

6 – Rice Weed Control

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Weeds compete with rice for sunlight, nutrients and water, and when not controlled reduce yield. In addition to competitive yield loss, weed seeds can reduce rice quality and grade. Economic losses from quality and grade reductions are usually quantified at the mill but competitive losses may go unnoticed when scattered weeds are left uncontrolled for the duration of the production season. Secondary effects of weeds are numerous and include reduced harvesting and processing efficiency, increased insect and disease severity, and increased production costs. Weed control costs in Rice Research Verification Program (RRVP) fields between 1993 and 1999 averaged \$50.42 per acre. During this same time period, the number of herbicide applications, including burndown, in the RRVP has ranged from 1.7 to 2.4 per acre per year with an overall average of 2.0 per acre per year. Custom application of herbicides typically represents nearly 15 to 20 percent of the costs associated with weed control. Arkansas rice growers spend an estimated \$50 to \$100 million each year on weed control alone.

To effectively manage weeds, understanding how and when they compete with rice is important. The following is a summary of research conducted by Dr. R. J. Smith, USDA-ARS weed scientist (retired), on weed competition in rice. Weeds vary in their competitive effects with rice (Table 6-1). In weed competition studies, rice grain yield reductions have ranged from 82 percent with red rice to 10 percent with eclipa. The factors that influence yield loss from weed competition include weed species, duration of competition, weed density, rice variety characteristics and other cultural management factors that influence rice growth. The influence of rice variety in fields with a history of high weed density, especially red rice, is often overlooked. Semi-dwarf or short rice varieties generally have greater yield losses from weed competition compared to taller rice varieties. The ability of a variety to tiller and its canopy architecture (erect or horizontal leaves) may also

Table 6-1. Rice Yield Loss from Heavy, Season-Long Weed Interference

Weed Species	Potential Yield Loss, %	Critical Time to Control to Avoid Yield Loss
Red rice	82	Midseason
Barnyardgrass	70	Early Season
Bearded sprangletop	36	Early Season
Amazon sprangletop	35	Early Season
Broadleaf signalgrass	32	Early Season
Ducksalad	21	Midseason
Hemp sesbania	19	Midseason
Spreading dayflower	18	Midseason
Northern jointvetch	17	Midseason
Eclipta	10	Midseason

R. J. Smith, Jr. 1988. Weed Technology. 2:232-241.

influence its ability to compete with weeds. For example, Lemont (semi-dwarf) yields were reduced by 17 percent by red rice densities of 8,100 red rice plants per acre. In comparison, Newbonnet (short-statured) yields were decreased by only 7 percent by the same red rice population.

Research on the duration of weed competition provides information on when each weed species competes with rice. Table 6-1 lists the critical time that several weeds should be controlled to avoid yield losses. Most grass weeds, except red rice, are highly competitive with rice early in the growing season and should be controlled shortly after emergence. For example, barnyardgrass grows faster and develops more biomass than rice during the early season which gives it a competitive advantage. Red rice and most broadleaf weeds compete with rice later in the season and thus can be controlled later in the season without significant yield losses.

Table 6-2. Suggested Critical Density Thresholds[†] for Selected Weeds

Weed Species	Plants/sq ft	Plants/sq yd	Plants/acre
Red rice	0.1 - 0.3 [‡]	0.8 - 2.5	4,300 - 13,000
Barnyardgrass	0.5 - 1.0	4.0 - 8.0	22,000 - 44,000
Bearded sprangletop	1.4 - 2.8	12.0 - 25.0	61,000 - 122,000
Broadleaf signalgrass	1.9 - 3.7	17.0 - 34.0	39,000 - 161,000
Hemp sesbania	0.1 - 0.2 [‡]	0.8 - 1.6	4,350 - 8,700
Northern jointvetch	0.3 - 0.6 [‡]	3.0 - 5.0	13,000 - 26,000

[†]Thresholds are the weed populations that represent the need for herbicide treatment. Compare weed densities to standard rice stand density of 20 plants per square foot or 871,000 plants per acre. Source: R. J. Smith, Jr. 1988. *Weed Technology*. 2:232-241.

[‡]Indicates that rice grade loss considered in critical weed density threshold.

Weed thresholds have been established from weed density and duration studies to serve as a guide for determining the need for a herbicide application (Table 6-2). In rice fields, there are generally multiple weed species that can potentially reduce rice yield and quality. Correct seedling weed identification in the field is critical for proper herbicide selection.

Herbicide Resistance Management

Resistance to several rice herbicides, including Facet, Londax and propanil, has been documented. Prevention of weed resistance to herbicides can be managed by rotation of herbicide chemistry (mode of action) and crops grown in the rotation. See the herbicide resistance section of MP-44 (*Recommended Chemicals for Weed and Brush Control in Arkansas*) for additional information.

Grass Weed Control

Barnyardgrass is the most common grass weed in rice. Barnyardgrass and other grass weeds (sprangletop and broadleaf signalgrass) must be controlled soon after emergence to prevent yield loss. Once a permanent flood is established, these grassy weeds usually will not emerge.

Herbicides to control grass weeds include Bolero, Command, Facet, molinate, propanil and Prowl. Herbicide selection for grass weed control should be specific for each situation. The weed

response rating table (Table 6-3) indicates the spectrum of activity for these herbicides applied alone or in tank mixed combinations. The following is a brief review of several herbicides that can be used for grass control in dry-seeded rice. **The statements included in this chapter do not imply endorsement of any product and do not substitute for labeled herbicide restrictions. Herbicide use information on labels often changes, so always check the label prior to use.**

Propanil

Propanil has been the primary herbicide used for rice weed control for nearly 40 years. Propanil is a contact herbicide and, when used alone, generally requires a second application before the permanent flood is established for complete grass control. Spray contact with weed foliage is important for control. Weed foliage must not be covered with water at time of application. Propanil does not have any residual activity for weed control from application to the soil. Poor weed control may occur when temperatures are cool and rice injury can occur when temperatures are hot. Many different propanil formulations (i.e., dry flowable and EC) are available. The addition of spray adjuvants to dry flowable formulations is required by the label. Spray adjuvants are not required for EC formulations. Arrosolo and RiceSolo are combinations of propanil and molinate. The molinate component may increase the contact activity of propanil and may improve propanil activity in marginal situations (i.e., cool temperatures). Residual control may be obtained

Table 6-3. Herbicide Ratings for Rice Weed Control

HERBICIDES	WEEDS																								
	Barnyardgrass	Crabgrass	Broadleaf Signalgrass (brachata)	Fall Panicum	Flatsedges	Sprangletop (lighthead) (Christmastree grass)	Sprangletop (loosehead) (bearded sprangletop)	Red Rice	Nutsedge	Spikerush	Ammania (red stem)	Cocklebur	Dayflower	Ducksalad	Eclipta	False Pimpernel	Gooseweed	Northern Jointvetch (curly indigo)	Indian Jointvetch	Morningglory	Palmleaf Morninglory	Hemp Sesbania (coffeebean)	Smartweed	Water Hyssop	Groundcherry
Bolero - Water seeded	8	7	7	-	7	8	8	8*	3	5	3	0	6	6	-	5	6	-	-	-	-	-	-	5	-
Ordram or RiceCue ppi - Water seeded	7	7	6	6	8	5	5	8*	3	5	0	0	3	0	2	2	2	0	0	0	0	0	2	5	2
Facet pre/delayed pre	9	9	9	9	5	0	0	0	0	-	3	-	5	3	-	3	3	-	3	3	7	7	0	0	0
Command pre/delayed pre	9	9	9	-	0	9	9	-	0	-	-	-	-	3	-	-	-	-	3	3	4	2	-	-	-
Bolero delayed pre	7	7	5	7	7	7	7	0	4	7	7	4	8	7	8	8	6	5	5	5	5	5	5	7	0
Prowl delayed pre	8	8	6	7	0	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Facet + Bolero delayed pre	9	9	9	9	8	8	8	0	0	7	6	-	7	7	9	7	5	8	8	8	8	8	5	6	0
Facet + Prowl delayed pre	9	9	9	9	5	7	7	0	0	-	3	0	5	3	8	3	3	7	7	8	8	7	0	6	0
Propanil early (weeds less than 2")	9	9	9	9	9	5	4	0	4	9	6	5	5	7	8	7	5	9	9	4	4	9	6	8	0
Propanil + Bolero early	9	9	9***	9	9	9	9	0	5	9	8	5	8	8	9	9	6	9***	9***	5	5	9***	6	9	0
Propanil + Prowl early	9	9	9	9	9	9	9	0	5	7	7	5	5	7	9	7	6	9***	9***	5	5	9***	6	7	0
Propanil fb propanil	9	9	9	9	9	8	7	0	6	9	6	6	6	7	9	7	5	9	9	5	5	9	8	8	0
Arosolo or RiceSolo early	9	9	9	9	9	7	7	0	5	9	6	5	7	7	9	7	5	9	9	4	4	9	6	9	0
Facet early post	9	9	9	6	5	0	0	0	0	-	3	-	3	3	9	3	3	8	8	8	8	8	0	3	0
Facet + propanil early post	9	9	9	9	9	5	4	0	5	9	6	-	5	6	9	7	5	9	9	8	8	9	6	8	0
Propanil + Londax prior to flood	9	9	9	9	9	5	4	0	8	9	9	8	8	7	9	8	9	9	9	9	9	9	8	8	0
Permit prior to flood	0	0	0	0	8	0	0	0	9	-	-	9	8	3	-	-	-	3	3	4	3	9	-	-	-
Propanil + Permit	9	9	9	9	9	5	4	0	9	9	6	9	8	7	8	7	5	9	9	4	4	10	6	8	-
Whip 360 (half rate)	4	4	4	4	0	7	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ordram or RiceCue 15G early (3-5" barnyardgrass)	9	9	8	8	5	5	5	0	4	7	0	0	7	0	8	0	2	0	0	0	0	2	4	2	0
Londax early post flood	0	0	0	0	8	0	0	0	6	8	9	5	8	9	8	9	9	6	6	5	5	6	6	9	0
Basagran early	0	0	0	0	8	0	0	0	6	8	8	9	9	6	8	7	7	3	3	3**	8	3	7	8	0
Blazer + propanil early	8	8	8	8	8	5	4	0	5	8	6	5	5	7	8	7	5	9	9	8	8	9	7	8	8
Basagran + propanil early	9	9	9	9	9	5	4	0	6	9	9	9	9	7	9	8	7	9	9	5**	8	9	8	9	4
Grandstand + propanil early	9	9	9	9	9	5	4	0	5	9	9	9	5	8	9	8	8	9	9	9	9	9	7	8	4
Propanil midseason	4	4	4	4	5	0	0	0	3	7	4	2	0	3	4	4	0	5	5	0	3	8	3	8	4
2,4-D midseason	0	0	0	0	8	0	0	0	5	8	9	9	9	9	9	9	6	5	5	9	9	9	6	9	5
MCPA midseason	0	0	0	0	8	0	0	0	5	8	9	9	9	9	9	9	6	5	5	9	9	6	6	9	5
Blazer midseason	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	9	0	0	3
Propanil + Blazer midseason	5	5	5	5	6	0	0	0	4	7	5	6	2	4	5	5	2	6	6	8***	7	9	4	8	5
Grandstand + propanil midseason	2	2	2	2	5	0	0	0	3	8	9	9	-	6	6	8	7	9	8	9	9	9	5	8	3
2,4-D propanil midseason for levees	6	6	6	6	8	6	6	0	6	8	9	9	9	8	9	9	8	8	8	9	8	9	7	9	5

*Water seed pin-point flood culture. **8 for palmleaf morningglory ***Postemergence control only. ****Runners less than 1 ft. Rating Scale - 0 = No Control 10 = 100% Control.

from the molinate component of the combination, but only for a very short time and erratically. **Note that some rice varieties are sensitive to molinate, and herbicides containing molinate should not be used or used only in limited amounts on these varieties.** A maximum of 8 pounds ai per acre propanil (8 quarts per acre) can be applied during a single growing season. A maximum of 6 pounds ai per acre can be applied in a single application. Below are several use precautions/tips for propanil use in weed control programs.

- Apply to grass in 1- to 3-leaf stage.
- Best activity when daytime maximum temperatures are above 75°F.
- Weeds must be actively growing. Flush before spraying if weeds are moisture stressed.
- Apply in 10 gallons water per acre to obtain good coverage.
- No surfactants, oils or additives are recommended unless using dry flowable or flowable formulations.
- Application when temperatures are > 95°F may burn rice, and propanil should not be applied at such high temperatures.
- Carbamate (Sevin, etc.) and organophosphate (methyl parathion, etc.) insecticides should not be applied within 14 days before or after propanil.
- Prevent drift of the above listed insecticides from adjacent wheat fields onto rice during the propanil-use season.
- Avoid contaminating mixing and spray equipment with insecticides when using propanil.
- Cotton is extremely sensitive to propanil drift and heavy drift rates prior to cotton emergence can cause injury.
- Soybean varieties react differently to propanil drift, so check the MP-44 for variety sensitivity to propanil.
- Avoid drift to gardens.

Propanil-resistant barnyardgrass has been found throughout most of Arkansas. Propanil-resistant barnyardgrass occurs most frequently in fields where rice has been grown continuously or in a 1:1 rice-soybean rotation. Resistance occurs less frequently in fields where rice is followed by two years of soybean in rotation. Herbicides that control propanil-resistant barnyardgrass include Command, Facet, Bolero, Prowl, molinate and tank mixtures of these herbicides. Strategies for preventing and managing propanil-resistant barnyardgrass include:

- Use a one-year rice followed with a two-year alternate crop rotation where possible.
- Use residual herbicides such as Bolero, Command, Facet or Prowl with propanil.
- Use Command and/or Facet pre-, delayed pre- or early postemergence.
- Do not use the same herbicide strategy more than two consecutive times on a field that is in rice.

Table 6-4. Weed Sizes for Optimum Control with Propanil

Weed	Weed Height	Number of Leaves
	Inches	
Fall panicum	≤ 1 - 3	1 - 3
Broadleaf signalgrass	≤ 1 - 3	1 - 3
Sprangletop	≤ 1 - 2	1 - 2
Morningglory	≤ 3	2 - 3
Ducksalad	≤ 1	2
Redstem	≤ 1	2 - 4
Smartweed	≤ 2	2 - 4
Volunteer milo	≤ 5	4 - 6
Northern jointvetch	≤ 12	—
Hemp sesbania	≤ 36	—

Use 4 pound rate if 4-leaf barnyardgrass is present or on larger stages of weeds listed above.

Residual Herbicides

Herbicides that provide residual weed control from soil application are Bolero, Command, Prowl and Facet. These herbicides may be tank mixed with propanil for contact and residual grass control or used alone prior to weed emergence in most dry-seeded rice weed control programs. Situations where propanil and/or a residual herbicide should receive consideration include:

- Management of propanil-resistant barnyardgrass.
- Water is in short supply.
- Sprangletop is a problem.
- Residual grass control is desired.
- Early planted rice.
- Gardens or susceptible crops will emerge before a second propanil application can be made.
- Flooding is delayed on high pH fields.

Bolero 8E

Environmental and cultural practices affect the length of residual activity of Bolero. Bolero can be applied delayed preemergence or postemergence with propanil. Bolero may injure rice if applied before germination water is imbibed. To prevent injury and maximize Bolero activity, apply to a soil surface that has been sealed by a rain or flushing. Residual activity is decreased if the soil becomes dry and cracks. Bolero (3 to 4 pints per acre) applied as a delayed preemergence treatment provides excellent control of sprangletop, barnyardgrass and several aquatic weeds. Delayed preemergence applications should be made one to five days before rice emergence or about five to nine days after planting provided that adequate moisture is present for rice seed to have imbibed water for germination. Drain any surface water before Bolero application. A rainfall or flush is required for activation if the soil begins to crack or if grass begins to germinate. Bolero provides poor control of broadleaf signalgrass. A maximum of 4 pounds ai per acre (4 pints per acre) can be applied during a single growing season. Most Bolero is applied either tank mixed with Facet as a delayed preemergence treatment or with propanil as an early postemergence treatment. Refer to Table 6-3 for more detail on specific weed control ratings with Bolero.

Prowl 3.3 EC

Prowl can be applied alone (delayed preemergence) for residual grass control or be tank mixed with Facet or propanil. Use Prowl only on dry-seeded rice. When applied as a delayed preemergence, the soil should be sealed by a rain or flush and any surface water should be drained before application. Rice seed should have imbibed germination water before application. Prowl controls both barnyardgrass and sprangletop but is weak on broadleaf signalgrass. Most Prowl is applied either tank mixed with Facet as a delayed preemergence treatment or with propanil as an early postemergence treatment. Refer to Table 6-3 for specific weed control ratings.

Facet 75DF

Facet is primarily a grass herbicide that also controls several important broadleaf weeds. Facet can be applied preemergence, delayed preemergence or early postemergence. Facet may also be applied to the soil surface prior to planting in stale or

no-till seed beds. Facet enters weeds mainly through root uptake; therefore, adequate moisture is important for maximum activity. Rice must be at least in the 2-leaf stage for Facet use in water-seeded rice and the flood water must be drained before application. The labeled application rates are dependent on soil texture. Coarse (sandy loams) soils require 0.33 pound per acre (0.25 pound ai per acre), silt loams require 0.5 pound per acre (0.33 pound ai per acre) and clay and clay loams require 0.67 pound per acre (0.50 pound ai per acre) for preemergence and delayed preemergence weed control. Rates may be reduced depending on length of residual control needed or under light weed pressure (refer to the reduced rate recommendations in MP-44). Facet should not be used on sandy soils with poor water-holding capacity because it may leach and reduce weed control. Delayed preemergence or early postemergence applications of Facet should be made to a moist soil or when frequent rains or flushing keeps the soil moist for improved weed control to be expected.

For foliar or postemergence grass control, the recommended application rates are from 0.17 to 0.67 pound per acre depending on soil texture and the length of desired residual control. Crop oil or an EC propanil formulation should be tank mixed with Facet for postemergence weed control. Crop oil concentrate is required for Facet applied alone or tank mixed with flowable or dry flowable propanil formulations. If an EC formulation of propanil is used, spray adjuvants are not needed. A maximum of 0.75 pound per acre (0.67 pound ai per acre) can be applied during a single growing season.

Rice tolerance to Facet has been excellent regardless of application method. However, if the rice seeds are exposed to direct spray, injury may occur. Facet provides excellent residual control of barnyardgrass, broadleaf signalgrass, morning-glory, hemp sesbania and northern jointvetch. Facet has little or no activity on sprangletop, smartweed or nutsedge. If fields have a history of these weeds, a tank mix with another herbicide or a pre-flood application of another herbicide may be necessary. Common purslane and carpetweed are not controlled by Facet. However, these weeds should be controlled by the flood. If weeds emerge after application, rainfall or flushing may be required for activation and reactivation.

Tomatoes and cotton are extremely sensitive to Facet. Follow all Arkansas State Plant Board application guidelines to reduce drift and prevent injury to nontarget plants.

Molinate (Ordram 15G and RiceCue 15G)

Granular molinate is recommended for postflood grass control. Best grass control is obtained when molinate is applied to small grass that can be at least two-thirds covered by the flood water. Molinate use best fits the situations described below:

- Large barnyardgrass is the problem weed.
- Barnyardgrass is tillering.
- After propanil application failed.
- Flood can be maintained until grass is controlled.

The molinate rate should be increased as barnyardgrass size increases. Apply to a flooded field and maintain the flood until grass is controlled. Use the 20 pounds per acre rate for barnyardgrass 3 to 5 inches tall. Use the 27 pounds per acre rate for barnyardgrass 5 to 12 inches tall. For heavy infestation less than 12 inches or for barnyardgrass 12 to 24 inches, use the 33 pounds per acre rate. Use the 33 pounds per acre rate for sprangletop control. Sprangletop must be two-thirds submerged and the flood maintained or poor control will result. The smaller the grass or the longer the flood on the larger grass, the better the suppression. Accurate calibration and uniform application are important for good grass control and to prevent rice injury. **NOTE: Variety restrictions – Some varieties are sensitive to molinate.** Of the current varieties grown, Priscilla has shown sensitivity to Ordram on silt loam soils. The degree of sensitivity is currently being evaluated, so check with your county Extension agent for updated information. Refer to Table 6-3 for specific weed control ratings.

Command 3ME

Command provides excellent control of barnyardgrass, sprangletop and broadleaf signalgrass. Broadleaf signalgrass will usually be the first grass to “break” following application. Command can be applied to dry-seeded rice from 14 days before seeding to 7 days after seeding. If applied before seeding, do not incorporate. Application rates vary with soil texture. Silt and sandy loam soils require 0.25 to 0.4 pound ai per acre (12 to 16 ounces per acre) and 0.5 to 0.6 pound ai per acre (20 to 24 ounces per acre) is recommended for clay soils. Labeled application rates range from 16 to 24 ounces per acre. Some bleaching can be expected following Command application, especially following a flush or a soaking rain.

Bleaching gradually diminishes as the soil dries but may return with flushing or rainfall.

Bleaching is generally not a problem, causes no yield loss or reduced seedling vigor and is greater on the sandy and silt loam soil textures. If rice is seeded into a stale seedbed, be sure that the drill gaps close and cover the seed. Shallow seeding may also increase bleaching. During application, avoid overlaps and other factors that result in poor application accuracy.

The Command rate will influence the length of residual. Research has shown excellent residual grass control from reduced rates of 0.2 to 0.3 pound ai per acre on silt loam soils. A follow-up herbicide treatment is generally required before flooding to “clean up” annual sedges and broadleaf weeds. Levees pulled after Command application may require additional weed control. Refer to Table 6-3 for specific weed control ratings.

Broadleaf and Aquatic Weed Control

Broadleaf weeds reduce rice yield by direct competition and also reduce grade if they produce dark-colored seeds. The broadleaf weeds – dayflower, hemp sesbania, northern jointvetch, smartweed and morningglory species – are dark-seeded weeds that are common in much of Arkansas. These broadleaf weeds will not germinate once a permanent flood is established. However, they are problems if they emerge prior to flooding or if they emerge after flooding on levees or areas in the paddy that are allowed to dry. Hemp sesbania, northern jointvetch, palmleaf morningglory, dayflower and smartweed thrive in flooded soils if they are allowed to emerge prior to flooding. Other morningglory species like entireleaf or pitted morningglory do not usually survive prolonged flooding. All morningglory species can be problems on levees. Other weeds that can be found on levees include cutleaf groundcherry, sicklepod, cocklebur, velvetleaf and pigweed. Eclipta is another broadleaf weed that survives flooding, may interfere with harvest and increases moisture of harvested grain.

Most broadleaf weeds can be controlled before or after flooding without yield or quality loss. Because broadleaf weeds usually emerge after barnyardgrass, herbicides that control broadleaf weeds are usually applied shortly before or after flooding. There are numerous pre-flood control options that can be used alone or tank mixed with propanil. General use guidelines for several herbicides that are specific for broadleaf weed control are reviewed below. Refer to Table 6-3 for specific weed control ratings for each herbicide.

Basagran, Blazer and Storm

Basagran, Blazer and Storm can be applied alone or tank mixed with propanil to increase their spectrum of control. Storm is a package mix of Basagran and Blazer labeled for rice. Storm applied at 1.5 pints per acre is equal to 1 pint of Blazer plus 1 pint of Basagran.

Basagran tank mixed with propanil will increase activity on smartweed, cocklebur, redstem, dayflower and spikerush. Apply Basagran when broadleaf weeds are small. Propanil timing for grasses should be applied as for propanil alone. Basagran does not provide residual control.

Blazer can be tank mixed with propanil and applied pre-flood to control small morningglories. Blazer applied alone may also be used to control large hemp sesbania post-flood. Apply Blazer when hemp sesbania is 1 to 5 feet and morningglory runners are less than 1 foot. Propanil plus Blazer is a good levee treatment for groundcherry and is a good alternative for 2,4-D levee sprays if cotton or other sensitive crops are nearby. Blazer may cause foliar burn on rice, but symptoms will be quickly outgrown. Do not apply more than 1 pint Blazer per acre per season. The addition of Blazer may reduce propanil activity on grasses. Blazer must be applied 50 days before harvest or no later than the early boot stage. When applied alone Blazer requires the addition of a surfactant.

Londax 60DF

Londax is a herbicide that is primarily used for aquatic weed and yellow nutsedge control. Londax plus propanil applied immediately (one to seven days) before flooding provides control of annual sedges and yellow nutsedge. For best results, maintain the permanent flood and keep water as static as possible. Londax is highly water soluble and will move with irrigation water. This tank mixture also increases control of several broadleaf weeds (i.e., smartweed, redstem and eclipta) compared to propanil alone. Some aquatic weeds (i.e., redstem and arrowhead) have developed resistance to Londax. Weed resistance is most likely to develop in fields where Londax is used continuously, such as in water-seeded fields. Failure to control aquatic weeds in water-seeded fields may suggest the beginning of weed resistance to this herbicide.

For post-flood applications, apply Londax within five days after flooding when target weeds

are small and maintain the flood at least seven days. For water-seeded rice, apply as soon as possible after rice has pegged and the flood is stabilized. Londax is weak on emerged ducksalad and roundleaf mud plantain but provides excellent control before they emerge. In water-seeded rice, excessive pumping (water flow) after application may result in poor control in the upper paddies. If possible, avoid pumping for seven days after treatment. Activity is slow. Most consistent results are obtained on aquatics before or just at emergence.

If applied alone or tank mixed with a dry-flowable propanil formulation, add 0.25 percent non-ionic surfactant or 1 percent (1 gallon per 100 gallons) crop oil concentrate. Londax has a 60 day preharvest interval and a maximum of 1.67 ounces per acre can be applied during a single growing season.

Permit

Permit is generally the best herbicide choice for the control of yellow nutsedge in rice. Unlike Londax, the flood does not need to be applied following application for yellow nutsedge control. Permit can also be applied with a burndown herbicide like Roundup before rice is planted in situations where heavy yellow nutsedge infestation occurs before seeding. Permit cannot be applied to flooded rice. Labeled application rates range from 0.67 to 1.33 ounces per acre (0.032 to 0.063 pound ai per acre). If applied alone or tank mixed with a dry flowable propanil formulation, add 0.25 to 0.5 percent non-ionic surfactant or 1 percent (1 gallon per 100 gallons) crop oil concentrate. Permit can be weak on certain broadleaf and aquatic weeds. However, Permit alone or tank mixed with propanil provides excellent control of hemp sesbania and dayflower. Permit tank mixed with propanil offers broader spectrum weed control.

Grandstand-R 3SL

Grandstand is a hormone-type herbicide that can be applied pre-flood or post-flood. It is commonly tank mixed with propanil to increase the spectrum of control. Grandstand plus propanil provides control of northern jointvetch, hemp sesbania, morningglory and several aquatic weeds.

Grandstand may be applied to dry- or water-seeded rice starting at the 2- to 3-leaf stage. The flood must be delayed for 72 hours to

prevent injury for Grandstand applications made prior to flooding. For postflood application, weeds should be exposed before application. If the flood is drained or lowered for this purpose, do not drain below (expose) the crown of the rice plants and wait 48 hours before raising flood level after application. To avoid rice injury and possible yield loss, Grandstand should not be applied after 1/2 inch internode elongation. If more than one application is made to rice during a single season, applications must be at least 20 days apart. A maximum of 2 pints per acre Grandstand 3SL can be applied per season but only 1 pint per acre for each application. Add a surfactant or crop oil concentrate if Grandstand is applied alone or with dry-flowable formulations of propanil. Coverage of weed foliage is important for optimum control. The Grandstand label prohibits tank mixes with liquid nitrogen and zinc fertilizers. Do not allow spray to drift to sensitive crops, especially cotton or blooming soybeans. Cotton is less sensitive to Grandstand than to 2,4-D. A preplant burndown application may be made at least 21 days before rice is dry seeded or 14 days before water seeded.

2,4-D

Many different formulations of 2,4-D are available for application to rice. The herbicide provides economical control of many broadleaf and aquatic weeds in rice. Northern jointvetch is not effectively controlled with 2,4-D. The recommended application window for 2,4-D use on rice is very narrow. Use the DD50 prediction as a guide for application, or apply when the first elongating internode begins movement. Do not apply when internode length exceeds 1/2 inch. Application after 1/2 inch internode elongation may result in severe crop injury and yield loss. To hasten recovery of the rice plant, apply 20 to 30 pounds nitrogen per acre within five days after phenoxy herbicide treatment. If nitrogen is applied first, a phenoxy herbicide can be safely applied within five days after nitrogen application, providing the first elongating internode is not longer than 1/2 inch. Follow State Plant Board regulations concerning applications near sensitive crops.

Aquatic Weed Control

Aquatic weeds germinate and thrive in saturated or flooded soils. Duckweed, purple ammannia (redstem), gooseweed, arrowhead, false pimpernel and roundleaf mud plantain are found in most Arkansas rice fields. These aquatic weeds compete with rice and interfere with harvest. Aquatic weeds are generally more prevalent and yield reductions are greater in thin stands of rice and in water-seeded fields. Establishing an adequate stand of rice will reduce the potential number of aquatic weeds, as well as the potential rice yield reductions from the competition of aquatic weeds. Herbicides that control aquatic weeds include Londax, Bolero and 2,4-D. Bolero is used pre-flood, Londax can be used early post-flood and 2,4-D can only be used from panicle initiation to panicle differentiation (1/2 inch internode elongation).

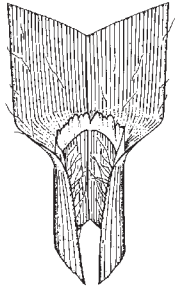
Harvest Aids – Sodium Chlorate

Sodium chlorate is commonly used to desiccate green foliage and weeds present in rice fields to increase harvest efficiency. The general guidelines are to apply sodium chlorate at 3 to 6 pounds ai per acre when rice grain is near 25 percent moisture and harvest within four to seven days after application. Grain moisture is also reduced by use of sodium chlorate. Preliminary research suggests that when used properly sodium chlorate does not reduce head rice yield. However, application of sodium chlorate at 6 pounds ai per acre has significantly reduced grain moisture by 2 to 5 percent within four days after application. Head rice yields may decline if grain moisture drops below 15 percent before grain is harvested. Thus, sodium chlorate should be applied to rice that is above 18 percent moisture with timely harvest following application. Desiccation of rice foliage is noticeable within 36 hours after application, especially when temperatures are high. Sodium chlorate may also reduce head rice and grain yield if applied too early, before grain fill is complete. Growers should exercise caution when considering sodium chlorate application to fields with uneven maturity to avoid yield and quality losses.



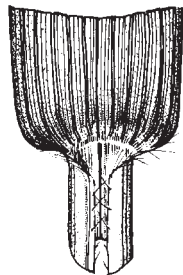
Large or Southern Crabgrass

First leaf very short – only about two times as long as wide.
 Leaf sheath and blades hairy.
 Ligule – membranous.
 Auricles – absent.



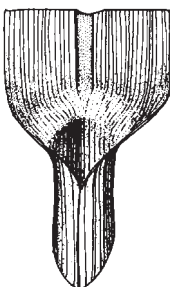
Goosegrass

First leaf obviously ribbed with veins, and dark green lines.
 Basal stem silver in color.
 Leaf sheath – light green or white.
 Ligule – very short, ciliated membrane.
 Long hairs on leaf base.
 Auricles – absent.



Broadleaf Signalgrass

First leaf four to five times as long as wide – often reddish.
 Basal stem often purple to red.
 Hairs short (velvety texture).
 Sheath – densely hairy.
 Blades – often tinged maroon, velvety hairy. Collar region red on edges.
 Ligule – a fringe of hairs.
 Auricles – absent.



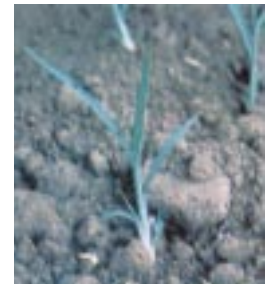
Barnyardgrass

Stems flattened.
 Sheath – smooth and flattened with solid, overlapping, smooth margins. Sometimes tinged maroon.
 Blade – smooth on both sides.
 Ligule – completely absent.
 Auricles – completely absent.



Junglerice

Very similar to barnyardgrass except leaf blade has red watermarks.
 Ligule – completely absent.
 Auricles – completely absent.





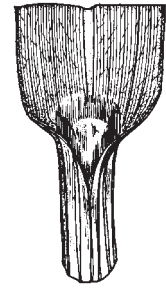
Fall Panicum

Seedling leaf blades densely hairy on both surfaces.
 Less hairy in older seedlings.
 Leaf sheath – hairy with overlapping membranous margin.
 Ligule – row of dense hairs approximately 1 mm long.
 Auricles – absent.



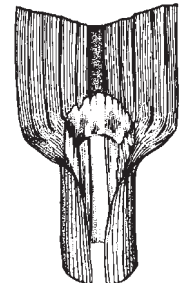
Giant Foxtail

Leaf blade – hairy upper surface (must be closely examined on seedling) and smooth to rough lower surface.
 Leaf sheath – smooth and split with overlapping sparsely hairy margins.
 Ligule – a hairy ring.
 Auricles – absent.



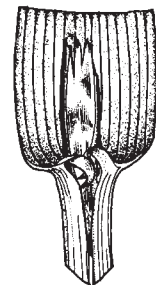
Johnsongrass

Leaf blade – smooth on both surfaces, midvein distinct at base as broad white line. Often has reddish spots caused by leaf rust. First leaf short.
 Stem – reddish in lower portion.
 Ligule – long rounded membrane.
 Auricles – absent.
 No evidence of rhizomes in seedlings up to 5th leaf stage.



Red Rice

Leaf blade – rough textured when rubbed from tip to base.
 Ligule – long membrane.
 Auricles – present, clasping, hairy.



Loosehead (Bearded) Sprangletop

Leaf blade – flat to slightly inrolled. Youngest leaf rolled. Distinct white midrib but often not obvious on seedling plants. Leaf blades obviously ribbed on seedling plant. Leaf on older plants very long and slender.
 Leaf sheath – smooth and open.
 Ligule – very long, thin, pointed membrane.
 Auricles – absent.
 A similar species, tighthead sprangletop, has shorter ligule and lacks the white midrib on older leaves.

