2004 GRAND PRAIRIE ECOSYSTEM PROGRESS REPORT

AGRONOMICS

A total of 18 varieties, hybrids, and experimental lines were evaluated at RREC in the Grand Prairie Ecozone. DD50 thresholds were developed for 4 new varieties, 5 hybrids, and one experimental line. The 2004 DD50 study was conducted at RREC over four seeding dates (April 1, April 29, May 21 and June 7). April seeding resulted in higher yields than later seeding in May or June for all lines. However, yields for some varieties were better when planted in mid-April than early April. Francis and Wells among the best varieties seeded late. The hybrids, CL XL8, XP710, and XP712 achieved the highest yields overall. Overall the highest yielding cultivars were the five hybrids. However, Francis was the fourth highest cultivar, outperforming CL XL8 and XP 716. Francis was the best conventional variety while Ahrent, Wells and Cocodrie also yielded very well. The best conventional varieties planted in June were Francis, Wells, and Bengal. The highest yielding hybrids planted in June were XP 710 and XP 712.

A total of 25 varieties, hybrids, and experimental lines were evaluated at 4 locations in the Grand Prairie Ecozone. The hybrids, XP 723 and XP 710, were typically the highest yielding entries in the study. Francis was the highest yielding entry at one location and was the highest yielding conventional at almost all locations. Wells, Cheniere, and Medark were other conventional varieties with the good yields across several locations. Development of computer-assisted variety selection program is currently underway.

Studies were conducted at RREC to evaluate the effects of row spacing, seeding rate, and variety on grain yield. As observed in other locations, 7 inch row spacing resulted in higher yields than 10 inch row spacing, with an average yield difference of 22 bushels per acre. Adjusting seeding rates were not typically successful at overcoming yield reductions observed with 10-inch row spacing. Banks, Cybonnet, and Francis yields were all reduced from wider row spacing. Optimum seeding rates for these varieties generally ranged from 67.5 to 90 lbs/acre. An economic analysis using partial budgeting and enterprise budgets was conducted. At this location, the 7-inch row spacing consistently produced higher net returns than the 10-inch spacing regardless of se ding rate. At the highest seeding rate, net returns decreased substantially. Input from producers suggests that broadcast seeding should be included in future studies.

On-farm seeding rate studies were conducted at one location in the Grand Prairie ecological zone. The highest yield was obtained by Francis and Wells across all locations, followed by Wells, Medark, Bengal, and CL 161. The results suggest that seeding rates may be reduced to 67.5 lbs/acre for CL 161, Medark, Bengal, Wells, and Francis with little effect on grain yield. Yields of CL 161 were reduced to a greater extent than the other cultivars when the seeding rate was reduced to 45 lbs/acre. Milling yields were not affected by seeding rate.

Aerial imagery was acquired every two weeks by a small aircraft. The resolution of the image was approximately two meters. During the growing season, the rice fields were scouted weekly for signs of stress that may change the biomass zones of plant health. The imagery did make scouting more efficient. Stress from sheath blight, blast dieses, soil characteristics, and irrigation deficiencies have often correlated well with the imagery. We have found that infrared imagery is a very effective scouting tool if timed correctly. Over the past three years, our studies have shown that the optimum period to acquire imagery for rice is between the flag leaf and boot stages, which corresponds to scouting periods indicated by the rice DD50 program. When the

rice DD50 program recommends scouting for diseases, it is the optimum time to acquire an image.

SOIL FERTILITY/NUTRIENT MANAGEMENT

A major strength of the rice-soil fertility research program has been the delineation of N fertilizer response curves for promising new rice cultivars. The rice cultivars and experimental varieties studied in 2004 were: 'Cheniere, Cybonnet, Medark, Arkansas experimental line RU0101093, and the RiceTec hybrids Clearfield XL8, XP 710, XP 716, and XP 723. Cheniere, Cybonnet, Medark, and RU0101093 required 120 lb N/acre to achieve maximum grain yield on silt loam soils of the Grand Prairie. The RiceTec hybrids usually achieved maximum grain yield on the silt loam soils when 90 lb N/acre was applied preflood and 0 to 30 lb N/acre was applied at late boot. The late boot N application of 30 to 60 lb N/acre seldom resulted in a grain yield increase, but this is typical in Arkansas. The late boot N application is recommended on the hybrids mainly to minimize lodging and secondly to increase rice grain yield.

Several studies were conducted on the influence of tillage, soil texture and urease inhibitor on N loss, N uptake and rice grain yield. The first year found that rice grain yields can be significantly reduced and > 30% of the preflood applied urea N can be lost via ammonia volatilization on silt loam soils if it requires more than 5 days to get a flood across a field. Conservation tillage slightly aggravates ammonia volatilization loss and causes a grain yield decrease, but this can probably be compensated for by increasing the preflood N rate by 10 lb N/acre. Use of Agrotain can decrease ammonia volatilization losses of urea on silt loam soils from > 30% to < 10%. Ammonium sulfate worked as well as Agrotain in decreasing ammonia volatilization losses of preflood N, but costs appreciably more than Agrotain. A study on the utility of Agrotain and ammonium sulfate as preflood N sources when application has to be made to a muddy soil showed both N sources were greatly superior to urea.

A soil test to measure N mineralization has long been sought to improve N fertilization recommendations. The first year of laboratory research has indicated that there are at least four methods (i.e., Illinois N soil test, permanganate/acid, and UV and NIR spectroscopy) under study that show promise in predicting N mineralization on silt loam soils. Clay soils on the other hand appear to be more difficult for the methods to predict N mineralization at this time. Further research will indicate the utility and accuracy of the methods under study.

Studies on the value of poultry litter as a fertilizer for non-leveled silt loam and clay rice soils has found after the first year that the N contained in poultry litter is not taken up very efficiently, but the P and K is taken up well by the rice. Because poultry litter has to be applied preplant the N contained in the litter has time to be nitrified in the weeks prior to flooding and this nitrate is lost via denitrification soon after flooding. The N from poultry litter applied preplant to delay, flood rice was only taken up by the rice with a 5 to 25% efficiency compared to typical preflood urea-N uptake of 60 to 80% efficiency. Conversely, initial studies indicate the P and K contained in poultry litter are as available to rice as commercial P and K.

Seven K rate studies and five P rate and time of application studies were established during 2004 on silt loam and clay soils. Significant yield increases due to K fertilization were measured at two grower sites that will help improve K fertilizer recommendations. Preplant applied P fertilizer was sufficient at most locations; however, on silt loam soils when the pH was excessive (i.e., >7.5) preflood P fertilization was best.

IRRIGATION

Studies were implemented at RREC to determine effects of early flood removal on grain and milling yields of Bengal, Medark, Cocodrie, and Wells. Draining 14 days after 50% heading significantly reduced grain yields compared to normal drain timing (28 days after 50% heading) by all varieties during 2004. Although yields of all cultivars were significantly reduced by early draing, Wells appears to have been the most tolerant to early draining. No benefit was observed for holding the water on the medium grain varieties for an additional 7 days. Head rice yields were not affected by drain date.

On-farm studies evaluating Multiple Inlet rice Irrigation were conducted at 11 locations in the Grand Prairie Ecozone. Most producers reported less water usage as the result of Multiple Inlet Irrigation. The savings in water where direct comparisons were available ranged from 2% to 28%. Two locations reported slightly more water usage.

WEED MANAGEMENT

A total of 79 red rice collections from 2003 around the state were grown and characterized for plant type, flowering time and seed production potential on Grand Prairie test sites. The collections varied widely in size, flowering dates and maturity date with DNA analysis planned for 2005.

The labeled rate of glyphosate provided up to 98% control of 136 red rice collections but 38 samples had surviving plants that produced seed. The same rate of glyphosate applied 30 days later provided better control, with only 4 samples having survivors that produced seed. The 1X rate of glufosinate resulted in 805 control with 69 samples surviving to seed while the same rate applied 30 days later was less effective and most samples survived to seed. The 1X rate of imazethapyr applied early only had 15 samples go to seed but this rate was not as effective when applied late. It appears that some red rice populations may have different tolerance to the three herbicides.

CL121 always flowered earlier than CL161, regardless of planting date and resulted in more overlap between red rice flowering and CL121 flowering than with CL161 flowering. CL161 planted April 16 and April 20 had more overlap in flowering with red rice than when planted April 29 or during May. Seed was collected for outcrossing rate determination.
Several herbicides used in soybean production were found to provide promising control of red rice, in anticipation of the development of herbicide resistant red rice populations.

A total of 80 applied weed management trials were conducted in 2004 with 52 in the Grand Prairie, 3 in the White River and 25 in the Delta Ecozones. Newpath and Beyond herbicides performed well at all locations for red rice and many other grass and broadleaf weeds control. Newpath did not control hemp sesbania, eclipta, and northern jointvetch well but tank mixes with Grandstand, Aim, Permit and Duet were effective. Command Pre in the Newpath system provided additional grass control and made Newpath timing more flexible. Newpath and Beyond herbicides performed well in a reduced tillage study at Lonoke and Beyond herbicide controlled barnyardgrass and broadleaf signalgrass in a non-red rice situation. These trials were planted to wheat after harvest for rotation study.

Grasp herbicide resulted in root pruning of rice at 3 test sites, which appeared to be somewhat variety related, however yield effect was not determined. Grasp appears to be similar to Regiment with some activity on various broadleaf weeds. Results on overall weed control were inconclusive.

Trials were started to evaluate control options for sicklepod, pigweed, groundcherry and other unusual broadleaf weeds in rice.

DISEASE MANAGEMENT

In the first year of funding, a controlled environmental screening protocol for *Pythium* resistance was developed. The results for the genotypes screened to date show that all lines had some reduction in stand count with the *Pythium* treatment. About 26% of the genotypes had stand counts in the inoculated treatment comparable to or better than those of the resistant control, indicating at least moderate resistance to the pathogenic *Pythium* isolate used. Another 26% of the lines tested had stand counts exceeding those of the susceptible control and cold resistant standard, but less than those of the resistant control, indicating some degree of resistance to the pathogen. The other 48% of the lines studied had extremely low stand counts in the inoculated treatment, indicating a high degree of susceptibility to this pathogen. A complicating factor is that some of these lines of rice appear to be less cold tolerant under these assays, a very low stand count in the uninoculated control under cold temperatures despite having exhibited a high percent germination. However, the majority of the lines with low stand counts in the inoculated medium are indeed very susceptible to damping-off by the *Pythium* isolate used in this study. Genotype reactions will be confirmed in the field at differing soil temperatures in 2005 at the Rice Research and Extension Center in Stuttgart.

A real-time PCR method to detect B. glumae in seed and plants was developed. Varieties LM-1 and Drew appeared to be resistant to *B. glumae* under greenhouse test condtions.

Flowering panicles of 5 rice varieties were inoculated with the blast fungus and various spots and blotches formed later on the seed. Very low levels (<1%) of seedborne *P. grisea* can result in blast in planted plots of M201 but higher levels appear to be necessary on Franics, Wells or Bengal. Blast was not noted in plots treated with azoxystrobin seed treatment until mid July. Lab work continued on isolation, growth and inoculation of the false smut fungus in culture and the greenhouse while strains of *B. glumae* were collected and stored for use in greenhouse experiments.

CL161 had numerous problems in the region, including neck blast, and reported yields were lower than expected. Francis was heavily damaged by neck blast in certain fields, despite $70/A use of fungicide and blast continues to "build up" in the region and has the potential to be worse in 2005. The "Mystery" root and crown rot disease in Arkansas and Lonoke counties was determined to be hydrogen sulfide toxicity. The URRN lines were evaluated for black sheath rot and stem rot in Lonoke County. Although the smuts were minor in our tests, flusilazole was evaluated but data were inconclusive. An unexpected shower following fungicide applications showed EC materials were not a rainfast as SC materials and 3 spray adjuvants tested did not affect fungicide performance.

Recommended fungicide treatment and high preventative treatment resulted in higher yields for Francis and CL161 at the Lonoke site but not at the Prairie co. site. There was no difference between the two systems, with recommended treatment cost $25/A and the preventative cost $70/A. Bengal and RiceTec CL-XL8 did not benefit from fungicides at either location. Chemical control trials for bacterial panicle blight was inconclusive due to low disease pressure.

INSECT MANAGEMENT

Rice water weevil traps were evaluated in 10 counties with one field exceeding the treatment threshold. Algae interfered with traps at one location and larvae were underestimated in fields without algae scum.

The impact of nitrogen on rice water weevil injury was not researched in 2004 and the impact of tillage practices on rice water weevil, rice stalk borer and grape colaspis was not determined because research plots did not emerge evenly due to bird damage and were not usable.

Wells was the least susceptible variety to stalk borer in field tests while Banks was very susceptible. MedArk was less susceptible than Bengal and Cybonnet was as susceptible as Cypress to the stalk borer. Even at rice water weevil levels of <10 per soil core, Banks suffered yield loss from root pruning.

There was no research completed on impact of natural armyworm damage.

Cocodrie lost 17 Bu/A with 30 RWW larvae/core; Francis 35 Bu/A with 35 larvae; Bengal 9 Bu/A at 37 larvae and Wells only 5 Bu/A with 32 larvae per core. Only Wells did not have a significant yield gain from insecticide treatment to control RWW in this trial.

A total of 1,560 samples from the Jackson and Clay counties, SEREC, NEREC, and RREC ARPT sites from 2003 were evaluated and data distributed to researchers. A total of 480 advanced breeding line samples from the RREC URRN in 2003 were evaluated and data distributed.

About 2300 samples collected from Riceland, Producers, and one independent rice buyer from the 2001 rice crop that had heavy rice stink bug damage have been evaluated now. A total of 74 lines (888 samples) from the USDA core collection have been evaluated for discolored kernels, kernel weights and measurements. Of 315 lines successfully planted in the field, only 139 lines (834 plots) were hand-cut due to observations noting that these lines were the only ones that had a good population of rice stink bugs.

Sweep net sampling captured more RSB at 9am and 7pm than at 1:30 pm while yellow pyramid traps and sweep net sampling of grass captured more RSB in field margins before and after rice heading than during rice heading. Trap catches increased to 20 bugs per trap in late September and then dropped to < 1 bug/trap after October 3.

There were relative differences in quantity of odors emitted by rice panicles and other grassy weed hosts for rice stink bugs compared to Amazon sprangletop, a non-host plant. Healthy rice panicles emitted trace amounts of cubebene but panicles at R5 emitted limonene and methyl salicylate after 2 days of stinkbug feeding. Barnyard grass and bearded sprangletop emitted various amounts of limonene and methyl salicylate while Amazon sprangletop emitted higher levels of limonene and caryophyllene than other hosts.

RICE QUALITY

Rice grain samples for the quality research were collected in all three ecosystems. Head rice yield was found to significantly vary across cultivars and harvest locations. This could be due to various factors including chemical composition of the kernel or a greater proportion of immature kernels. Lipids tend to decrease rice flour viscosity while proteins have an opposite effect. At the onset of storage, the proteins and lipids tend to neutralize each other as to their impact on peak viscosity is relatively equal. However, as storage progressed, proteins tended to impact viscosity a lot more than lipids. This explains the general observation that peak viscosity in rice flour will increase during the first year of rough rice storage. The implication for those in

the rice industry is that first degree of milling is crucial when flour is used as a thickening agent in food formulations. There may therefore be some applications for which broken kernels could be further milled to increase the quality of the flour produced. In addition, rice flour processors and users can count on an increase in flour viscosity as rice is stored for longer durations. During storage, proteins have a tendency to oxidize and to form strong intermolecular bonds, creating a strong network of protein that tend to make kernels stronger and less susceptible to breakage during milling. The implication for the rice industry could be important if a process that could rapidly oxidize these proteins (i.e., making kernels stronger) can be found.

A total of 72 lot samples of rough rice were collected from multiple locations in the three ecosystems. Samples were collected at three HMC levels (high - 22 to 24%; medium - 18 to 20%; and low - 14 to 16%) to determine: individual kernel MC distributions at the different HMCs (Completed); individual brown rice kernel dimensional distributions (Completed); breaking force distributions (40% completed); fissure counts (Completed); adsorption effects on fissure counts and head rice yields (50% completed); head rice yields (Completed); degree of milling (80% completed); paste viscosities (75% completed); brown rice lipid levels (10% completed); millability (10% completed); and equilibrium moisture contents (10% completed). Data loggers were utilized at each location and temperature and relative humidity were recorded from the 50% heading until the last date of harvest. The intention is to determine if nighttime air temperatures during the R6 growth stage are correlated to kernel property distributions.

ECONOMICS

The basic farm price and policy effects that are incorporated into the FLIPSIM representative farm models are based on the baseline projections of the Arkansas Global Rice Model. The model was used over the past year to evaluate the potential effects of trade policy reforms. Specifically, the model was simulated to evaluate the economic effects of: 1) elimination of domestic supports in the U.S., EU and Japan, 2) elimination of tariffs and tariff rate quotas (TRQs) in major rice importing nations, and 3) elimination of export subsidies by the EU. The results suggest that the major distortion in global rice trade is import protection such as tariffs and TRQs. These policies depressing export prices and inflate consumer prices in the importing nations, resulting in significantly less rice trade. These results suggest that it will be critical to the U.S. and Arkansas rice industry to seek expansion in market access through the reduction in rice import tariffs and expansion of TRQ quota levels. Additionally, an analysis of differential tariffs on rough and milled rice was conducted to examine the effects on the domestic rice milling industry. Current tariff differences, which favor the export of rough rice result in a reduction of approximately $80 million in rice milling activity annually in the U.S. Much of this cost is absorbed by rice producer cooperatives in the Arkansas.