Effect of Weeds on Rice Stink Bug (Hemiptera: Pentatomidae) Populations in Florida Rice Fields[1]

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Abstract The effect of weeds on rice stink bug, *Oebalus pugnax* (F.), populations was studied in Florida rice fields. Fall panicum, *Panicum dichotomiflorum* Michaux, was the most common grassy weed found in weedy areas of rice fields, and significantly more rice stink bugs were found in these weedy areas vs nonweedy areas in the fields. Large numbers of rice stink bugs also were found in unmowed roadsides containing heading weeds, especially coast cockspur, *Echinochloa walteri* (Pursh) Heller. In contrast, few rice stink bugs were found in mowed roadsides which prevented weed heading around rice fields. Our study shows that weed control helps reduce rice stink bug populations in Florida rice.

Key words Rice, stink bugs, weeds, *Oebalus pugnax*

Rice, *Oryza sativa* L., is an important crop grown in the Everglades Agricultural Area of southern Florida. Although many different insects are found in rice fields in the area, stink bugs are the most important pest. Jones and Cherry (1986) reported the relative abundance and seasonal occurrence of stink bugs in southern Florida rice based on extensive surveys. In their study, the rice stink bug, *Oebalus pugnax* (F.), was the dominant species comprising >95% of all stink bugs. *Oebalus pugnax* is a major insect pest of rice found in many rice growing areas of the United States. Another stink bug pest of rice, *O. ypsilongriseus* (DeGeer), was first observed in Florida rice fields in 1994. In surveys conducted during 1995 and 1996, *O. ypsilongriseus* was widespread in Florida rice fields being found in 100% of the fields surveyed (Cherry et al. 1998). *Oebalus ypsilongriseus* is a known pest of rice (Kashino and Alves 1994) and occurs in several Latin American countries (Pantoja et al. 1995). Currently, the two species of *Oebalus* stink bugs are the main insect pest complex attacking Florida rice and comprise >99% of all stink bugs in Florida rice fields (Cherry et al. 1998).

Although numerous studies have been conducted investigating insect-weed interactions, the full significance of insect-weed interactions remains poorly recognized in most agroecosystems, including rice. Rice stink bugs are known to feed on numerous graminaceous weeds as well as six graminaceous crops (Tindall et al. 2004). Several studies on various species of rice stink bugs in different locations have indicated that weeds may be important in increasing numbers of rice stink bugs in rice fields.

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However, some of these studies present conflicting data (see McPherson and McPherson 2000). Moreover, the effect of weeds on rice stink bugs has not been measured on Florida species under Florida rice growing conditions. Preliminary unpublished data obtained during 2002 by Cherry and Bennett indicated that weeds may be very important in increasing rice stink bug populations in Florida rice. The objective of our research was to determine the effect of weeds on rice stink bug populations in Florida rice.

Materials and Methods

Rice fields were located in Palm Beach Co., FL, and were sampled during May and June 2003. Fields were sampled during afternoons, and one field was sampled on any one day. Effectiveness of sweep nets for estimating insect populations may be affected by different factors such as wind, temperature, etc. Hence, samples from each field were collected in a 2-h period to reduce the possibility of external weather conditions affecting sweep net catch comparisons of stink bugs. Four commercial rice fields were chosen for sampling based on three criteria. First, each field had both patches of grassy weeds and relatively nonweedy areas. Weedy areas were located throughout the rice fields. However, samples were taken in weedy versus nonweedy areas 50 m apart in each field. Second, infloresences (i.e., heading) were present on grassy weeds but not on the rice (i.e., preheading rice). Third, the field had a roadside area along the field that could be sampled. All fields sampled were approximately 13.8 ha in size. Weedy, nonweedy, and roadside areas of each field were sampled with sweep nets. Six transects of 100 sweeps were taken in each of the 3 areas of each field. Sweeps were made with 38-cm diam sweep nets. Each sweep was one 180° horizontal stroke with the net in either direction, and one sweep was made with each forward step. Sweep collections were placed in plastic bags and frozen. At a later date, adults and nymphs of rice stink bugs of both *Oebalus* species were counted under a microscope.

Weed populations in weedy and nonweedy areas within each field were determined at each transect. Whereas traversing each transect, six random stops were made to observe weeds present and, from these observations, the number of weeds per 9.2 m^2 in the transect was determined. Roadside weed populations were sampled by taking three 0.36 m^2 quadrants within each transect used to sample stink bugs. The use of quadrants, rather than visual determination, was based on the much higher populations of weeds in roadsides compared with scattered weed populations within the fields. Numbers of weeds within the quadrants were counted except common bermudagrass, *Cynodon dactylon* (L.) Pers., which was evaluated based on percentage groundcover, as the stoloniferous and rhizomatous growth habit of the plant makes it impossible to identify individual plants.

An LSD analysis (SAS 1996) was used to determine mean differences in populations of stink bugs (nymph, adults, and total) between the three different field areas of each of the four fields. This analysis was conducted only on the rice stink bug, *O. pugnax*, because too few *O. ypsilongriseus* were found for analysis. As noted earlier, different sampling techniques were required between in-field weed populations and roadside weed populations which prevented direct statistical comparisons of means of weed populations between the three areas. Hence, only means (±SD) of weeds measured in different field areas are presented. The lack of statistical comparison of weed populations posed little problem for weed comparisons because different weed species were either present or entirely absent in different field areas.

Results and Discussion

In rice field 1, fall panicum, *Panicum dichotomiflorum* Michaux, was the only grassy weed observed in weedy and nonweedy areas within the field (Table 1). Fall panicum was 24× more abundant in weedy versus nonweedy areas. *Oebalus pugnax* populations also were significantly greater in weedy versus nonweedy areas with 30× as many *O. pugnax* in the weedy areas. These data are consistent with Douglas (1939) who reported that *O. pugnax* fed on fall panicum that occurred in and around rice fields. Most recently, Tindall et al. (2004) reported on the effects of barnyard grass, *Echinochloa crus-galli* Beauv., on rice stink bug populations in mixed rice plots in Louisiana. Similar to our data, they reported that rice stink bugs were found on barnyard grass before panicle emergence of rice. In our study, weed species also were recorded in roadside samples. However, roadsides had been mowed preventing seedhead formation that would reduce the attraction of *O. pugnax*. As expected, no *O. pugnax* were observed in roadside samples.

In rice field 2, fall panicum was the only grassy weed observed in weedy and nonweedy areas within the field (Table 2). Fall panicum was 30× more abundant in weedy versus nonweedy areas. *Oebalus pugnax* populations were also significantly greater in weedy versus nonweedy areas with 65X as many *O. pugnax*

Table 1. Weeds and rice stink bugs (*O. pugnax*) in Florida rice, Field 1

	Area of field		
Rice stink bugs*	Non-weedy	Weedy	Roadside
Nymphs	0 ± 0 B	6.8 ± 7.8 A	0 ± 0 B
Adults	0.7 ± 0.8 B	14.5 ± 8.5 A	0 ± 0 B
Total	0.7 ± 0.8 B	21.3 ± 13.5 A	0 ± 0 B
Weeds	Non-weedy**	Weedy**	Roadside†
Coast cockspur	0 ± 0	0 ± 0	0 ± 0
Common bermudagrass‡	0 ± 0	0 ± 0	69.2 ± 34.6
Fall panicum	0.4 ± 0.2	9.7 ± 2.1	0 ± 0
Other graminaceae§	0 ± 0	0 ± 0	0.4 ± 1.2

* Mean ± SD per 100 sweeps. Means in a row followed by the same letter are not significantly different ($P > 0.05$) using the LSD test (SAS 1996).
** Mean ± SD weeds per 9.2 m^2.
† Mean ± SD weeds per 0.36 m^2.
‡ Percentage groundcover.
§ Other graminaceae = 63% *Setaria parirflora* (Poir.) Kerguelen and 37% *Urochloa adspera* (Trin.) Webster.

Table 2. Weeds and rice stink bugs (*O. pugnax*) in Florida rice, Field 2

	Area of field		
Rice stink bugs*	Non-weedy	Weedy	Roadside
Nymphs	0 ± 0 B	5.5 ± 3.4 A	0 ± 0 B
Adults	0.3 ± 0.5 B	14.0 ± 6.8 A	0 ± 0 B
Total	0.3 ± 0.5 B	19.5 ± 3.6 A	0 ± 0 B
Weeds	Non-weedy**	Weedy**	Roadside†
Coast cockspur	0 ± 0	0 ± 0	0 ± 0
Common bermudagrass‡	0 ± 0	0 ± 0	27.8 ± 31.7
Fall panicum	0.5 ± 0.3	15.0 ± 5.8	0 ± 0
Other graminaceae§	0 ± 0	0 ± 0	1.9 ± 1.7

* Mean ± SD per 100 sweeps. Means in a row followed by the same letter are not significantly different ($P >$ 0.05) using the LSD test (SAS 1996).
** Mean ± SD weeds per 9.2 m^2.
† Mean ± SD weeds per 0.36 m^2.
‡ Percentage groundcover.
§ Other graminaceae = 83% *Digitaria ciliaris* (Retz.) Koeler and 17% *Sorghum almum* Parodi.

in the weedy areas. Three weed species were recorded in roadside samples. However, these areas had been mowed, and no *O. pugnax* were observed in roadside samples.

In rice field 3, fall panicum was the only grassy weed observed in weedy and nonweedy areas within the field (Table 3). Fall panicum was 59× greater in weedy versus nonweedy areas with no *O. pugnax* being observed in the nonweedy areas. Three weed species were observed in roadside samples. However, unlike fields 1 and 2, roadsides were unmowed and contained large numbers of weeds, especially coast cockspur, *Echinochloa walteri* (Pursh) Heller, in various states of heading. Although coast cockspur has not been reported to be a host of *O. pugnax*, other species in its genus, *Echinochloa*, have been (McPherson and McPherson 2000) making it a likely host plant. Unlike previous fields with mowed roadsides, large numbers of *O. pugnax* were found in the unmowed roadsides of this field. *Oebalus pugnax* in roadside samples were not significantly different from weedy samples within the field, but were significantly greater from nonweedy areas.

In rice field 4, fall panicum was the only grassy weed observed in weedy and nonweedy areas within the field (Table 4). Fall panicum was 87× more abundant in weedy versus nonweedy areas. The total number of *O. pugnax* also was significantly greater in weedy versus nonweedy areas with 10× more *O. pugnax* in the weedy areas. Three weed species were recorded in roadside samples. However, these areas had been mowed, and very few *O. pugnax* were found there.

In summary, fall panicum was the most common grassy weed found in weedy areas of Florida rice fields, and more *O. pugnax* were found in these weedy areas

Table 3. Weeds and rice stink bugs (*O. pugnax*) in Florida rice, Field 3

	Area of field		
Rice stink bugs*	Non-weedy	Weedy	Roadside
Nymphs	0 ± 0 A	5.5 ± 5.0 A	5.8 ± 8.7 A
Adults	0 ± 0 B	7.2 ± 2.9 A	7.3 ± 4.7 A
Total	0 ± 0 B	12.7 ± 3.8 A	13.2 ± 11.7 A
Weeds	Non-weedy**	Weedy**	Roadside†
Coast cockspur	0 ± 0	0 ± 0	5.1 ± 4.1
Common bermudagrass‡	0 ± 0	0 ± 0	77.8 ± 15.1
Fall panicum	0.2 ± 0.1	11.7 ± 3.3	0 ± 0
Other graminaceae§	0 ± 0	0 ± 0	0.9 ± 1.7

* Mean ± SD per 100 sweeps. Means in a row followed by the same letter are not significantly different ($P >$ 0.05) using the LSD test (SAS 1996).

** Mean ± SD weeds per 9.2 m^2.

† Mean ± SD weeds per 0.36 m^2.

‡ Percentage groundcover.

§ Other graminaceae = *S. almum.*

Table 4. Weeds and rice stink bugs (*O. pugnax*) in Florida rice, Field 4

	Area of field		
Rice stink bugs*	Non-weedy	Weedy	Roadside
Nymphs	0 ± 0 A	0 ± 0 A	0 ± 0 A
Adults	0.5 ± 0.8 B	4.8 ± 4.4 A	0.7 ± 1.2 B
Total	0.5 ± 0.8 B	4.8 ± 4.4 A	0.7 ± 1.2 B
Weeds	Non-weedy**	Weedy**	Roadside†
Coast cockspur	0 ± 0	0 ± 0	0 ± 0
Common bermudagrass‡	0 ± 0	0 ± 0	3.9 ± 8.5
Fall panicum	0.1 ± 0.1	8.7 ± 2.5	0 ± 0
Other graminaceae§	0 ± 0	0 ± 0	1.4 ± 2.4

* Mean ± SD per 100 sweeps. Means in a row followed by the same letter are not significantly different ($P >$ 0.05) using the LSD test (SAS 1996).

** Mean ± SD weeds per 9.2 m^2.

† Mean ± SD weeds per 0.36 m^2.

‡ Percentage groundcover.

§ Other graminaceae = *S. almum.*

versus nonweedy areas in rice fields. *Oebalus pugnax* in weedy areas consisted of adults and nymphs, the latter indicating that *O. pugnax* reproduction was taking place in the weedy areas. Large numbers of *O. pugnax* including nymphs were found in unmowed roadsides containing heading weeds, especially coast cockspur. In contrast, few *O. pugnax* were found in mowed roadsides which prevented weed heading around rice fields. The ability of *O. pugnax* to feed and reproduce on a wide range of wild grasses plays a significant role in its status as an economic pest. When adults become active in the spring, only wild grasses are available as suitable hosts. Therefore, early reproduction occurs on these hosts resulting in increased numbers of bugs (McPherson and McPherson 2000). In Texas, Douglas (1939) reported that the average number of rice stink bugs per acre in rice fields containing wild host plants was 3,465 for field edges and 3,133 for field centers whereas the average number per acre in fields without wild host plants was 1585 for field edges and 2448 for field centers. However, surprisingly, Douglas concluded that there was no relationship between the abundance of bugs in the rice fields and abundance of wild hosts on levees because of an extremely high population of bugs in one field with wild hosts. In contrast, Odglen and Warren (1962) unequivocally reported that the severity of rice stink bug infestations was directly related to the degree of grassiness in Arkansas rice fields. McPherson and McPherson (2000) reviewed studies containing somewhat contradictory data concerning the effect of weeds on *O. pugnax* populations and concluded that reducing weed populations, particularly grasses, on levees and in and around rice fields helped in reducing *O. pugnax* populations on rice. Most recently, Tindall et al. (2004) reported that rice stink bugs were up to 9× more abundant on rice in mixed plots of barnyardgrass and rice compared with whole plots of rice in Louisiana. Their data also suggested the presence and developmental stage of barnyardgrass can influence the severity and timing of rice stink bug infestations. Our data from Florida rice fields support previous studies that show that weed control helps reduce *O. pugnax* populations in rice fields.

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