Chapter 1

General Agronomic Guidelines

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Site Selection and Land Forming

Rice is grown under flooded conditions; therefore, it is best produced on land that is nearly level. Level tracts of land minimize the number of water-retaining barriers or levees required per unit of area (Fig. 1-1). Some slope is required, however, to facilitate adequate drainage even though the practice of growing rice on "zero grade" or level fields has gained in popularity (Fig. 1-2). Generally, a slope of less than 1 percent is adequate for water management. Most of Louisiana's rice-growing areas are well-suited for rice production with a minimum of land forming. Recent innovations using laser systems have made precision leveled or graded fields physically and economically feasible.

Fig. 1-1. More slope requires more levees.

Precision grading a field to a slope of 0.2-foot or less difference in elevation between levees is important in rice production for several reasons: (1) it permits uniform flood depth, (2) it may eliminate a large number of levees, (3) it facilitates rapid irrigation and drainage, (4) it can lead to the use of straight, parallel levees that will increase machine efficiency, (5) it eliminates hills and potholes that may cause delay of flood and/or less than optimum weed control and (6) it reduces the total amount of water necessary for irrigation.

In the past, leveling land was done first by identifying the natural slope or contour in fields using standard surveying methods. Then, levees were constructed following contour lines with a 0.2-foot elevation interval. The development of laser-leveling equipment has drastically improved both accuracy and efficiency

Fig. 1-2. Zero grade field.

Fig. 1-3. Laser leveling.

of land forming (Fig. 1-3). A laser emitter is set up on a stationary platform. Tractor-drawn implements, ranging from a simple straight blade to massive dirt buckets, are equipped with laser receivers and a computer. The computer is programmed according to the needs of the grower and field. As the tractor travels over the field, the implement removes soil from the high areas and deposits it in low areas creating either a gradual slope or completely level field depending on the programming and intended farming practices. On silt loam soils with a distinct hard pan, the procedure may be done while the field is flooded and is termed water leveling (Fig. 1-4).

On soils with deep profiles, such as the heavy clay soils of Mississippi and Red River alluvium, drastic cuts are often made to land. Although this practice certainly facilitates water management, it often creates fertility or productivity problems. Some herbicides prohibit their use on recently leveled ground because of phytotoxicity to rice and/or ineffective weed control. Until the subsoil layers weather, production problems may occur. Recovery of these areas usually takes from two to several years, depending on severity of cut and soil properties.

Soils

Rice can be grown successfully on many different soil textures throughout Louisiana. Most rice is grown on the silt loam soils derived from either loess or old alluvium that predominate the southwestern region and, to a lesser extent, the Macon Ridge area

Fig. 1-4. Water leveling.

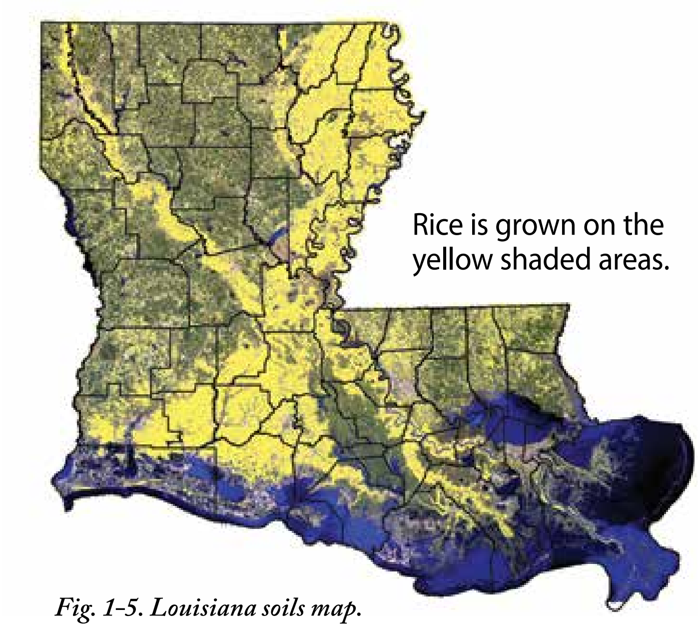

Fig. 1-5. Louisiana soils map.

of northeast Louisiana. The clay soils in the northeastern and central areas derived from more recent alluvial deposits are also well adapted to rice culture (Fig. 1-5). Deep, sandy soils are usually not suitable for rice production. The most important soil characteristic for lowland rice production is the presence of an impervious subsoil layer in the form of a fragipan, claypan or massive clay horizon that minimizes the percolation of irrigation water. Rice soils in Louisiana must be able to hold water in the paddies, which are, in essence, small ponds.

Experimentation with rice production under upland or nonflooded conditions in Louisiana has not been successful.

Water Requirements

The ability to achieve optimum water management is essential in attempting to maximize rice yields. The single most important management practice is the ability to flood and drain rice fields in a timely manner. In general, pumping capabilities are adequate if a field can be flushed in 2 to 4 days, flooded in 4 to 5 days and drained, dried and re-flooded in 2 weeks. This is much easier to accomplish on fields that have been uniformly leveled to a slope of no more than a 0.2-foot fall between levees.

Sloped fields take advantage of gravity to flood and drain the fields. Usually, the top paddy is flooded and water overflows into the next paddy and so on continuing to the bottom of the field. Draining is accomplished using the same openings in levees until the end of the season when levees are opened mechanically and the field is allowed to dry completely.

On zero grade fields, flooding and drainage are accomplished by constructing the field so that at least two sides are bordered by deep trenches. Most often, these are on three sides of the field. The surface of the field then is crossed (in two directions if necessary) with shallow ditches. Water is pumped into the border ditches until it spreads through the shallow surface ditches, eventually overflowing them and spreading throughout the field. Drainage in these fields is the reverse of the process.

The use of plastic (polyethylene) tubing, often called poly pipe, to flood multiple paddies simultaneously, has gained in popularity in some of the rice-growing regions of the state (Fig. 1-6). The plastic pipe is attached to the pump and water is pumped down one side of the field. Gates are installed in the tubing, or in some cases, the tubing is simply punctured to permit irrigation of all paddies at once. Size, shape and layout of the field all affect the economic efficiency of using this system.

Fig. 1-6. Using polypipe for irrigation.

Planting Dates

Some of the most important decisions that producers face are made prior to planting. Variety selection, planting date and appropriate seeding rate set the stage for the rest of the year, and good decisions here can translate into a better and more efficient harvest. Date-of-planting studies are conducted each year by LSU AgCenter researchers to adjust planting date recommendations. These studies include multiple varieties and planting dates and are designed to evaluate the optimum planting dates for new and popular varieties. Each year presents different environmental conditions, so there is not a single recommended date but rather a timeframe of about 1 month that is acceptable for planting.

LSU AgCenter recommendations for planting rice are from March 10 to April 15 in Southwest Louisiana and April 1 to May 5 in north Louisiana. On average, varieties planted during this time have the highest yield potential and milling quality and are generally easier to manage. Within this range is a lot of flexibility, and decisions should be based on specific field conditions. Average daily temperatures above 50 degrees F, calculated by adding the daily high and low temperatures and dividing by 2, are critical in obtaining an acceptable stand. Also, sufficient seeding rates and a well-prepared seedbed that promotes good seed-to-soil contact are necessary when planting at the early end of this range.

Planting early is desirable for high-yield potential, good milling quality and the option to produce a second crop (in south Louisiana), but extremely early planting can be detrimental in some cases. Slow emergence and reduced seedling vigor in cold conditions can lead to seedling disease and stand reductions. Depredation due to birds is more common in early-planted rice, so higher seeding rates are necessary to compensate for potential stand loss. Many herbicides are less effective under cooler conditions often associated with very early seeding dates. On the other end of the spectrum, late-planted rice can also be challenging. In addition to lower yield potential and milling quality, most insect and disease pests are more damaging in late-planted rice. Yield loss due to high temperatures and a lower chance for a successful second crop are common in late-planted rice.

Seeding Rates

Planting date should always be a major consideration when determining seeding rates because of the impact of temperature on stand establishment and the relationship between uniform stands and yield. A number of factors, such as low germination percentage, poor seedbed conditions, cold weather damage, seedling disease and bird depredation, can result in stand loss; therefore, sufficient seeding rates are critical to compensate for potential yield reductions. Rice is naturally a compensatory crop because of its ability to produce tillers, which provide flexibility in plant stand without affecting yield, but stands outside of the recommended range and uneven stands can be difficult and costly to manage.

LSU AgCenter recommendations for rice varieties range from 50 to 80 pounds of seed per acre for drill-seeding or dry broadcast seeding and 80 to 120 pounds of seed per acre for water-seeding rice to achieve a final plant stand of 10 to 15 plants per square foot. Typically, the lower end of these ranges should be used when conditions are ideal and the higher end when conditions are not conducive for good germination and plant establishment. Seeding rates for hybrid rice seed are much lower than for conventional varieties, and the hybrid seed representative should be consulted for recommendations. Stands that are too thin can result in increased weed competition, delayed maturity and decreased crop uniformity and quality. Conditions that justify a higher seeding rate include early planting, a poor seedbed, potential bird depredation, water-seeding and any other factor that can cause stand loss and impede plant establishment.

Excessively high seeding rates should be avoided as well, as they are more costly and can increase disease pressure and lodging. Ultimately, the goal is to determine how much seed should be planted to ensure a plant stand of 10 to 15 plants per square foot given the current field, seedbed and weather (soil moisture, temperature, forecast, etc.) conditions.

Conventional rice varieties, varieties and hybrids with Clearfield technology, and conventional hybrid rice vary widely in seed costs and reduced seeding rates are attractive economically requiring ideal planting conditions when reducing seeding rate or planting early. The money saved with a lower seeding rate or poor stand must be considered against potential additional expenses, such as replant costs, higher herbicide costs and other economic and agronomic factors.

Another important consideration is that seed size affects the recommended seeding rates in pounds per acre. For rice varieties, a final stand of 10 to 15 plants per square foot is optimal. In typical conditions, about 50 percent of planted seed produces a grain-bearing plant so a target seeding rate of 20 to 30 seeds per square foot is suggested to reach 10 to 15 plants per square foot. Seed size, and thus number of seeds per pound, varies among varieties, so a target seeding rate of 10 to 15 plants per square foot might require a different total seed weight per acre. For example, a medium-grain variety and a long-grain variety have 16,839 and 19,660 seeds per pound, respectively. Thus, a seeding rate for the medium-grain variety at 30 seeds per square foot would require 78 pounds of seeds per acre. The same seeding rate for the long-grain variety would require only 66 pounds to have the same number of seeds per acre.

Seeding rates of hybrid rice varieties are much lower than conventional rice varieties. Producers should consult the hybrid seed representative for guidelines and recommended seeding rates.

When water-seeding or dry broadcasting, 40 to 60 seeds per square foot will be required to obtain a satisfactory stand. When drill seeding, 30 to 40 seeds per square foot will be required. Within each category is a range of seeding rates to allow for some adjustment. The higher seeding rates should be used when planting under less than optimal conditions. Circumstances when the higher seeding rate should be used are as follows:

- When planting early in the season when the potential for unfavorably cool growing conditions exists. Cool conditions will favor water mold (seedling disease) in water-seeded rice, which can reduce stands. Varieties also differ in tolerance to cool growing conditions in the seedling stage.
- Where seed depredation by blackbirds is potentially high.

Fig. 1-7. Drilling seed into stale seedbed.

- Where seedbed preparation is difficult and a less than optimal seedbed is prepared.
- If the seed source has a low germination percentage. Certified seed with high germination percentage should always be used, if possible.
- When water seeding into stale or no-till seedbeds with excessive vegetation.
- If any other factor (slow flushing capability, saltwater problems, etc.) exists that may cause stand establishment problems.
- If dry or nontreated seed are used in a water-seeded system. Water-seeding research has shown that the best plant populations are obtained when planting presprouted, fungicide-treated seed. Presprouted, nontreated and dry fungicide-treated seed produce somewhat lower plant populations. Dry, nontreated seed produce the lowest plant populations.

Dry Seeding

Fertilization Timing and Water Management

Dry seeding is the predominant seeding method used in the north Louisiana rice-growing areas. Dry seeding normally performs well on soils where a well-prepared seedbed is practical and/or red rice is not a severe problem. Rice can be dry seeded using a grain drill or by broadcasting (Fig. 1-7).

When rice is drill-seeded, a well-prepared, weed-free seedbed is advantageous. A well-prepared seedbed will facilitate uniform seeding depth, which is important in establishing a uniform stand. Seeding depth is important with all varieties. It is especially critical with semidwarf varieties because these varieties are inherently slower in development during the seedling stage, and the mesocotyl length is shorter than conventional-height varieties. Therefore, semidwarf varieties should be seeded no deeper than 1 inch to maximize uniform stand establishment. Conventional-height varieties may be planted somewhat deeper, but seeding depths greater than 2 inches should be avoided with any variety.

Where soil moisture is adequate, a flush, or surface irrigation, following seeding may not be necessary. When soil moisture is insufficient and rainfall is not imminent, the field should be flushed within 4 days of seeding to ensure uniform seedling emergence. Therefore, levees should be constructed and butted at or soon after seeding.

Rice can be broadcast on a dry seedbed using either ground or aerial equipment. Seed should be covered using a harrow or similar implement. Uniformity of seeding depth is much more difficult to obtain when dry broadcasting. As with drill seeding, an immediate flush may facilitate uniform seedling emergence.

Fertilization timing and water management are similar for both drill-seeded and dry broadcast-seeded rice. Phosphorus (P), potassium (K) and micronutrient fertilizers should be applied preplant and incorporated based on soil test results. The addition of 15 to 20 pounds of preplant nitrogen (N) is generally recommended to ensure against N deficiency in seedling rice. Application of large amounts of preplant N should be avoided in a dry-seeded system since wetting and drying cycles before the permanent flood is established can lead to the loss of much of this N.

The majority of the N fertilizer should be applied to a dry soil surface within 3 days prior to permanently flooding the field. The remainder of the N requirement should be applied midseason. In some cases, all of the N fertilizer can be applied ahead of the permanent flood if the precise N requirement for a field is known and if the permanent flood can be maintained throughout the season. If a field must be drained, however, for any unforeseen reason such as water weevil larva control or straighthead, appreciable amounts of N can be lost requiring reapplication of N. When the required N fertilizer rate is not known or the field will be drained before harvest for any reason, apply 60 to 70 percent of the estimated N fertilizer requirement prior to flood establishment. Additional N fertilizer should be applied at midseason at the beginning of reproductive growth between panicle initiation [(PI), green ring (Fig. 4-10), or beginning internode elongation (IE)] and panicle differentiation (PD) (1/2 inch IE) (Fig. 4-11).

Large amounts of N fertilizer should not be applied into the floodwater on seedling rice because it is subject to loss. With this system, the permanent flood should be established as soon as possible without submerging the rice plants. This will normally be at the 4- to 5-leaf rice stage in fairly level fields. Delaying permanent flood with the intention of reducing irrigation costs may increase other production costs, reduce yields and decrease profits. Additional information on fertilizer timing in relation to water management can be found in the Soils, Plant Nutrition and Fertilization section.

Water Seeding

Fertilizer Timing and Water Management

Water seeding was once the predominant method of rice seeding used in Louisiana. It is still widely used in Southwest Louisiana and, to a lesser extent, in the northern portion of the state.

The use of a water-seeded system can provide an excellent cultural method for red rice suppression, which is the primary reason for the popularity of water seeding in Southwest Louisiana. Rice producers who raise crawfish in rice fields use water seeding because this planting method is easily adapted to rice-crawfish rotations. Other producers have adopted water seeding as a matter of custom, convenience or both. Water seeding is also an alternative planting method when excessive rainfall prevents dry seeding.

Seedbed preparation is somewhat different when water seeding is used compared with dry seeding. With water seeding, the seedbed is left in a rougher condition than for dry seeding. This is accomplished by preparing a seedbed consisting primarily of large clods (approximately baseball-size), which is often easier to attain with heavy-textured soils. A flood is established as soon as possible following tillage, and rice is seeded within 3 to 4 days. This will reduce potential weed problems and provide a more favorable oxygen situation at the soil/water interface. Low oxygen levels are often a problem where floodwater is held for a long time before seeding.

A preferable alternative to a rough seedbed is preparation of a smooth seedbed similar to that for drill

Fig. 1-8. Aircraft sowing seed.

seeding. Following smoothing, the seedbed is firmed with a grooving implement, resulting in a seedbed with grooves (1 to 2 inches deep) on 7- to 10-inch spacings. In some situations, a field cultivator can achieve the desired grooves. Some producers have constructed tools specifically for the purpose of establishing grooves, and these tools are based on similar tools used in California and on Louisiana ingenuity.

A rough seedbed will minimize seed drift following seeding and facilitate seedling anchorage and rapid seedling development. Seed and seedling drift is often quite severe, especially in large cuts common in precision-leveled fields. The large clods or shallow grooves provide a niche into which the seed can fall and provide some protection from wave action in a flooded field.

Dragging a field while it is flooded should be avoided before seeding because dragging: (1) leaves an extremely slick seedbed, which will compound problems with seed drift; (2) increases the severity of crusting and curling of the surface during the initial drain; (3) may displace and unevenly distribute incorporated fertilizers and herbicides; and (4) increases soil loss during the initial drain.

Water seeding is by necessity accomplished with aircraft using either dry or presprouted seed (Fig. 1-9). Presprouted seed offers the advantages of higher seed weight and initiation of germination because the seed has already imbibed water (Fig. 1-10). Presprouting is accomplished by soaking seed for 24 to 36 hours followed by draining for 24 to 36 hours prior to seeding (Fig. 1-11) These periods may need to be extended under cool conditions. A disadvantage to presprouting is that seed must be planted shortly after presprouting or deterioration will occur. Water management of water-seeded rice after seeding may be categorized as delayed flood, pinpoint flood or continuous flood.

Fig. 1-9. Loading aircraft with seed.

Fig. 1-10. Presprouted seeds.

Fig. 1-11. Soaking seeds.

Delayed-flood System

In a delayed-flood system, fields are drained after water seeding for an extended period (usually 3 to 4 weeks) before the permanent flood is applied. This system is normally used in fields where red rice is not a problem because the delayed flood system provides no red rice suppression. Fertilizer application timings and water management after the initial drain are similar to those in dry-seeded systems.

Pinpoint Flood System

The most common water-seeding method is the pinpoint flood system. After seeding with presprouted seed, the field is drained briefly. The initial drain period is only long enough to allow the radicle to penetrate the soil (peg down) and anchor the seedling (Fig. 1-12). A 3- to 5-day drain period is sufficient under normal conditions. The field then is permanently flooded until rice nears maturity (an exception is midseason drainage to alleviate straighthead). In this system, rice seedlings emerge through the floodwater, and seedlings must be above the water surface by at least the 4-leaf rice stage. Before this stage, seedlings normally have sufficient stored food and available oxygen to survive. Atmospheric oxygen and other gases are then necessary for the plant to grow and develop. The pinpoint flood system is an excellent means of suppressing red rice emerging from seeds in the soil because oxygen necessary for red rice germination is not available as long as the field is maintained in a flooded (or saturated) condition.

Continuous Flood System

Use of a continuous flood system is limited in Louisiana. Although similar to the pinpoint flood system, the field is never drained after seeding. Of the three water-seeded systems, a continuous flood system is normally best for red rice suppression, but rice stand establishment is most difficult. Even the most vigorous variety may have problems becoming established under this system.

Fertilization timing is the same for both the pinpoint and continuous flood systems. Phosphorus (P), potassium (K), sulfur (S) and zinc (Zn) fertilizers are

Fig. 1-12. Emerged seedlings ready for pinpoint flood.

applied preplant incorporated as in the dry-seeded system. Once the field is flooded, the soil should not be allowed to dry.

If the N requirement of a particular field is known, all N fertilizer should be incorporated prior to flooding and seeding. Otherwise, one-half to two-thirds of the estimated N fertilizer requirement should be incorporated prior to flooding and seeding or during the brief drain period in a pinpoint flood system. Additional N fertilizer can be applied at midseason at the beginning of reproductive growth between PI and PD. More information on fertilizer timing in relation to water management is in the Soils, Plant Nutrition, and Fertilization section.

Ratoon (Second or Stubble) Crop Production in Rice

The climatic conditions of Southwest Louisiana and the earliness of commonly grown rice varieties combine to create an opportunity for ratoon, or second/stubble, crop production. Ratooning is the practice of harvesting grain from tillers originating from the stubble of a previously harvested crop (main crop).

Weather during the fall will normally dictate the success of ratoon rice production. In Southwest Louisiana where rice is ratooned, the growing season prior to the onset of unfavorable temperatures is not long enough in every year to allow maturation of the ratoon grain. A decline in temperature and day length as the ratoon crop is developing could produce negative impacts on pollination, grain filling, ratoon rice yield and milling quality. Furthermore, the months of September and October, when ratoon rice is developing, are also the months when the production area is most susceptible to tropical weather systems.

Mild temperatures will speed ratoon maturity and prevent excessive sterility (or blanking) associated with low temperatures at flowering. Average daily high and low temperatures used in DD-50-based predictions are just as important in the development of ratoon rice as it is in the main crop. Later-than-normal first-frost dates will aid ratoon rice production, especially when the main crop is harvested later than August 15. The main crop should be harvested by August 15 to ensure adequate time for ratoon rice to develop. In years with an abnormally mild fall and a late first frost, ratoon rice can be produced when the main crop is harvested as late as the first week of September, but this is the exception rather than the rule.

While cooperation from the weather is essential for ratoon rice production, cultural practices play a critical role in maximizing ratoon rice yields. Cultural practices used in the main crop can have a major impact on ratoon rice production. Every management decision in the main crop will in some way impact the ratoon crop. Planting date, fertilization, and weed, disease and insect management in the main crop will all influence ratoon rice development and yield. Excessive nitrogen fertilizer applied to the main crop can delay regrowth of ratoon rice; therefore, overfertilization should be avoided even with a lodging-resistant variety. Severe disease pressure in the main crop may cause death of tillers and prevent regrowth from these plants, which will reduce ratoon rice production. Therefore, a foliar fungicide applied to the main crop can be beneficial to the ratoon crop.

Conditions at main-crop harvest will influence whether a ratoon harvest should be attempted. If the main crop is harvested under muddy conditions and the field is excessively rutted, ratoon rice production will be difficult and is not recommended. Excessive red rice in the main crop will also limit ratoon rice yield and quality. Where red rice is severe, ratoon rice production should be avoided and efforts should be concentrated on encouraging germination of red rice seed followed by destroying the seedlings with fall tillage, which may decrease red rice populations in successive crops.

An application of N fertilizer is necessary for high ratoon rice yields. Nitrogen fertilizer applications should be made to a dry soil surface and a shallow flood established immediately after harvest. This procedure will facilitate rapid regrowth and efficient use of applied N fertilizer. Recent studies with N fertilization rates in the ratoon crop indicate that a rate of 75 to 90 pounds of N per acre is sufficient for most commonly used rice varieties when first crop is harvested before August 15. Consult the annual LSU AgCenter publication 2270, "Rice Varieties and Management Tips," when selecting varieties with the intention of producing ratoon rice.

The second (ratoon) rice crop has become an integral part of commercial rice production in Southwest Louisiana. The ratoon crop will generally yield approximately one-third of that realized in the main crop. Although, ratoon yields are much less than that of the first crop, there is a definite economical advantage of growing the ratoon crop. It is economically productive because the input costs for producing the ratoon crop are kept at a minimal. Generally, the only costs associated with grow a ratoon crop are nitrogen (N) fertilizer, irrigation, harvesting and grain drying. While growing a ratoon crop is economically favorable to a producer, having a successful ratoon crop is not guaranteed every year. Although, traditional weather patterns in the southern rice growing region give us the opportunity to grow a ratoon crop, it is often weather that dictates the ultimate success of the endeavor. We cannot control the weather; however, there are several management strategies and decisions that we can use to improve our probability of success.

The first management decision begins before the main crop is even planted and that is to select an early maturing rice variety with a high ratoon potential. The second management decision is truly the "go" or "no-go" decision on attempting a ratoon crop. This decision should be made with information gathered from the main crop including an evaluation of disease pressure prior to harvest, the stubble conditions after harvesting and the date of harvest. Harvesting the first crop prior to August 15 will generally give the ratoon crop enough days of warm weather to grow a ratoon crop. There have been many seasons in the past when a main crop harvested after August 15 produced excellent ratoon yields; however, these were in years with mild fall temperatures and late first frosts. Unfortunately, there is no way of determining if this year will be one of those years. The earlier the main crop is harvested the better the probability of success with the ratoon crop. We must also remember that all management practices that we apply towards the main crop will have a bearing on the ratoon crop. For example, less than optimum weed and disease control will not only reduce yield in the main crop but will also be detrimental to the ratoon crop. A clean first crop will improve second crop yield potential. Another example would be harvesting a main crop in muddy soil conditions. This will certainly lead to increased rutting of the field and reduced ratoon yields in the rutted areas. There are even times when we may want to make the decision not to grow a ratoon crop at all. For example, high disease pressure will almost certainly spell disaster in the ratoon crop. You also might want to consider not growing a ratoon crop in fields with a heavy infestation of red rice. Take the measures to control the red rice problem now before it becomes more of a problem in future crops.

The final major decision is to determine whether or not to use a stubble management practice. Stubble management practices, such as harvesting at a lower than normal harvest height, reducing the stubble height by post-harvest flail mowing or bush hogging to around 8 inches, and rolling the stubble have all shown a yield benefit in studies conducted at the Rice Research Station in most years. The yield benefit can be up to several barrels per acre in some years. However, both harvesting the main crop at a lower than normal platform height, flail mowing, bush hogging, and rolling the stubble will delay the maturity of the ratoon crop approximately 2 weeks. So, if the main crop is harvested at a later than optimum date, further delaying the ratoon maturity by using one of these stubble management practices may not be the best decision. Interest in using a fungicide application in the ratoon crop has gained interest over the past several years. In a recent study at the Rice Station, application of a fungicide 4 weeks after harvest (coinciding with the first ratoon panicle emergence) did not reduce Cercospora incidence in the ratoon crop. On the other hand, lowering the ratoon stubble height by either flail mowing, bush hogging, or harvesting lower did reduce Cercospora incidence.

The next true management decision is when and how much N fertilizer to use. Our past ratoon N studies have shown that 90 pounds of N applied on a dry soil just after the main crop is harvested and immediately followed by a very shallow flood is the best management strategy in almost every study across all varieties and hybrids. If you make a decision to attempt a ratoon crop when the main crop was harvested after August 15, you will need to reduce the N rate. This will reduce the time to maturity of the ratoon crop and also reduce your investment in the ratoon crop. Nitrogen fertilizer should not be applied to the ratoon crop if the first crop is harvested after September 1.

Conservation Tillage Management

Enhancement of soil physical, chemical and biological properties is one of the major goals of sustainable agricultural production. Tillage practices are one way to impact soil properties and crop yields, hopefully with positive effects. Improvement of soil physical, chemical and biological properties is a technical factor. Tillage practices, however, are also directed by economic factors such as production costs, a producer's economic situation, commodity prices and credit availability. Therefore, a balance must be discovered that allows a producer to use sustainable production practices at economical levels.

Most rice in the United States is grown using conventional tillage; however, conservation tillage has gained acceptance in many rice-growing areas. No-till and reduced-tillage systems, such as fall- and spring-stale seedbeds, have been shown to significantly improve the quality of floodwater being removed from rice fields by reducing sediment losses. Problems, however, are associated with producing rice in this manner. Previous research conducted at the LSU AgCenter Rice Research Station since 1987 has addressed issues related to varieties not adapted to conservation tillage systems and yield reductions related to numerous factors involving conservation tillage. This research has firmly established the advantages and disadvantages of reduced-tillage rice production, and it has identified stand establishment and early-season plant density as critical components of managing a reduced-tillage rice production system.

Preplant and/or early season vegetation management are vital elements in reduced-tillage rice production systems. By minimizing the amount of preplant vegetation present in the seedbed, competition between the vegetation and the establishing rice crop is reduced. Additionally, plant residue can increase immobilization and volatilization of N fertilizer applied during the seedling rice stage, so proper management of preplant and early season vegetation also may reduce the amount of N fertilizer lost due to immobilization and volatilization.

The following information on conservation tillage in rice is based in part on specific research results obtained from reduced tillage rice research studies. Some information is generalized based on observations from these studies and not necessarily scientific measurements.

The basic components of these alternative tillage practices are summarized emphasizing advantages and disadvantages. This information is intended as general guidelines, but it may not be applicable to every situation. Three alternative methods of seedbed preparation have been compared with conventionally prepared seedbeds in both water- and drill-seeded cultural systems. These methods are defined as follows:

Spring Stale Seedbed

Seedbeds are prepared 3 to 6 weeks prior to planting. Depending on temperature and rainfall, vegetation that emerges prior to planting is usually small and easily controlled with herbicides. Most producers find little cultural advantage with spring stale seedbed compared with spring seedbed preparation at the normal time under a conventional tillage system. The spring stale seedbed system, however, offers one important benefit; during dry springs, seedbeds can be worked earlier in the year and prepared for planting, which improves the likelihood of timely planting. Time, money and labor are conserved by controlling preplant vegetation with a burndown herbicide rather than waiting for the seedbed to dry for mechanical preparation if excessive rainfall occurs prior to planting.

Fall Stale Seedbed

Seedbeds are completely prepared in the fall prior to rice planting in the spring. Vegetation that emerges during the winter months is usually uniform, 8 to 10 inches in height and consists of winter annual grasses, clovers, vetches and other broadleaf weed species. The fall stale seedbed system is the most popular reduced tillage practice in Southwest Louisiana. Better drying conditions and favorable weather in the fall allow more opportunity for field preparation.

No-till

Rice is planted directly into the residue of a previously harvested crop or native vegetation. In Southwest Louisiana, soybean is the typical rotational crop. Cotton and soybean are options in north Louisiana. Preplant vegetation is usually not uniform in size and usually consists of larger, woody winter weeds that create problems when controlling preplant vegetation (Fig. 1-13). Rice establishment practices used in conservation tillage systems are described below.

Preplant vegetation control. Several herbicides are labeled for preplant burndown applications in rice. The herbicide label should be consulted for application rate and weed control spectrum. Application rate depends on type and size of weeds present, and herbicides should be applied according to label directions. Some rice is planted in a no-till system without termination of preplant vegetation, which is possible if weed growth is minimal and species include winter annuals that will eventually die in the spring or be killed by flooding. Significant yield reductions have occurred in studies where preplant vegetation was excessive and a burndown herbicide was not used. Choosing not to apply a burndown chemical is risky, and weed identification is critical.

Time of application in relation to planting. Best results in most burndown research have occurred with a 7- to 10-day preplant herbicide application timing. These results are especially true when residual herbicides are tank-mixed with burndown herbicides. Longer intervals between burndown and planting reduce the effectiveness of residual weed control in the planted rice crop. Plant back restrictions also exist for a number of burndown herbicides, and these restrictions for rice vary dramatically depending on the choice of burndown herbicide. Burndown herbicides must be applied according to label directions. See the section on Weed Control for more details on burndown herbicide materials and timing.

Planting practices. Presprouting seed when using a water-seeded system will speed stand establishment and minimize seedling problems associated with poor floodwater quality, low oxygen, seedling diseases and

Fig. 1-13. Drilling seed into standing vegetation.

potential seed midge. Seed-to-soil contact is important and is a function of the amount of vegetation and, to some extent, the type of vegetation. When drill seeding, it is important to use planting equipment that places seed at a uniform depth and closes the seed furrow to conserve moisture. On some soils, no-till equipment may not be required. High-quality, conventional grain drills perform well on well-prepared seedbeds. Heavy, no-till equipment is desirable where vegetation is excessive and seedbeds are compacted.

Water management. Inadequate stand establishment is a common problem in water-seeded, no-till rice, especially in a pinpoint flood system. Delaying permanent flood establishment for 2 to 3 weeks after water seeding and initial draining will improve stand establishment in some situations. Adequate moisture, however, must be available through rainfall or irrigation in delayed flood systems. Excessive drying of the seedbed during rooting also can cause stand reductions. Delayed flooding is not a desirable management practice when red rice is a problem, and control or suppression of red rice will be significantly lower when delayed flooding is practiced. Red rice suppression using water seeding is less consistent under conservation tillage compared with conventional tillage systems.

Stand establishment difficulties encountered when drill seeding are often associated with inadequate moisture. If moisture is inadequate at planting, the field should be flushed to encourage uniform emergence and stand establishment. Gibberellic acid seed treatment also may enhance emergence of some varieties. In water-seeded systems, seed-to-soil contact is often poor. Consequently, frequent flushing in delayed flood systems may be required. In a pinpoint flood system, draining a field multiple times may be required to encourage rooting.

Variety selection. Variety selection when using a no-till system is important. Good seedling vigor, tillering ability and yield potential are important characteristics. Under ideal conditions, any recommended commercial variety could be considered. Research supports the fact that no-till and weedy stale seedbeds are not ideal situations, and varieties that possess the characteristics listed above perform most consistently under conservation tillage systems. Seedling vigor in some semidwarf varieties is lower than in tall varieties, often causing stand establishment problems in no-till seedbeds, especially if water seeded. This problem may result in lower yields. Taller varieties or those that possess good seedling vigor have performed best under conservation tillage systems.

Fertilizer management. Plant nutrients can be surface applied in a no-till system. In stale seedbed systems, phosphorus (P) and potassium (K) can be incorporated at the time of land preparation or surface applied in the spring. Nitrogen management in the spring rice crop is much easier when P and K are applied in the fall. Fertilizer efficiency, however, is much higher when spring-applied compared with fall applications, especially for K. In a no-till system where scumming may be a problem, P and K should be applied after rice stand establishment but before the 5-leaf rice stage. These nutrients can be applied into standing floodwater or before permanent flooding.

When not to no-till. Excessive vegetation, hard-to-control weeds, rutted fields, unlevel fields and fields where red rice is a problem are situations where a producer should consider conventional tillage practices. Heavy vegetation reduces seed-to-soil contact and increases problems establishing adequate stand. Weeds not controlled before planting will cause significant problems after planting. Rutted and unlevel fields impact both flooding and draining of rice fields.