Second (Ratoon) Crop Growth Stages

With favorable conditions for planting and growing rice in March, the opportunity for second (ratoon) cropping rice in 2007 is better than average, even with the cool weather in April. There were almost twice as many days with average daily temperatures of 70 degrees F or above following March 11 in 2007 than in any year in the past 10 years. This may allow a significant amount of acreage of the first crop to be harvested between mid July and mid August. If so, it will present a unique situation in which significant acreage of second crop rice will be initiated early. With the warm temperatures and long day lengths in July and August, this second crop can be expected to grow fast and move through growth stages quickly.

The second crop grows from the base and stem nodes of the stubble remaining after harvest of the first (main) crop. Depending on the maturity and health of the first crop and environmental conditions, second crop growth can be present at or shortly after harvest of the first crop or even delayed for several weeks after first crop harvest. This second crop growth will appear as young plants emerging from the base of stubble (Figure 1) and in many cases along the stems of stubble (Figure 2). This early growth, as in the first crop, is in the shape of a spike and eventually grows into leaves. Several weeks after appearance of second crop growth, internode formation begins, and by the fourth to fifth week, a majority of the second crop begins the reproductive phase. At this time some heading may be noted because the second crop grows in an uneven manner compared with the first crop.

The second crop advances through the reproductive phase in much the same manner as the first crop. Panicle differentiation (PD) can be observed by splitting stems in half and noting a small, fluffy growth (approximately 0.1 inch in length). Internode elongation occurs at this time. Panicle growth continues inside the stem with the panicle growing to 4 to 8 inches in length before emerging through the top of the stem at heading. Upper internode elongation pushes the panicle through the boot during heading as it does in the first crop. Heading is followed by grain filling. Grain filling advances through the milk, dough and physiological maturity stages as in the first crop. Significant heading and grain filling in the second crop is noted around two months after harvest of the first crop, and grain is mature enough to harvest about three months after harvest of the first crop. As with all growth stages in the second crop, maturity is uneven, and some heading can occur even at the time the second crop is harvested.

Photos and detailed descriptions of rice growth are presented in the Rice Production Handbook available through country agents or online at [http://www.lsuagcenter.com](http://www.lsuagcenter.com) and search for Rice Production Handbook.

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- Second (Ratoon) Crop Growth Stages
- Defining Different Specialty Rice Types
- Rice Breeding Objectives
- 2007 Rice Field Day
- Pest of the Quarter - Rice Stink Bug
- Research to Refine Soil Test Recommendations in Rice
- Breeding for Higher Protein: Added Value Rice for Health Benefits
- Focus on Research Associates

**Special Dates of Interest:**
- **USA Rice Federation Rice Outlook Conference**
  - Lake Buena Vista, FL
  - December 2-4, 2007
- **Rice Technical Working Group**
  - San Diego, CA
  - February 18-21, 2007
Defining Different Specialty Rice Types

In the United States, specialty rices can be defined as those with different grain shape, size, color, chemical composition and cooking characteristics compared with the common long-, medium- or short-grain type. Over the past two decades, the specialty rice market (especially aromatics) has dramatically expanded. Based on the current growth rate of ethnic populations – the biggest consumers of much of the specialty types – as well as the increased selective preference of other American consumers, specialty rice markets are expected to grow in the future. Following are some of the most popular specialty rice types.

**Della Rice.** It is an aromatic, long-grain rice originally developed in Louisiana. It cooks like long-grain but gives off an aroma like that of roasted nuts or popcorn. Della type varieties include Della, Dellrose, Dellmont and A-301.

**Toro Rice.** It is a long-grain rice developed in Louisiana. It has the grain size and shape of other U.S. long-grains but possesses cooking and eating characteristics of U.S. short- and medium-grain rices. Toro rice is used by people who prefer the clingy cooked texture of short- and medium-grains in long-grain types. It is characterized as a low-gelatinizing, low-amylose type like those of conventional short- and medium-grain varieties. Toro-2 is the only variety currently available.

**Basmati Rice.** It is an extremely slender, aromatic long-grain rice originated from India and Pakistan. Basmati is a Hindi word that means “queen of scents” or “pearl of scents.” This rice has a high amylose content and a firm, almost dry texture when properly cooked. The cooked rice kernels increase mostly in length (by more than three times) with minimal increase in width. The best Indian Basmati has been aged for at least one year to increase firmness of cooked texture and increase the elongation achieved in cooking. U.S.-bred Basmati rice varieties are Dellmati, Texmati, A-201, Calmati 201 and Calmati 202.

**Jasmine Rice.** It is an aromatic long-grain rice from Thailand. This rice cooks similarly in taste and aroma to Della, but cooked grains are softer and clingier in texture. Jasmine types are characterized by low amylose and low gelatinization temperature like Toro and conventional short- and medium-grain

**Arborio Rice.** It is an Italian medium-grain variety commonly used in risotto dishes. It has a bigger kernel with a distinct chalky center. This rice develops a creamy texture around a chewy center and has exceptional ability to absorb flavors.

**Waxy (Mochi-type) Rice.** They are short-grain rice varieties favored for sushi and characterized by opaque endosperms of virtually all amyllopectin starch. The cooked rice is sticky and tends to clump together.

**Wild Rice.** It is not actually the grain of a true rice but is the seed of a water grass (*Zizania aquatica*), the only grain crop native to North America, and has been the staple food of the Sioux and Chippewa Indians. The grains are extremely long with dark brown to black pericarps and have a wonderful smoky, nutty flavor and are chewy in texture.

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Rice breeders are often asked, “What do you look for when you are making selections?” This seemingly simple question requires a complex answer. Rice varieties are composed of many genes that control every function of the individual plant. Some plant traits are controlled by only one gene (simply inherited) while others are controlled by many genes (polygenic). An example of a simply inherited trait is the presence (pubescence) or absence (glabrous) of leaf hairs. This trait is controlled by a single pair of genes, one each having been inherited from each parent. An example of a polygenic trait is yield. The yield potential of a variety is controlled by many genes. In general, the physical expression of polygenic traits is subject to more environmental influence. This means that while a plant possesses a complex of genes with potential for high yield, under less than favorable environmental conditions, that high yield potential will not be realized. An example would be if one were to grow a field of the rice variety Cocodrie in Louisiana with no applied nitrogen. In spite of the genetic yield potential inherent in that variety, that yield potential will never be realized without adequate nitrogen.

Plant breeders face a tremendous challenge in breeding varieties that will be successful for production. A successful long grain variety must have certain grain dimensions, so grain shape and size are important. Uniformity of grain shape and size are also critical. Plant height is important because plants need to be tall enough to provide a plant structure to support high yield as well as facilitate harvest. The plants cannot be so tall, however, that they will be more susceptible to lodging. Plant height is another example of a simply inherited trait. But the expression of that potential is highly influenced by environmental conditions, such as adequate nitrogen fertilizer.

Disease resistance is another important breeding objective for Rice Research Station breeders and pathologists. To select for this trait requires the presence of the proper disease causal agent. Sheath blight is the most troublesome disease in Louisiana rice production year in and year out. To facilitate screening for resistance to this disease, the pathologist will typically inoculate plots and rows with inoculum containing *Rhyzoctonia solani*, which is the fungal organism that causes this disease. With diseases such as rice blast, planting highly susceptible varieties around breeding nurseries will typically assure high disease pressure and eliminate the need for inoculation. This illustrates the importance of knowledge of each disease and the use of that knowledge to create the most favorable environment for effective screening for that particular disease.

Milling quality is another critical aspect of a successful rice variety. There are numerous factors that will influence the quality of rice. One of the most important is the percentage of whole (unbroken) grains remaining after the milling process. This is an example of a trait with a high level of genetic control but also a substantial environmental influence. Grain shape and uniformity are important. Some rice varieties will always have fairly low whole grain milling yields, regardless of the environment. Others can have high milling yields in favorable environments, but much lower yields under unfavorable conditions. Also, the grain moisture at harvest can have a significant impact on this characteristic. To further complicate this, environment here refers not only to the field conditions under which the plants are grown, but also the conditions under which the grain is artificially dried after harvest. Drying at excessive temperatures can dramatically reduce milling yields. This will illustrate why this trait is a difficult one to select for, and the true measure of this trait comes when samples are actually milled when breeding lines reach the yield testing stage.

The traits discussed are just a few of the multitude of traits that must be considered when a rice breeder is making selections. Others include seedling vigor, cold tolerance (both at the seedling and reproductive stage), response to plant growth regulators, cycle (number of days from emergence to maturity), grain shattering, herbicide tolerance or resistance, insect resistance, panicle exertion, seed dormancy and raatooning characteristics.

Putting all of these traits together in a package is what keeps rice variety development worthwhile.
2007 Rice Field Day
2007 Rice Field Day
Pest of the Quarter

Rice Stink Bug

The rice stink bug, *Oebalus pugnax*, is the most important late-season pest of rice in Louisiana. This insect feeds on rice grains as they develop. Feeding by this insect reduces both grain yield and grain quality. The rice stink bug is probably present in nearly all rice fields in Louisiana every year, and one or more applications of insecticides are often required to control this insect in fields. Guidelines for managing this insect are well-established, but efforts to improve the current management program continue.

Rice stink bugs have piercing/sucking mouthparts and damage rice by removing the liquid contents of grains as the grains mature. The consequences of rice stink bug feeding depend on the stage at which the grain is attacked. The entire contents of rice grains may be removed at anthesis (flowering stage) and during the early milk stages of grain development, resulting in empty or atrophied grains and in reduced yields. Feeding during later stages of grain development (late milk and dough stages) can also result in reduced grain size. More importantly, however, attack during the late milk and dough stages often results in chalkiness and discoloration around the feeding site.

Microorganisms (bacteria or fungi) introduced into the grain during feeding are involved in causing this chalkiness and discoloration. Rice grains so affected are referred to as “pecky” and have a lower market value. Pecky rice often breaks during milling, further reducing the market value of the grain. Pecky rice shows reduced viability and does not germinate well when planted.

Before moving into rice fields, the rice stink bug can be found feeding on grassy weeds in or around rice fields. Because this is true, keeping fields and field margins free of weeds may reduce the severity of stink bug infestations.

Scientists are investigating the factors that attract rice stink bugs to rice fields. Recent research in Texas suggests that rice at the milk and soft dough stages of development is more attractive to rice stink bugs than rice at anthesis. Current research in Louisiana is focused on identifying volatile compounds involved in attracting bugs to heading rice. This research may lead to improved methods for monitoring this insect.

These insects are called “stink bugs” because they emit an odor when disturbed. We have characterized the chemical components of this odor, again as part of an effort to develop ways of more effectively monitoring this insect in rice fields.

Current management guidelines call for monitoring this insect using a standard insect sweep net. Sweep sampling should begin at or before 50% heading. Applications of insecticides are recommended when stink bug densities exceed three bugs per 10 sweeps during the first two weeks of heading or 10 bugs per 10 sweeps during later stages of grain development. The action threshold increases during later stages of grain development because rice in the hard dough stage of development is more tolerant of stink bug feeding.

A number of insecticides are labeled for use against the rice stink bug: methyl parathion, malathion, lambda-cyhalothrin (Karate), gamma-cyhalothrin (Prolex) and zeta-cypermethrin (Mustang Max). The major problem with these insecticides is that they have short residual activities, although the pyrethroid insecticides (Prolex, Mustang Max and Karate) probably have longer residual activities than the other two insecticides. Malathion has shown lower efficacy than the other insecticides in small-plot studies conducted at the Rice Research Station. Alternative insecticides are currently being evaluated.

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Research to Refine Soil Test Recommendations in Rice

The application of inorganic fertilizers to optimize grain yields is a common practice in southern U.S. rice production. Probably the most challenging part of nutrient management is determining whether to apply a particular fertilizer nutrient or not. Then, if needed, we must determine how much of the nutrient to apply. Soil testing is one of the most useful tools to help make these decisions. Soil testing provides an estimate of the current nutrient status of a particular soil and the potential response of a crop to fertilizer applications.

The LSU AgCenter’s Soil Testing and Plant Analysis Laboratory began using a multi-element soil test about two years ago. It is referred to as the Mehlich III soil test extraction and is used to estimate soil phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sodium (Na), sulfur (S) and zinc (Zn).

While analytical instrumentation and extraction procedures continue to improve, a sound soil testing program is only as good as the database used to produce crop-based fertilizer recommendations. The accuracy at which any soil test can be interpreted is dependent on the quality of field research on which the soil test fertilizer recommendations are based. The field research studies used are often referred to as soil test calibration studies. The Agronomy Project at the Rice Research Station is actively collaborating with the LSU AgCenter Soil Testing and Plant Analysis Laboratory on several soil test calibration studies for the 2007 growing season. Two P and two Zn soil test calibration studies are being conducted to improve soil test recommendations.

The P calibration studies are being conducted at two locations – the Rice Research Station on a Crowley silt loam soil and in Morehouse Parish in north Louisiana on a Perry clay soil. The studies consist of six rates of P (zero, 20, 40, 60, 80 and 100 lb/A) broadcast at planting. Data obtained from the study will include plant height before flooding, tissue content at the 2-3 leaf stage, total P content at maturity, total biomass, total P uptake, days to heading, plant height at harvest, moisture content and grain yield.

The two Zn studies are co-located with the P studies. Five rates of Zn (zero, 5, 10, 15 and 20 lb Zn/A) applied as granular zinc sulfate in-furrow at planting are used in the studies. Elemental S was also applied in-furrow at planting to supplement added S from the zinc sulfate (all treatments had a total S application of 10 lb/A) to ensure any response was due to applied Zn and not S. Data obtained from the Zn studies will be similar to that obtained from the P studies.

Changes in the varieties grown, crop rotations, tillage systems and other cultural management practices can cause shifts in the soil testing calibration curves and thus fertilizer recommendations. For these reasons, the calibration of a soil test for a particular agricultural crop is a continual process. Fortunately, soil testing laboratories, such as the LSU AgCenter’s laboratory, have the support staff needed to ensure field-based calibration research is being conducted for improving fertilizer recommendations. The Rice Research Station Agronomy Project will continue to conduct the necessary field-based nutrient research to ensure quality soil testing for fertilization recommendations in rice.

Breeding for Higher Protein: Added Value Rice for Health Benefits

A number of high protein rice lines are under development at the Rice Research Station. The aim of this research is to look beyond yield and improve profit by enhancing the added value of rice. It is hoped that the success of this research could eventually open new markets and improve the value of the crop.

Currently, this research is attempting to improve two aspects of the nutritional quality of rice. The first is to improve the whole grain protein content to levels of 11% to 12.5% without changing the yield, milling quality and other grain characteristics. The second goal is to improve the content of individual essential amino acids. Protein is composed of 20 amino acids, and 10 of them are essential in the human diet. These 10 essential amino acids cannot be produced by the human body and must be supplied through nutrition. Therefore, improving the content of these essential amino acids will directly increase the nutritional value of rice.

A multi-year replicated yield trial for advanced lines is being conducted and is in the second year. Among entries tested are lines FRN783, 936 and 937 (Francis derived) and WLS07 and 97 (Wells derived). These lines have shown improved protein content to levels of 11% to 12.5%, while conventional Francis or Wells have protein levels of about 8% or 9%. Their protein and other phenotypic characteristics are similar to those displayed by the parental varieties. In terms of amino acid content, Line WLS97, for example, has a 47% increase in the level of lysine compared with that typically found in Wells. Since lysine is the essential amino acid with the lowest percentage in the rice grain, having higher lysine content in this line means higher quality and more available protein in the grain.

Around 500 newly developed lines are being evaluated for total protein content. The 2007 growing season is the first year for field tests on these lines, so some variability among them is expected. These lines are derived from Cocodrie, Cypress and Trenasse.

Research at the Rice Station also includes the quantification of B vitamins, minerals and phytochemicals among five advanced high protein lines. These compounds have known links to lipid lowering, as well as antioxidant, anti-inflammatory, glycoregulatory or anti cancer effects. Advance-ment in these research areas could possibly improve the health benefits of rice. If successful, this will expand the markets for rice in areas such as the cereal industry, the bread industry, as well as the antioxidant or gluten-free products and other health enhancement industries.

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Jennifer Nash has worked at the Rice Research Station for more than 10 years.

“It’s going to be 11 years this October,” she said.

She started working at the station as a research associate after completing her master’s degree in plant breeding and genetics at the University of Tennessee. She earned her bachelor’s degree in biology at Wheaton College in Norton, Mass.

Jennifer said she enjoys lab work.

“I like to see the results,” she said. “It’s exciting when we try something new and it works.”

Her work involves decoding DNA, often to find out if new lines of rice have a desired traits.

She said she enjoys working for Dr. Herry Utomo.

“He’s a good boss,” she said. “I don’t think his mind ever stops.”

In her career, she has seen changes in her field, resulting in faster and more accurate results.

“Mostly what I’ve seen is things that were labor intensive and toxic, you can now buy in a kit and do in a couple of hours without dangerous chemicals,” she said.

While she works extensively to help develop new rice varieties, her work is not limited to rice. She is involved in Dr. Utomo’s work to develop superior varieties of natural coastal plants to be used to fight coastal erosion.

Dr. Steve Linscombe, Rice Research Station director, has always been impressed with Jennifer’s work ethics and dedication. “Jennifer is an outstanding research associate and a valuable member of the Rice Research Station.”