RICE INFORMATION

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Managing Furrow-Irrigated Rice in Arkansas

Introduction

Furrow-irrigated rice, also known as row rice or upland rice, has recently become an increasingly interesting option to simplify crop rotations in the Mid-South. Since rice is a semi-aquatic plant, upland (non-flooded) production research efforts are limited. Contained in this information sheet are general recommendations to follow if attempting to grow upland rice using furrow irrigation. **Please be advised that at this time, furrow irrigated rice is not eligible for crop insurance through USDA-RMA.**

Fig 1. Early-season furrow irrigated rice.

Cultivar Selection

In furrow-irrigated rice, blast disease is of serious concern. Therefore, it would be wise to select a cultivar that is less susceptible to blast. Choose a hybrid or select a less-susceptible variety that makes disease easier to manage with a fungicide. **Please note that in some situations, a disease such as blast may not be effectively managed with fungicides.**

Standard cultivar performance trials do not provide dependable predictions of performance for row rice production. Modern breeding programs focus on cultivars intended to perform optimally in flooded conditions – these cultivars may not necessarily perform similarly in the absence of a flood (see **Table 1** for cultivar reactions to diseases).

The general expectation is that similar yields to conventional rice production can be achieved, but growers should be prepared for a 10% yield reduction in row rice production depending on field conditions and management capabilities. The goal of this system is to achieve increased profit margins by reducing input costs in other areas that offset the potential yield loss.

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Table 1. Reaction[1] of selected rice cultivars to selected diseases (2016).

Cultivar	Blast	Straight head	Bacterial Panicle Blight	Narrow Brown Leaf Spot	Kernel Smut	False Smut	Lodging
Caffey	MR	--	S	R	--	MS	MR
CL111	MS	S	VS	VS	S	S	MS
CL153	MS	--	MS	S	S	S	MR
CL172	MS	--	MS	S	MS	S	MR
CL272	MS	--	VS	S	MS	--	MR
RT CL XL729	R	MS	MR	R	MS	S	S
RT CL XL745	R	R	MR	R	S	S	S
RT XL723	R	S	MR	MS	MS	S	MS
RT XL753	R	MS	MR	R	MS	S	MS
RT XL760	MR	--	MR	--	MS	VS	S
Taggart	MS	R	MS	MS	S	S	MS
Titan	MS	--	MS	--	MS	MS	MS

[1] Reaction: R = Resistant; MR = Moderately Resistant; MS = Moderately Susceptible; S = Susceptible; VS = Very Susceptible (no values indicate no definitive Arkansas disease rating information available). Reactions were determined based on historical and recent observations from test plots and in grower fields across Arkansas. In general, these ratings represent expected cultivar reactions to disease under conditions that most favor severe disease development.

Seed Treatments

Insecticide and fungicide seed treatments should be used in upland rice. Rice water weevil is less of a concern than in flooded rice, but grape colaspis and billbug can be incredibly damaging in upland rice situations. A seed treatment containing a neonicotinoid insecticide, such as CruiserMaxx® Rice, NipsIt INSIDE®, or NipsIt® Rice Suite, is recommended to protect against these pests in upland rice.

Drainage is improved with the use of furrows, but much of the field will have standing water after a rain or irrigation event. In conditions with a combination of standing water and cool temperatures, seedling diseases can negatively impact rice growth and lead to stand loss. Fungicide seed treatments provide short-term protection to combat and allow for plants to "outrun" seedling diseases.

Planting Furrow Irrigated Rice

Furrow irrigated rice should be planted at a higher density than would be recommended for the same variety in a flooded system. Add 10% to the seeding rate for furrow irrigated rice. To plant furrow irrigated rice use a drill with spacing no greater than 7.5".

Adjust the press wheels to provide adequate but not excessive down pressure for their locations relative to the furrow and the bed so that the drill "fits" the furrows and beds. That is provide more down pressure for furrows and reduce it for beds. Often times the planting depth will be deeper on the beds than the furrows, but as long as the rice is covered with soil, it should be acceptable. Avoid planting the beds too deep (greater than 1.5 inches).

Fertility Management

Nitrogen (N)

Nitrogen efficiency in furrow irrigated rice systems is still being evaluated. At this time multiple options appear favorable depending on field conditions and management considerations (**Table 2**). Where possible, it is recommended that furrows be end blocked to keep tailwater on the field after an irrigation event. Collected tailwater does not have a detrimental effect as with other row crops and the standing water can assist with management of the system. Water management will also affect nitrogen management.

In fields with shallow slopes, holding as much water in the field as possible will increase nitrogen efficiency. For these shallow sloped fields, apply the recommended single preflood N rate as urea to the entire field. Approximately two weeks later, an additional 100 lbs of urea should be applied to the upper portion of the field that does not remain moist at all times – this may range from the upper 1/3 to upper 1/2 of the field.

In fields with steeper slopes that are able to hold very little water, the strategy necessarily changes and "spoon-feeding" is preferred. In these situations, dividing the N fertilizer into smaller more frequent applications is recommended. At the 5-leaf stage, apply 100 lbs urea and irrigate the field. After this, make additional 100 lb urea applications weekly for a total of 4 applications – it is preferred that each application go out immediately prior to an irrigation event.

Another alternative is to apply half of the single preflood N rate prior to the first irrigation with the remainder applied 10 days later as plant N demand increases. Finally apply an additional 100 lbs urea near midseason and at least 7-10 days after the previous N application.

If there are doubts about the water and field management, then more frequent and smaller applications of N applications should be used.

> **Management Key:**
> Furrow irrigated rice requires, at minimum, an additional 100 lbs of urea than flood irrigated rice to achieve maximum yield potential.

Table 2. Nitrogen (N) management programs for furrow irrigated rice.

Field Characteristic	Preflood[†] N (prior to first irrigation)	2nd application	3rd application	4th application
Shallow Slope (0.1'/100') or less)	100% preflood N[‡]	100 lbs urea 14 days later (upper area of field only)		
Steep Slope (0.1'/100') or greater)	50% preflood N[‡]	50% preflood N[‡] 10 days later	100 lbs urea 7-10 days later	
Spoon-Feed (all situations)	100 lbs urea	100 lbs urea 7 days later	100 lbs urea 7 days later	100 lbs urea 7 days later

[†] Preflood N timing refers to the typical 4-5 leaf rice growth stage at which the flood is normally established after nitrogen fertilizer application – this term is used for consistency across rice systems.
[‡] Preflood N refers to optimum preflood N rate, NOT the rate applied prior to flood in a split application typically used for varieties in flooded rice production systems.

Fig. 2. Late-season furrow irrigated rice.

Phosphorous (P)

Phosphorous availability to rice is significantly increased when a permanent, continuous flood is applied. Therefore, when using furrow or overhead irrigation methods, P deficiency might be more prevalent in areas with high pH (>7.0). Soils that have a combination of low soil test P and high pH should be monitored closely for P deficiency symptoms especially following N applications when rice experiences periods of rapid growth.

Weed Management

The lack of a flood changes weed management for rice considerably. However, repetitive irrigation can increase herbicide activation and ground-rig applications are possible. This may call for multiple residual herbicides to be applied slightly later in the growing season to compensate for the lack of weed suppression accomplished by the establishment of a permanent flood.

A good program for conventional rice in upland conditions may include Command applied at planting as a pre-emergence herbicide; followed by Propanil + Bolero® early post-emergence; followed by Ricestar® HT + Facet® or a similar program that provides residual grass control multiple times throughout the season. Permit® or Permit Plus® should be included as needed for nutsedge control. The reduced need for aquatic weed control in furrow irrigated rice is often replaced by the need for multiple applications of grass and broadleaf herbicides. Care should be taken to follow labeled cut-off dates and timings for certain herbicides and pre-harvest intervals (see MP44, MP519, or product label).

For Clearfield® rice in furrow fields, Command followed by Clearpath®; followed by Newpath®; followed by Beyond® may be a sufficient program. Many producers find the length of residual offered by Newpath® in Clearfield® rice to be a good fit in furrow and overhead irrigated scenarios; however, care should be taken not to rely solely on the ALS chemistry to prevent resistance.

***Mention of a specific product does not constitute endorsement and are only provided as examples.**

Fig. 3. Early-season furrow rice with broadleaf weeds emerging.

Disease Management

Aerobic conditions created by upland rice production are more favorable for development of rice blast disease. There is known risk to planting fields to cultivars rated very susceptible, susceptible, or moderately susceptible for blast. The safest option is to select a highly resistant cultivar, as fungicides may not be able to control neck blast on furrow-irrigated rice under some conditions for susceptible cultivars.

All commonly grown varieties have some level of blast susceptibility and should be scouted regularly to manage for this disease – even more so than flooded fields. Upland rice fields can be more easily managed with resistant cultivars (i.e. hybrids). Do not forget a new pathogen race may even attack resistant rice cultivars.

In an upland rice production system you need to be prepared to treat with a fungicide unless resistant cultivars are used. In a blast season, upland rice should be managed very carefully because of its increased susceptibility to blast disease. Two well-timed fungicide applications should be made: the first as heads begin to emerge from the boot (boot split to 10% heading) and the second approximately 7 days later when ~70% of the head is out of the boot.

Sheath blight and other minor diseases such as sheath blight are of little concern in upland rice. However, cultivars susceptible to kernel smut and false smut will still require preventative treatments particularly if the season is cool and wet. Moreover, remember these two diseases are aggravated with high nitrogen fertility and late planting, especially false smut.

Management Key:
If planting blast-susceptible cultivars in furrow-irrigated rice, multiple fungicide applications are needed for management of blast disease, but still may not be sufficient in certain situations.

See **Table 2** for a list of disease ratings for selected cultivars. Listed cultivars can be grown under upland conditions, though extreme care should be taken if growing a cultivar susceptible to blast. Cultivars rated as very susceptible for blast are not included in the table and should not be considered for production under upland conditions.

Insect Management

As mentioned earlier, the use of an insecticide seed treatment is strongly recommended in furrow rice. Grape colaspis can result in significant stand loss (and the larvae feed underground so no foliar options are available). Insecticide seed treatments will protect plants from rootworm and wireworm infestations which can be a problem in furrow rice. Also, billbugs tunnel into rice plants near the base and can result in blank heads – severe infestations have been observed causing 10% yield loss across the field.

Insecticide seed treatments should help reduce issues with this pest. Neonicotinoid seed treatments (CruiserMaxx Rice or NipsIt INSIDE) may be the best options for upland rice. Rice stink bug (RSB) management will remain similar to that for flooded rice with a threshold of 5 RSB per 10 sweeps the first 2 weeks of heading and 10 RSB per 10 sweeps the next 2 weeks.

Irrigation Management

Irrigation

Shallow beds should be used for furrow irrigated rice. Beds should be just adequate to convey water down the furrows without breaking over. In clay soil types the beds can be extremely shallow, because the preferential flow of water follows the cracking nature of the soil, which dominates the movement of water in a furrow irrigated field. Thus in a clay soil the bed height is very forgiving. However in silt loam soils, a bed that is too shallow will break over easy creating water stress in un-irrigated rows. If bed height is too aggressive, then the rice plants on the top of the bed will not receive adequate water if the soil seals and does not wick across the bed easily. This will limit nitrogen and water availability and also prevent herbicide activation, so bed height is critical to success in furrow irrigation.

Fig. 4. Early-season furrow rice irrigation.

Set implements as shallow as comfortable to ensure a successful furrow for the season. If rotating with soybeans, consider using the existing furrows or dressing them up, this will result in a firmer bed and more established furrow. Beds can be established in the fall if desired to allow for earlier planting and less spring field work.

Depending upon soil type, a wider bed may be preferable if water soaks across beds easily. Bed widths of 36-40" are acceptable; however, in silt loams that seal, it is suggested to use 30" beds to provide more soil area for irrigation water to contact. Bed height and width choice are driven by equipment availability, soil type and land slope. Use the combination that works best for the conditions. Larger beds on some soil types can have difficulty wicking moisture across the entire bed. In some situations with certain irrigation sources, water chloride content (salts) can evaporate from the top of the beds and cause injury to rice.

Next, fields should have adequate capacity with a reliable irrigation pumping plant to irrigate the field in 24-30 hours for a 2.5-3 ac-in/ac set. Both gated pipe and lay-flat polypipe have been used successfully in furrow-irrigated rice. The irrigation pipeline and sets should be planned with computerized hole selection (CHS), such as Pipe Planner (www.pipeplanner.com) to ensure that water is uniformly applied across the crown of the field.

Additionally it is suggested to use surge irrigation in furrow irrigated rice, especially if soil sealing is experienced during the season in silt loams or in clays if set times are long or it is difficult to get the water to advance through the field. Surge irrigation improves the down-furrow uniformity, thus improving water delivery to the rice plants at the tail end of the field. If end-blocking does not impound water over a significant part of the field, then surge irrigation should be used. For fields that end blocking results in a large area of impounded tail-water a surge valve may provide less benefit. However, in either situation a surge valve should help to keep the upper area of the field saturated longer as the irrigation water cycles from one side of the field to the other.

Manage irrigation so that only a small amount of tail water is created, or if end blocked terminate the advance before the water reaches the flooded rice so that the recession (remainder of the water) replenishes the flood of the end blocked furrows. Large volumes of tail water leaving a furrow irrigated rice field indicate a problem with water management or infiltration. Seek the corrective remedies mentioned above.

Initial research on furrow irrigated rice has indicated that furrow irrigated rice when properly managed can use 10%-40% less water than conventional flood irrigated rice. However, if soil sealing is excessive or sets are not managed, furrow irrigated rice can quickly become excessively irrigated.

Water use for furrow-irrigated rice has the *potential* to be less than for flood-irrigated rice depending on rainfall, soil type, and environmental conditions. It should be noted that in some studies comparing furrow and flood irrigation, it was difficult to achieve similar yields with furrow irrigation to those achieved with flood irrigation. However, variations in agronomic management of these fields may have played a greater role than simply irrigation management.

Fig. 5. End blocking or a "tail levee" holding water on the low end of a furrow irrigated rice field. Maintain 1-2" of freeboard to capture rainfall.

General recommendations for improving irrigation in furrow-irrigated rice include the use of end blocking the field. This can be done by blocking the drains and in some cases constructing a 'tail levee' at the bottom of the field to back water in the field resulting in the lower end of the field holding some level of flood throughout the season. Also, irrigation should occur more frequently in furrow rice.

Rice is different than other row crops because the rooting depth is very shallow and thus there is much less soil water available to the plants than in other row crops. Application rates in furrow irrigation are typically between 2-3 ac-in/ac, but in furrow irrigated rice, the target application rate should be near 1.0-1.5 ac-in/ac. Measure flow from wells or pumps to ensure adequate irrigation volumes are being applied. A surge valve can assist in getting the correct irrigation volume applied to a field or set.

Maintaining adequate soil moisture will require irrigating every 2-3 days generally.

Soil moisture sensors are a useful tool in furrow irrigated rice. Watermark™ sensor or other soil moisture sensors can be used to track the soil water balance, monitor rice water demand, and ensure irrigations are effective in furrow irrigated rice.

Place sensors at shallow depths, for example if using Watermark sensors place shallow sensors at 4” or 6”and 8”. Place at least one sensor at 12” and/or 24” to monitor any subsoil moisture change. Generally sensor readings for depths past 12” will not change during the season, so make decisions based on the shallow sensor readings. Sensors should be placed in the top center of the bed soon after rice emerges, so sensor installation does not damage rice roots. Damaged plants may not represent the water use of un-damaged plants in the field.

Irrigation in silt loams and clays should not exceed 40 cb. Zero cb is saturated, so keeping sensor reading in single digits is not recommended, but do not allow sensor readings to exceed 40 cb and a good result is keeping levels near field capacity (28-32 cb) or in a range of 20-30 cb for most soils. Experience with soil moisture monitoring has shown that even a 2-3 day schedule may not be adequate for periods of the season when rice plants are at peak transpiration.

Sensors are also helpful to decide if irrigation can be delayed if rain is expected in near future. With all types of sensors, monitor the trend of the sensor readings, the upper sensors should respond to irrigation and plant water use. A good result is a repeatable pattern within a range of the sensors readings that correlate to visual observations about crop condition.

Irrigation practices for furrow-irrigated rice will vary widely depending on soil type, field slope, irrigation capacity, and the cultivar being grown. Use the tools mentioned and adapt the furrow irrigation system that is successful for the conditions.

Management Key:
In furrow-irrigated rice, use shallow beds, computerized hole selection, irrigate every 2-3 days, and monitor irrigation with soil moisture sensors. Figure out what works for your soil type.

Irrigation Termination

Little information is available for determining the timing of irrigation termination for furrow rice systems. Care should be taken not to terminate irrigation too early and risk drought stressing plants as they fill remaining kernels. As a general rule, keep irrigating until the crop reaches maturity. Irrigation will be necessary longer in upland rice than in flooded rice – flooded fields have saturated soil that will take more time to dry out. If using sensors, stop when the plants stop using water and the trends flat-line.

Budgeting for Furrow versus Flood Irrigation

Budgeted costs differ among rice production systems (conventional, Clearfield, hybrid, and Clearfield hybrid) for flood and furrow irrigation. Expenses and revenue can vary greatly for individual fields and farming operations. Initial field setup and management are the driving factors and the greatest differences can be seen between fields using the previous year's beds to eliminate tillage passes versus creating new beds specifically for furrow irrigated rice.

Notable differences in costs associated with flood versus furrow irrigation are in regard to tillage and field passes, nitrogen fertilization, herbicide program, fungicide program, and application costs. For certain inputs, higher costs are associated with furrow irrigation due to the inclusion of additional nitrogen to offset losses, additional herbicides to improve residual weed control, additional fungicide applications primarily for control of blast disease, and additional application costs. These additional inputs may not always be needed, but should be included in conservative budgets.