3 – Rice Stand Establishment

Nathan Slaton and Rick Cartwright

Stand establishment is the first step to a successful rice crop. Factors that influence stand establishment include variety, seedling vigor, seeding method, seeding date, soil properties, seeding rate, seed treatments, environment and geographic location. Later management decisions are affected by stand density and uniformity. The goal in stand establishment is to obtain a uniform stand of healthy rice seedlings. Uniformity of emergence is important for accuracy of the DD50 program, pesticide application, milling yield, drain timing for straighthead prevention and harvest.

Seeding Rate

Seeding rates vary depending on the variety due to differences in seed size or weight. The RICESEED program is available to assist growers

Table 3-1. Seeds Per Square Foot for Different Seeding Rates Based on Seed Weight

Variety	Seed Weight[1]	Seeding Rate, lbs/A							
		80	90	100	110	120	130	140	150
		number of seed/sq ft							
AB647	25.3	33	37	41	45	49	54	58	62
Adair	26.6	31	35	39	43	47	51	55	59
Alan	21.9	38	43	48	54	57	61	66	70
Bengal	29.4	28	32	36	40	44	48	52	56
Cocodrie	23.5	35	40	44	49	53	58	62	66
Cypress	23.7	35	40	44	49	53	58	62	66
Drew	21.7	38	43	48	53	58	62	67	72
Earl	27.4	30	34	38	42	46	50	53	57
Gulfmont	25.8	32	36	40	44	48	52	56	60
Jackson	24.4	34	38	43	47	52	56	61	65
Jefferson	28.7	29	33	36	40	44	47	41	54
Jodon	24.0	35	39	43	48	52	56	61	65
Katy	20.8	40	45	50	55	60	65	70	75
Kaybonnet	20.8	40	45	50	55	60	65	70	75
L202	26.1	32	36	40	44	48	51	55	59
Lacassine	24.8	34	38	42	46	50	54	58	62
Lafitte	25.6	33	37	41	45	49	53	57	61
LaGrue	25.1	33	38	42	46	50	54	58	62
Lemont	26.2	32	36	40	44	48	52	56	60
Litton	24.8	34	38	42	46	50	55	59	63
Madison	22.1	38	42	47	52	57	61	66	71
Mars	25.6	33	37	44	45	49	53	57	61
Maybelle	23.9	35	40	44	48	52	56	60	64
Millie	26.7	31	35	39	43	47	51	55	59
Newbonnet	23.3	38	43	48	53	57	62	67	72
Orion	22.5	37	42	46	51	56	60	65	69
Priscilla	25.9	32	36	40	44	48	52	56	60
Rexmont	22.8	37	41	46	50	55	60	64	69
Rico 1	25.1	33	37	42	46	50	54	58	62
Tebonnet	24.0	35	39	43	48	52	56	61	65
Wells	25.1	33	37	41	46	50	54	58	62

[1]Grams per 1,000 grains or milligrams per seed.

in determining the correct seeding rate for different seeding dates and methods, soils, seedbed conditions and varieties. This program is available at the local county Extension office or may be downloaded free from the Cooperative Extension Service, University of Arkansas, website at http://www.aragriculture.org. Table 3-1 provides a list of seed weights and seeding rates needed to obtain the different number of seed per square foot for commonly grown varieties. Under most conditions where rice is drill seeded, 40 per square foot are adequate to obtain the optimum stand density of 15 to 25 plants per square foot (or 9 to 15 seedlings per 7 inch drill row foot, or 13 to 21 seedlings per 10 inch drill row foot). Stand densities above the optimum density may increase disease, plant height and lodging. Stand densities < 10 to 15 plants per square foot are capable of producing high yields provided that plant distribution is uniform, weeds are controlled and additional nitrogen is supplied to stimulate tillering. Most varieties compensate for low seedling population by increasing the number of grains per panicle and tillering. Seeding rates should be increased by 10 percent for no-till seedbeds and early seeding; 20 percent for broadcast seeding, poor seedbed condition or clay soils; and 30 percent for water seeding.

Recommended drill row widths for rice are between 4 and 10 inches. Limited research data suggest that under most conditions row widths between 4 and 10 inches can produce similar yields. However, as row width increases, the importance of uniform stand density also increases. Several studies show a trend for higher grain yields with narrower drill row spacing, thus drill row spacings of 6 to 8 inches are ideal. Seeding rates do not need to be adjusted for differences in drill row widths in the 4 to 10 inch range. Table 3-2 provides the number of seed per row foot for 6 to 10 inch drill row spacing and seeding rates for drill calibration.

Table 3-2. Seed Spacing for Calibration Drills

Seeds/ Sq Ft	Seed per Row Foot for Row Spacing				
	6”	7”	8”	9”	10”
20	10	12	13	15	17
30	15	17	20	23	25
40	20	23	27	30	33
50	25	29	33	38	42
60	30	35	40	45	50
70	35	41	47	53	58
80	40	45	54	60	68

Seed Treatments

Seed treatments are often considered as “insurance” and include fungicides, fertilizers, growth regulators and insecticides. Although most seed treatments are generally inexpensive, they are not always recommended for use. The decision to use seed treatments should be based on planting date, tillage/planting method, variety, soil texture, insect problems and field history. Most seed treatments are for use only by commercial seed treaters, although a few are available as planter box treatments.

Fungicide treatments are generally recommended for early planting, clay soils, reduced tillage (especially no-till) or on fields that have a history of poor seedling emergence and seedling disease. Under the right conditions, fungicide seed treatments can result in a 10 to 20 percent stand increase over untreated seed. However, there may not be a yield increase since rice can compensate for thin, uniform stands by increased tillering. Fungicide seed treatments do not speed the rate of emergence like growth regulator treatments, nor do they control kernel smut. The use of fungicide treated seed also does not guarantee that seedling disease will not be present and reduce stand density. Most fungicide seed treatments are specific for certain groups of fungi that may cause stand loss. Table 3-3 lists the registered seed treatments, recommended rates of application and the fungi controlled. Refer to MP389, *Plant Disease Management Guide*, for additional information on fungicide seed treatments.

Recommended growth regulator seed treatments are currently limited to gibberellic acid (or GA3) products which include Release and GibGro. Seed treatments containing GA3 are not recommended for water-seeded rice and do not prevent seedling disease. The use of GA3 is highly recommended for semi-dwarf rice varieties, varieties having poor seedling vigor, clay soils, reduced tillage situations and early seeding dates. Use of GA3 treated seed may increase uniformity of emergence, minimize the effects of deep seed placement and speed germination and emergence (Figure 3-1). Growth regulator seed treatments may be used in combination with other types of seed treatments, but always check the product labels for mixing instructions and precautions prior to use. When treated with GA3, rice seedlings may appear tall and yellow shortly after emergence. Seedlings normally outgrow these symptoms within one or two weeks after emergence. If a stand failure occurs and a residual herbicide has

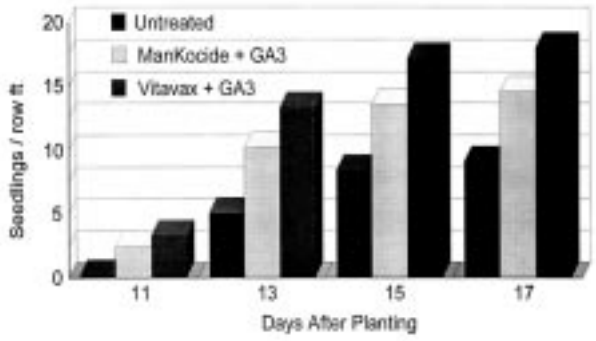
Table 3-3. Fungicide Seed Treatment Products and Disease Control Spectrum for Rice[1]

Product - Formulation	Active Ingredient	Disease Controlled
Allegiance	metalaxyl	Pythium seed rots, damping off
Apron XL	mefenoxam	
Manzate 200 DF	mancozeb	Fusarium, Rhizoctonia, Helminthosporium seedling blights, and seed rots; general seed problems but not pythium.
Dithane - F-45, M-45, DF, WSP, and DF Rain Shield NT	mancozeb	
Thiram - 42-S and 50 WP Dyed	thiram	
Vitavax - 200	carboxin and thiram	
Maxim 4 FS	fludioxonil	
Kocide	copper hydroxide	general protectant

[1]Specific product labels should be consulted for use rates and precautions. Some products may be mixed to broaden the spectrum of seed protection. The highest labeled rates should be used for very early planting or other situations where seed germination and emergence may be delayed by environmental conditions. Most products' effectiveness are relatively short-lived under field conditions, providing about 2 to 3 weeks of seed protection at most.

been used, check the herbicide and GA3 product labels for replanting restrictions/recommendations with GA3 treated seed. For example, the Prowl herbicide label recommends that GA3 treated seed not be used to replant fields that have been treated with Prowl.

Figure 3-1. Influence of Seed Treatment on Rice Stand Density Over Time



The use of fertilizer (i.e., Zn seed treatments) and insecticide seed treatments are addressed in later chapters that concern fertilization practices and insect control. Check with your local county Extension office for the most recent recommendations for use of new seed treatment products.

Seeding Date and Soil Temperatures

The daily maximum, mean and minimum soil temperatures measured at a 4-inch depth at three University of Arkansas Agriculture Experiment Stations are provided in Table 3-4. Rice should be seeded in a seedbed that is conducive to good seed-to-soil contact when the daily average soil temperature at the 4-inch depth is above 60°F. Soil temperature measurements taken from Rohwer, Stuttgart and Keiser indicate that the average soil temperature at a 4-inch depth reaches 60°F about April 8, 11 and 16, respectively. Assuming adequate moisture for germination, rice emergence should occur within approximately 8, 14 and 20 days after seeding when 4-inch soil temperatures average 70°, 65°, and 60°F, respectively (based on data from seeding date studies).

When rice is planted early, more time is required for germination, emergence and development to the 5-leaf stage. For example, in the 1991 Rice Research Verification Program (RRVP), 10 commercial fields seeded from May 10 to June 1 required an average of 7 days between seeding and emergence. An additional 18 days were required for rice development to the 5-leaf growth stage. In comparison, eight 1992 RRVP fields seeded between April 8 and April 27 required 15 and 32 days for emergence and

Table 3-4. Minimum, Maximum and Mean Undisturbed Soil Temperatures at a 4-inch Depth for Selected Dates at Three Locations in Arkansas

Location	Rohwer, SEREC[1]			Stuttgart, RREC[2]			Keiser, NEREC[1]		
Latitude	33.45 N			34.49 N			35.68 N		
Soil Texture	Perry Clay			DeWitt Silt Loam			Sharkey Clay		
Daily Temp.	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Date	4-inch undisturbed soil temperature, °F								
March 15	50	57	54	46	56	51	44	54	49
April 1	53	62	57	49	62	55	46	55	51
April 15	60	69	64	56	69	63	55	64	59
May 1	63	74	69	59	71	65	58	69	64
May 15	69	75	72	66	79	72	64	81	73
May 31	69	78	74	69	78	73	70	74	72

[1]Temperatures are the six-year average from 1990 to 1995.

[2] Temperatures are the nine-year average from 1990 to 1998.

development to the 5-leaf growth stage, respectively. The extended time between planting and flooding at the 5-leaf growth stage may increase production costs associated with flushing and weed control.

Specific beginning and ending seeding dates were once suggested, by variety, for the geographic regions of south, central and north Arkansas. However, seeding date studies conducted in the 1990s suggest these variety selection guidelines were not appropriate for late seeding. Varieties with longer growing seasons may produce higher yields than very short-season varieties when seeded late. Variety selection decisions for late planted rice should be made based on variety performance in seeding date studies. Results from annual seeding date studies are published each year in *Rice Information Sheets* that summarize variety yield performance among different locations and seeding dates.

Seeding date studies conducted at the Rice Research and Extension Center (RREC), located near Stuttgart, Arkansas, were analyzed to predict the optimum seeding dates for central Arkansas (Table 3-5). The optimum seeding date range was defined as "seeding dates producing

Table 3-5. Predicted Relative Yield Potential for Drill Seeded Rice in Central Arkansas by Seeding Date

Relative Yield Potential	Actual Yield Potential[2]	Seeding Date Range[3]	
%	bushels/Acre	Begin	Cut-off
95.0 - 100.0[1]	143 - 150	March 23	May 20
90.0- 94.9	135 - 142	May 21	June 1
85.0 - 89.9	128 - 134	June 2	June 11
80.0 - 84.9	120 - 127	June 11	June 18
70.0 - 79.9	105 - 119	June 19	June 30

[1]Considered optimum seeding date based on potential grain yield and does not consider other management risks or milling yield potential.

[2]Actual yield potential is based on a 100% relative grain yield of 150 bu/A at 12% moisture.

[3]Seeding date and relative yield potential are based on a quadratic relationship described by the equation % relative yield = $22.4 + 1.33x - 0.006x^2$ (where x = day number of year, where April 20 = day 110).

Table 3-6. General Suggested Optimum and Recommended Seeding Dates for South, Central and North Arkansas Geographic Areas Based on Yield Potential and Management Considerations

Geographic Region	Optimum[1]		Recommended Absolute[2]	
	Begin	Cut-off	Begin	Cut-off
South	April 1	May 20	March 25	June 20
Central	April 10	May 15	April 1	June 15
North	April 15	May 10	April 1	June 10

[1]Seeding during the optimum time frame does not guarantee high yields or suggest that crop failure cannot occur when rice is seeded during these times.

[2]Recommended absolute does NOT mean that a successful rice crop cannot be grown if seeded outside of the dates listed. Success may be evaluated and/or interpreted using various parameters (i.e., cropping systems, management, cash flow, field reclamation, etc .) and may differ among specific varieties.

95 to 100 percent yield potential." Results suggest that the optimum time period for drill seeded rice in most years, based solely on grain yields, in central Arkansas is March 23 to May 20 (Table 3-5). Growers must be cautioned that "risk factors" increase for very early seeding dates. These risk factors include, but are not limited to, stand reduction or failure, seedling stress and increased production costs. Management may overcome many of these risks and must be weighed against the potential benefits of early planting. For this reason, it is recommended that the optimum time for seeding rice be based on grain yield potential and management factors. Therefore, the estimated optimum seeding dates listed in Table 3-6, based on yield and management, are suggested for grower use. Relative yield, as affected by seeding date, is presented in Table 3-5 and should be used to make decisions concerning the profitability of late seeded rice compared to alternate crops. Optimum seeding dates for northeast Arkansas are being developed from seeding date studies initiated at the Northeast Research and Extension Center (NEREC) located near Keiser, Arkansas, and will be available when sufficient data are collected.

Specific variety recommendations for late seeded rice (June seeding dates) should be made on yield performance in seeding date studies, seed availability and planned seeding date. Of the current available varieties that have been tested in seeding date studies, Bengal, Cocodrie, Cypress, Drew, Kaybonnet and Wells are recommended for late planting. Contact your local county Extension agent or refer to the Cooperative Extension Service web page for the latest planting date study yield information. If the estimated date of 50 percent heading is after September 10 to 20, rice should not be planted since cool temperatures and possible frost may significantly reduce grain yield and quality. The DD50 program, available at the county Extension office, can be used to estimate heading dates for different varieties. A range of dates for the occurrence of freezing temperatures in several geographic regions is provided in Table 3-7. Table 3-8 lists the predicted dates for Cocodrie and Drew, emerged on June 1, 15 and 30, to reach 50 percent heading in northeast (Clay County) and southeast (Chicot County) Arkansas. Finally, seeding date may influence certain diseases. Therefore, disease susceptibility must be considered when selecting a variety for early or late seeding. For example, earlier seeded rice is often less subject to false smut or blast damage but may have increased sheath blight problems compared to late seeded rice.

Tillage and Post Seeding Management

In Arkansas, the most common method of seeding rice is direct, dry seeding using either a drill, airplane or airflow truck. Broadcast seeding is most commonly used on clay soils or in wet years when speed of planting is important. Dry, broadcast seeded rice is covered either by a final tillage operation or by flushing after levees are pulled. Dry seeding is practiced on about 97 percent of the Arkansas rice acreage. The remaining 3 percent is direct, water-seeded for stand establishment or red rice suppression.

The use of reduced tillage practices has increased in rice production over the past ten years. Reduced tillage practices may be more appropriately divided into two groups including stale seedbed (soil is tilled and floated in fall or late winter) or true no-till (rice is planted in previous crop stubble). A level seedbed free of

Table 3-7. Expected Freeze Dates for Several Eastern Arkansas Locations

City - County	Last Date in Spring with Temp. < 32°F[1]	First Date in Fall with Temp < 32°F[1]
Corning - Clay[2]	April 4 to April 17	October 11 to October 25
Augusta - Woodruff[3]	March 29 to April 14	October 19 to November 2
Pine Bluff - Jefferson[2]	March 20 to April 3	October 26 to November 9
Crossett - Ashley[2]	April 4 to April 16	October 22 to November 2

[1]Freeze dates were obtained from county soil surveys and are the dates for which temperatures below 32°F first or last occur in one to five out of every ten years.

[2]Time period from 1951 to 1974.

[3]Time period from 1951 to 1990.

Table 3-8. Expected 50 Percent Heading Dates of Drew and Cocodrie Rice Varieties in Southeast and Northeast Arkansas for Three June Emergence Dates

		Predicted 50% Heading Date[1]	
Emergence Date	Variety	Chicot County	Clay County
June 1	Drew	August 13	August 14
	Cocodrie	August 11	August 12
June 15	Drew	August 26	August 28
	Cocodrie	August 24	August 26
June 30	Drew	September 12	September 15
	Cocodrie	September 10	September 13

[1]Predictions are for 50 percent heading using the 30-year weather temperature means. Add 35 to 45 days for estimates of 20 percent grain moisture.

Table 3-9. Influence of Rolling Behind Drill on Final Rice Stand Density on a Sharkey Clay Soil at the Southeast Branch Experiment Station, located near Rohwer, Arkansas

Variety	Rolled[1]	Non-rolled[1]
	Seedlings per Square Foot	
Bond	21	17
Lemont	21	16

[1]Seeding rate was 40 seed per square foot for each variety.

potholes and excessive stubble or trash is desired, regardless of tillage and seeding method. A land plane or float is commonly used two times in conventional tillage operations to help eliminate small depressions and high spots in fields. Tillage practices implemented in conventional tilled fields may include a disk, field cultivator, roller and a land plane or float. Tillage requirements differ among soil textures, previous crop and field condition after previous crop harvest. An excellent seedbed can be prepared on most sandy and silt loam soils with minimal tillage. Tillage on clay soils usually produces a cloddy seedbed that does not provide good seed to soil contact. Stale seedbed or no-till seeding usually improves seed-to-soil contact on clay soils. The use of a roller before or behind the drill often improves seed-to-soil contact and speeds emergence by compacting the soil. This is best illustrated by field observations seen each spring where rice first emerges in truck or tractor tire tracks. Research has shown that rolling behind drilled or broadcast seeded rice can increase stand population (Table 3-9).

Generally, levees should be surveyed on 0.2 foot vertical intervals for proper water management. However, if a field is very flat and a single levee may contain more than 10 acres, levees should be marked on 0.1 foot intervals to facilitate flooding. Rice fields having considerable slope may require that levees be surveyed on 0.3 to 0.4 foot intervals to reduce the number of levees. Levees may be surveyed and marked before or after seeding. Surveying levees in minimum and no-tillage systems during the late fall, winter or early spring spreads out labor requirements that are typically encountered following planting operations. Levee formation may be completed with two to eight passes with a levee disk, depending on soil texture. A couple of hours for drying may be required between levee disk passes for clay soils. On clay soils using reduced tillage practices, a levee base may be pulled after surveying in fall, winter or early spring to minimize water seepage losses. Levees are typically seeded on the final pass or final two passes with a levee disk that has a broadcast seeder. A levee gate should be installed in each levee by pushing out a section of soil in the direction of water flow. The ability to manage water is essential for all rice crop management practices. Construction of levees and gate installation should be performed as soon after planting as possible to enable flushing or flooding and to aid in stand establishment or pest management practices. Additional information on irrigation of rice will be covered in the water management section.

Rice harvest must be considered in planting and variety selection to ensure that rice matures over a range of dates and allows for timely harvest. Rice that is planted during a three-week period in April may mature and be ready for harvest at the same time. Table 3-10 lists the estimated dates of 20 percent grain moisture for five varieties that differ in maturity or grain length.

Table 3-10. Influence of Emergence Date on Predicted Dates for 20 Percent Grain Moisture for Five Varieties Using 30-year Weather Norms for Stuttgart, Arkansas

	Rice Emergence Date					
Variety	**April 15**	**April 25**	**May 5**	**May 15**	**May 25**	**June 5**
	Predicted Date for 20% Grain Moisture[1]					
Jefferson	Aug. 13	Aug. 18	Aug. 23	Aug. 29	Sept. 5	Sept. 14
Wells	Aug. 20	Aug. 24	Aug. 29	Sept. 5	Sept. 12	Sept. 21
Cypress	Aug. 19	Aug. 24	Aug. 29	Sept. 4	Sept. 11	Sept. 20
Drew	Aug. 20	Aug. 24	Aug. 30	Sept. 5	Sept. 12	Sept. 21
Bengal	Aug. 29	Sept. 2	Sept. 8	Sept. 14	Sept. 21	Sept. 30

[1]Approximate date of 50 percent heading can be estimated by subtracting 35 days from listed date for Cypress, Drew, Jefferson and Wells or 45 days for Bengal.

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