Rice Water Weevil (Coleoptera: Curculionidae) Damage in Florida Rice Fields[1]

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Abstract The rice water weevil, *Lissorhoptrus oryzophilus* Kuschel, is the most widely distributed and destructive insect pest of rice, *Oryza sativa* L., in the United States. The objective of this study was to determine overall damage levels of rice water weevils in Florida rice fields. Fifty rice fields were sampled over 2 yr for adult foliar damage. These damage data were used as the criteria for determining when control measures are justified. Although the weevils were widespread in Florida rice fields, damage levels at which control is required occurred in only 2% of fields sampled. An increase in adult feeding damage was observed as the rice season progressed. And, there was a significant correlation of feeding damage among fields within a paddy. These data suggest that Florida rice growers may not have to sample all fields in a paddy to estimate weevil damage in the paddy.

Key Words rice, rice water weevil

The rice water weevil, *Lissorhoptrus oryzophilus* Kuschel, is the most widely distributed and destructive insect pest of rice, *Oryza sativa* L., in the United States (Way 1990). The insect is native to the eastern United States and was accidentally introduced into California rice fields in the 1950s (Lange and Grigarick 1959). The rice water weevil was first reported in Florida in 1916 (Blatchley and Leng 1916). It was briefly noted first occurring in rice grown in Florida in 1979 by Genung et al. (1979). These authors reported that the weevil attacked rice at the Everglades Research and Education Center at Belle Glade and, according to curculionid authority Dr. C.W. O'Brien, the species occurred over all of Florida. There has been recent interest in the pest by Florida rice growers leading to recent publications on the weevil in Florida rice fields. Cherry et al. (2013) showed that adult weevil leaf scars had a uniform distribution into Florida rice fields. These data suggested that rice water weevil damage may be overlooked by Florida rice growers because it is uniform and not aggregated on field edges where it would be more conspicuous. More recently, Cherry et al. (2015) reported that shallow flooding reduced rice water weevil populations in Florida rice fields. Other than these few publications, there is little understanding of this pest and its control in Florida rice fields.

Several seed treatments have recently been registered for control of the rice water weevil in the United States (Adams et al. 2015). These seed treatments are

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used as preventative control for anticipated economic damage by future weevil populations. Currently there is not a clear understanding of the damage levels of the weevil in Florida rice fields. Hence, rice growers are unsure if seed treatments and cultural methods such as controlled flood depth (Cherry et al. 2015) and/or drain-dry are needed. The objective of this research was to determine damage levels of rice water weevils in Florida rice fields. Additional data on the effect of season on infestations are also reported. These data should provide a basis for determining the necessity of scouting and/or control of the weevils in Florida rice fields. Correlation of damage among fields in a paddy is also reported. These latter data should provide a basis for determining how to sample for the weevils in fields within a rice paddy.

Materials and Methods

Rice production in Florida occurs in the southern part of the state in the Everglades Agricultural Area (EAA). A rice paddy is the typical rice production unit in Florida. The paddy contains several contiguous rice fields of the same variety, planting date, etc. Each paddy is surrounded by slightly elevated roads to contain water, and canals and/or levees separate fields within the paddy. Agronomic data for the paddies sampled are listed in Table 1.

Commercial rice fields in 25 rice paddies in the EAA were sampled during 2014 and 2015. All sampling was conducted in commercial rice fields in order to gain insight into the overall importance of the rice water weevils in rice production in Florida. No insecticides were used for weevil control in these fields so that fields sampled represented natural infestations expected in the absence of insecticidal control. These paddies were drill-seeded at planting and located at different locations throughout the EAA to provide adequate representation of Florida's rice production area. Paddies also were sampled over the widest range of planting dates possible to determine if time of planting date affected weevil abundance. Sampling was conducted for adult foliar damage caused by rice water weevil. The damage appears as translucent, longitudinal scars on leaves. Rice water weevil adult feeding scars were found to be associated with increasing larval infestations by Grigarick (1965) and Tugwell and Stevenson (1974) and are used for scouting purposes. Adult feeding scars have been used to estimate subsequent larval infestations by Tugwell and Stephen (1981) and Morgan et al. (1989). More recently, use of this method has been reported in population dynamic studies of rice water weevil (Shang et al. 2004) and for scouting (Lorenz and Hardke 2015).

Two rice fields were randomly selected for sampling in each paddy. The objective of using two fields within a paddy was to correlate damage among fields in a paddy. This information would be useful in determining if all fields in a paddy need to be sampled when scouting for weevil damage.

Both fields in a paddy were sampled at the same time on the same day by two different people. Each person entered a field from the midpoint of a field edge and then proceeded toward the field center in a transect stopping at six 10-m intervals into the field. Leaf scar counts were made using suggested scouting methods of Lorenz and Hardke (2015). Fields were sampled 7 d after the establishment of the permanent flood because drill-seeded rice is attractive to colonizing adult rice water

Table 1. Agronomic data for rice paddies sampled for adult feeding scars of rice water weevil.

Paddy	Sample Date*	Variety	Number of Fields	Hectares
1	7 April 2014	Mermentau	8	110.4
2	8 April	Cocodrie	8	108.7
3	9 April	Cheniere	6	80.4
4	11 April	Roy J	8	112.5
5	14 April	Roy J	6	81.4
6	15 April	Taggart	7	93.8
7	24 April	Wells	6	70.4
8	2 April 2015	Roy J	9	95.6
9	7 April	Jupiter	8	115.3
10	10 April	Mermentau	8	111.7
11	16 April	Roy J	8	113.5
12	24 April	Cheniere	6	84.0
13	27 April	Roy J	8	107.2
14	28 April	Roy J	6	79.8
15	13 May	Mermentau	8	110.3
16	28 May	Roy J	3	45.0
17	1 June	Roy J	4	53.6
18	3 June	Roy J	3	41.2
19	8 June	Cheniere	4	62.8
20	11 June	Roy J	6	115.2
21	16 June	Roy J	4	58.8
22	19 June	Roy J	5	69.1
23	30 June	Taggart	4	56.2
24	6 July	Taggart	8	115.3
25	16 July	Mermentau	8	119.2

* Date is 7 d after establishment of the permanent flood.

weevils for only 1 or 2 weeks after flood establishment. At each of the six stops, 40 rice plants were randomly selected and inspected for adult feeding damage. The number of plants with at least one scar on the youngest mature leaf was recorded. The two people frequently compared plants to ensure consistency in methods between the two.

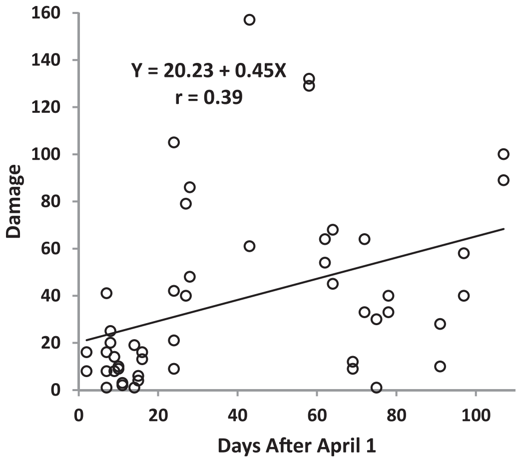

Fig. 1. Correlation of number of rice plants showing adult feeding damage with time of sampling.

Linear regression analysis was used to determine if date of sampling was correlated with weevil damage (SAS 2015). Sampling occurred from early April into July. The total number of rice plants in a field showing weevil damage was correlated with days after the start of April, that is, 7 April = 7, 20 April = 20, etc. Linear regression was also used to determine correlation in weevil damage among fields in the same paddy. The total number of rice plants showing weevil damage in a field was compared with the second field sampled in the same paddy. These 25 pairings (2 fields × 25 paddies) were then compared for correlation by regression analysis (SAS 2015). Data were pooled for the two years, giving greater power for regression analysis to determine possible trends in data.

Results and Discussion

Sample dates ranged from 7 April to 16 July (Table 1). This period represents the time when most Florida rice fields are newly flooded and appropriate for sampling adult feeding by rice water weevils. Seven rice varieties were grown commercially, indicating that growers were wary of using a single rice variety. The variety 'Roy J' was the predominant variety grown being 48% of all varieties grown. Paddies contained from three to nine fields and ranged from 41 to 119 ha in area.

Weevil damage was observed in all fields sampled, indicating the pest is widespread in the rice-producing area during the rice-growing season. However, the total rice plants of the 240 sampled in each field ranged from 1 to 157, being highly variable. Lorenz and Hardke (2015) reported that when the percentage of plants with youngest mature leaves with feeding scars equals or exceeds 60% in drill-seeded rice, control measures are justified. In our study, only 1 of the 50 fields sampled exceeded this threshold of 144 damaged plants/field (Fig. 1). These data show that although water weevils are widespread in Florida rice fields, control measures would have been justified in only 2% of fields in these two seasons.

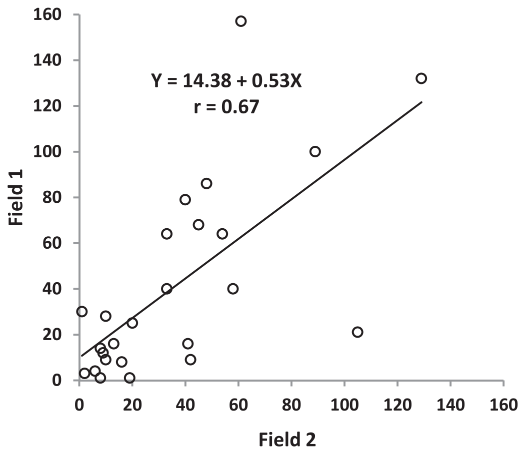

Fig. 2. Correlation of number of rice plants showing adult feeding damage between two fields randomly selected in Florida rice paddies.

Manipulating planting date has been suggested as a cultural control tactic for rice water weevils. Thompson et al. (1994) concluded that early-planted rice was less susceptible to yield reductions caused by the weevils than later planting dates in Louisiana. Shang et al. (2004) also reported that a comparison of weevil population dynamics in rice plots planted on different dates supported the use of early planting as a management strategy for the weevil in Louisiana. However, Tarpley et al. (2008) noted that planting earlier or later than recommended planting dates may decrease yields significantly in Texas. Similarly, Espino et al. (2009) reported that planting date did not affect yield relationships during most years and reinforced the importance of managing the weevil populations when planting rice at recommended dates in Texas. A later study in Louisiana (Stout et al. 2011) demonstrated that early rice planting dates can serve as an important component of a management program for rice water weevil. Most recently, Lorenz and Hardke (2015) note that planting date can have an influence on rice water weevil infestations in Arkansas. When flooded, fields planted during the usual early dates will attract overwintered adults and can have low to high infestations. Rice that is planted after the majority of the rice is planted will generally have fewer weevils available and infestations will be low to moderate. Late-season-planted rice will attract the first-generation adults and will tend to have high infestations. Our data show that there was a significant ($P = 0.005$) positive correlation ($r = 0.39$) of adult feeding damage with sampling days after 1 April (Fig. 1). Also, there was a significant ($P = 0.0002$) positive correlation ($r = 0.67$) among fields in a paddy in the number of plants showing adult feeding damage in each field (Fig. 2).

To summarize, this study has three findings of significance to Florida rice growers. First, there was an increase in adult feeding damage as the rice season progressed. These data show that Florida rice growers may consider planting rice earlier or at least be aware that late-planted rice may have more rice water weevil damage. Second, there was a positive correlation in adult feeding damage among fields within the same paddy. These data suggest that growers may not have to sample all fields in a paddy to estimate weevil injury levels in the paddy. In an earlier study, Cherry et al. (2013) determined the distribution of rice water weevil adult damage in Florida rice fields. This study and the earlier 2013 study provide useful information to help Florida rice growers sample for weevil damage. Third, survey data showed that although water weevils are widespread in Florida rice fields, control measures would have been justified in only 2% of fields sampled. These data show that the rice water weevil was not a significant pest in Florida rice during our 2-yr study. This information is already being used by Florida rice growers by reducing the use of insecticide-treated rice seeds as preventative control for the weevils and reducing time spent on scouting for weevil damage.

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