

2005 GRAND PRAIRIE ECOSYSTEM PROGRESS REPORT

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AGRONOMICS

Seeding date studies were conducted at RREC, in the Grand Prairie Ecozone, to evaluate the performance of 20 rice varieties and hybrids to various seeding dates and to establish thermal unit thresholds necessary for the Rice DD50 Program. Across all seeding dates, Wells and Jupiter were the highest yielding conventional varieties. Wells and Cybonnet were among the most consistent when planted late. The hybrids normally yielded higher than all conventional varieties when planted early and tended to be more stable at later seeding dates.

A total of 41 varieties, hybrids, and experimental lines were evaluated at 7 locations in the Grand Prairie Ecozone during 2005. Across all locations, the two hybrids, XP 723 and XP 710, had higher yields than any of the conventional varieties and experimental lines. Jupiter, Wells, Cheniere, Francis, and Bengal were the highest yielding conventional varieties. Development of a computer-assisted variety selection program is currently near completion with an anticipated prototype version ready by mid-summer and the complete version online prior to the 2007 production season.

Studies were conducted at RREC to evaluate the effects of row spacing, seeding rate, and variety on grain yield. At RREC, Banks, Cybonnet, and Francis each yielded over 20 bushels higher when the row spacing was 7 inches compared to 10 inches. The broadcast seeded plots yielded approximately 10 bushels/acre less at RREC than the 7" row spacing drilled plots. Optimum seeding rates for these varieties generally ranged from 67.5 to 90 lbs/acre at all locations. 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 seeding rate. At the highest seeding rate, net returns decreased.

On-farm seeding rate studies were conducted at one location in the Grand Prairie ecological zone. Five varieties (Bengal, CL 161, Francis, Medark, and Wells) were evaluated at seeding rates ranging from 45 to 135 lbs/acre in 0.5 bushel increments. At each location, 67.5 lbs/acre was equal to the recommended 90 to 112 lbs/acre. Seeding rate recommendations have been reduced from 40 seeds/ft² to 30 seeds/ft² as the result of this research.

Multi-spectral aerial imagery has been shown to provide descriptive information about the plant biomass of rice. When enhanced, and then classified into a thematic map, the value of this imagery shows promise as a scouting tool. Areas of plant stress can be recognized but must be ground-truthed for identification. The objective of this project was to provide classified imagery for the fields enrolled in the RRVP to be used as scouting tool and to record field conditions for later assessments. A second objective of this work was to provide an educational component about the concepts of remote sensing to the farmer and county agent. A web site to view and download these images was developed. For 2005, there were 19 fields in the remote sensing program with 2 images acquired early and at midseason. R

For the first time in the rotation/tillage study, yields from no-till rice plots were higher than conventional-till during 2005 at the Rice Research and Extension Center. No-till plots also did not have to be flushed during the dry period following planting to establish stand while conventional-till plots were flushed and stand was lost as a result. 'Cybonnet' suffered more stand loss than 'Wells' after flushing to encourage emergence. No significant yield difference

was noted between nitrogen rates of 100 lb N per acre and 150 lb N per acre in any of the tillage systems. No-till plots were drained earlier since soil moisture levels remained higher than in conventional-tilled plots. No-till plots had less soil resistance than conventional-tilled plots in all rotations. Rice and no-tillage management resulted in the highest soil aggregate stability. Less soil resistance and increase soil aggregate stability indicate better soil quality. A 4 year Clearfield rice – soybean rotation study was completed in 2005 with results being summarized. Results support current Clearfield rotation recommendations.

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 2005 were: 'Banks', 'Cheniere', Clearfield 'CL131', 'Cybonnet', 'Jupiter', 'Spring', 'Trenasse', USDA experimental line '4484', and the RiceTec hybrids 'XP721', 'XP723', 'XP728', 'XP729', Clearfield 'CLXP730', 'XP731', and 'XP732'. Banks, Cheniere, CL131, Jupiter and Trenasse usually required 90 lb N/acre to achieve maximum grain yield when grown on silt loam soils and 150 to 180 lb N/acre when grown on clay soils. Cybonnet and Spring typically required 120 lb N/acre to achieve maximum grain yield when grown on silt loam soils and 180 lb N/acre when grown on clay soils. The RiceTec hybrids usually achieved maximum grain when 90 lb N/acre was applied pre-flood 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.

Studies on the utility of Agrotain for use on muddy silt loam soil at pre-flood N application time have shown this urease-inhibitor-treated urea fertilizer to be superior to urea alone. Ammonia volatilization was much greater for urea compared to Agrotain whether they were applied to a dry soil or a muddy soil. In addition, ammonia volatilization was much greater when the N sources were applied to a muddy soil compared to a dry soil. Surprisingly, ammonia volatilization was greater for urea applied to a dry soil than for Agrotain applied to a muddy soil. When the N sources were applied to a dry soil 1 or 3 days prior to flooding urea and Agrotain produced similar grain yields, but when the flood was delayed for 5 to 7 days Agrotain produced grain yields higher than urea. When the N sources were applied to a muddy soil 3, 5 or 7 days prior to flooding Agrotain produced much higher grain yields compared to urea.

Data for N fertilizer infiltration and downward movement in a Dewitt silt loam when the flood water is applied revealed a trend of immediate and deeper movement of N in the urea form as compared to the ammonium form. The data showed urea moved 0 to 8 cm below the soil surface and ammonium only moved 0 to 4 cm. Thus, urea would be deeper in the soil and less prone to nitrification/denitrification loss compared to ammonium after flooding.

A N soil test that predicts N mineralization in rice soils has long eluded researchers. The objective of this study was to compare proposed analytical methods for predicting N mineralization with the NH_4^+ -N mineralized after a 14 d anaerobic incubation on Arkansas silt loam rice soils. The proposed methods were i.) acid oxidation, ii.) ultraviolet absorbance of NO_3^- - reduced and unreduced soil extracts, and iii.) diffusion of amino sugar-N using the Illinois Soil N Test. Linear regression models revealed that the acid oxidation procedure, the ultraviolet absorbance of NO_3^- - unreduced soil extracts, and the diffusion of amino sugar-N using the

Illinois Soil N Test all accurately predicted the NH_4^{+} -N mineralized in silt loam soils of eastern Arkansas after a 14 d anaerobic incubation. In 2006, we will take the methods to the field.

Studies on the value of poultry litter as a fertilizer for non-leveled silt loam and clay rice soils have found after two years of study 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 be taken up by the rice with a 5 to 25% efficiency compared to typical pre-flood urea-N uptake of 60 to 80% efficiency. Conversely, the P and K contained in poultry litter are as available to rice as commercial P and K.

Six K rate studies and three P rate and time of application studies were established during 2005. Rice showed no significant response to P fertilization. Significant yield increases due to K fertilization were measured at four of six sites. Responsive sites had soil-test K of 64 to 94 ppm. Unresponsive sites had soil-test K of 94 and 164 ppm K. Additional sites are needed to verify the correlation between soil-test K and rice yields response to K fertilization and to calibrate the appropriate K rate for various soil-test K. The long-term K-fertilization study, conducted at the PTBS, also showed large and significant rice yield increases from K fertilization. The focus of future field tests will be on K fertilizer calibration studies.

IRRIGATION

Studies were implemented at RREC (Grand Prairie Ecozone) 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 20 bu/acre compared to normal drain timing (28 days after 50% heading) for all varieties during 2005. No significant 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 in the 2005 study at this location.

On-farm multiple inlet irrigation trials were conducted in Lonoke and Monroe counties within the Grand Prairie Ecozone. Overall, this irrigation method reduced irrigation water use by 20% and saved considerable labor during the growing season. Measurements on one field showed a savings of \$17.50 per acre in reduced pumping costs as well. During 2005, 7 remote pump electronic monitors were also installed for testing.

A model was developed to predict safe draining dates for rice based on predicted water use at different growth stages; predicted thermal time intervals between growth stages; and available water for rice plants in the soil once drained. The model was tested at the RREC and in a grower field near Gillett using 'Wells' rice. At the RREC, the model predicted safe draining at 14 days after 50% heading when 80% of plants had 1 brown seed on the main panicle. Yield from this treatment was 191 bu/A while yield from the control plot that was drained at 28 days after 50% heading yielded 192 bu/A – no significant difference. At the Gillette site, the model predicted treatment was drained 10 days after 50% heading while control treatments were drained 23 days after 50% heading. Yields were 228, 213 and 217 bu/A respectively, again no significant difference.

WEED MANAGEMENT

Red rice biotypes continued to be classified based on ALS gene sequence with 5 distinct types sequenced. Some types had the same sequence as 'Bengal' rice while others had up to 11 mutations in this gene. A collection of red rice types from around the state were tested for natural tolerance to glyphosate, glufosinate and imazethapyr. Most types were susceptible to these herbicides but a few appeared to have limited tolerance to imazethapyr. Glyphosate and glufosinate were most active when applied during the tillering stages of red rice, rather than seedling stages. CL 161 planted between Apr 16-20 at the RREC during 2005 had the highest synchrony of flowering with red rice. Outlook, Dual Magnum and Sencor + Dual Magnum herbicides provided 95-100% control of Newpath-resistant red rice in soybean rotation experiments, with Dual + Treflan providing 90-100% control. There was no carry-over injury to conventional rice in these studies.

There were 31 herbicide studies conducted during 2005 near Lonoke and 18 studies at the RREC in the Grand Prairie Ecozone. These included multiple herbicide program approaches for Grand Prairie weed complexes in rice, several studies on difficult-to-control weed problems like ducksalad, smartweeds and certain other broadleaf weeds, and increased efforts on Clearfield weed control systems. In the latter, there were 5 studies on the use of Beyond herbicide in support of the Clearfield system. In addition to weed control, rice tolerance studies to Grasp and glyphosate were conducted. Because Permit herbicide was sold to another company and certain label changes are imminent, increased efforts to evaluate Permit in rice at new timings were initiated. Red rice control work at the RREC using Newpath and Beyond programs continues to look very good while ClearPath (Facet + Newpath) is in its third year of evaluation.

DISEASE MANAGEMENT

Cold-tolerance and stand trials were planted at the RREC in Mid-February, Mid-March and Mid-April – and included 42 previously identified rice lines with and without fungicide seed treatments. Results indicated that cold-tolerant rice lines have the best stands and do not benefit from the use of fungicide seed treatments. There were 12 lines identified in the field tests previously identified as resistant to Pythium that performed well without fungicide seed treatment protection when planted very early. Cybonnet was the only commercial cultivar tested that showed both resistance to Pythium and no response to fungicide seed treatments in the field.

Seeds infected by the rice blast pathogen were shown to develop infected seedlings that in turn results in blast disease in the field resulting in a new generation of infected seeds. The level of infected seedlings that arise from infected seeds is influenced by the resistance of the cultivar, the initial amount of infected seeds in a lot, and environmental conditions at and shortly after planting. Greenhouse inoculations with the false smut fungus were not successful in 2005. False smut spores were shown to germinate on young roots of rice and the fungus may be able to infect root tissue under laboratory conditions. Some infected seedlings died. A DNA-based PCR protocol was developed to detect the fungus in infected plants.

Bengal grain and seed lots collected from cooperators during 2004 continued to be screened using a DNA PCR protocol developed to detect the bacterial panicle blight pathogen in seed. A second set of samples were collected during the fall of 2005 for continuing analysis. Preliminary results at Lonoke showed consistent detection of infected and non-infected seed lots. Validation of these results and greenhouse/field verification will be done in 2006.

Sheath blight and stem rot were major problems in the state during 2005, and both kernel smut and false smut more serious than 2004. However, rice blast disease was minimal due to the persistent drought in the region. Nevertheless, disease monitoring showed that at least 12 'Banks' rice fields suffered some damage due to neck blast from the I-40 region in the Grand Prairie counties of Lonoke and Prairie, as well as scattered throughout northeast Arkansas. This damage indicates that blast race IE-1k has spread through much of the state after being detected in at least one field in northeast Arkansas during 2004. This resulted in 'Banks' rice no longer being considered a resistant cultivar in our recommendations. Disease monitoring showed that 'Francis' was heavily damaged by bacterial panicle blight in at least 2 fields in the Grand Prairie. Mystery elongated plants were found for the second year in the Grand Prairie at very low levels – the cause is not known. The rice pest survey was conducted for the second year with over 160 samples collected in the Grand Prairie region. Eyespot, aggregate sheath spot and bordered sheath spot were confirmed in this region during 2005. None of these diseases have been officially reported in Arkansas. White tip nematode symptoms were observed in most 'Wells' fields in the region, but at non-economic levels, however severe white tip nematode symptoms were observed in breeding nursery lines at the RREC. The plant growth regulators Apogee and Palisade were shown to eliminate lodging in Koshi-hikari rice in test plots in Lonoke County but also reduced yield up to 25%. Results from area disease monitoring plots were used to update disease reactions for 30 cultivars and advanced lines, with pertinent information published in the 2005 ARPT report. The URRN was screened for stem rot, black sheath rot and bacterial panicle blight in Lonoke County. Pressure was heavy and consistent for all three diseases at this location. Several new fungicides were evaluated on rice for kernel and false smut control, however disease was very minor. None of the products appeared to be phytotoxic. Spray adjuvants did not affect fungicide performance or phytotoxicity where tested. Fungicide trials at the Lonoke site showed 30-40 bu/A yield response when CL131 and CL161 were properly protected from sheath blight while Cheniere only showed a 10-15 bu/A response. High rates and early application timing were needed to completely protect CL131 and CL161 from the disease. CL131 was rated as susceptible as CL161, however yield potential of CL131 appeared somewhat higher when protected. Preventative fungicide trials at Lonoke County (not inoculated) showed no economic response to fungicides for CL161, Francis or Bengal cultivars but did show a significant increase in milling quality for CL XL8 hybrid rice.

INSECT MANAGEMENT

Field testing of the aquatic rice water weevil trapping system was completed. A field trial near Lonoke showed that Poncho seed treatment insecticide controlled grape colaspis injury to rice seedlings compared to a 56% stand loss in untreated plots. Yields for Poncho treated plots at this site showed 27 – 36 bu/A higher yields than untreated plots. Cruiser and Trebon insecticides were evaluated at the RREC for control of rice water weevil. Trebon was not effective but test procedures may have influenced this so tests will be repeated in the future. Cruiser provided 56% control of RWW while ICON provided 96%. Icon treated plots yielded 153 bu/A while Cruiser yielded 133 bu/A. Another experimental compound was also not very effective.

Rice grain samples continued to be evaluated for rice sting bug damage and other discolorations during 2005. Of 1248 grain samples collected, 588 were evaluated by the end of 2005 and results reported in the ARPT report. Another 480 samples were collected from advanced breeding line nurseries and samples from the 2005 Rice DMP plots around the state were also collected. Earlier samples from the DMP (2002) were completed during 2005. Evaluation of

grain samples from the USDA core germplasm collection continued in 2005 with 432 medium grain lines harvested and stored for later evaluation.

During 2005, 3 rice fields near Stuttgart and 3 in the Arkansas River Valley were scouted every 2 weeks for stinkbug and predator populations in the field margins. Traps using lures developed by this project were also installed and monitored. Several fields had margins continually mowed during 2005 resulting in low numbers of stink bugs and other insects caught. However, rice fields with mostly host grasses around the edges had the highest numbers of rice stink bugs compared to fields with non-host broadleaf weeds or grasses in the margins. Fields with the most diverse vegetation around fields had the highest number of predator insects. More rice stink bugs were collected and trapped when rice was heading than at other times. Rice stink bugs feeding on rice panicles or other host grasses for 3 days induced increased production of limonene, methyl salicylate and caryophyllene than found in healthy panicles or those fed on for 5 days.

RICE QUALITY

Rice grain samples for milling quality research were collected in all three ecosystems. Head rice yield ranged from 64.0 to 70.9% and was significantly different across varieties and location. This could be due to various factors including chemical composition of the kernel or a greater proportion of immature kernels. Amylose and protein content in rice was significantly different across varieties and locations. Rice harvested in Cleveland, MS (*Delta* ecosystem) showed the highest amount of amylose compared to rice from other locations. Rice from Newport, AR (*White River* ecosystem) showed the highest protein content. Pasting viscosity as well as cooked rice texture properties varied across ecosystems and cultivars. Cocodrie yielded less sticky and firmer rice than Wells across harvest locations. Significant variability was observed for rice constituents (amylose and proteins) across harvest locations. This variability translated in quality differences for rice flour and cooked rice. The effect of harvest location was in some instances as large as varietal differences.

Ambient air temperatures and relative humidities from the R6 growth stage to the last day of harvest were monitored and recorded at hourly intervals using HOBO sensors in all yield trials. A total of 84 lot samples were collected from the ecosystem locations indicated in Table 2 at HMCs ranging from 13.5 to 26.5%. The locations were selected based on sites at different latitude within the ecosystem that had the desired varieties/hybrids for property characterization. Individual kernel MC distributions at the three different HMC levels as well as field air temperature and relative humidity measurements were completed. Samples are being analyzed in the lab to determine the following: HRY; degree of milling; individual kernel dimensional distributions; breaking force distributions; adsorption effects on fissure counts and HRYs; paste viscosities (RVA); and brown rice lipid levels.

ECONOMICS

Rice budgets were completed for the 2006 crop year and posted on the UA Extension website (www.uaex.edu). Rice breakeven yields required to cover variable expenses were also posted for each crop budget for the following tenure arrangements: 1) full owner; 2) 25% crop-share; 3) 20% crop-share; and 4) 50% cost-share.

The UA and Texas A&M are working together to develop and maintain a database of representative Arkansas rice farms for farm policy analysis. The results highlighted differences

in farm economic viability among program crops. Most rice and cotton farms were in “poor” financial position, while most wheat, feed grain and oilseed farms were in “good” to “marginal” financial position.

An assessment of the 2005 Arkansas rice crop estimated total economic losses for Arkansas rice producers of \$214 million due to more irrigation, higher energy prices, prevented plantings and lower yields. Arkansas rice producers were reported to have prevented plantings of 21,513 acres and reduced yields that resulted in reduced returns of \$105 million. Higher energy prices have increased irrigation, machinery and fertilizer prices. An additional 4 acre-inches of irrigation water added to normal requirements of 30 acre-inches was assumed. In areas where ground water is pumped from deeper wells, the estimated additional production cost in 2005 was \$90.22/acre as a result of higher energy prices. In areas with better ground water conditions, higher energy prices are estimated to have increased production costs by \$63.33/acre.

Economic analyses have been conducted on the following Arkansas Rice Research Board funded projects: Variety X Nitrogen Study of Conventional and Hybrid Rice, Midseason Nitrogen Timing Study, Influence of Nitrogen Fertilizer Source, Soil Moisture Study and Application time on Rice, Starter Fertilizer Study, On-Farm Agrotain Study, Nitrogen on Clay Soil, Northeast Arkansas Seeding Date Study, On-Farm Fungicide Trials, DD-50 Study, Commercial Rice Variety Performance and Disease Monitoring Program (DMP), Row Spacing Studies, Seeding Rate x Seeding Date Study, On-Farm Seeding Rate Studies, and the CoRoN X Fungicide Study.