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Identification, Biology and Control of Barnyardgrass in Arkansas Rice

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Background

The evolution of herbicide-resistant barnyardgrass [*Echinochloa crus-galli* (L.) Beauv.] has resulted in the complete loss of activity from several herbicide modes of action. Therefore, control of this troublesome grass weed has become more difficult to achieve in many Arkansas rice fields. Barnyardgrass infestations in rice can result in detrimental yield losses ranging from 30 percent to complete crop loss. In a recent survey, crop consultants in Arkansas listed barnyardgrass as the number one problematic weed in rice (Figure 1). To date, the University of Arkansas herbicide resistance screening program has confirmed barnyardgrass resistance to propanil, Facet® (quinclorac), Newpath® (imazethapyr), Grasp® (penoxsulam), Regiment® (bispyribac), Beyond® (imazamox) and Command® (clomazone). A number of these populations were found to be resistant to more than one of these herbicides. Resistance in Arkansas barnyardgrass has not been confirmed to Prowl®, Bolero® (thiobencarb), Roundup® (glyphosate), Ricestar HT® (fenoxaprop) or Clincher® (cyhalofop), but a population of barnyardgrass in Mississippi has been confirmed resistant to fenoxaprop and cyhalofop. The widespread existence of resistance to multiple herbicide modes of action can make management of this weed extremely difficult, especially when earliest applications are noneffective.

Figure 1. Arkansas rice field infested with barnyardgrass.

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Propanil was first used to control barnyardgrass in rice fields in 1959, and the first occurrence of resistance was documented in 1990. By 1993, 16 of the 38 rice-producing counties had fields containing propanil-resistant barnyardgrass. Shortly following the documentation of widespread propanil-resistant barnyardgrass, Facet® (quinclorac) was rapidly adopted as an alternative herbicide to control the resistant barnyardgrass. After nearly a decade of reliance on quinclorac for control of propanil-resistant barnyardgrass, quinclorac resistance was confirmed in 1999. One year later, Command® (clomazone) was registered and used on approximately 80 percent of the total rice acreage in Arkansas. Once again, not even a decade later clomazone resistance was confirmed in 2008. As a result of widespread use of ALS (WSSA Group 2) herbicides in rice, especially Clearfield® rice, resistance to this mode of action was first noted in 2009, with the number of rice fields containing ALS-resistant barnyardgrass increasing significantly in 2013.

Identification and Biological Characteristics

In order to prevent yield loss, proper identification and control of barnyardgrass soon after emergence is critical; albeit, one should always try to control it prior to emergence. A member of the Poaceae family, barnyardgrass is a summer annual grass weed that reproduces through seed. It is not uncommon for the weed to reach heights over 3 feet tall with a large inflorescence capable of producing over 39,000 seeds per plant in rice (Figure 2). Similar to other grass weeds, the easiest way to identify barnyardgrass is to examine the collar region of the leaf. Barnyardgrass can be identified as having a flat stem with no ligule, auricle or pubescent (hairs).

Figure 2. Barnyardgrass seed.

Figure 3. Barnyardgrass seedling.

Figure 4. Clumping pattern of barnyardgrass in Arkansas rice field.

The first true leaf is often smooth and wide with a rounded leaf tip (Figure 3). This troublesome grass weed is often observed growing in clumps with a fibrous root system (Figure 4). Barnyardgrass is easily visible in rice fields at maturity. When barnyardgrass reaches maturity, it produces a large, dense inflorescence with typically erect, branched panicles.

It is not uncommon for other similar *Echinochloa* species to be present in the Midsouth, including junglerice (*Echinochloa colona*) and coast cockspur grass (*Echinochloa walteri*), which are often misidentified as barnyardgrass. Junglerice often has purple striations on the leaf and is lower growing with a smaller inflorescence than barnyardgrass. Coast cockspur grass is the largest of the *Echinochloa* grasses in Arkansas, reaching a height of more than 6 feet at maturity with the seed generally having long awns. Failure to control coast cockspur grass with preemergence herbicides may be a result of the larger seed size than barnyardgrass, and control late in the year is often challenging due to the large stature of the plant, rendering most herbicides ineffective. While not biologically identical to barnyardgrass, the same herbicides used to control barnyardgrass have activity on both of these species.

An important biological characteristic of barnyardgrass is its highly efficient photosynthetic pathway. Barnyardgrass possesses a C_4 photosynthetic pathway making it biologically dissimilar from C_3 grass crops such as rice. Barnyardgrass has a competitive advantage over rice which allows the weed to proliferate in the high light and high temperature environment commonly found in Arkansas rice fields. Barnyardgrass possesses a high reproductive capability deeming resistance development a serious concern; hence, particular caution should be focused on the transfer and spread of barnyardgrass seed from field to field (Figure 5). Growers should remain

mindful that seed has the potential to spread through contaminated seed sources, irrigation water and the movement of equipment through infested fields.

Figure 5. Barnyardgrass seed head at maturity.

Control Recommendations

With barnyardgrass resistant to multiple modes of action, it can be beneficial for growers to submit samples to the University of Arkansas herbicide resistance screening program in order to determine the level of resistance present within their field. Use of multiple effective modes of action for control of barnyardgrass will only be realized if the sensitivity of populations is known in advance of applications each spring. The current herbicide recommendations for barnyardgrass can be found in Table 1, with specific guidelines for the effective management of populations with resistance to propanil, Command® (clomazone), Facet® (quinclorac) or ALS herbicides such as Newpath® (imazethapyr), Beyond® (imazamox), Regiment® (bispyribac) or Grasp® (penoxsulam). It should be noted that most Facet-resistant populations of barnyardgrass are most often resistant to propanil and the occurrence of resistance to propanil, Facet and ALS herbicides within a single population is becoming more common. In the case in which this three-way resistance exists, Command® should be applied preemergence followed by an early postemergence application of Ricestar HT® tank-mixed with Prowl® or Bolero®. RiceBeaux®, a mixture of propanil plus thiobencarb, can be substituted for Bolero®. Furthermore, the importance of

Table 1. Herbicide recommendations for control of herbicide-resistant barnyardgrass in Arkansas rice.

Resistance to:	Herbicide Recommendation:
Propanil	Apply Command® preemergence followed by a tank mix of residual herbicides such as Bolero® (thiobencarb), Prowl H_2O® (pendimethalin) delayed preemergence and Facet® postemergence.
Command® (clomazone)	Apply Prowl H_2O® preemergence followed by RiceStar HT® or Facet® postemergence.
Facet® (quinclorac)	Apply Command® preemergence followed by Newpath® in Clearfield® rice. In conventional rice, apply Command® preemergence followed by Ricestar HT® (fenoxaprop) or Clincher® (cyhalofop) postemergence.
ALS: Newpath® (imazethapyr), Grasp® (penoxsulam), Regiment® (bispyribac)	Apply Command® preemergence followed by Ricestar HT®, Facet® or Clincher® postemergence.
Propanil + Facet®	Apply Command® preemergence followed by Newpath® in Clearfield® rice. In conventional rice, apply Command® preemergence followed by Ricestar HT® and Prowl H_2O® or Bolero® postemergence.
Propanil + Facet® + ALS	Apply Command® preemergence followed by a tank mix of Ricestar HT® and Prowl H_2O® or Bolero® postemergence.

an effective crop rotation must not be forgotten. When in rotation from rice into beans, preemergence herbicide applications should include Dual Magnum® and Zidua® for population control of barnyardgrass. For the most up-to-date recommendations, refer to the Extension publication *MP44, Recommended Chemicals for Weed and Brush Control*, available at www.uaex.edu.

Even with emerging technologies such as Provisia® rice, which will allow growers to apply an ACCase herbicide such as quizalofop, growers need to stay mindful that ACCase-resistant barnyardgrass already exists in the Midsouth (Mississippi) and that we already have a history of using fenoxaprop and cyhalofop in rice, both of which are ACCase inhibitors (WSSA Group 1). Hence, even with this technology likely providing another effective herbicide for barnyardgrass control, remember that the use of ***multiple*** effective modes of action must remain a top priority. Herbicide resistance will repeatedly occur if we continue to rely on a single mode of action and allow escapes to occur and produce seed. Inevitably, resistance will occur if Arkansas rice growers fail to practice program approaches utilizing effective preemergence followed by postemergence herbicides to control barnyardgrass within their fields.

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