# PROGRAM

## 108th ANNUAL RICE FIELD DAY

**JUNE 28, 2017**

***Dedicated to Dr. Steve Linscombe for his 35 years of hard work and commitment to the rice industry.***

**H. ROUSE CAFFEY RICE RESEARCH STATION**
**CROWLEY, LOUISIANA**

LSU AgCenter
Research · Extension · Teaching

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# H. ROUSE CAFFEY RICE RESEARCH STATION
# FIELD DAY PROGRAM

**JUNE 28, 2017**

**FIELD TOURS** **7:15 A.M. – 9:00 A.M.**

Rice Weed Control............ Drs. Eric Webster and Ben McKnight

Rice Breeding............ Drs. Steve Linscombe and Adam Famoso

Rice Pathology............ Drs. Don Groth and Clayton Hollier

Rice Entomology............ Drs. Michael Stout and Blake Wilson

Rice Hybrid Breeding/Drone Demonstration............ Dr. James Oard and Mr. Brady Williams

Rice Agronomy............ Drs. Dustin Harrell and Bobby Golden

*The last tour will depart no later than 9:00 A.M.*

**POSTER SESSION** **7:15 A.M. – 10:30 A.M.**

**PROGRAM** **10:45 A.M.**

Activities of the Louisiana Rice Research Board ............ **Mr. Jackie Loewer**
Chairman
Louisiana Rice Research Board

Rice Market Update ............ **Dr. Michael Deliberto**
Assistant Professor of Agricultural Economics
Department of Agricultural Economics and Agribusiness, LSU

USA Rice Update............ **Ms. Betsy Ward**
Chief Executive Officer
USA Rice Federation

Sustainability in USA Rice Production............ **Ms. Jennifer James**
Arkansas Rice Producer
Chairman, USA Rice Sustainability Committee

Remarks ............ **Dr. William B. Richardson**
Vice President for Agriculture
LSU AgCenter

**Dr. B. Rogers Leonard**
Associate Vice President
LSU AgCenter

**BENEDICTION**

**LUNCHEON**

# 2017 Rice Field Day
# Dedicated to
# Dr. Steve Linscombe

On behalf of the faculty and staff of the H. Rouse Caffey Rice Research Station, we would like to extend to you a warm welcome to our annual rice field day that is dedicated to Dr. Steve Linscombe.

Steve is a native of Gueydan, Louisiana, and is married to Judy Linscombe of New Orleans. He received his B.S. in 1976 and M.S. in 1979 both from Louisiana State University. He attended Mississippi State University where he obtained his Ph.D. in Agronomy-Plant Breeding and Genetics in 1982. Steve has been working as a scientist within the LSU AgCenter for 35 years. He served as the statewide extension rice agronomist for the Louisiana Cooperative Extension Service the first six years, 1982-1988. Since 1988, he has led the rice variety development efforts at the Rice Research Station. In this position, he is directly responsible for the development of new superior conventional long- and medium-grain types, as well as Clearfield long- and medium-grain varieties. As principal investigator, he has received in excess of $17 million in grant funds during his tenure at the Rice Research Station to support his research efforts. He has extensively published his work as both senior and co-author in more than 350 publications of which 72 are refereed. During his tenure, there have been 33 new improved rice varieties developed and released from the LSU AgCenter's rice breeding program. The varieties developed by this program have dominated the southern U.S. rice acreage over the last 20 years. The average rice yield in Louisiana has increased from 4,500 lb/acre in 1988 to an estimated 7,500 lb/acre in 2014. While all of this increase is not attributable to genetic improvement, a very large portion of it is. A conservative estimate on the value of these varieties to the U.S. rice industry is well over $1 billion.

Over his successful career, Steve has released the following 33 rice cultivars.

| | | |
|---|---|---|
| 1991 | Lacassine | Long |
| 1992 | Bengal | Medium |
| 1992 | Cypress | Long |
| 1994 | Jodon | Long |
| 1995 | Dellrose | Long (Aromatic) |
| 1996 | Lafitte | Medium |
| 1998 | Cocodrie | Long |
| 1999 | Dellmati | Long (Aromatic) |
| 2000 | Earl | Medium |
| 2001 | CL121 | Long |
| 2001 | CL141 | Long |
| 2002 | CL161 | Long |
| 2003 | Cheniere | Long |
| 2003 | Pirogue | Short |
| 2004 | Ecrevisse | Short |
| 2005 | CL131 | Long |
| 2005 | Jupiter | Medium |
| 2005 | Trenasse | Long |
| 2008 | Catahoula | Long |
| 2008 | CL151 | Long |
| 2008 | Neptune | Medium |
| 2009 | CL111 | Long |
| 2009 | CL261 | Medium |
| 2009 | Jazzman | Long (Aromatic) |
| 2010 | Caffey | Medium |
| 2010 | CL152 | Long |
| 2010 | Jazzman-2 | Long (Aromatic) |
| 2012 | Della-2 | Long (Aromatic) |
| 2012 | Mermentau | Long |
| 2013 | CL271 | Medium |
| 2015 | CL153 | Long |
| 2015 | CL272 | Medium |
| 2017 | PVL01 | Long |

He has received a number of significant awards and recognitions during his career. Included here:

| | | |
|---|---|---|
| 1995 | Recognized: | By the Louisiana Rice Growers Association for "Exceptional Accomplishments in Varietal Development and Outstanding Contributions to the Louisiana Rice Industry." |
| 1996 | Awarded: | United States Department of Agriculture Award for Superior Service - "For Personal and Professional Excellence in the Development and Release of Superior Rice Varieties that have Resulted in Increased Income to the Rice Industry and Improved Quality for Consumers." |
| 1996 | Awarded: | First Mississippi Corporation Award of Excellence for Outstanding Work in the Louisiana Agricultural Experiment Station. |
| 1997 | Recognized: | By the Progressive Farmer Magazine as "Man of the Year in Louisiana Agriculture." |
| 1997-1998 | Selected and Participated: | USA Rice Federation Rice Leadership Development Program. |
| 1998 | Awarded: | Distinguished Rice Research and Education Award by the Rice Technical Working Group. |
| 1999 | Awarded: | Endowed Professorship - American Cyanamid Professorship for Plant Genetics, Breeding, and Variety Development. |
| 2001 | Awarded: | Friend of the Farmer Award by Riceland Foods. |
| 2003 | Awarded: | Tipton Team Research Award by the LSU AgCenter. |
| 2006 | Awarded: | Distinguished Rice Research and/or Education Award by the Rice Technical Working Group. |
| 2007 | Awarded: | USA Rice Federation Lifetime Achievement Award. |
| 2009 | Awarded: | 2009 International Rice Festival Honoree - 73rd International Rice Festival. |
| 2009 | Awarded: | 2009 Rice Researcher of the Year - Cotton/Rice Conservation Tillage Conference. |
| 2012 | Awarded: | Doyle Chambers Research Award by the LSU AgCenter. |
| 2015 | Awarded: | Tipton Team Research Award by the LSU AgCenter. |
| 2016 | Awarded: | Louisiana Agricultural Consultants Association Hall of Fame. |
| 2016 | Awarded: | Distinguished Rice Research and Education Team Award by the Rice Technical Working Group. |
| 2016 | Awarded: | Rice Industry Award - Rice Outlook Conference. |

Steve will officially be retiring on October 1, 2017. Words cannot express how deeply he will be missed by the faculty and staff of the H. Rouse Caffey Rice Research Station, the LSU AgCenter as a whole, and the entire rice industry. Thank you Steve for all of your hard work, dedication, and commitment to the rice industry.

# RICE WEED MANAGEMENT

*Eric Webster, Ben McKnight, Sam Rustom, Gustavo Teló, Matt Osterholt, and Connor Webster*

**Interactions with Provisia Herbicide plus Herbicides with Broadleaf Activity Mixtures.** The active ingredient in Provisia is quizalofop, and this herbicide is only active on grass species. Studies were conducted at the H. Rouse Caffey Rice Research Station (HRCRRS) and at the Northeast Research Station (NERS). At 15 and 30 days after treatment (DAT), weedy rice and barnyardgrass were controlled 88 to 99% when treated with Provisia at 15.5 oz/A. Barnyardgrass treated with Provisia mixed with Grasp, Grasp Xtra, and Regiment was below 50% control at 15 and 30 DAT; however, Permit, Halomax, Strada Pro, League, and Londax mixed with Provisia provided similar barnyardgrass control compared with Provisia alone. All of the ALS products were less antagonistic to Provisia when applied to weedy rice. Similar results were observed on conventional rice lines also evaluated in this trial. Another trial was conducted to evaluate mixtures of Provisia with herbicides with contact activity. Herbicides used to mix with Provisia in the contact trial were Aim, Bolero, Basagran, propanil, or Sharpen. Antagonism was observed when Provisia was mixed with propanil at 3 qt/A at 10 and 24 DAT. At 24 DAT, barnyardgrass control decreased from 93% with Provisia applied alone to no control when Provisia was mixed with propanil. Red rice control decreased to 80% when treated with Provisia plus propanil. Little to no antagonism was observed with the other contact herbicides mixed with Provisia. Another study evaluated the application of Provisia at 7, 3, 1, and 0 days prior to a RiceBeaux application or followed by Provisia at 1, 3, and 7 days after a RiceBeaux application. At 16 DAT, no antagonism was observed for barnyardgrass control with Provisia applied prior to RiceBeaux; however, when applied 1 or 3 days after a RiceBeaux application, control decreased 47 and 31%, respectively. When Provisia was mixed with RiceBeaux at 0 days, antagonism was severe with a 55% reduction in barnyardgrass control compared with barnyardgrass treated with Provisia alone with 96% control. If a Provisia application was delayed for 7 days after a RiceBeaux application, no antagonism was observed. In all of the trials, a second application of Provisia was needed to overcome antagonism.

**Broad Spectrum Weed Control with the Dow Herbicide Loyant.** Loyant is the new herbicide currently under development by Dow AgroSciences. Loyant is projected to have a full label in the second half of 2017, which will allow the use of this herbicide to occur for the first time during the 2018 growing season. The mode of action of Loyant is similar to 2,4-D and Grandstand; however, the specific mode of action of this herbicide is slightly different than those two herbicides. For a herbicide with auxin activity, one would not expect activity on grass and sedge weeds; however, Loyant has excellent activity on barnyardgrass, rice flatsedge, yellow nutsedge, hemp sesbania, Indian jointvetch, grassy arrowleaf, creeping burhead, ducksalad, and many other weeds. Loyant has little to no activity on Texasweed. The use rate of this herbicide will be 1 pt/A with the addition of a methylated seed oil. Long-grain rice cultivars have excellent tolerance of Loyant; however, medium-grain rice and hybrids are slightly sensitive. Rice grown on soil that has been recently land leveled should also be avoided.

**Evaluation of Experimental Herbicide - benzobicyclon (GWN-10235).** Benzobicyclon is one of many experimental herbicides this program has evaluated in recent years. Benzobicyclon is a new herbicide for U.S. rice production that works on susceptible weeds through HPPD inhibition, a mode of action not currently labeled for rice in the United States. Benzobicyclon must undergo a conversion to render the active herbicide and must be applied directly into flood irrigation water to facilitate this conversion and subsequent activity on susceptible weeds. This herbicide has excellent activity on troublesome, early-season ducksalad infestations in water-seeded rice. A study was conducted for four years, 2013, 2014, 2015, and 2016, to evaluate different rates of benzobicyclon on common Louisiana rice weeds. No rice was grown in these field studies in an effort to encourage maximum stands of naturally occurring weeds in the study area. Galvanized metal rings, 3-ft diameter by 1-ft tall, were installed in the field to contain benzobicyclon treatments, and each ring served as an individual plot. Benzobicyclon was applied at 1, 2.1, 4.2, 6.3, 8.4, 16.9, 25.3, 33.7, and 42 fl oz product/A. Ducksalad biomass was reduced 87% compared to the nontreated when treated with 2.1 oz/A, and Indian toothcup biomass was reduced 78% compared to the nontreated following 8.4 oz/A treatment. Other studies have demonstrated benzobicyclon activity following treatment with higher rates on aquatic weeds that become troublesome in crawfish/rice rotational systems including *Ludwigia spp.*, cattail, and grassy arrowhead.

**Management and Competition of Nealley's Sprangletop.** Clincher and RiceStar HT were evaluated at the HRCRRS for control of Nealley's sprangletop. Clincher was applied at 13, 15, and 20 oz/A, and RiceStar HT was applied at 13, 17, and 24 oz/A at a pre-flood and post-flood timing. Nealley's sprangletop densities were low with 3 to 5 plants/yd$^2$. RiceStar HT and Clincher controlled Nealley's 89 to 95% at 15, 30, and 45 DAT. Previous research has shown that high densities, greater than 50 to 100 plants/yd$^2$ of Nealley's sprangletop is more consistently controlled with RiceStar at 24 oz/A.

**Managing Red Rice Outcrosses and Hybrid Rice Volunteers.** A long-term study was established on a grower location in 2013 to evaluate the management of red rice outcrosses and/or hybrid volunteers often referred to as weedy rice. The four-year study evaluated five rotations including the use of Provisia rice in 2014 and 2015. The rotations used were: **Rotation 1)** Roundup Ready® (RR) soybean (2013)/Provisia rice (2014)/RR soybean (2015)/Clearfield (CL) hybrid rice (2016); **Rotation 2)** Fallow (2013)/Provisia rice (2014)/RR soybean (2015)/CL hybrid rice (2016); **Rotation 3)** CL hybrid rice (2013)/ Liberty Link (LL) soybean (2014)/Provisia rice (2015)/CL hybrid rice (2016); **Rotation 4)** RR soybean (2013)/LL soybean (2014)/RR soybean (2015)/CL hybrid rice (2016); **Rotation 5)** RR soybean/CL hybrid rice (2014)/RR soybean (2015)/CL hybrid (2016). Rotation 4 included three years of Roundup or Liberty Link soybean followed by Clearfield hybrid rice in 2016, and this rotation has been recommended to help manage weedy rice. At the end of the 2016 growing season, there were 20 weedy rice plants/A present in this rotation, compared with a high of 12,550 plants/A in 2014. Rotation 1 employed a soybean-rice-soybean-rice rotation with Provisia rice grown in 2014 and CL hybrid in 2016, and at the end of the growing season in 2016, there were 23 weedy rice plants/A. Rotation 5 employed the standard rotation of soybean-rice-soybean-rice with CL hybrid rice grown in the rice rotation and RR soybean in the soybean rotation. At the end of the 2016 growing season, there were 683 weedy rice plants in Rotation 5. This long-term study indicates the use of Provisia rice, along with proper rotation, can reduce weedy rice populations to manageable levels.

**Evaluation of Experimental Herbicides.** This project continues to evaluate several experimental herbicides. In 2016, this project evaluated 14 experimental herbicides. The experimental herbicides included several numbered compounds along with several herbicides that are close to receiving a full federal label. The experimental herbicide benzobicyclon has a great deal of potential for use on aquatic weeds. It continues to be an excellent herbicide for control of ducksalad and other aquatic weeds. Benzobicyclon will probably not receive a full label for use in mid-south rice until the 2018 growing season.

# RICE BREEDING

## Rice Varieties, Hybrids, and Advanced Experimental Lines

*Steve Linscombe*

1. CL111 (LA) – Very early semidwarf Clearfield long grain
2. CL151 (LA) – Very early semidwarf long-grain Clearfield variety
3. CL153 (LA) – Early semidwarf long-grain Clearfield variety, good quality and blast resistance
4. CL163 (MS) – Early semidwarf long-grain Clearfield variety
5. CL172 (AR) – Early semidwarf long-grain Clearfield variety
6. CL 272 (LA) – Early semidwarf Clearfield medium grain
7. Cocodrie (LA) – Very early semidwarf long grain
8. Cheniere (LA) – Early semidwarf long grain
9. Catahoula (LA) – Early semidwarf long grain, very good yield potential and quality
10. Cypress (LA) – Early semidwarf long grain, excellent milling quality and stability
11. Mermentau (LA) – Early semidwarf long grain
12. LaKast (AR) – Conventional height long grain
13. Roy J (AR) – Early Conventional height long grain
14. Antonio (TX) – Conventional semidwarf long grain
15. Presidio (TX) – Early semidwarf long grain, very high quality and very good ratoon potential
16. PVL01 (Cheniere/BASF 1-5) – Provisia long grain
17. PVL 013 (CPRS/BASF 1-13) – Provisia long grain
18. PVL 038 (TRNS/BASF 1-10) – Provisia long grain
19. PVL 080 (CHENIERE/BASF 1-2) – Provisia long grain
20. PVL 081 (CHENIERE/BASF 1-2) – Provisia long grain
21. PVL 108 (CHENIERE/BASF 1-6) – Provisia long grain
22. CLPYJ 027 (JZMN/08CLR004//RU0802146/3/RU0802146) – Clearfield Jazzman long grain
23. MS 1504114 (Cheniere/Banks) – Conventional long grain
24. MS 1504083 (CL131/PSCL) – Clearfield long grain
25. MS 1504122 (CL151//COLUMBIA 2/BNGL) – Clearfield long grain
26. Titan (AR) – Conventional medium grain
27. Diamond (AR) – Conventional long grain
28. Thad (MS) – Conventional long grain
29. CLXL729 (RiceTec) – Clearfield long-grain hybrid
30. CLXL745 (RiceTec) – Clearfield long-grain hybrid
31. XL753 (RiceTec) – Conventional long-grain hybrid
32. XL760 (RiceTec) – Conventional long-grain hybrid
33. Gemini 214 (RiceTec) – Conventional long-grain hybrid
34. Aura 115 (RiceTec) – Conventional long grain
35. CLH161 (LA) – Clearfield long-grain hybrid
36. LAH169 (LA) – Conventional long-grain hybrid
37. 09A/R608 (LA) – Conventional long-grain hybrid

38. Jazzman (LA) (A) – Jasmine-type aromatic long grain with soft-cooking characteristics
39. Jazzman-2 (LA) (A) – Early semidwarf Jasmine-type variety with strong aroma
40. Della-2 (LA) – Conventional semidwarf Della-type long grain
41. BSMT01 – Short stature Basmati-type long grain
42. Jupiter (LA) – Early semidwarf medium grain, very good disease package
43. Caffey (LA) – Early semidwarf medium-grain variety, very high yield, excellent quality
44. LA 1602002 (TRNS/4/9502008-A/DREW//CLR 20/3/CPRS/KBNT//WELLS/CFX 18) – Clearfield long grain
45. LA 1602097 (CL131/TRNS) – Clearfield long grain
46. LA 1602091 (CL131/3/CPRS/KBNT//9502008-A) – Clearfield long grain
47. LA 1402174 (9502008/3/MBLE//LMNT/20001-5/4/WELLCFX-18/5/TAGGERT) – Clearfield long grain
48. LA 1602112 (9502008-A/DREW//CLR 20/5/9502008-A/DREW//CLR 20/4/CPRS/…) – Clearfield long grain
49. LA 1602131 (LGRU/LCSN/3/CFX-18//CCDR/9770532 DH2/4/CCDR/JEFF/3/…) – Clearfield long grain
50. LA 1602195 (9502008-A/DREW//CLR 20/4/CPRS/KBNT//9502008-A) – Clearfield long grain
51. LA 1502094 (CPRS/3/9502008-A//AR 1188/CCDR/4/CPRS/9502008-A/…) – Clearfield long grain
52. LA 1602189 (9502008-A//AR 1188/CCDR/3/CFX-26/9702128/4/9502008-A//…) – Clearfield long grain
53. LA 1702042 (TRNS//CCDR/JEFF/5/9502008-A/DREW//CLR 20/4/CPRS/KBNT//…) – Clearfield long grain
54. LA 1702162 (11AY022/CTHL) – Conventional long grain
55. LA 1702088 (RU1102034/MRMT) – Conventional long grain
56. LA 1702091 (CPRS/9502008-A/3/CFX 29//AR 1142/LA 2031/4/CCDR//CFX-29/…) – Clearfield long grain
57. LA 1702094 (CCDR/JEFF/3/CFX-18//CPRS/KBNT/4/TRNS//CCDR/JEFF) – Clearfield long grain
58. LA 1702097 (9502008-A//AR 1188/CCDR/3/CFX-26/9702128/4/TRNS) – Clearfield long grain
59. LA 1702103 (CCDR/JEFF//CFX-26/9702128/3/WELLS/CFX-18//DREW/CFX-18) – Clearfield long grain
60. LA 1702106 (9502008-A//AR 1188/CCDR/3/CFX-26/9702128/4/9502008-A//…) – Clearfield long grain
61. LA 1702109 (9502008-A//AR 1188/CCDR/3/CFX-26/9702128/4/CHENIERE) – Clearfield long grain
62. LA 1702112 (CL162/CATAHOULA) – Clearfield long grain
63. LA 1702115 (CPRS//82CAY21/TBNT/3/CFX 29//AR 1142/LA 2031/4/CATAHOULA) – Clearfield long grain
64. LA 1702146 (CCDR/JEFF/3/CFX-18//CCDR/9770532 DH2/4/AR 1188/CCDR//…) – Clearfield long grain
65. LA 1502183 (BNGL//MERC/RICO/3/MERC/RICO//BNGL/4/MARS) – Conventional medium grain
66. LA 1602051 (CATAHOULA/3/TRNS//9502008-A/DREW) – Conventional long grain
67. LA 1702068 (RU1102034/MRMT) – Conventional long grain
68. LA 1702125 (LFTE/BNGL/5/EARL/4/BNGL/3/SMARS/MARS//MARS) – Conventional medium grain
69. LA 1702128 (11AY023/MRMT) – Conventional long grain
70. LA 1702131 (RU0401182/RU0902134) – Conventional long grain
71. LA 1702134 (RU1102137/CTHL) – Conventional long grain
72. LA 1702137 (MRMT/RU0602025) – Conventional long grain

# Application of Molecular Breeding Approaches in Variety Development

*Adam Famoso, Brijesh Angira, Christopher Addison, Jennifer Dartez, Jessica Thornton, Rick Zaunbrecher, Mona Meche, and Steve Linscombe*

In 2016, we established a high-throughput, single nucleotide polymorphism (SNP), DNA marker lab with the support of the Louisiana Rice Research Board. The objective of this lab was to facilitate the use of DNA markers as one of the core components of our variety development pipeline. This investment has enabled us to process 10,000s of data points in a day at a cost of pennies per data point.

Over the last year we have focused on discovering, developing, and validating new markers for key traits, such as blast and Cercospora resistance, grain quality traits, and herbicide resistance. In addition, we have identified a set of 12 markers that creates a genetic profile fingerprint that can differentiate any two varieties from each other. Throughout the last eight months we have begun to apply these markers to our breeding and foundation seed efforts. Three examples of how these efforts are being utilized are summarized below.

1) **Foundation Seed Purity:**
A primary focus of the Foundation Seed Program, led by Rick Zaunbrecher, is to produce and maintain the highest purity seed of our current varieties. Starting in 2016, we now routinely test all seed sources going into foundation seed headrows to identify potential off-types, outcrosses, or other impurities before we even plant the foundation seed fields. This has already proven effective in cleaning up some material that had some impurities present, and we anticipate it will also reduce the work load required for rouging of off-types in the foundation fields.

2) **Novel Blast Resistance:**
In 2016, we began crossing three new blast resistance genes from exotic, un-adapted lines into three elite LA varieties (CL272, CL153, and Mermentau). Each of these genes alone has been previously demonstrated to confer resistance to all U.S. blast races. However, the varieties these genes were in are not desirable to use as parents for developing new elite varieties due to poor grain quality, agronomics, etc. To facilitate rapid introduction of these genes, we have developed DNA markers to track each of the genes and have continuously crossed them into our elite lines. The markers allow us to select desired plants based on the DNA, rather than conducting phenotyping in the field. We are currently at the BC2 generation and will be testing the lines under field conditions this year. We will use the finished BC3 lines as new parents in breeding crosses starting in 2018.

3) **Early Generation Breeding Selections:**
A significant utilization of the marker lab is in evaluating plants at the beginning of the breeding pipeline for traits that we typically could not screen at this stage. Since October 2016, we have screened over 20,000 new experimental lines for multiple blast resistance genes, grain quality genes, and herbicide traits. Only the selected plants are then advanced for the typical screening in the field. This allows us to increase the frequency of plants in the field that met our desired level of disease resistance, grain quality, etc. It also provides flexibility in the new breeding crosses we make when developing new conventional rice varieties, as we can now cross a Clearfield line to a conventional line and select for Non-Clearfield types based on the DNA marker profile and test these lines as part of our conventional breeding efforts.

# RICE PATHOLOGY

## Rice Disease Management

*Don Groth*

Numerous diseases pose major threats to rice (*Oryzae sativa* L.) production. In Louisiana, sheath blight (*Rhizoctonia solani Kuhn*), bacterial panicle blight (*Burkholderia glumae* Kurita and Tabei), blast (*Pyricularia grisea* Sacc.), and narrow brown leaf spot (*Cercospora oryzae* (Racib.) O. Const.) continue to be the most important diseases of rice causing significant yield and quality reductions costing farmers millions of dollars each year. Narrow brown leaf spot developed into a major pest during the 2006 growing season, and since that year, it has been problematic in later planted rice and in the second crop. Bacterial panicle blight has been a major problem in many rice fields during abnormally hot conditions. In 2010 and 2011, strobilurin fungicide-resistant sheath blight pathogen was detected in Acadia Parish. Most recently in 2012 and 2015, major blast epidemics developed on several major rice varieties causing significant damage. Information is critically needed on these disease pest and their interactions to determine best control practices. Data from inoculated research plots and surveys in farmers' fields suggest that these rice diseases cause an average 6 to 25% loss each year in yield and quality. With present production costs and the low rice prices, these yield and quality losses can represent negative net returns due to rice diseases. Direct losses due to disease include thin stands, lodging, spotted kernels, fewer and smaller grains, reduced milling, and a general reduction in plant efficiency. Indirect losses include the cost of pesticides used to manage diseases, application costs, and reduced yields associated with special cultural control practices that reduce disease but may not be conducive to producing maximum yields.

A number of factors affect disease development, including varietal resistance, cultural management, cropping history, weather, and pesticides. Host resistance is the best control method, but often, it is not available or breaks down after varietal release. Most long-grain varieties are susceptible to sheath blight, and several major varieties are also susceptible to blast. Cultural practices often play an important role in disease development as evidenced by the fact that sheath blight was a minor disease until the introduction of semi dwarf varieties, high fertilization rates, and soybeans as a rotational crop. Cultural practices, such as reducing seeding rates and nitrogen levels, can reduce disease development, but this can limit yield. As a result, rice farmers often rely on fungicides to control diseases. Constant effort on breeding for resistance and development of effective chemical control programs is needed to keep rice diseases at tolerable levels.

Diseases occur in all rice growing regions of the world. In the United States, disease pressure is higher in the mid-south growing region than in the arid California production area; although, California has had significantly more disease pressure recently with the introduction of blast in 1997 and the introduction of bakanae in 1999. The United States is fortunate that it does not have any of the devastating viral diseases that occur in most other production areas of the world. Also, the United States has a limited number of nematode and bacterial diseases compared with most of the world production areas. Unfortunately, there are enough fungal diseases that increase production costs and reduce yields and quality to limit the economic return U.S. farmers receive for their crop.

The objective of these studies is to develop effective economical rice disease management practices. These include disease resistance, cultural management, and chemical control.

# RICE ENTOMOLOGY

## Rice Insects Project

*Michael Stout and Blake Wilson*

### Introduction

The goal of the LSU AgCenter Rice Insects Project is to develop and implement sustainable, cost-effective management programs for the insect pests that attack rice in Louisiana. These management programs for insects must be compatible with management practices for disease and weed pests and with agronomic practices used in Louisiana rice. In addition, management practices for insects must have minimal impacts on crawfish, which are often cultivated in close proximity to rice in southwest Louisiana. Although use of insecticides remains the primary tactic for managing insect pests, alternatives to insecticides are needed to reduce management costs, improve long-term sustainability, and minimize environmental impacts. The Rice Insects Project conducts both applied research directed at short-term solutions to insect-related problems and fundamental research aimed at discovering long-term, sustainable solutions to insect-related problems in rice.

Research conducted by the Rice Insects Project has been funded over the past 20 years by generous grants from the Louisiana Rice Research Board, with additional funds coming from the USDA, EPA, National Science Foundation, The Rice Foundation, Louisiana Board of Regents, and industry.

### Research on the rice water weevil

The rice water weevil is the most important early-season insect pest of rice in the United States. Virtually every field in Louisiana is infested with this insect, and it can cause yield losses in excess of 15% if not managed properly. Research conducted by the Rice Insects Project over the past two decades has generated data that have been used to justify the registration of a number of new insecticides for weevil management: Dermacor X-100®, a seed treatment containing the active ingredient chlorantraniliprole; CruiserMaxx®, a seed treatment containing thiamethoxam; NipsitINSIDE®, a seed treatment containing clothianidin; Belay®, a foliar insecticide containing clothianidin; and a group of foliar insecticides called pyrethroids. As a result of these registrations, rice producers in Louisiana have a broader range of insecticide options for weevil management than they have ever had before, and the seed treatments in particular have been widely adopted in southwest Louisiana. Small-plot and commercial-scale tests have confirmed the effectiveness of these products, but research continues to better define optimal rates and application timings for these insecticides. In addition, laboratory and field studies with Dr. McClain's lab have shown that the products containing chlorantraniliprole, clothianidin, thaimethoxam, and dinotefuran are much less acutely toxic to crawfish than the pyrethroids. Although the labels for these new insecticides prohibit their use in fields that will be rotated into crawfish production the following season, the lower acute toxicities of the new insecticides mean that drift and tailwater issues are less of a concern as these new insecticides become more widely used.

A few new insecticides are currently being evaluated by the Rice Insects Project, but the major focus of research on the rice water weevil has shifted to other areas:

1) *Varietal resistance*. For many years, the Rice Pathology program has recommended commercial rice varieties on the basis of their resistance to various diseases. One current priority of the Rice Insects Project is to characterize the resistance of widely grown rice varieties to insect pests, most importantly the rice water weevil but also stem borers and fall armyworms, so that varieties can be recommended on the basis of their overall pest resistance. Ultimately, this may allow a reduction in the amount of pesticide needed to produce a high-yielding crop, or it may allow the use of cheaper insecticide options. Another line of research is aimed at understanding the characteristics of certain rice varieties that allow them to tolerate, withstand, or resist attacks by the rice water weevil. Hybrids and conventional varieties are being

evaluated to determine if any of them possess inherent tolerance of weevil feeding. Plant hormones are being tested to determine if applying them to rice can stimulate rice plant resistance to the rice water weevil.

In addition, the Rice Insects Project is attempting to develop rice varieties resistant to the rice water weevil. The Breeding program has crossed 'Cocodrie' (susceptible to weevils) and 'Jefferson' (moderately resistant to weevils), and we are evaluating the results of this cross in an effort to develop a variety with improved resistance to the rice water weevil.

2) *Novel aspects of insecticide use.* The neonicotinoid seed treatments (Cruiser® and NipsitINSIDE®) and Dermacor X-100® have different spectra of activity against some of the sporadic pests that attack early-season rice, such as fall armyworms, thrips, colaspis, and aphids. In certain circumstances, combining lower rates of Dermacor® with one of the neonicotinoid seed treatments may be an economical approach to protecting rice from the full spectrum of potential early-season pests. In addition, combining neonicotinoid seed treatments with Dermacor X-100® seed treatments or with foliar pyrethroid applications may be helpful when weevil infestations are heavy.

Some data suggest CruiserMaxx® can stimulate rice plant growth and perhaps yields. We have investigated this possibility. Results from greenhouse and field tests support the claim that CruiserMaxx® can stimulate plant growth and enhance plant vigor in some varieties under some conditions, but our experiments have not supported claims of yield enhancement by CruiserMaxx®.

3) *Other practices for rice water weevil management.* Alternatives to insecticides are needed to reduce management costs, improve long-term sustainability, and minimize environmental impacts. Increased reliance on non-chemical tactics will also reduce the impact of weevil management on crawfish. Over the past decade, the Rice Insects Project has investigated the impact of agronomic practices, such as planting date, seeding rate, and water management, on the rice water weevil. Small-plot studies have shown that early planting of rice (planting in mid- to late-March) can result in lower weevil populations, reduced yield losses, and increased efficacy of foliar insecticides. Seeding rate studies have demonstrated that rice planted at low seeding rates (25-40 lb/A) is sometimes more susceptible to yield losses from the rice water weevil. Water management studies have shown that delayed flooding and shallow flooding can help reduce problems with weevils, although these practices are not always compatible with optimum disease management or crop management. Several studies this year are evaluating the interactive effects of variety, silicon soil amendment, and nitrogen fertilization on weevil infestations.

**Research on the rice stink bug**

Over the past several years, the Entomology Program at LSU has led a multi-state effort, funded by the USDA and the Louisiana Rice Research Board, to revise the management program for the rice stink bug in the southern United States. The most important part of this revision is a reevaluation of thresholds for insecticide use (in other words, the density of rice stink bugs needed to trigger applications of insecticides). This reevaluation is necessary in light of data from Texas suggesting that current thresholds are too low (in other words, that too much insecticide is being used). Preliminary analysis of two years of data indicates that thresholds for insecticide use against stink bugs are probably too low. Other experiments have shown that rice stink bug nymphs can cause significant losses in grain quality and that nymphs should be counted when sampling for stink bugs. In concert with this effort to revise thresholds, alternatives to currently used insecticides are being evaluated for efficacy. New insecticides are needed to replace pyrethroids, which often show inadequate residual activity, and methyl parathion, which was removed from the market in 2013. Evaluations of alternative insecticides are done in small plots at the H. Rouse Caffey Rice Research Station and in commercial-scale demonstration trials. Tenchu®, one of the alternative insecticides tested over the past few years, received a full label for use against rice stink bug in rice for 2013. Revision of the management program for the rice stink bug also includes investigations of varietal resistance and cultural practices (planting date, in particular) to improve rice stink bug control.

**Research on stem-boring insects**

The Mexican rice borer, a potentially destructive stem-boring pest of mid- to late-season rice, was first found in Louisiana in 2008. It appears to be spreading west at a rate of approximately 15 miles per year, and populations have been observed in nine parishes in southwest Louisiana. We are cooperating with the Louisiana Department of Agriculture and other AgCenter researchers to monitor the spread of the Mexican rice borer and to develop more effective means for predicting the severity of stem borer infestations in fields. In anticipation of increasing problems with stem-boring insects over the next decade due to the invasion of the Mexican rice borer and the expansion of populations of the sugarcane borer, another stem-boring pest, research is continuing on the biology and management of borers in Louisiana rice. A number of tactics may contribute to reducing the impact of stem borers in rice: early planting, using Dermacor X-100® seed treatments, destruction of rice stubble in the fall, amending soil with silicon, using resistant varieties, and applying pyrethroid insecticides when borer eggs or adults are found in fields. Although all of these tactics show promise, they have not yet been integrated into a cohesive program and communicated effectively to producers, particularly producers in Louisiana who have historically not suffered large losses from stem-boring pests. Developing and implementing a borer management program will be an increasing focus of the Rice Insects Project over the next several years. This year, experiments are being conducted on varietal resistance to borers, the relationship between rice plant age and susceptibility to infestation by borers, the effects of increased nitrogen fertility on susceptibility of rice to borer injury, the use of Dermacor X-100® against borers, and the potential for silicon soil amendments to reduce borer infestations. We are also running experiments to better understand the impacts of stem borers on rice yields.

**Basic research on rice-pest interactions**

The Rice Insects Project also conducts basic research aimed at understanding the mechanisms and processes that allow some types of rice to resist or tolerate attacks by insect pests. One example of this type of research is our research on arbuscular mycorrhizal fungi (AMF) in rice. Arbuscular mycorrhizal fungi are ubiquitous soil microbes that form symbiotic associations with many plant root systems, including crop plants like rice. Usually, these associations show beneficial effects on plants such as plant growth promotion through enhanced uptake of essential nutrients from the soil. Colonization by AMF has also been shown to increase resistance of some plants to abiotic and biotic stresses, such as insect herbivores and plant pathogens. Prior laboratory and field studies at the H. Rouse Caffey Rice Research Station, however, have shown that AMF colonization increases the susceptibility of rice to insects and diseases. We are using this discovery as a tool to understand the traits that make rice susceptible to insect attacks, and this knowledge will ultimately allow us to develop rice varieties with enhanced pest resistance. We are also investigating whether the positive effects of AMF on plant growth translate into greater tolerance of rice water weevil injury.

Another example of basic research in our lab involves the response of rice to different biotic and abiotic stresses. Plants are dynamic organisms, and often respond to stresses by changing in ways that make the plant more resistant to subsequent stresses. For example, we have found that feeding by fall armyworms on seedling rice makes the plant more resistant to rice water weevils after flooding. In addition, application of herbicides in some cases can alter rice plants in ways that make the plants more resistant to subsequent infestation by rice water weevils. Understanding the responses of rice plants to stress can help us develop varieties more resistant to insects.

# RICE HYBRID RESEARCH

## Rice Hybrid Breeding

*James Oard*

Hybrid rice, produced from the first generation ($F_1$) of seeds between a cross of two genetically dissimilar pure line (inbred) parents, represents a relatively new option for Louisiana farmers. Commercial hybrids typically yield 10-20% more than the best inbreds grown under similar conditions believed to be the result of hybrid vigor or heterosis from crossing the two parents. Research goals of the Hybrid Rice program at the H. Rouse Caffey Rice Research Station include: 1) development of male sterile lines (cytoplasmic A or environmental sensitive S), restorer (R), and maintainer (B) lines adapted to the southern U.S. environmental conditions; 2) identifying elite cross combinations through extensive test-crossing; and 3) exploring the feasibility of economical hybrid seed production including Unmanned Aerial Vehicles (UAV).

### Commercial Advanced Trials

The 2016 Commercial Advanced (CA) trials were conducted at five Louisiana locations in cooperation with Dr. Linscombe to access yield, disease resistance, and other traits of elite breeding lines. Three Louisiana experimental hybrids showed high yield potential and good milling performance in Acadia, Evangeline, Jefferson Davis, Lake Arthur, and Rice Station locations. The Louisiana experimentals produced a mean total yield of 13,419 lb/A (main and ratoon crop) that was comparable to six commercial hybrids at 13,832 lb/A. Mean head rice yield of the three experimental hybrids at 59% was similar to the 60% yield for six commercial hybrids and 62% for two Clearfield varieties. Similarly, average total milling yield of the three experimentals at 70% was similar to the total yields for the commercial hybrids and Clearfield varieties, both at 72%. The three hybrids in inoculated plots showed good to moderate levels of resistance against leaf blast, sheath blight, and bacterial panicle blight diseases in Evangeline and Jefferson Davis parishes.

### Observational (Testcross) Trials

The objective of the Observational Trial is to identify new hybrid combinations with high grain yield, good milling yields, height, maturity, lodging percentage, and other agronomic characteristics. In 2016, two Louisiana long-grain conventional hybrids were identified with high yield potential, early maturity, and comparable plant height vs. three commercial hybrids. Lodging, seed dimensions, gelatinization temperature, and percent amylose of the two experimentals showed similar values to those of the commercial hybrids. Percent chalk of the Louisiana hybrids was low at 6.1%. A long-grain Clearfield hybrid was identified in the second Observational Trial with high yield and acceptable maturity, height, lodging, seed dimensions, gelatinization temperature, amylose content, and low chalk. A third trial identified two Clearfield, one conventional, and one Provisia herbicide-resistant hybrid with good yield potential and excellent grain characteristics.

### Hybrid Seed Production Using Unmanned Aerial Vehicles (UAV).

In 2017, we will evaluate a drone (Unmanned Aerial Vehicle) in small plots at the H. Rouse Caffey Rice Research Station for increased hybrid seed production vs. standard practices. A short demonstration of the drone will be provided at the Hybrid Breeding plots during the field tour. The drone is registered and the remote pilot Mr. Brady Williams is licensed with the Federal Aviation Administration.

# RICE AGRONOMY

## Reducing Nitrogen Volatilization Losses in Rice Production

*Dustin Harrell*

In drill-seeded, delayed flood rice production, the most important nitrogen (N) fertilizer application is the application applied just before permanent flood establishment. This fertilizer application timing is the most important because the largest amount of fertilizer N is applied at this time, and it has the largest potential for loss. Urea is the most commonly used N fertilizer source because it is the cheapest per pound of N. The only problem with urea is the potential for it to turn into ammonia ($NH_3$) gas and simply float off the field if it is left exposed on the soil surface for an extended period of time. This process is called ammonia volatilization. Studies conducted at the H. Rouse Caffey Rice Research Station over the last several years have shown that when urea is left on the soil surface for a 10-day period of time prior to permanent flood establishment volatilization losses can range between 17 to 30%. That's a potential for 30% of a rice producer's fertilizer dollar to be lost before he ever gets the water on the field!

Unfortunately, in commercial rice production in Louisiana, it may take 10 or more days for a flood to be established on some of the larger fields. In these situations, a urease inhibitor containing the active ingredient N-(n-butyl) thiophosphoric triamide, or NBPT for short, is recommended. Urease inhibitors come in a liquid form and are applied on urea by a producer's local fertilizer distributor. The urease inhibitor basically slows down the breakdown of urea to the ammonium-N form, which is available to plants. Because it temporarily delays the breakdown of urea, it also temporarily delays the potential for ammonia volatilization losses.

It is also important to apply preflood N fertilizer onto a dry soil. Applications to a moist or flooded soil will increase the initial rate of ammonia volatilization as compared with applications on a dry soil. Urea treated with NBPT will have a reduced benefit when applied on moist or into a flooded soil. Increased rates of nitrification, the conversion of ammonium-N to nitrate-N, can also occur when N fertilizer is applied to a moist soil or into a flooded soil. The nitrate-N will then be lost quickly by denitrification, the conversion of nitrate-N to gaseous N forms, when the rice field is flooded and anaerobic conditions occur.

A demonstration field trial illustrating the effect of time of application on ammonia volatilization from urea and urea treated with two urease inhibitors will be observed during the field tour. The trial contains four fertilizer application timings (15, 10, 5, and 1 days prior to flood establishment). Three fertilizer sources evaluated include urea, NBPT-treated urea, and one not yet released urease inhibitor. The demonstration visually indicates that nitrogen use efficiency is reduced and volatilization N losses are greater the longer the fertilizer is left exposed on the soil surface. The application of a urease inhibitor that contains the active ingredient NBPT onto urea will reduce volatility losses and increase nitrogen use efficiency when the fertilizer must remain on the soil surface for more than three to five days.

## Summary of Phosphorus Research in Mississippi

*Bobby R. Golden – Mississippi State Extension Rice Specialist*

Phosphorus (P) deficiency in rice generally occurs early in the season and can be identified by very distinct characteristics. Typical symptomology of P-deficient rice plants are an overall stunting, dark green color, and erect leaves with little to no tillering. Stems will often appear thin and spindly with the symptomology first occurring on the older leaves. Much of the rice production in Mississippi occurs on precision graded fields where most of the topsoil has been redistributed allowing for ideal conditions for a P deficiency to occur. Phosphorus-deficient rice was identified in MS in the late 1990s, with soil test correlation and calibration trials established in 2002. Across the rice belt, yield increases have been shown to P fertilization; however, traditional soil test methods have been poor predictors of yield responsiveness. This data will summarize and explore P correlation/calibration research from the last 14 years in Mississippi. Our objective is to better predict when a yield response to P fertilization will occur based on routine soil testing.

Field experiments were established between 2002-2016 at the Delta Research and Extension Center (DREC) and on production farms in the Mississippi Delta area. Soybean was the previous crop grown at all site-years. Rice cultivars seeding rates differed among site-years and research locations. In general, rice was seeded at rates ranging between 60 and 90 lb seed $ac^{-1}$. Prior to fertilization, the untreated control plots from each replicate were soil sampled for extraction via the Lancaster method to determine soil test P. Most trials received P fertilization between planting and the 2-LF stage of rice growth and development. A limited number of trials evaluated timing with P application timing ranging from fall to midseason. In all trials, P application rates ranged from 0 to 100 lb $P_2O_5$ $ac^{-1}$ in 25 lb $P_2O_5$ $ac^{-1}$ increments. At the 5-leaf stage, prior to establishing a permanent flood, urea was applied at total nitrogen (N) rates to maximized rice grain yield at research station locations. On producers' farms, N management was conducted by the producer. Total aboveground P uptake was determined near the mid-tillering stage by harvesting whole plants in a 3-ft section of a row from the first inside row of each plot. Plants were dried to a uniform weight, weighed, ground to pass thru a 1-mm sieve, digested, and whole plant P concentration was determined by ICP. Grain yield, adjusted to 12% moisture content, was determined by harvesting the each plot with a small-plot combine. In the field, each experiment was arranged as a randomized complete block and was compared to an untreated control. At each site, the suite of P fertilization rates and/or application timings was replicated no less than 5 times. For the purpose of this summary, all trials were analyzed separately to determine if rice responded to P fertilization. The Fishers Protected Least Significant Difference (LSD) procedure ($p = 0.20$) was used to compare treatment means when appropriate. A secondary analysis using single degree of freedom contrasts comparing plots receiving P fertilization to the untreated control was also used to determine responsiveness.

Rice grain yield was significantly influenced by P fertilization rate at 16 of 34 site-years. Averaged across both responsive and non-responsive site-years, P fertilization increased rice grain yield by 225 lb $ac^{-1}$. When considering only sites that responded positively ($p < 0.20$) to P fertilization, yields were increased above the untreated control by approximately 585 lb $ac^{-1}$. Evaluation of distribution of soil test levels at responsive sites (n = 16) suggested that approximately 46% fell below 10 ppm soil test P, 62% < 20 ppm soil test P, and 85% < 30 ppm soil test P. The remaining 15% of responsive samples had soil test P levels greater than 30 ppm. Relative yield from the untreated control at responsive sites ranged from 75 to 95%. For numerous years, 30 ppm had been observed as a critical level for soil test P regardless of extractant. When examining non-responsive sites the distribution across soil test levels was startling. For non-responsive sites (n = 18), approximately 75% of sites had soil test P below 30 ppm P. On non-responsive sites, relative yield from the untreated control ranged from 94 to 100%. With trials evaluating P application timing, a clear trend presented suggesting that on soil with a pH above 7.5, rice tissue concentration and grain yield were greater when P application was conducted in the year rice was grown (i.e. spring to 2-LF). On soil with pH > 7.5, rice grain yields were increased by 675 lb $ac^{-1}$ when P applications were conducted in the spring rather than the fall. On soils with pH < 7.5, there was no difference in rice yield due to P application timing (Fall vs Spring application). This data alone illustrates

the need for additional research centered on determining additional methods to determine crop responsiveness to soil-test P and on what soils P application timing should be altered from the traditional fall application time.

If any of you have questions about this research or other research we are conducting in MS, my contact information is below:

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Acadia Rice Growers ........ Crowley, Louisiana
American Plant Food Corp. ........ Liberty, Texas
Armor Seed, LLC ........ Fisher, Arkansas
BASF Corporation ........ Winnsboro, Louisiana and Research Triangle Park, North Carolina
Bank of Commerce & Trust Co ........ Crowley, Louisiana
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The Mosaic Company ........ Plymouth, Minnesota

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## VARIETIES RELEASED FROM THE H. ROUSE CAFFEY RICE RESEARCH STATION

| Variety | Grain Type | Year Released |
|---|---|---|
| Colusa | Short | 1917 |
| Fortuna | Long | 1918 |
| Acadia | Short | 1918 |
| Delitus | Long (A) | 1918 |
| Tokalon | Long | 1918 |
| Evangeline | Long | 1918 |
| Rexora | Long | 1928 |
| Nira | Long | 1932 |
| Magnolia | Medium | 1945 |
| Lacrosse | Medium | 1949 |
| Sunbonnet | Long | 1953 |
| Toro | Long | 1955 |
| Nato | Medium | 1956 |
| Saturn | Medium | 1964 |
| Della | Long (A) | 1973 |
| Vista | Medium | 1973 |
| LA 110 | Medium | 1979 |
| Leah | Long | 1982 |
| Toro-2 | Long | 1984 |
| Mercury | Medium | 1987 |
| Lacassine | Long | 1991 |
| Bengal | Medium | 1992 |
| Cypress | Long | 1992 |
| Jodon | Long | 1994 |
| Dellrose | Long (A) | 1995 |
| Lafitte | Medium | 1996 |
| Cocodrie | Long | 1998 |
| Dellmati | Long (A) | 1999 |
| Earl | Medium | 2000 |
| CL121 | Long | 2001 |
| CL141 | Long | 2001 |
| CL161 | Long | 2002 |
| Cheniere | Long | 2003 |
| Pirogue | Short | 2003 |
| Écrevisse (crawfish forage) | Short | 2004 |
| CL131 | Long | 2005 |
| Jupiter | Medium | 2005 |
| Trenasse | Long | 2005 |
| CL151 | Long | 2008 |
| Catahoula | Long | 2008 |
| Neptune | Medium | 2008 |
| Jazzman | Long (A) | 2009 |
| CL111 | Long | 2010 |
| CL261 | Medium | 2010 |
| Caffey | Medium | 2011 |
| CL152 | Long | 2011 |
| Jazzman-2 | Long (A) | 2011 |
| Della-2 | Long (A) | 2012 |
| Mermentau | Long | 2012 |
| CL271 | Medium | 2013 |
| Frontière | Long | 2015 |
| CL153 | Long | 2015 |
| CL272 | Medium | 2015 |
| PVL01 | Long | 2017 |

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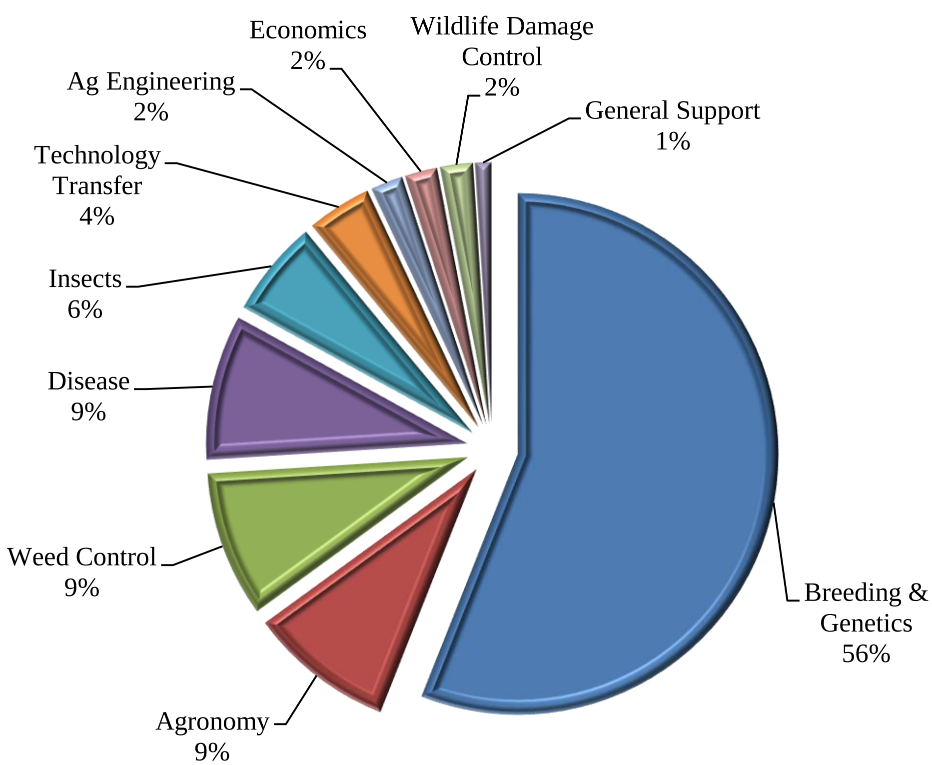
## Louisiana Rice Research Board Allocation of Funds - 2017



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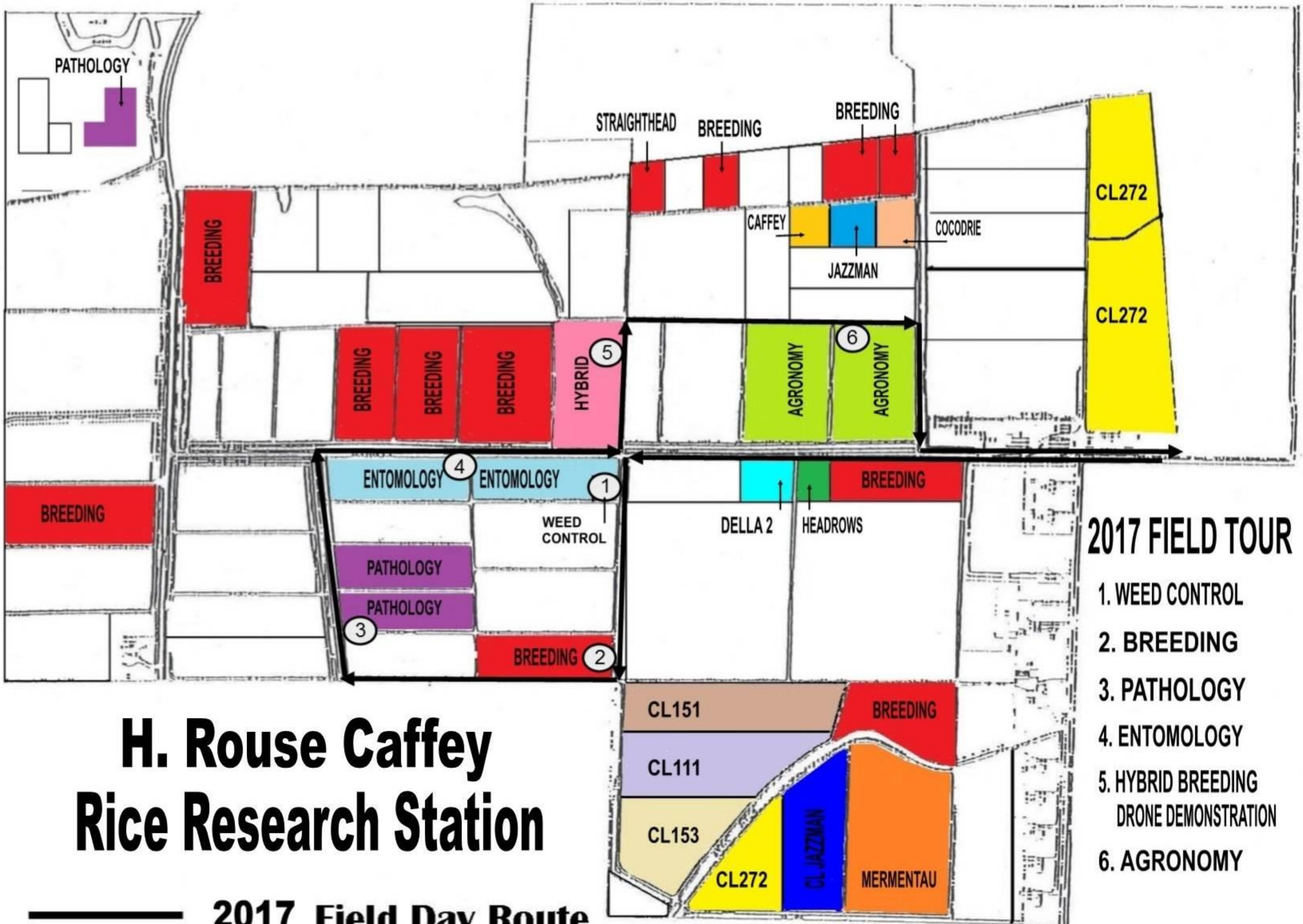


# H. Rouse Caffey Rice Research Station

2017 Field Day Route

## 2017 FIELD TOUR

1. WEED CONTROL
2. BREEDING
3. PATHOLOGY
4. ENTOMOLOGY
5. HYBRID BREEDING DRONE DEMONSTRATION
6. AGRONOMY