RICE INFORMATION

UofA DIVISION OF AGRICULTURE RESEARCH & EXTENSION
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Managing Water-Seeded Rice in Arkansas

Introduction

Water-seeding rice typically accounts for 5 percent of rice acres in Arkansas. However, in certain years when wet weather conditions persist it can have an increased role in helping get acres planted to areas that fail to dry enough for drill-seeding. Historically, the primary reasons for water-seeding have been for red rice suppression, reduced labor, and reduced inputs. Water-seeding can also aid in timely planting and reduce the risk of herbicide drift in areas where crops such as cotton are grown in close proximity to rice. Fields precision-leveled to zero grade are ideal candidates for water-seeding rice and have the benefit of decreased labor, ease of management, potentially fewer input costs, and the ability to produce rice continuously.

Water-seeded rice can be grown successfully in the right situations. However, those without prior experience managing water-seeded rice should approach the practice with caution and consultant with specialists, county agents, and experienced growers before attempting the practice. Water-seeded rice offers a means to plant rice earlier in wet years when field work is prohibited, but we need to weigh the risks associated with water-seeding versus waiting for fields to dry enough to drill seed.

Fig. 1. Aerial water-seeding of rice.

Fig. 2. Water-seeded rice during peg-down period prior to re-establishing the flood.

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Field Preparation

Conventional Tillage

When conditions allow, it is desired to properly prepare fields in advance of water-seeding to maximize production potential and minimize issues. The primary objectives in field preparation are to destroy winter vegetation and reduce the chance of seedling drift. Water-seeding presents many new problems to rice farmers that are not common in dry-seeding rice. The following information is a general outline of water-seeding procedures. Following these guidelines should reduce the potential of stand loss, resulting in the need for replanting.

A rough seedbed is essential and leaving the soil ridged helps minimize seedling drift. Seedling drift occurs when seeds with an emerged coleoptile are suspended in the floodwater and blown by the wind prior to the root or radicle successfully pegging down into the soil. If drift occurs, there can be areas in the field with little or no rice seedlings, and replanting may be necessary. On clay soils, this can generally be accomplished with a disk and/or field cultivator. The field should be left with large clods (baseball size or smaller) to allow seedlings an area to settle without being subject to drift. On silt loam soils, the ridges created by the field cultivator may dissolve due to water movement and leave the soil surface smooth. Therefore, this method is not recommended on silt loam soils.

The recommended method of final seedbed preparation before flooding on both silt loam and clay soils is to use an implement called a groover. It is similar to a flat roller with angle iron rings on 6- to 8-inch centers. The groover forms small furrows in the seedbed, and the weight of the groover packs the soil, preventing the wave action of the water from smoothing the soil surface. Packing the soil also creates a level seedbed, which prevents high spots in the field where the soil may be exposed. Generally, high spots develop into areas that are heavily infested with weeds and/or red rice because of the lack of water coverage.

Management Key:
Begin with a rough seedbed through the use of a groover or thorough tillage and leave the surface cloddy on clay soils. The rough seedbed minimizes seedling drift and increases stand uniformity.

No-Till Water-Seeded Rice

While tillage does not influence many of the concerns for water-seeded rice, some specific circumstances should be considered when no-till water seeded rice is produced, particularly in continuous rice rotations. In many instances where wet spring weather is a factor, situations may dictate increased use of no-till water-seeded rice production.

One of the biggest challenges to producing continuous rice is managing the stubble from the previous crop. Obviously, in no-till systems, cultural practices must be worked out to prevent the stubble from interfering with the current crop. When the stubble is left in the field, decaying residue from the previous crop can cause production of organic compounds that are toxic to seedling rice. This happens regardless of whether the field is flooded in the winter or not. Therefore, the residue should be

destroyed by tillage or burning. Since tillage is not desired in no-till systems, burning becomes the means to destroy the stubble. When a stripper header is used for harvest, the stubble will probably need to be cut and spread with a flail mower or equivalent to aid in more complete burning of residue. However, a conventional header with a good straw spreader will also prepare the field for an effective burn without the need for mowing.

Management Key:
Burn the rice stubble in the fall for continuous, no-till rice fields to reduce negative impacts on the next rice crop.

Fig. 3. Seedling establishment failure due to thick residue from previous rice crop.

Methods of Presoaking

In water-seeding, the rice seed can be dry or pregerminated (presoaked). Pregerminated seed is highly recommended to enhance stand establishment and reduce risk of injury from rice seed midge. Pregerminated seeds are generally soaked for 24 to 36 hours, drained 24 to 48 hours and then flown into the flooded field. The duration of the drain period is dependent upon the air and water temperature. Under cool conditions (50°-60°F), seedling development is slow and a longer drain period may be necessary; however, in warmer conditions (greater than 65°F), a drain period of 24 hours or less is usually sufficient.

In general, when rice is pregerminated, about 50 percent of the seeds have the coleoptile emerging from the seed coat. This stage of seedling development is sometimes called 'pipping.' Rice seeds treated with gibberellic acid (Release or GibbGro) should not be used in water-seeded rice. Gibberellic acid promotes rapid shoot development which increases the risk for seedling drift.

Management Key:
Use presoaked seed to minimize injury from rice seed midge and increase the potential for stand establishment.

When the rice is seeded dry, seeds are more likely to drift. If rice is presoaked, the heavy, wet seeds immediately fall through the floodwater into the grooves in the prepared seedbed. **If Bolero herbicide is used preplant, seeds must be pre-soaked.** One problem farmers have is determining the best soaking method when pregerminating seed. Some farmers have built small grain bins which hold the seed and the water. After soaking and draining, the seeds are then augured into a truck prior to being flown into the water. Super (bulk) bags are often used to soak rice seed. The super bags are placed into a soak tank or pit. After soaking and draining, a boom is necessary to load the seed into the plane. Various other methods are commonly used by growers to soak seeds. Consult your county Extension agents or

other growers with experience in water-seeding rice for more information on pregerminating seed.

Seeding Rates

Standard seeding rate recommendations for drill-seeded rice are 30 seed/ft^2 for varieties and 10 seed/ft^2 for hybrids on loamy soils. Soil type/texture is not a factor when determining seeding rates in water-seeded rice as the seed is placed on top of the soil.

The general recommendation is to increase seeding rates by 30% for water-seeded rice compared to loam soil rates for drill-seeded rice. Additional seed is needed to account for stand loss related to blackbirds, rice water weevil, and rice seed midge. In addition, higher seeding rates result in more uniform seed distribution in the field.

Note that no recent research has been conducted comparing drill-seeded and water-seeded rice seeding rates. However, standard seeding rates for drill-seeded rice have been lowered in recent years (from 40 seed/ft^2 to 30 seed/ft^2) which has subsequently reduced the recommended seeding rate for water-seeded rice, which is calculated as a 30% increase over the standard rate.

Note that for hybrid rice in the below table, seeding rates have only been increased 20% rather than the 30% used for varieties. This is due to the increased tillering of hybrid cultivars and seed cost associated with higher seeding rates. Further increases in seeding rate of hybrids may be needed.

Additional factors that may warrant further increases in seeding rate in water-seeded rice include poor seedbed condition, no-till situations with excessive residue, areas with high blackbird pressure, and cool growing conditions.

Consult the Rice Seed Calculator (https://riceadvisor.uaex.edu/srate/) for specific seeding rates for cultivars in water-seeded rice.

Table 1. Seeding rate recommendations for selected cultivars in water-seeded rice.

Cultivar	Seeds/lb	Drill-Seeded†	Water-Seeded‡
CL151	19,346	68	90
CL153	19,146	68	91
CLL15	19,102	68	91
CLM04	18,880	69	92
Diamond	18,843	69	92
Jupiter	17,584	74	99
PVL01	19,270	68	90
PVL02	20,816	63	84
Titan	16,470	79	106
RT 7301	19,899	22	26
RT 7321 FP	18,579	23	28
RT 7521 FP	18,498	24	28
RT CLXL745	19,500	22	27
RT Gemini 214 CL	20,630	21	25
RT XP753	19,647	22	27

† 30 seed/ft^2 (variety) or 10 seed/ft^2 (hybrid) seeding rate for drill-seeded rice.

‡ 40 seed/ft^2 (variety) or 12 seed/ft^2 (hybrid) seeding rate for water-seeded rice.

Water Management

An adequate water supply is necessary for water-seeded rice. Fields should be small to ensure precise water management. Poor water management results in loss of both preplant nitrogen (N) and red rice suppression. The methods of water management used in water-seeding rice are pinpoint and continuous flood.

The pinpoint flood is recommended, especially if Bolero is used preplant. In pinpoint flooding, the water is drained to allow seedlings to anchor (peg down) their

roots in the soil. The soil should not be allowed to crust (dry). Using the pinpoint flood method, you should be able to flood the field within five days and drain and reflood within three to five days for maximum red rice suppression. Thus, small fields approximately 40 acres in size are desirable for optimum water management.

During the drain period, the seedling is exposed to oxygen, which promotes root growth for seedling anchorage. The drain period generally ranges from one to five days, depending upon soil type and weather conditions. The field should be reflooded with a shallow flood and the flood increased as the rice seedlings develop.

With the continuous flood method, the water is maintained at a constant level and is never drained. Seedlings may take longer to peg down and be more susceptible to drift with this method. This method is best used on precision-leveled fields where a uniform, shallow flood can be maintained.

Management Key:
Small fields are more effectively managed than larger fields when water seeding because of ability for more precise water management.

Nitrogen Management

A number of nitrogen (N) management options exist in water-seeded rice, though most are less efficient compared to dry-seeded, delayed flood rice production. Each management scenario must be addressed in a unique fashion in regard to N management. The principles of N fertility are similar whether rice is dry- or water-seeded, but the methods used to attain efficient uptake of the early N application are quite different. When able, removing the flood and allowing the soil to dry prior to the 4-5 leaf growth stage (beginning of active tillering) and applying preflood N similar to a dry-seeded, delayed flood management system will result in the highest N use efficiency and reduce the potential for more N additions throughout the season. This is the preferred approach to maximize N efficiency in water-seeded rice.

Table 2. Nitrogen management strategies for different water-seeded rice situations.

Situation	N Strategy
Dry Field prior to planting	Apply ammonium-N source onto dry soil and incorporate (PPI, 2-4 inches).
Field is drained for pegdown	Apply preflood N rate + 30% to account for N loss on muddy soil.
Field is drained at 5-leaf stage (preferred)	Apply normal preflood N rate to dry soil. Highest N use efficiency.
Continuous flood or no-till	Apply 100 lbs urea weekly beginning at 5-leaf stage totaling 3 to 4 applications.

In a planned water-seeding situation where the field is dry prior to flooding, N can be applied preplant onto dry soil and mechanically incorporated (PPI, 2 to 4 inches). The flood should be established immediately after N incorporation to minimize nitrification.

Surface application of N (without incorporation) followed by flood establishment for water-seeding does not

adequately incorporate the N and prevent loss. In contrast, in the dry-seeded, delayed-flood rice system the preflood N is applied at or around the 4- to 5-leaf growth stage and takes only three to four weeks to be taken up, whereas in water-seeded rice the N is applied around seeding and takes seven to eight weeks to be taken up. One advantage of PPI N application is that early N can be applied with ground equipment, which may potentially reduce streaking and application costs.

In the PPI approach prior to flooding there is a long time period between application and plant uptake. The early N must be stored in the soil for a longer period of time before the rice crop can use the early N. Therefore, it is very important that the early N be incorporated deep and the flood maintained throughout the vegetative growth stage. If the soil does not stay saturated (flooded), the fertilizer N can undergo nitrification during the unsaturated periods and be lost via denitrification upon reflooding.

With the pinpoint flooding method, the field must remain saturated when the field is drained for pegdown. Two alternative methods of early N application for water-seeded systems include N application: i) when the field is drained for pegdown, or ii) after draining at the 5-leaf to early tillering stage. These alternative methods have been used successfully by several Arkansas growers.

Based on field experiences, incorporate only the early preflood N rate recommended for the cultivar. Regardless of the preflood N rate, supplemental N has usually been required in water-seeded Rice Research Verification Program fields. The need for supplemental N, either during active tillering or at midseason, is highly likely in water-seeded fields. Water-seeded rice should be closely monitored for signs of N deficiency, and if N deficiency occurs, N should be applied immediately.

No-Till Water-Seeded Rice

No-till water-seeded rice is not an efficient N management system. Preplant incorporation of the early N with the flood does not move the N deep enough into the soil to prevent substantial loss for the 7-8 weeks required for water-seeded rice to take up the early N. Spoon-feeding the rice with biweekly top-dress N applications typically requires 25 percent more N fertilizer and may still produce lower than normal yields. One viable alternative is to knife anyhydrous or aqua ammonia 4-6 inches beneath the soil surface prior to planting. This is not a common practice in the southern rice belt, but is the standard practice for N fertilization of water-seeded rice in California. Another possible option is to drain and dry the field at the 4-5 leaf stage, apply the N fertilizer onto a dry soil, and then reflood.

Nitrogen management is a critical part of no-till water-seeded rice. The system does not allow efficient use of N fertilizer. Applications into the floodwater can result in loss via ammonia volatilization. Preplant applications onto dry soil prior to flooding and seeding are not effective because the N is not incorporated. Many have found that multiple applications spread about 10 to 14 days apart are the most efficient means. However, this technique will usually result in as much as 25 percent more N fertilizer

required compared to what would be needed in a dry-seeded field.

Weed Control

Starting clean is critical in a water-seeded system to help maintain weed control until post-emergence applications can be made. If **Command** is applied preplant (prior to flood), it can be tank-mixed with **glyphosate** to effectively kill any emerged weeds and make sure the field begins clean. However, be aware of surrounding areas to mitigate drift of glyphosate onto a neighboring susceptible crop.

The biggest challenge with weed control in water-seeded rice is residual herbicide options. **Prowl** is not an option as severe rice injury may occur due to exposed roots as a result of the water-seeding method (the mode-of-action of **Prowl** is a seedling root growth inhibitor).

Bolero can be used successfully, but requires very specific application conditions. **Bolero** has activity on red rice, barnyardgrass, sprangletop, and some aquatic weeds. It should be applied after the field has been grooved, but applied preplant to a dry seedbed with flood establishment 2 to 3 days after application. Rice seeding then should not occur until 24 hours after the flood is stabilized, and rice seed should be presoaked. All of this is not a viable option in wet weather conditions. **Bolero** can also be applied postemergence to moist soil or in a flood; however rice must be at least at the 2-leaf stage which leaves an open window for weeds to germinate prior to its application. Some rice cultivars are sensitive to **Bolero** in the water-seeded system; therefore, these cultivars are not recommended for water-seeding.

Sharpen is an option to be applied prior to flood and seeding, but is primarily used for broadleaf weeds like pigweed and does not provide grass control.

Overall, **Command** is the best and most viable option for water-seeded rice in Arkansas, especially under wet weather conditions. **Command** can be applied preplant (prior to flood establishment) or at pegging stage to one-leaf rice when the flood has been drained for seed set. There is a higher potential for rice injury when applied preplant, but typically it isn't severe enough to affect yield. As a result of limited options for residual herbicides, it is a must to be timely with postemergence applications to effectively manage weeds.

Many postemergence herbicides have specific restrictions on when they can be applied in water-seeded systems, and it is critical to keep a watchful eye on fields to make timely and effective applications. **Gambit** is one of the most flexible options as it can be applied from preplant to post-flood. One note with water-seeded rice, however, is if **Gambit** is applied in flood, floodwater must be held for at least 14 days, making this a more viable option after pegging.

Grasp can be applied at pegging if no roots are exposed, but fields must be at least partially drained prior to application. **Strada** and **Loyant** can be applied when rice reaches the 2-leaf stage with no exposed roots, but again fields must be partially drained. **Ricestar HT** and **Provisia** (Provisia rice) each require 2-leaf rice before applications can be made. Fields do not specifically need to be drained for **Ricestar HT** or **Provisia**,

but good weed coverage/leaf contact is needed.

Facet, **Grandstand**, and **Regiment** all require at least 3-leaf rice in water-seeded systems as significant crop injury can occur if applied earlier. In a Clearfield or FullPage system, **Newpath** or **Preface** can be applied preflood or at pegging when there is not standing water in the field, and **Beyond** or **Postscript** can be applied post-flood for additional grass control, especially assisting with red rice control. (Note: **Newpath** and **Beyond** are labeled for Clearfield rice only while **Preface** and **Postscript** are labeled for FullPage rice only).

Clearfield rice (**Newpath** and **Beyond**) and FullPage rice (**Preface** and **Postscript**) can be effective tools for use in water-seeded rice. The main benefit of using Clearfield or FullPage rice is red rice control. The main drawback to using Clearfield or FullPage rice in water-seeded systems is that many of these systems are in continuous rice production. The safe plant-back interval of **Newpath** or **Preface** herbicides to regular rice cultivars is 18 months. Crop rotation to soybeans is recommended prior to planting conventional cultivars behind **Newpath** or **Preface**. Two applications of **Newpath** or **Preface**, or one application of **Newpath** or **Preface** followed by one to two applications for **Beyond** or **Postscript** are required for season-long red rice control. This can be challenging as in water-seeded rice there are fewer opportunities to make the **Newpath** or **Preface** applications.

Additionally, the flooded environment changes the weed species that may cause problems in water-seeded fields. Weeds such as ducksalad, redstem, gooseweed, eclipta, dayflower, and arrowhead are aquatic weeds that may be more severe problems in water-seeded rice. The herbicide **Londax** has good activity on most of these aquatic weeds. **Londax** should be applied after seedling rice has pegged down and the flood is stabilized as aquatic weeds are small and emerging. The best control is obtained when **Londax** is used before aquatic weeds become established or are just emerging. Alternative control measures for aquatic weeds include **propanil**, **Regiment**, **Grasp**, **propanil** tank mixed with **Basagran**, **Strada,** or **Grandstand** after removing the flood or **2,4-D** at mid-season.

Due to a heavy reliance on **Permit**, **Newpath**, and other ALS-inhibiting herbicides over the past few years, a few populations of ALS-resistant annual sedges and yellow nutsedge have been identified. In addition, umbrella sedge is typically only found in zero-grade fields and cannot be effectively controlled with ALS herbicides. A good program approach for these sedge populations is to apply 3 quarts per acre of propanil and 4 pints per acre of **Bolero** early post-emergence (1-2 leaf) and then follow that later in the season with an application of propanil plus 1.5 pints per acre of **Basagran** or an application of **Loyant** at 1 pint per acre. This program will typically provide 80 to 90 percent control of heavy sedge populations.

To provide more postemergence herbicide options and create greater flexibility within the limited windows for applications, our recommendation is to use a Clearfield or FullPage rice cultivar for a water-seeded rice system. Apply **Command** (or **Command** plus **glyphosate**) preplant and **Newpath** or **Preface** at pegging to overlap

residual chemistries for grass control. After the pegging application, postemergence herbicides can be selected and applied based on need, appropriate timings, and weed species as previously described.

For more in-depth details regarding herbicide usage in a water-seeded system, please refer to the MP44 Recommended Chemicals for Weed and Brush Control (http://bit.ly/UAEX-MP44) and always read and follow the herbicide label.

Fig. 4. Water-seeded rice with weeds emerging during peg-down.

Insect Control

Rice water weevils (RWW) can be a severe problem in water-seeded rice. The adult weevils are attracted to open areas of water during early seedling development. RWW larvae cause damage to rice seedlings by pruning the root system. Root pruning occurs much earlier in water-seeded rice than in drill-seeded rice. The RWW are attracted to the field earlier than in drill-seeded rice. Because the younger rice is flooded, more generations of RWW larvae are likely, leading to longer time for feeding pressure compared to drill-seeded rice. In water-seeded rice, the larvae feed on less-developed roots of 2- to 3-leaf rice causing more severe injury early compared to tillering rice in drill-seeded culture. Preventative treatments are generally required to control RWW in water-seeded rice.

Dermacor X-100 has a 24C label for use in water-seeded rice (seed cannot be pre-soaked). **Dermacor** has shown excellent control of RWW larvae. **Dermacor** is the only seed treatment labeled for use in water-seeded rice.

CruiserMaxx Rice, **NipsIt INSIDE**, and **Fortenza** are not labeled for water-seeded rice, and expressly prohibit it on the label.

Foliar insecticides labeled for RWW control in water-seeded rice include pyrethroids (**Warrior II**, **Mustang Maxx**, **Declare**, etc.), **Dimilin** (diflubenzuron), and **Belay** (clothianidin). In water-seeded rice, foliar insecticides should be applied when adults are present and leaf scars are found on 50 percent of the youngest leaves. Carefully scout after the first application for the presence of adult weevils since a second application may be necessary 5 to 7 days after the first application.

Pyrethroid applications, whatever the seeding method, should be made during the morning hours (approximately 9 to 11 a.m.). Application during this time will be most effective due to the behavior of adult weevils. Pyrethroid insecticides have a short residual time, and depending on application rate and environmental conditions, residual time will range from 3-5 days. This short residual time makes the timing of applications even more critical. Water cannot be released for 7 days following a pyrethroid application.

Dimilin 2L is an insect growth regulator that has activity against RWW eggs. **Dimilin**

needs to be in the water when adults are present and actively laying eggs. Timing of **Dimilin** application(s) is the key to controlling RWW with this product.

The recommended **Dimilin 2L** rates are 12 or 16 ounces per acre. A split application of 6 or 8 ounces per acre after the leaf scar threshold is reached followed by another 6 or 8 ounces per acre in 5 to 7 days will improve control of RWW. The split application is recommended for water-seeded rice since egg laying is extended and the peak may not occur until 7 to 28 days after permanent flooding. No more than 16 ounces of **Dimilin** can be applied in a growing season and there is an 80-day pre-harvest interval.

Belay is a neonicotinoid insecticide that has been observed to provide good RWW control. **Belay** should be applied at 4.5 ounces per acre. Only one application of **Belay** is allowed in rice per year. Good results have been observed with an initial application of **Belay** followed by a pyrethroid 5-7 days after the **Belay** application. Water cannot be released for 14 days following a **Belay** application.

None of the foliar insecticides discussed have been documented to interact negatively with herbicides. Always check and follow the most recent label of any insecticide for use and restrictions.

Management Key:
Scout carefully for rice water weevil during the first 8 weeks after peg-down. Rice water weevil will be more severe in water-seeded rice than drill-seeded rice.

Additional Information

For more information please visit the Extension rice page at http://uaex.edu/rice.

Additional information on topics throughout this publication may be found in:

- Arkansas Rice Production Handbook
- MP44 – Recommended Chemicals for Weed and Brush Control
- MP144 – Insecticide Recommendations for Arkansas
- MP154 – Arkansas Plant Disease Control Products Guide

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