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Yield components and quality of rice in response to graminaceous weed density and rice stink bug populations

K.V. Tindall[a,*], B.J. Williams[b], M.J. Stout[a], J.P. Geaghan[c], B.R. Leonard[d], E.P. Webster[e]

[a]*LSU AgCenter, Department of Entomology, 402 Life Science Bldg., Baton Rouge, LA 70803, USA*
[b]*LSU AgCenter, Northeast Research Station, P.O. Box 438, St. Joseph, LA 71366, USA*
[c]*LSU AgCenter, Department of Experimental Statistics, 67 Ag. Admin. Bldg., Baton Rouge, LA 70803, USA*
[d]*LSU AgCenter, Macon Ridge Research Station, 212-A Macon Ridge Road, Winnsboro, LA 71295, USA*
[e]*LSU AgCenter, Agronomy Department, 104 M. B. Sturgis Hall, Baton Rouge, LA 70803, USA*

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Abstract

Field experiments were conducted in 2002 and 2003 to investigate weed density, its relationship to rice stink bug (*Oebalus pugnax*, F.) populations, and damage to rice caused by stink bugs. Graminaceous weeds examined were barnyardgrass, *Echinochloa crus-galli* Beauv., Amazon sprangletop, *Leptochloa panicoides* (Presl.) Hitchc., broadleaf signalgrass, *Brachiaria platyphylla* Nash., and large crabgrass, *Digitaria sanguinalis*, (L.). Rice seed weight, percent filled seed, percent pecky rice, milling quality, and yield were measured. Data showed that 13–23 weeds/1 m^2 was associated with an increase of one rice stink bug per plot. Weeds served as hosts of rice stink bugs prior to panicle emergence of rice; consequently, rice stink bugs infested rice early in the grain filling process and reduced the percentage of filled seeds. One hundred weeds/1 m^2 caused a 1% increase in pecky rice, and for every 1% pecky rice, milling quality was reduced by 0.5%. Plots not treated with insecticide had significantly more non-filled seeds, pecky rice, and broken kernels than treated plots. Neither weeds nor insects at the densities observed in this test appeared to effect seed weight. Rice stink bug damage did not significantly contribute to yield losses greater than weeds in the absence of rice stink bugs. Rice stink bugs had more of an affect on the quality of rice rather than the yield. Results reported here suggest that late season weed control may be important in terms of indirect losses in grain quality associated with increased populations of rice stink bug.
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1. Introduction

Weed and insect pests are important problems faced by rice producers worldwide. Typically research focuses on these pests individually; however, there are numerous ways in which they interact in crop fields. Insects can feed on the vegetative and/or reproductive plant tissues of weeds, possibly reducing the seed bank for following years (Meyer and Root, 1993; Honek et al., 2003). The presence of weeds can have both positive and negative effects on insect populations (Andow, 1991). Weeds can be used as alternate hosts and serve as a source of infestation, or insects may prefer to feed on weeds and not damage crop plants. Weeds may also interfere with the ability of an insect to locate the crop plant. Additionally, weeds provide a nectar source for parasitoids and create a more diverse ecosystem with more beneficial insects present to suppress insect pest populations.

The rice stink bug, *Oebalus pugnax* (F.), is an important insect pest of rice. Female rice stink bugs lay two rows of barrel-shaped green eggs that turn red as they mature on plant foliage or panicles (Odglen and Warren, 1962; McPherson and McPherson, 2000). Early

*Corresponding author. Tel.: +1 225 578 1850; fax: +1 225 578 1643.
E-mail address: ktindall@agcenter.lsu.edu (K.V. Tindall).

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in grain development, nymphs and adults damage rice by removing the endosperm from immature kernels, resulting in non-filled seeds. Feeding in the later stages of grain development causes atrophied seeds and reduces the quality of the grains (pecky rice). Pecky rice is a broad term used to describe the appearance of discolored kernels that results from a combination of insect feeding and pathogen infection (Tullis, 1936; McPherson and McPherson, 2000); several pathogens have been isolated from pecky rice kernels (Tullis, 1936 [and sources within]; Daughtery and Foster, 1966; Marchetti and Peterson, 1984; Hollay et al., 1987; Lee et al., 1993). Lee et al. (1993) provided evidence of an insect–vector relationship between rice stink bugs and pathogens. Pecky rice and atrophied seeds reduce grain quality because kernels are more likely to break during the milling process (Douglas, 1939; Odglen and Warren, 1962; McPherson and McPherson, 2000). Insecticides are the primary method of control of rice stink bugs. Current recommendations suggest that insecticide should be applied when numbers of rice stink bugs reach 30 per 100 sweeps during the first 2 weeks of heading, and 100 stink bugs per 100 sweeps after the first 2 weeks (Ring et al., 1999).

Rice stink bugs primarily feed on monocotyledonous plants, many of which are common graminaceous weeds associated with rice fields (Douglas, 1939; Odglen and Warren, 1962; Nilakhe, 1976; Naresh and Smith, 1984; McPherson and McPherson, 2000). Barnyardgrass, *Echinochloa crus-galli* Beauv., Amazon sprangletop, *Leptochloa panicoides* (Presl.) Hitchc., broadleaf signalgrass, *Brachiaria platyphylla* Nash., large crabgrass, *Digitaria sanguinalis*, (L.), bemudagrass, *Cynodon dactylon* (L.) Pers., fall panicum, *Panicum dichotomiflorum* Michx., and *Cyperus* spp. are common weeds in rice agroecosystems (Jordan and Sanders, 1999). These weeds also serve as alternate hosts for the rice stink bug (Odglen and Warren, 1962; Nilakhe, 1976; Naresh and Smith, 1984; McPherson and McPherson, 2000); therefore, the potential exists for interactions to occur between weed management and rice stink bug management.

Previous studies showed that the presence of barnyardgrass in rice fields affected the numbers of rice stink bugs present on rice (Tindall et al., 2004). Variations in rice stink bug densities on rice were detected depending on the phenology of barnyardgrass relative to rice. When barnyardgrass and rice had panicles present at the same time; rice stink bug infestations were lower on rice plants in the presence of barnyardgrass than in pure stands of rice plants. However, when barnyardgrass senescence occurred during panicle emergence of rice, barnyardgrass served as a source of rice stink bug infestation on the newly emerging rice panicles. If weeds serve as a source of rice stink bug infestation, an increase in rice stink bug damage may be an indirect effect of the presence of graminaceous weeds. The experiments reported here were designed to examine the effects of varying densities of graminaceous weeds on rice stink bug populations and to determine if the damage from the combination of rice stink bugs and weeds is greater than damage from weeds alone.

2. Materials and methods

Experiments were conducted at the Macon Ridge Branch Station, Winnsboro, LA (Franklin Parish) in 2002 and 2003. 'Cocodrie' rice was drill seeded into a loessial upland soil (Gigger silt loam) at a rate of 112 kg/ha on May 28, 2002 and May 24, 2003. The drill spacing was 19 cm, and plots consisted of 8 rows 4.5 m in length (7 m^2/plot). Each plot was separated by a 2 m weed-free border; weed-free borders were treated pre-emergence with applications of 0.45 kg/ha of quinclorac and 0.55 kg AI/ha of clomazone. On June 24, 2002 and June 30, 2003, nitrogen in the form of prilled urea was applied at 126 kg/ha immediately prior to the establishment of permanent floods. Rice plots were flushed as needed.

The experimental design was a completely randomized design with 36 plots that had varying graminaceous weed densities. Graminicides were applied to assigned plots at various timings and rates to achieve a range of graminaceous weed densities[1]. Additionally, broadleaf weeds and sedges were removed from all plots by applying 25 g AI/ha halosulfuron to all plots at the four to five leaf stages of rice. Approximately 2 weeks prior to panicle emergence of rice, weed density was estimated for each plot by placing 0.1 m^2 quadrants over two rows of rice. All vegetation within the 0.1 m^2 area was removed and taken to the laboratory. Plants were categorized by species and counted to determine the percentage of each weed present and weed density. Two samples were collected from each plot and averaged to get an estimate of weed density. In 2002, the study area had a native infestation of barnyardgrass (57%), Amazon sprangletop (10%), and broadleaf signal grass (33%). Weed composition in 2003 consisted of barnyardgrass (38%), Amazon sprangletop (33%), broadleaf signalgrass (8%), and large crabgrass (22%).

After individual plots were assessed for weed composition and density, plots were divided into two groups of 18 plots of similar weed density. One group received 672 g AI/ha lamda-cyhalothrin approximately every 4 to 5 d after 20% panicle emergence of rice to minimize the

[1]Herbicide programs consisted of no herbicide, 224.2, 448.3, and 672.5 g AI/ha clomazone applied pre-emergence, and 448.3 and 672.5 g AI/ha clomazone applied pre-emergence followed by 213 g AI/ha cyhalofop at the 4–5 leaf rice stage. Herbicide treatments were arranged in a completely randomized design.

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