incidence and severity reach approximately 60% and 1.5, respectively.

OBJECTIVE 3) Investigate the effect of reduced water flow during heading and grain fill on stem rot development.

Reduced water flow during the heading and grain filling stage did not increase the incidence or severity of stem rot.

OBJECTIVE 4) Monitor the response of M-210, a blast resistant variety, to blast epidemics in the field.

During the season, there were no reports of blast in the Sacramento Valley. Blast was confirmed in two fields in the San Joaquin Valley. This is the first report of blast for rice in this area. Additionally, *Nigrospora oryzae* was identified causing a panicle branch rot in one of the San Joaquin Valley blast affected fields. This pathogen has been identified in 2022 causing collar blight in Butte County and in 2021 causing panicle discoloration in Yolo County. A bacterium, *Pantoea ananatis* was also identified in 2021 in the San Joaquin Valley. The industry needs to remain vigilant and monitor further development of these pathogens.

Table 1. Location and important dates for stem rot and aggregate sheath spot (AGSS) variety trials, 2022.

Location	**Target**	**Seeding date**	**Quadris application date**	**Tiller samples**	**Harvest date**
Biggs, Butte County (RES)	Stem rot	5/22	8/8* and 8/11**	9/13* and 9/20**	10/17
Richvale, Butte County	AGSS	5/2	7/28* and 8/4**	8/29* and 9/6**	9/30

* S-102, CM-101, M-105, L-208

** M-206, M-209, M-211, CJ-201

Table 2. Varieties used in stem rot and aggregate sheath spot variety trials, 2022. Days to 50% heading is the average from trials conducted at the Rice Experiment Station (RES) during 2017, 2018, and 2019.

Variety	**Grain type**	**Maturity**	**Days to 50% heading at RES**
CM-101	Specialty (Glutinous)	Very early	73
S-102	Short	Very early	72
M-105	Medium	Very early	72
M-206	Medium	Early	74
M-209	Medium	Early	81
M-211	Medium	Early	82
L-208	Long	Early	74
CJ-201	Long	Early	80

Table 3. Stem rot and aggregate sheath spot disease severity scale.

Category	Stem rot	Aggregate sheath spot
0	No disease	No disease
1	Disease lesions on outer leaf sheath	Disease affecting second leaf below flag leaf or lower
2	Disease lesions have penetrated into inner leaf sheaths	Disease affecting leaf below flag leaf
3	Disease lesions on culm	Disease affecting flag leaf
4	Culm is rotted though	Disease affecting panicle

Table 4. Average stem rot incidence, severity, yield and milling quality parameters for stem rot variety trial, Biggs, Butte County, 2022.

Variety	**Incidence (%)**	**Severity**	**Yield (lbs/a)**	**MY (%)**	**HRY (%)**
S-102	96.05	2.57 f	7,576 a	70.05 cd	50.4 bc
CM-101	96.00	2.12 de	7,816 a	72.22 ef	55.53 e
M-105	92.13	2.06 cde	8,861 bc	70.84 de	56.53 e
M-206	95.02	1.91 bcd	8,920 cd	67.99 b	52.37 cd
M-209	91.97	1.6 a	9,266 cd	68.97 bc	49.47 b
M-211	93.23	1.78 ab	9,322 d	66.13 a	45.45 a
L-208	92.74	1.82 abc	10,668 e	76.01 g	54.37 de
CJ-201	96.77	1.98 bcd	8,440 b	72.56 f	45.23 a

MY= milling yield
HRY= head rice yield
Means within a column followed by different letters are statistically different (LSD, $P<0.05$).

Table 5. Average aggregate sheath spot incidence, severity, yield and milling quality parameters for aggregate sheath spot variety trial, Richvale, Butte County, 2022.

Variety	**Incidence (%)**	**Severity**	**Yield (lbs/a)**	**MY (%)**	**HRY (%)**
S-102	38.45 b	0.43 b	8,953 c	68.83 d	51.28 c
CM-101	35.13 b	0.38 b	8,664 ab	71.33 e	53.63 d
M-105	37.17 b	0.37 b	9,715 e	69.18 d	60.21 f
M-206	42.85 b	0.44 b	9,411 de	67.67 c	56.83 e
M-209	40.09 b	0.41 b	8,800 bc	66.04 b	47.9 b
M-211	39.97 b	0.4 b	8,520 a	64.69 a	38.91 a
L-208	17.94 a	0.19 a	11,195 f	71.38 e	48.05 b
CJ-201	39.42 b	0.42 b	9,340 d	69.32 d	46.18 b

MY= milling yield

HRY= head rice yield

Means within a column followed by different letters are statistically different (LSD, $P<0.05$).

Table 6. Trials sampled to collect data to relate disease ratings before heading to disease ratings at drain time, Biggs, Butte County, 2022.

Trial	**Seeding date**	**1st sampling time**	**2nd sampling time**	**Number of samples for each sampling time**
1	5/22	8/2, 8/10	9/13, 9/20	32
3	5/22	8/12	9/21	32
4	5/22	8/12	9/23	20
5	5/22	8/5	9/8	16
6	5/22	8/5, 8/10	9/13, 9/20	36

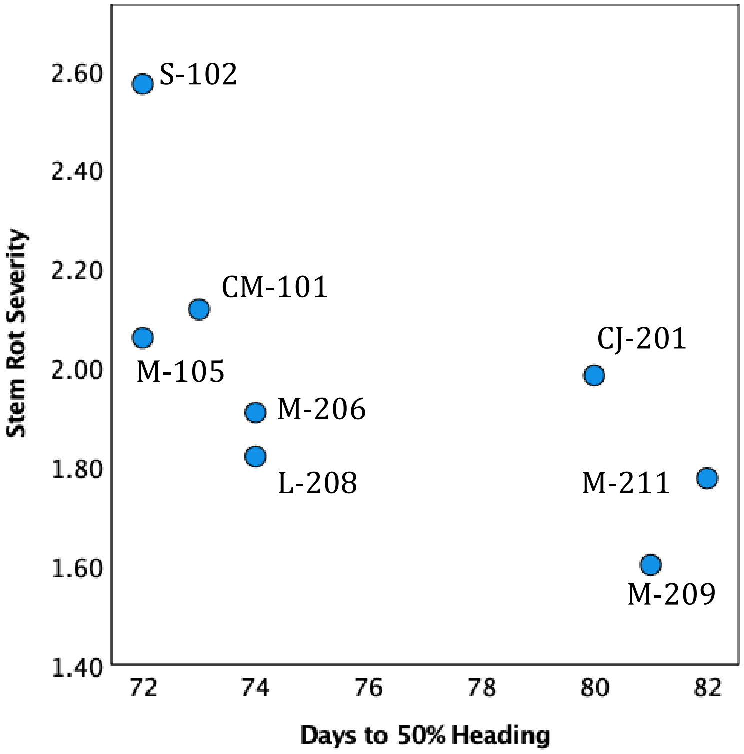

Figure 1. Average stem rot severity and days to 50% heading for varieties tested in stem rot variety trial, Biggs, Butte County, 2022.

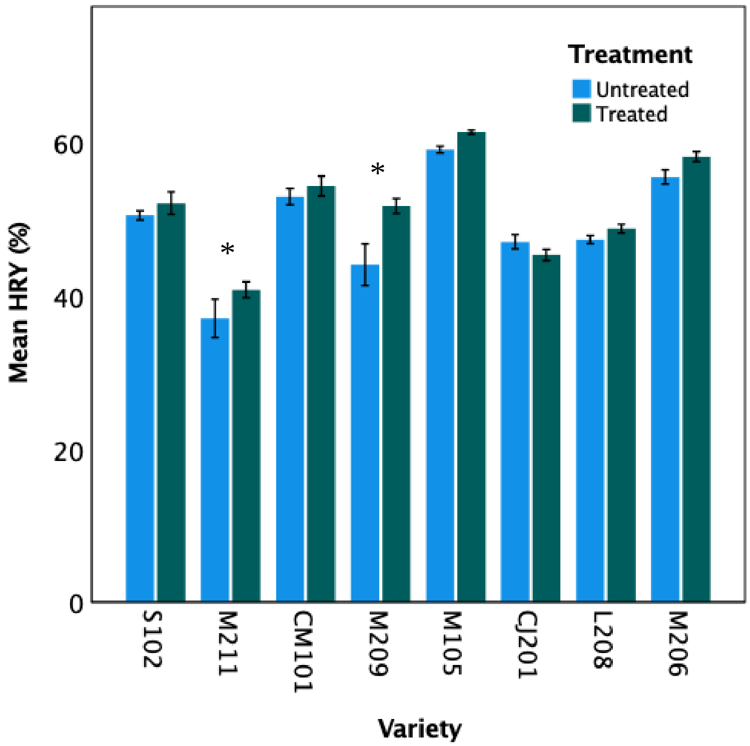

Figure 2. Percentage head rice yield (HRY) for azoxystrobin treated and untreated plots, aggregate sheath spot variety trial, Richvale, Butte County, 2022. Bars followed by asterisk show a significant (LSD, $P<0.05$) difference between treated and untreated plots.

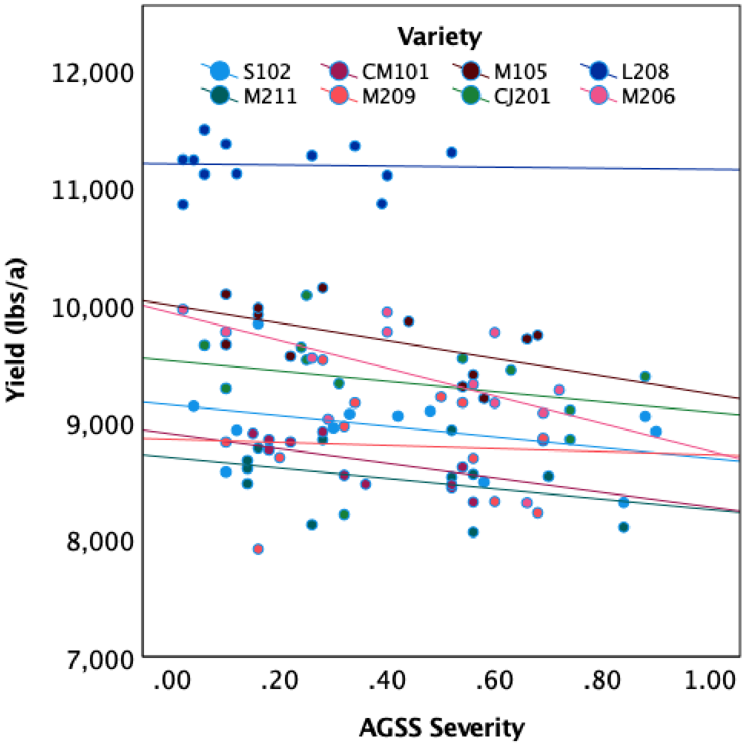

Figure 3. Relationship between aggregate sheath spot (AGSS) severity and yield for variety trial, Richvale, Butte County, 2022. Analysis of covariance indicates a common slope of -1,350 lbs/a (adjusted r^2=0.839).

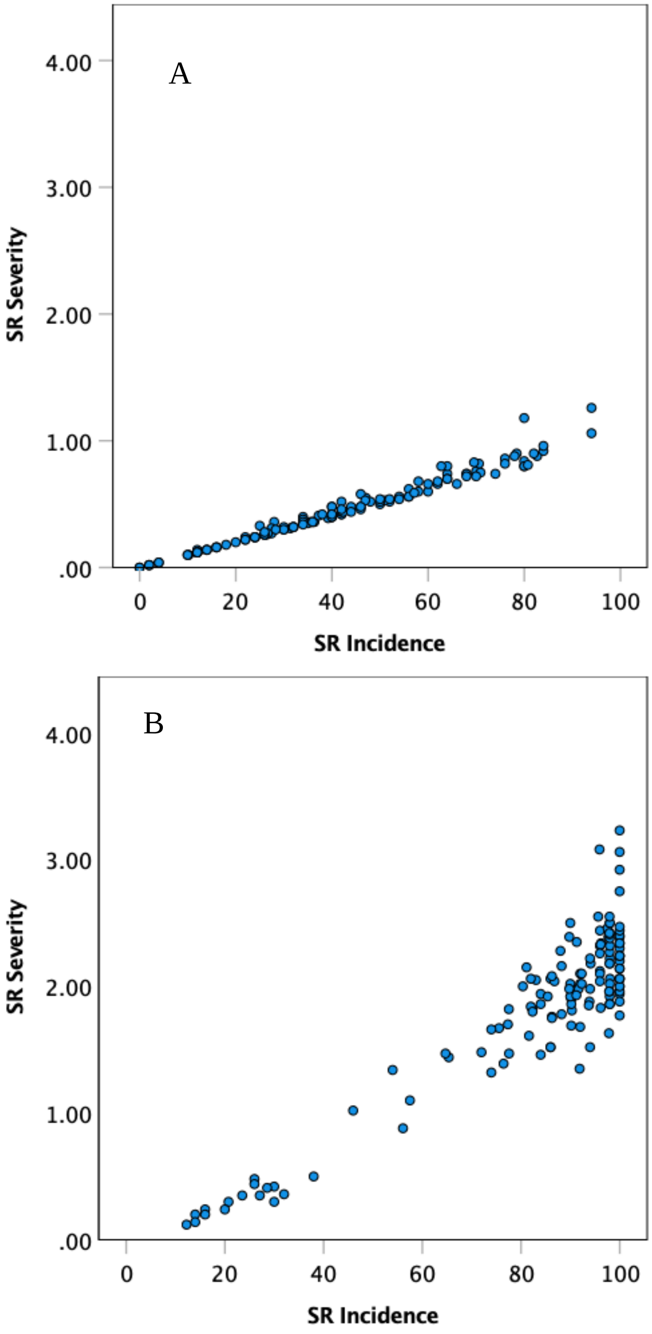

Figure 4. Relationship between stem rot incidence and severity ratings taken before heading (A) and at drain time (B). Biggs, Butte County, 2022.

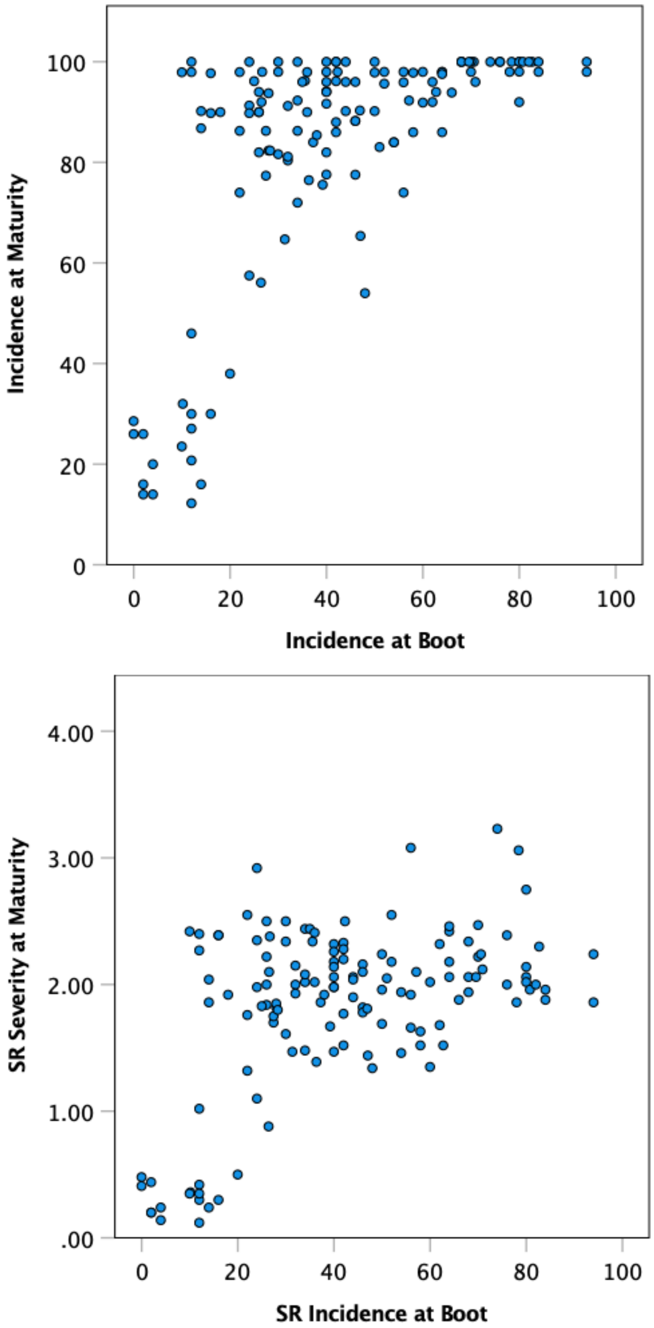

Figure 5. Relationship between stem rot incidence at the boot stage and incidence or severity at maturity, when up to 50% of kernels in panicles had turned yellow. Biggs, Butte County, 2022.

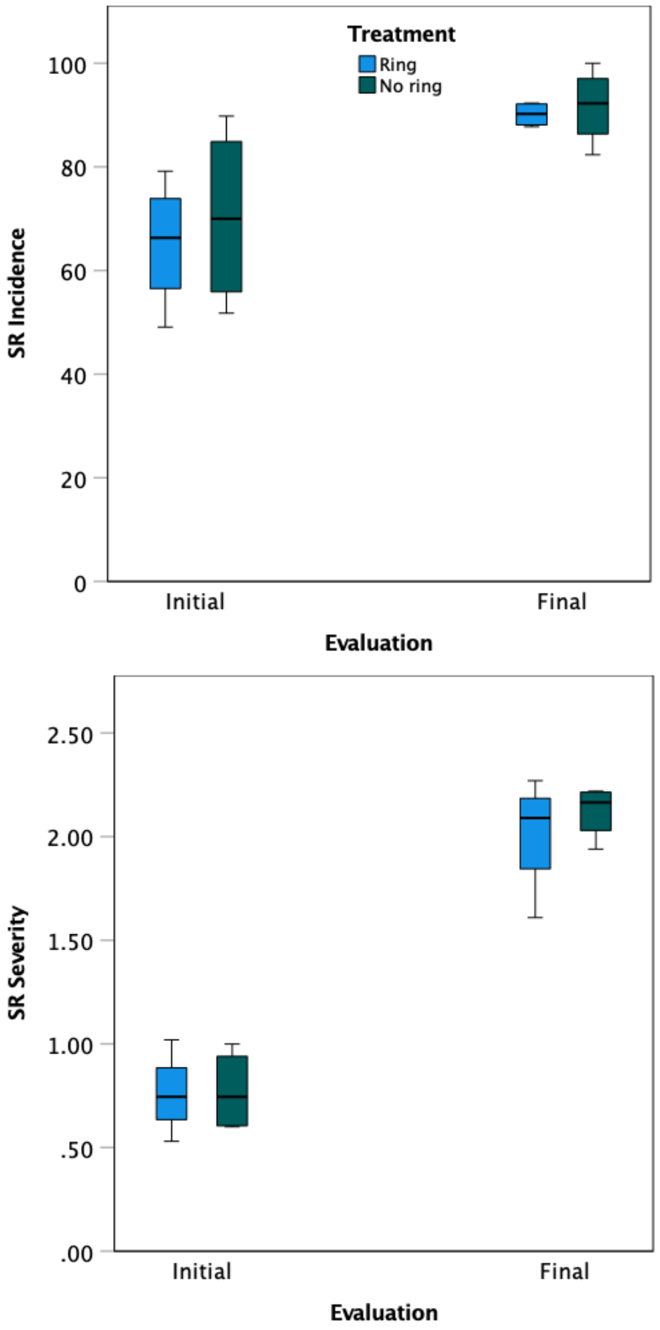

Figure 6. Boxplot of stem rot (SR) percentage incidence and severity in samples from within and outside metal rings. Initial evaluation refers to samples taken at full flowering and final evaluation to samples taken at drain time. Biggs, Butte County, 2022.

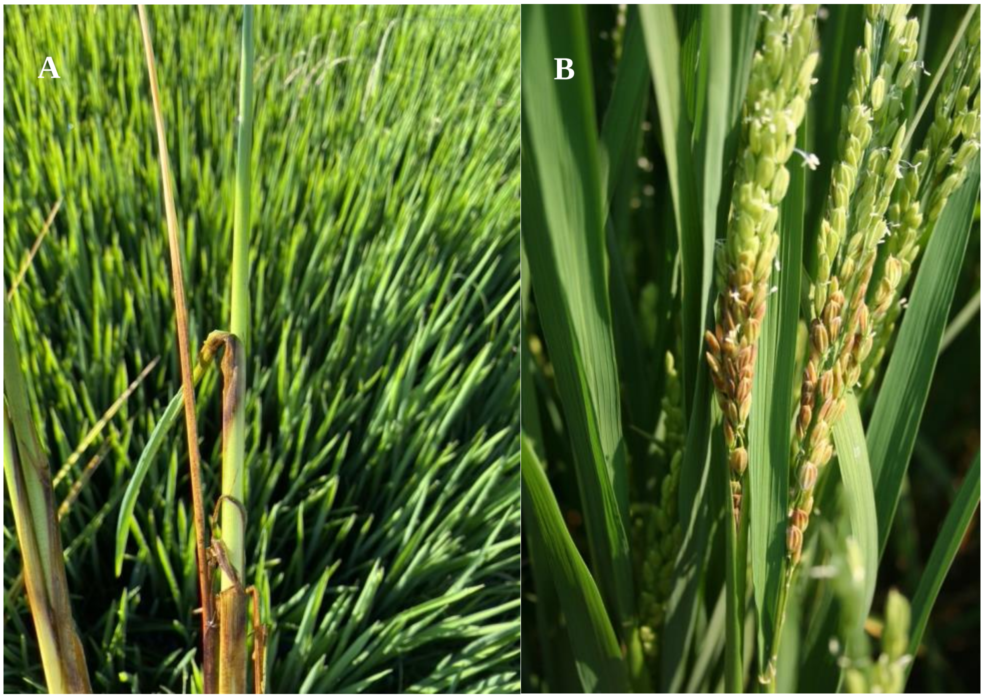

Figure 7. A. Ear blight caused by *Nigrospora oryza* on M-211 rice, Butte County, 2022. B. Panicle discoloration caused by *Nigrospora oryza* on CM-203, Yolo County, 2021.

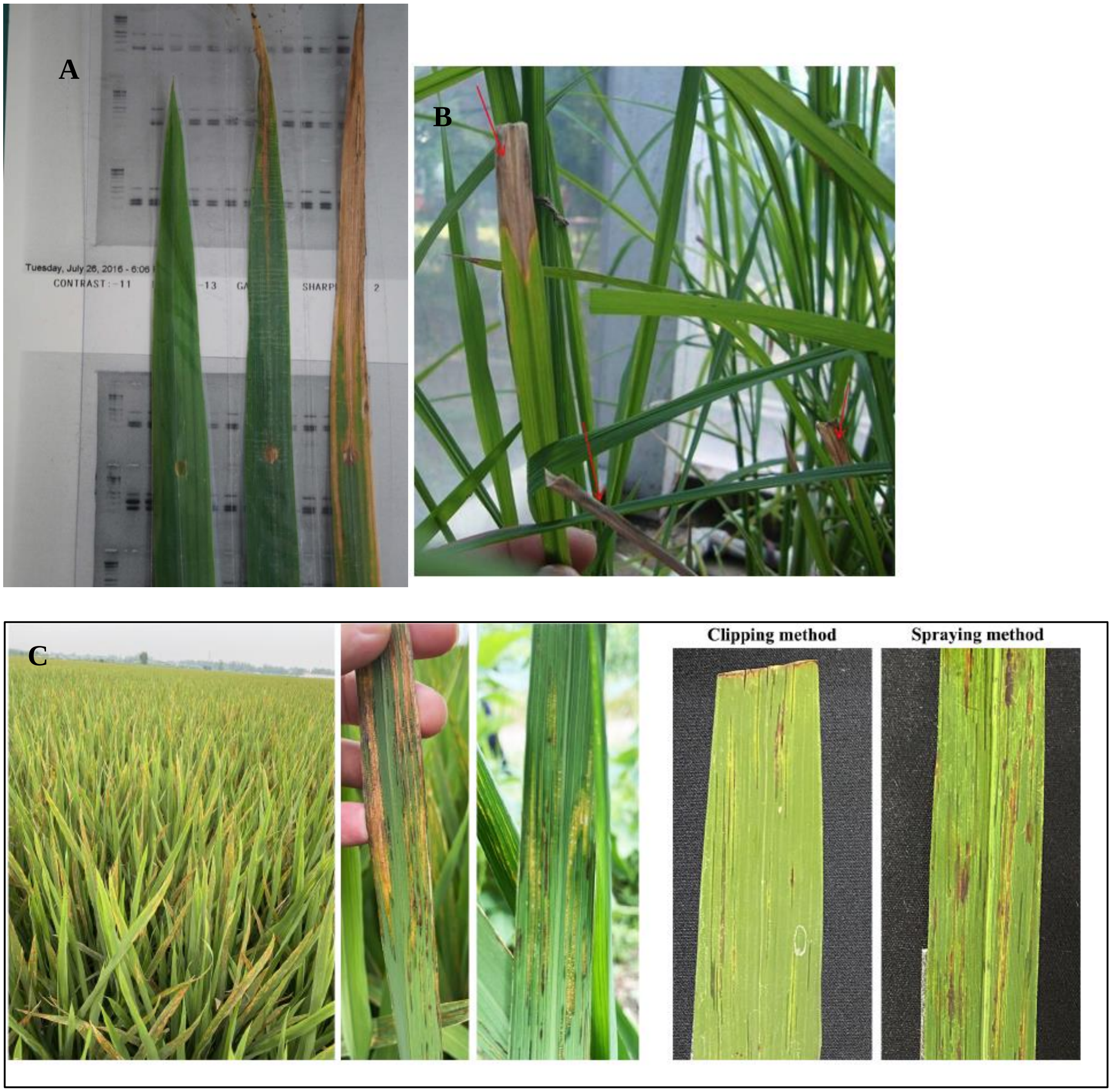

Figure 8. Symptoms of leaf blight caused by *Pantoea ananatis*. A. Yellow stripes on leaves that turn brown as disease progresses. B. Water-soaked lessions of leave tips. C. Water-soaked streaks. (A from Kini et al., 2016, Plant Disease 101 (1): 241; B from Mondal et al., 2011, Plant disease 95 (12): 1582; C from Xue et al., 2021, Plant Disease 105 (8): 2078-2088).