Lesson 1: Planning the Crop

Archeologists believe that rice has been cultivated for more than 5,000 years. Two-thirds of the world's population consume rice. In the United States, rice production is focused in Arkansas, Louisiana, Mississippi, Missouri, and Texas. Producers must plan their crops carefully to ensure high yield and profitability.

Environmental Conditions

Rice grows under frost-free conditions. The average planting dates are between April 15 and June 10. Harvesting usually starts on September 10, becomes most active from September 25 to October 25, and ends November 1.

Soil temperature must be above 50°F; germination occurs between 50-104°F. Soil moisture must be adequate for planting seeds but not too muddy. Do not plant seeds on dry soil. A water supply is adequate for a given field if the producer can (1) flush in 2-4 days, (2) flood in 3-5 days, and (3) maintain the flood for the growing season. Pumping rates, measured in gallons per minute per acre (gpm/A), vary for different types of soil, as illustrated in Table 1.1.

Table 1.1 - Recommended Pumping Rates for Various Soil Textures

Soil Type	Minimum Pumping Rate (gpm/A)	Desired Pumping Rate (gpm/A)
Silt loam with pan	10	10
Sandy loam	15	25
Silt loam, no pan	10	15
Clay and silty clay	15	20

Rainfall is critical for rice production, supplemented by irrigation. The water is added to the flood to maintain depth. If the field is water seeded, two types of flooding occur: pinpoint and continuous. In pinpoint flooding, water is drained out, allowing the seedlings to anchor in the soil. It is important that the soil remain moist and not dry out. Within 5 days, the field is flooded, then drained. Reflooding occurs 3-5 days later. This is a shallow flood; as the seedlings develop, the flood increases. In continuous flooding, water is maintained at a constant level and never drained.

Evaluating Field History

Several factors should be considered in evaluating field history. In rice production, knowing the previous crop provides valuable information. If the field was rotated with soybeans, red rice (a disease) is controlled. Also, because soybeans require more potassium and phosphorous than rice, there might be enough residual nitrogen in the soil for rice under tillering. If other crops were rotated (e.g., grain sorghum or wheat), fertilizer requirements for rice are affected. If the previous crop was precision graded on silt or sandy loam soils, the topsoil has been removed, which reduces productivity.

Rice producers enlist the help of the University Extension office or other professional experts to conduct a soil test to determine the fertility of the field and to assess what occurred on the acreage in the past. Soil tests diagnose whether potassium or phosphorous should be applied, based upon the crop rotation pattern. If soybeans are in a yearly rotation with rice, potassium or phosphorous may be required. If rice is in a 2-year rotation with soybeans and a 1-year rotation with rice, potassium and phosphorous may not be required. A soil test may recommend liming and if so, it would be done several months before planting rice to allow time to raise the pH in the soil. A soil test can also detect if zinc is needed when rice dies soon after flooding and help diagnose why seedling rice dies.

Knowing the previous tillage tells the producer the condition of the field. In rice production, there are two basic tilling methods: drill seeding (which includes broadcast seeding) and water seeding. Drill seeding, the most common method in Missouri, provides many options for crop rotations and herbicides, but this method is prone to sheath blight and delays tilling and planting during wet spring weather. In water seeding, red rice is suppressed; rice can be cultivated continuously without threat of this disease. However, fields are prone to insect pests and sheath blight. Limited disease controls are available.

Fertilizer Requirements

Nitrogen requirements depend on several factors: rice variety, cultural practices, crop rotations, soil conditions, and soil moisture. Early application of nitrogen is important if the following four conditions have **not** been met: (1) rice grown in rotation after soybeans, (2) soil with a pH less than 6.5, (3) optimum stand density, and (4) land in cultivation for more than 5 years. It is very important to avoid overapplying nitrogen; this will significantly reduce yield through lodging and disease.

Lime, which is used to benefit the other crops in rotation, is required only if a soil test determines this to be the case. The preferred time to apply lime is several months before planting rice, which allows time for raising the soil's pH. Otherwise, lime is applied under these circumstances: (1) not before planting rice because this could induce a zinc deficiency or (2) immediately after the rice crop is harvested and before other rotated crop is planted.

Phosphorous is applied in limited amounts and only as recommended. Overapplication will harm development of seedlings. In southeast Missouri, Delta soils already have high levels of phosphorous.

The fertilizer source for potassium is potassium chloride, which is a salt. A few southeast Missouri soils already contain excessive amounts of sodium salt, so limited applications of potassium chloride are advisable to avoid harming seedlings.

Summary

In planning the rice crop, the producer has to determine the best environmental conditions for planting. Knowing the range of frost-free dates, soil temperature, desired level of soil moisture, and correct level of rainfall/irrigation is essential. Before actually planting producers have to evaluate the field's history: previous crops, soil tests, and tillage methods used. Rice does have basic fertilizer requirements (nitrogen, lime, zinc, phosphorous, and potassium), but specific amounts and timing of application for each fertilizer vary. The producer should follow the recommendations from the soil test.

Credits

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Lesson 2: Selecting a Variety

After planning the rice crop, the producer selects a suitable rice variety and grade and determines which diseases are prevalent locally. A consultant is a valuable resource for helping the producer manage and assess the growing crop.

Consultants

Producers seek the expertise of consultants because these professionals are usually located in the same area as the producers and therefore understand the various challenges rice growers face. Consultants have technological and scientific expertise; research capabilities; and are a source of up-to-date information, publications, web sites, and other resources. In Missouri, rice consultants are available through the Delta Research Center, Missouri Agricultural Experiment Station; and the University Extension at the University of Missouri-Columbia.

Consultants assist producers with crucial management decisions: selecting the most suitable rice seed, implementing pest control, performing soil tests to determine fertility requirements, managing tillage and seeding, and selecting and applying herbicide. During the growing season, consultants assess the rice crop for insect/disease infestation, nutrient/fertilizer deficiencies, and weed identification and treatment thresholds.

Seed Variety

Producers want a seed variety whose graining and milling yield will provide more total income from more bushels per acre. Newer varieties yield much more than older varieties. It is important to consider economics; a rice variety must be relatively high quality and risk free to produce a high yield. Tolerance to disease also determines which seed variety a producer selects. Some varieties are totally devastated by certain diseases; other varieties can tolerate some diseases but at a reduced yield and quality. Preventing diseases in rice crops is very expensive. Resistant varieties frequently do not produce the highest yield, but they are less risky, require less production costs, and provide a higher-milling quality. Producers need the guidance of their local rice consultant to help resolve these concerns with the most risk-free seed variety for the area.

Another consideration in selecting a rice variety is maturity, which refers to when the crop is produced. In Missouri there are four maturity groups for rice: (1) early short season, (2) very short season, (3) short season, and (4) mid-season. To maximize yield, a producer may wish to combine maturity groups so that harvesting is staggered, thereby extending the crop.

Cost is another factor in selecting seed variety. Newly developed seeds, which are desirable for their resistance to disease and insects, can be very expensive. Also, the amount and duration of water required for irrigation increase costs.

Another key factor in selecting a seed variety is the expected milling quality and special traits of the rice. A producer wants to grow the type of rice that will meet the standards of the mill.

Grade

Producers want maximum economic returns from the grade of rice. If a lower-yielding variety has high-milling yield and quality, the producer will realize a profit. High returns can also occur from very high-yielding varieties that have a somewhat lower-milling yield.

Value, which is the income from each bushel sold, comes from high-milling yield, called head rice, and from high-quality rice (milled rice). Value of the rice grade depends on the mill's demand for a specific rice type: long-grain of parboil quality, medium-grain, short-grain, or aromatic/waxy.

The U.S. Department of Agriculture has established six grades of rice based on standards for color and maximum limits for number of seeds, heat-damaged kernels, and chalky kernels. There is also a U.S. Sample Grade, which does not meet any of the requirements for grades 1-6.

Prevalent Diseases

In order to determine what diseases are widespread locally, the producer has to know the field history of the soil to determine which diseases infested the field in the past. Neighboring acreage that suffered infestations must be identified because diseases can drift to the producer's field.

Sheath blight is the most destructive disease for rice and has recently increased in severity. Symptoms include oblong, water-soaked lesions that appear on the leaf sheath at or near the water line. Within 2-3 days, a grayish-white center appears, up to 1 inch long, which is surrounded by dark purplish- or reddish-brown margin.

Sheath blight is caused by the fungus *Rhizoctonia solani* and the following factors: (1) increased use of highly susceptible varieties, (2) short intervals between crop rotations, (3) thicker stands than recommended, (4) use of higher nitrogen rates, and (5) planting short maturity groups at earlier planting dates.

The progression of the disease begins after jointing. The fungus survives in the soil year after year as a hard, weather-resistant structure called sclerotium, which floats to the surface of the rice flood water. After the fungus makes contact with the rice plant, it grows out from the sclerotium and moves to the leaf sheath. New sclerotia that develop on the infected stem surfaces fall from the rice plant and remain in the soil for several years. When the temperature is above 95°F and the canopy humidity is 96-97%, the *Rhizoctonia solani* fungus flourishes.

To control sheath blight, producers should plant high-yielding seed varieties that are the least susceptible to this disease. Stand density should be 15-20 plants per square foot. Plant when it is best for a specific variety. Avoid extremely early planting. Time nitrogen applications so that 30 pounds per acre or less are applied at internode elongation. A few days before heading, examine the field carefully for symptoms. Use a labeled fungicide when sheath blight reaches threshold level.

Blast, also called rotten neck, causes crop losses and has been increasing since 1984. Although it does not develop yearly, it is destructive when it does occur. In 1986, the estimated losses in Missouri from blast were $2.4 million.

Symptoms of this disease occur on leaves, leaf sheaths, nodes, and panicles. Oval-shaped leaf spots appear, with gray-white centers and brown to red margins. Fully developed leaf lesions are 0.4-0.7 inch long and 0.1-0.2 inch wide. The color and shape of the spots depend on the environment, age of lesions, and rice variety. Lesions on leaf sheath rarely develop, but if they do, they are the same as those on the leaves.

The fungus that causes blast is *Pyricularia oryzae*. Long periods of wetness and rainy, cloudy weather promote spore growth.

The disease progresses as airborne spores spread from rice seeds and infected rice stubble, which is where the fungus overwinters, to new rice plants. There are several new strains of this fungus, but it is unknown which strains are prevalent in Missouri. When spore contacts plant tissue, a sticky substance is produced that adheres spore to plant and initiates infection.

Controlling blast requires establishing a stand of 15-20 plants per square foot and selecting a seed variety that is the least susceptible to this fungus. Use a broad-spectrum seed treatment and reduce the areas where fungus might overwinter. Incorporate or roll rice stubble soon after harvest to promote early decomposition. From the time plants are 6-8 inches tall, keep the soil flooded until drained for harvest. Apply no more than 30 pounds of nitrogen per application at mid-season. If the field has a history of blast, always split applications. Fungicides should be applied 5-7 days before heading and again about 2 days after 50% heading. Check for leaf symptoms of blast beginning at the seedling stage and continue until early heading.

Summary

In selecting the appropriate rice variety and grade, rice producers benefit greatly from the expertise of consultants who help with management decisions and assess the growing crop. Selecting the best seed variety entails weighing several factors: expected yield, tolerance to disease, maturity group, and cost. The choice depends on the producer's unique circumstances. To determine grade, the producer expects the highest economic return and value. The U.S. Department of Agriculture has classified rice grades into six categories.

Credits

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Lesson 3: Tilling and Planting the Crop

As soon as the producer has planned the acreage and selected the appropriate seed variety, it is time to till and plant the crop. To develop the best possible crop, the seedbed must be prepared and the most effective seeding options and seeding rates should be selected. Using a rice planting calendar helps the producer organize all the events during the growing season. Water must be managed by means of carefully constructed levees.

Proper Seedbed Preparation

In rice production, proper seedbed preparation depends upon the seeding technique used. To prepare a drill-seeded seedbed, disk in the early spring and only if the soil moisture will not create clods. To increase straw decomposition, disk the stubble or roll in the fall and flood the field. "Landplane" (flood) the field once or twice by going in opposite or diagonal directions of disked areas. Prepare a shallow, firm seedbed with field cultivar equipment. Limit trips across the field and destroy any existing vegetation to avoid drift from the previous season's seedlings.

For a water-seeded seedbed, field grade to zero (up to 0.02 grade) to permit some field drainage, planned crop rotation, or substitution of other crops if rice fails. Dig a canal about 2 feet deep and 2 feet wide to help drainage during harvest. Fill all potholes and wheel tracks. Create ridged, rough seedbed to minimize seedling drift. Just before flooding, use a groover (similar to a flat roller), which forms small furrows on the seedbed and packs the soil. This prevents wavelike movement of water and smooths the soil surface. On clay surfaces, disk the fields and leave large clods that provide a place for seeds to settle without threat of drift.

Seeding Options

The seeding options, as stated above, are drill seeding and water seeding. Drill seeding, the most prevalent technique in Missouri, offers several advantages. Several crop rotation options are available that help control red rice. Herbicides and fertilizers can be applied by ground equipment, which is much less expensive than by airplanes. Rice weevils are controlled through field drainage. In drill seeding, the field sizes are larger. The disadvantages are that tilling and planting are delayed during wet spring weather. Sheath blight is especially serious with this seeding option and significant labor is needed to construct and remove levees. Season-long attention is required to maintain the levee and water level. Weeds in levees are a problem.

The advantages of water seeding are that it does not require construction, maintenance, or removal of levees. Rice can be in continuous cultivation without the threat of red rice. If a field is infested with red rice, water seeding suppresses the disease, which simplifies weed control. Water management is precise and facilitates uniform crop emergence. Water seeding's disadvantages are that the field must be smaller in order to pinpoint flood and maintain season-long flood. There is a strong risk of sheath blight, various insects, and aquatic weeds; limited control options are available. Higher seeding rates are required and pregermination and pumping costs are greater. Seeding an established flood and applying nitrogen fertilizer at first tillering growth stage must be performed by airplanes, which is a very expensive method.

Seeding Rates

Seeding rates, measured in pounds per acre, vary according to the number and weight of seeds per variety. Soil texture, seeding date, seedbed, and seeding option all affect the recommended seeding rate.

For drill-seeded crops, calibrate the grain drill to deliver 40 seeds per square foot when planting under ideal conditions. The rate is increased by 10% for early seeding and increased by 20% if seeding in clay soil or a poorly prepared seedbed.

For water-seeded crops, seeds are pregerminated, which means they are soaked for 24-36 hours and then drained for 24-36 hours before planting. Increase the seeding rate by 30% over the drill-seeding option to compensate for poorer germination, insect injury, and reduced tillering.

Rice Planting Calendar

A rice planting calendar helps the producer determine when to prepare the field and seedbed. It also indicates when to plant the selected seed variety. Times for irrigation, fertilizer application, and monitoring for disease are noted as well. The calendar tells the producer when to drain for harvest and when to deliver the grain to the elevator. See Table 3.1 for a sample rice planting calendar.

Table 3.1 - Rice Planting Calendar

Dates	Activity
March	Start preparing field: plane land & disk
Mid-April - early June	Prepare final seedbed & planting
1-2 weeks after planting (May & June)	Flush irrigate field if necessary for emergence
4-6 weeks after planting (May & June)	Apply herbicide(s) to control very young weeds
Immediately after weed control (late May to July)	Top dress bulk of nitrogen fertilizer
Immediately after fertilizing (late May to July)	Flood field & maintain even water depth
10-14 days after flooding (late May to June)	Scout for rice water weevil & treat if necessary
20-30 days after flooding (June & July)	Measure plant growth for nitrogen sufficiency
30-40 days after flooding (late June to July)	Apply mid-season nitrogen according to variety & growth
After mid-season nitrogen (late June to mid-August)	Monitor crop for sheath blight and blast
July & August	Treat for disease control as necessary
10 days before harvest	Drain for harvest
Mid-Sept. to Oct.	Harvest & dry crop
After harvest	Roll the stubble
Throughout the year	Deliver grain to the elevator as scheduled

Levee Construction

To construct a levee, the field is surveyed first, usually on 0.2-foot vertical intervals. For flat fields with more than 10 acres per levee, survey on 0.1-foot vertical intervals. Increase vertical intervals 0.3-0.4 foot for fields with steep slopes and stacked levees.

A plow, consisting of two sets of disks, is pulled across a field. The height of the levee is obtained by making two to eight passes with the levee disk. To minimize formation of clods on clay soils, allow several hours of drying. Disks then dig out two parallel ditches. The soil thrown up from the center forms the levee. If the field was already graded, the levee runs at right angles to the edge of the field; otherwise, the levees run along the contour of the existing slope and wind across the field.

Install levee gates in each levee where they can be checked daily; ensure that the bottom of each levee gate is directly on the soil line. The gates in the levee are set to run the water across depressions in the soil and to leave no more than 2 inches in drop from levee to levee.

Importance of Levees

The main purpose of levees is to regulate the amount of water. Controlling amount and duration of water on rice plants is critical to yield and productivity.

Importance of Water

Rice grows best in shallow water, 4-6 inches. Water in the plant dissolves and carries nutrients through the cell wall and roots. On hot, dry, windy days, water is especially necessary for the survival of the rice plant. Water also controls weeds, which is a critical factor for a productive yield.

Summary

In tilling and planting rice, the producer must prepare the seedbed according to which seeding option is used. Drill seeding is the most prevalent option in Missouri; water seeding is another technique. Each option has advantages and disadvantages. Seeding rates, based on pounds of seed per acre, differ according to seed variety, soil texture, and other factors. A rice planting calendar helps producers ensure timely completion of important tasks. Levees provided needed water and regulate the amount used. Water is critical for the rice plant's survival. Shallow water (4-6 inches) is sufficient for growth. Most important, water controls weeds and thereby helps improve the yield.

Credits

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Lesson 4: Scouting and Maintaining the Crop

The producer must continually evaluate, or scout, the rice crop throughout the growing season. At each phase of the plant's development, the producer monitors various factors and might determine that replanting is necessary.

Plant Condition Factors

In examining the rice crop, the producer monitors for damage from disease, weeds, or insects. At various points during the growth stages, flooding and preventive treatment are used to minimize these pests. The times for treatment applications are at critical points: ½-inch internode, early boot, and 10% heading.

Moisture levels influence how well the rice plant grows. Throughout the growing season, 4-6 inches of water must be maintained. If drought stress is a threat, the producer should flush over the field quickly, close the gates, and raise the flood level to the appropriate depth.

The timing of nitrogen application is another critical factor for the producer to observe. Early application of preflood nitrogen determines potential grain yield. Nitrogen applied mid-season (beginning at 1/2- or 3/4-inch internode elongation) is 65-80% efficient, depending on preflood rate, soil fertility, and seed variety.

The quality of the seedbed helps the producer evaluate the status of the growing crop. A past history of red rice, insect infestation, sheath blight, or blast adversely affects crop yield. The previous tillage method must rid the field of past vegetative growth to prevent seedling drift.

Replanting Decisions

Deciding whether to replant a crop involves several factors. The producer must evaluate the extent of the plant stand. For all rice varieties except Katy and Millie, the optimal plant density stand is 15-20 plants per square foot. If the stand is thinner, larger panicles are produced with more grains per panicle. This does compensate for thickness but additional insecticides, herbicides, and nitrogen are required. Thick stands are susceptible to lodging, incur greater severity of diseases, and require extra seed, which increases cost.

Additional factors to consider is the amount of damage from disease, weeds, and insects. If the crop has sustained a devastating amount of loss, replanting might be considered. On the other hand, some varieties can sustain damage and still produce an acceptable yield. Producers can manage pest damage through integrated pest management (IPM) that emphasizes using biological control, host-plant resistance, and various cultural practices to maintain low pest populations while preserving the majority of the crop. By using natural enemies of insect pests and diseases, IPM helps keep pest populations below damaging levels. Natural biological controls, combined with specific field management practices and diverse rice varieties, provide an alternative to managing pests without chemicals.

A producer may choose to plant different maturity groups to offset losses. For example, planting a very short season can compensate for crop failures. By combining different types of maturity groups on the same field rather than just one variety, the producer can avoid total crop loss.

Summary

Throughout the growing season, the producer has to evaluate, or scout, the field for signs of distress and then must consider whether replanting is appropriate. The producer will evaluate the degree of damage from disease, weeds, and insects; the level of moisture and irrigation; timeliness of nitrogen applications; and overall quality of the seedbed. In deciding whether replanting is a reasonable option, the producer will examine the extent of plant stand density, assess the degree of damage from pests, and consider planting different maturity groups on the same field.

Credits

Rice Production Handbook (MP 192). Cooperative Extension Service, University of Arkansas. 2201 Brookwood Drive, P.O. Box 391, Little Rock, AR 72203. 1996.

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Lesson 5: Harvesting the Crop

If the rice crop is successfully managed throughout the growing season, the producer's efforts are rewarded at harvest time. Managing the harvest and postharvest activities involves several factors.

Timing of the Harvest

The maturity of the rice variety indicates the ripening, or grain filling stage, and the time of ripening differs with each variety. The size and weight of rice grain increase, and the color of the plants changes from green to straw or gold. At this point, light intensity is crucial because 60% or more of the carbohydrates are now photosynthesized. Temperature is another factor that affects the ripening stage.

Grain moisture content should be 17-21% to avoid reduced quality or yield. The producer should plan to complete harvesting when rice reaches 16% moisture.

The timing of seeding also affects when harvest occurs. It is advisable to avoid extremely early- or late-season seeding.

Levee Breakage

Deciding when to drain the levees is an important decision for the producer. Water management entails maintaining the flooded field until 2 weeks before harvest unless draining is required to control straighthead. Stop pumping the field to prepare for harvest 10-14 days after heading if enough flood is on the field to prevent drought stress. If it is exceedingly hot, continue pumping for 5-7 days. When the rice plant has fully matured, it is time to drain the levee.

Seed Damage

The producer wants to harvest whole, undamaged rice kernels because they will be more marketable. However, rice seeds can be damaged during harvest under the following circumstances.

Harvesting at either high or low moisture content damages the seed. If the rice kernels get wet, the ends grind off and become dust. If dried below 15%, rice could crack. Lowered yields of head rice occur with rapid rewetting once rice reaches 15% or less moisture content.

Environmental stress differs among rice varieties. Drought, inadequate or excessive nitrogen, low intensity of sunlight, disease and insect infestation (for example, kernel smut, blast, straighthead, and sheath blight), and draining water too soon during hot weather are factors that damage the rice seed.

Crop Loss During Harvest

The entire crop can be lost during harvesting if the producer is not careful. Poor harvesting practices account for a major source of crop loss. The optimal operating speed on threshers differs among rice varieties. Lower speeds will not separate rice very well. The speed and efficiency of the thresher are affected by moisture content, amount of material entering the combine, and weeds. The level of a stripper/combine must be adjusted according to the height of the rice heads and ease of grain detachment. The producer should obtain and calibrate a separation loss monitor based on local conditions. Separation losses increase when the stripper overspeeds. Stripper headers can help avoid crop losses because they are fast, efficient, and collect most of the leaves, trash, and stems from the field. Platform headers are slower and tend to miss a lot of the leaves, trash, and stems.

Foreign matter, such as stems, weed seed, and other trash can have more moisture than rough rice and will lower the total yield for milling.

A major cause of crop loss is rapid field rewetting, such as from abundant rainfall. The yield for head rice that has reached 15% or less moisture is lowered measurably. Not all rice varieties are as susceptible to this head rice reduction; Lemont is vulnerable but Newbonnet is not.

Rice Storage

Storing and drying rice require special attention and care. Missouri rice producers have access to commercial elevators that will dry and store the crop. Other producers prefer to dry and store their rice on the farm.

Rice stored in commercial elevators is first dried through continuous flow dryers, as seen in Figure 5.1. For a short amount of time, large volumes of heated air move through layers of rice, 12 inches or less. The rice is passed through the dryer several times; the dryer removes 2-3% moisture with each pass. The continuous flow dryer is used

Figure 5.1 - Continuous Flow Commercial Dryer

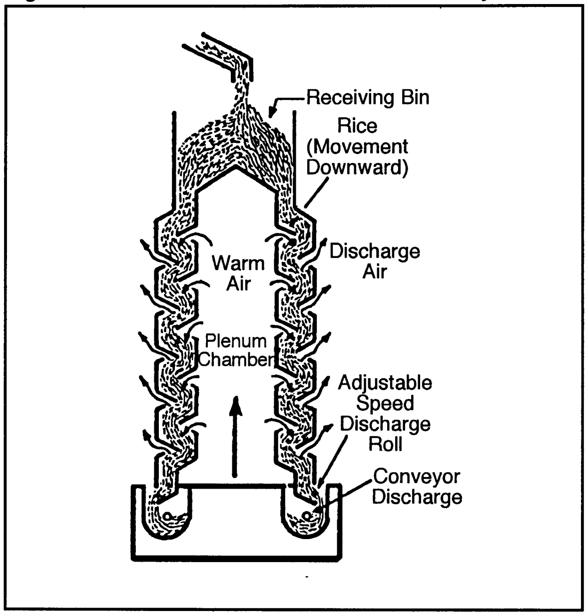
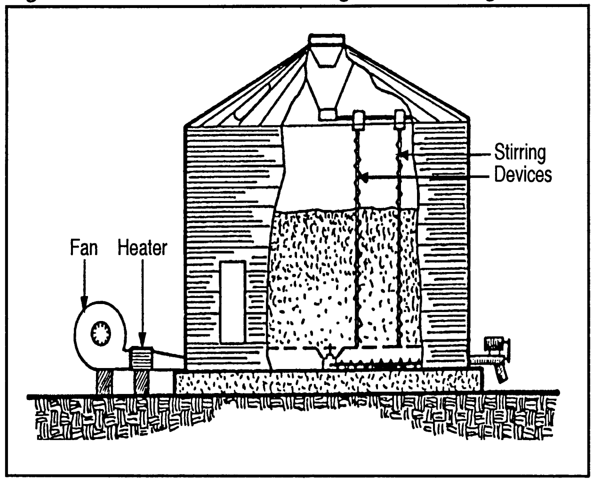


Figure 5.2 - On-the-Farm Storage with Stirring Devices



again to remove additional moisture. The air temperature is higher in commercial dryers; rice is exposed to the heated air for a shorter period of time.

In storage, the moisture at the center of the rice kernel slowly moves to the outer layers in tempering bins within 4-12 hours, depending on the temperature and moisture of the grain. Rice is transferred to storage bins after the last pass and aerated until the temperature of the grain kernels reaches about 50°F. At this point the rice is moved to different bins and aerated as needed to prevent the top layers from spoiling or hot spots from developing within the bin.

<u>On-farm facilities</u> have two methods of drying: layer drying and continuous flow, in-bin drying. In <u>layer drying</u>, rice is dried in 4-foot-deep layers to a moisture level of 15% or less. Then 2- to 3-foot layers are added and dried until the bin is full. Overdrying the bottom layer before the top layer reaches proper moisture content can cause problems. It is important to maintain the moisture equilibrium between the drying air and the desired moisture content of the rice. To help maintain this equilibrium, stirring devices in the storage bin mix and level the rice. The rice producer must not rewet the rice or keep the fan on. It is also important to avoid overdrying the kernels because they will crack when milled. The drying process must be very slow and conducted over a low heat. See Figure 5.2.

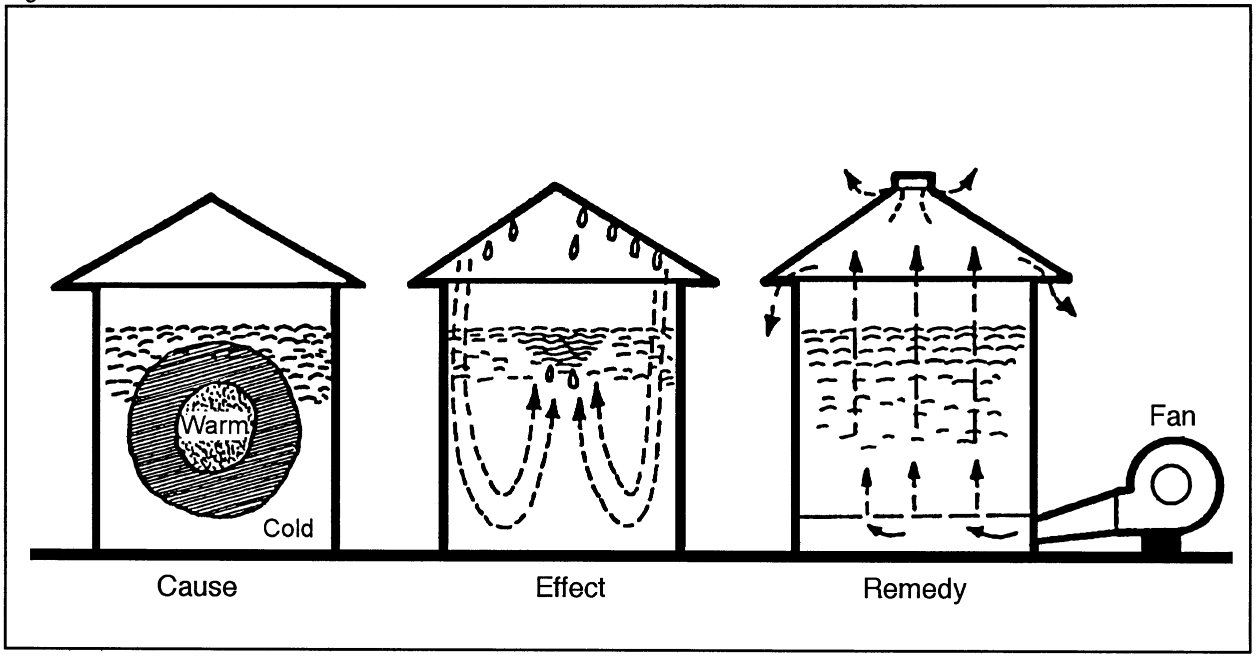
In <u>continuous flow, in-bin drying</u>, a tapered auger rides on top of a perforated floor and removes 5- to 6-inch layers of rice in a circular sweep. The depth of the rice is kept at 3-4 feet. The spreader at the top of the bin maintains equal distribution and depth across the drying bed at all times. Aeration is provided by a constant airflow of 25-35 cubic feet per minute per square foot of floor surface. The air temperature during drying is 110°F. This temperature can vary above or below 10 degrees if the rice kernel temperature does not exceed 100°F before removal from the sweep auger,

On-farm storage is in circular bins with perforated floors or ducts at the bottom, which promotes air circulation. After rice is dried in batches 6-12 feet deep, it is transferred into storage where it is cooled through aeration. Figure 5.3 illustrates the aeration process.

Storage Problems

Because harvested rice is a valuable commodity, storing it properly is a major concern. Storage bins contain many insects, some of which are pests. The severity of insect infestation depends on the amount and type of insect, condition of the new rice, grain moisture, and temperature. If the storage bin is unclean, insect populations can survive in the feed for years. The floors and walls contain lodged grain, sweepings, and old rice, which harbor insects. Insects can migrate to the new rice in unsanitized storage bins.

Figure 5.3 - Aeration



Maintaining Crop Quality During Storage

The producer should take the following steps to guarantee that the rice crop will retain its quality during storage. Sanitize the storage area by removing all waste grain, dust, and other trash. Then remove or bury waste away from the storage area.

Clean all equipment that handles rice. After they are cleaned, spray storage bins with an approved protective insecticide treatment. Then spray the rice as it enters the cleaned storage bin.

Fungi also affect the growing plant. Fungi grow when moisture content is below 13.5%. Temperature is a major factor in the growth of fungi. At 40-50°F fungi grow slowly; at 80-90 F fungi grow rapidly.

Summary

All of producer's efforts are focused on harvesting the rice crop. Several factors dictate the proper time for harvest: maturity stage, grain/moisture content, and when rice variety was seeded. The producer must decide when to drain the levee. A potential problem during harvest is that seeds can be damaged and the crop itself could be lost. Storing rice requires careful attention. All equipment that handles rice and all storage bins must be kept clean to maintain the quality of the rice crop.

Credits

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Lesson 6: Marketing the Crop

This lesson addresses how the producer markets the rice crop, determines when to sell or store the rice, and assesses the effect of rice quality on the price. The purpose of rice checkoff dollars is also discussed.

Marketing Options

Rice producers can contract with commercial mills or use producer-operated cooperatives to market their harvested rice. Riceland Foods Cooperative, in Stuttgart, Arkansas, is the world's largest miller and marketer for rice growers. In Jonesboro, Arkansas, Anheuser-Busch has a mill. The Louis Dreyfus Corporation rice mill in New Madrid, Missouri, offers rice producers a new market and options for pricing. Rice producers can also use marketing consultants, satellite, and Internet marketing services.

Rice producers can use forward contracting as a marketing option. The rice is contracted before it is processed and delivered. The sale price is already established and does not reflect fluctuations in the cash market at harvest time. This system has some risks, however. If the market moves upward to a higher price, the producer receives only the negotiated price. On the other hand, if the crops fail, the producer must purchase rice to meet the contract.

Determining When to Sell or Store Rice

The rice producer's decision when to sell or store rice is affected by many factors: storage costs, interest rates, and price trend predictions. Predicting the rice market depends on supply and demand, governmental programs that promote exporting and importing, and the global market.

Rice Quality and Effect on Price

The quality of the rice crop affects the price that the producer will receive. Basically, the rice must meet the

Table 6.1 - Grades and Grade Requirements for Rough Rice

Grade	Maximum limits of							Color requirements
	Seeds and heat-damaged kernels			Red rice and damaged kernels (singly or combined) (%)	Chalky kernels		Other types (%)	
	Total (singly or combined) (number in 500 grams)	Heat-damaged kernels and objectionable seeds (singly or combined) (number in 500 grams)	Heat-damaged kernels (number in 500 grams)		In long grain rice (%)	In medium or short grain rice (%)		
U.S. No. 1	4	3	1	0.5	1.0	2.0	1.0	Shall be white or creamy
U.S. No. 2	7	5	2	1.5	2.0	4.0	2.0	May be slightly gray
U.S. No. 3	10	8	5	2.5	4.0	6.0	3.0	May be light gray
U.S. No. 4	27	22	15	4.0	6.0	8.0	5.0	May be gray or slightly rosy
U.S. No. 5	37	32	25	6.0	10.0	10.0	10.0	May be dark gray or rosy
U.S. No. 6	75	75	75	15.0	15.0	15.0	10.0	May be dark gray or rosy

U.S. Sample grade shall be rough rice that:
(a) Does not meet the requirements for any of the grades from U.S. No. 1 to U.S. No.6, inclusive;
(b) Contains more than 14% of moisture;
(c) Is musty, sour, or heating;
(d) Has any commercially objectionable foreign odor; or
(e) Is otherwise of distinctly low quality.

mill's standards. The grains must be whole and the length must conform to the designated criteria. There should be no diseases or foreign matter in the harvested rice. The amount of weeds and red rice in particular must be limited. Table 6.1 shows the grades and grade requirements for rough rice.

Checkoff Dollars

For every bushel sold at the elevator or mill, the Missouri Department of Agriculture collects 2¢. These checkoff monies are used to promote and market rice in the United States and overseas and to conduct rice production research. By comparing newly released varieties from breeding programs, agronomists can help rice producers with future crops. Scientists observe how plants respond to various diseases. This type of analysis can help develop disease-resistant varieties. Thanks to checkoff dollars that fund rice performance trials, producers gain greater knowledge of what seed varieties will flourish in their fields.

Summary

Cooperatives, mills, professional marketing consultants, satellite, and Internet marketing services are all options for marketing rice. Forward contracting is a marketing option that can be used. Farm-related expenses, price trends predictions and fluctuations, and global markets are factors that the rice producer must consider in determining when to sell or store rice. The price the producer can receive depends on the quality of the rice. Marketing efforts and research activities result from checkoff dollars.

Credits

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Lesson 7: Figuring Crop Costs

Throughout the growing season, the rice producer faces several types of expenses that must be accurately recorded. This lesson examines the various costs the producer must calculate in order to determine if he/she has earned a profit on the crop.

Variable Costs

Variable costs (also known as direct, or operating, costs) depend on the extent of rice production. For high-yielding acreage, more plants are produced, which increases the costs of seed, maintenance, equipment, and water. If there is a lower planting rate, yield is lower but less seed is required. Examples of variable costs in rice production are seeds, fertilizer and lime, fungicides, herbicides, pesticides, and labor. The expenses associated with maintaining, repairing, and fueling equipment are also variable costs.

Fixed Costs

Fixed costs are those expenses that the rice producer cannot avoid, despite the level of production. Also known as ownership expenses, fixed costs include items that are a one-time purchase, such as equipment: tractors, threshers, combines, stripper heads, seed drillers, land planes to level land, and airplanes to cast seeds over dry or flooded fields. Depreciation and interest on machinery are also fixed costs. The rice producer's grain separator monitor and chlorophyll meter, levee, gates, and laser guidance systems that determine placement of levees also represent fixed costs. Finally, mortgage payments, interest, taxes, rent, and insurance on land are fixed costs.

Determining Acceptable Return on Investment

In order to evaluate whether an acceptable return is received on the investment, the producer must consider the variable and fixed costs. If these expenses are less than the net return from sales of the rice crop, the producer has earned a profit. Profitability also depends on supply and demand.

Calculating Cost per Acre

As with any crop, the cost of producing an acre of rice is the combination of the variable costs and the fixed costs per acre. If all expenses have been listed and categorized, this total is readily apparent to the producer.

Red Rice and Effect on Price

Because red rice is a weed, it can reduce profit if there is too much of it. Red rice can kill off healthy plants and reduce stand density.

Summary

To figure the cost of the rice crop, the producer adds the variable and fixed costs and subtracts those expenses from the sales received from the crop. To determine an acceptable return on investments, the variable and fixed costs should be less than the labor and expenses. The price can be adversely affected if there is too much red rice.

Credits

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