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SEASONAL POPULATION DYNAMICS OF WIREWORMS (COLEOPTERA: ELATERIDAE) IN FLORIDA SUGARCANE FIELDS

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ABSTRACT

Wireworms are important insect pests of Florida sugarcane. The objective of this study was to determine the seasonal population dynamics of wireworms in Florida sugarcane. In a preliminary test, significantly more total numbers of wireworms were found under sugarcane stools than between stools in a row or between rows. Hence, the sugarcane stool was used as the sampling site for wireworms in the population dynamics study. A sugarcane field was sampled for wireworms monthly from Jun 2004 to Jun 2006. The total number of wireworms was significantly less in the summer than other seasons and these wireworms were also significantly smaller at this time. Data in this study should be useful to southern Florida growers in understanding expected wireworm damage in different seasons.

Key Words: Elateridae, wireworms, sugarcane

RESUMEN

El gusano alambre (Coleoptera: Elateridae) es una plaga insectíl importante en la caña de azucar en el estado de la Florida. El objetivo de este estudio fue determinar la dinámica estacional de la población del gusano alambre en la caña de azucar en el estado de la Florida. En un estudio preliminar, el numero total de gusanos de alambre fue significativamente mayor en la parte localizada debajo de plantas de caña de azucar que entre plantas en un mismo surco o entre los surcos. Por lo tanto, la planta de caña fue usada como el sitio de muestreo para gusanos alambres en el estudio de la dinámica de población. Un campo de caña de azucar fue muestreado para el gusano alambre mensualmente de junio de 2004 hasta junio de 2006. El número total de gusanos de alambre fue significativamente menor en el verano que en las otras estaciones y estos gusanos de alambre fueron significativamente mas pequeños en este tiempo. Los datos de este estudio deben ser útiles para los agricultores en el sur de la Florida para entender los daños que pueden suceder por el gusano alambre en las diferentes estaciones.

Wireworms are important insect pests of Florida sugarcane. These insects attack the underground portions of the plant by feeding on the buds and root primordial during germination and on shoots and roots after germination. Wireworms are primarily a pest in newly planted sugarcane although the insects are also found in ratoon sugarcane. Of the different wireworm species found in Florida sugarcane, *Melanotus communis* (Gyllenhal) is the most important pest. Damage by this wireworm has been thoroughly documented in studies by Hall (1985, 1990). Cherry & Hall (1986) reported on the flight activity of *M. communis* in Florida sugarcane and Cherry (1988) noted the distribution and abundance of the species in Florida sugarcane.

Detailed studies of wireworm biology are rare (Lefko et al. 1998). This paucity or information has resulted largely because most wireworms are difficult to collect in large numbers and have extremely prolonged life cycles, thereby making them rather intractable for study (Keaster et al. 1975). However, understanding the seasonal population dynamics of wireworms in a crop may be important in predicting expected wireworm damage. For example, Bynum et al. (1949) reported that wireworm damage was more severe to fall planted sugarcane than summer planted sugarcane in Louisiana. Also, Burrage (1963) noted that wireworm damage to potatoes increased with rising soil temperatures in the spring to a peak in Jun in Canada.

Currently, the seasonal population dynamics of wireworms in Florida sugarcane are not known. This information is important in understanding the basic biology of these important pests. Moreover, besides sugarcane, wireworms attack other crops such as corn and potatoes in southern Florida. Hence these data may help predict wireworm seasonal damage in these crops also. The objective of this research was to determine the seasonal population dynamics of wireworms in Florida sugarcane.

MATERIALS AND METHODS

Spatial Distribution

This first study determined where to sample for wireworms within a sugarcane field since this information was necessary for later population dynamic study. Five sugarcane fields on muck soils in

southern Florida were sampled. These fields were 2 to 4 years old because since fewer wireworms are found in newly planted sugarcane fields due to pre-planting practices such as flooding, discing, or insecticide application at planting. Samples were obtained from post-harvest fields from Oct 2003 to Feb 2004 because it is much easier to sample these fields than pre-harvest standing sugarcane.

Six sugarcane plants within each field were randomly selected for sampling. Three samples were taken at each sugarcane plant (stool) that included soil from under the stool, in the row between stools, and between rows of stools. Soil sampling for soil insect pests by digging is laborious and time-consuming (Toba & Turner 1983; Robertson & Simpson 1989). Hence, each sample consisted of a $40 \times 40 \times 30$-cm deep volume of soil which was dug-up and visually examined on a table in the field by one person for 1 h. The 1-h period was necessary to thoroughly examine the large volume of soil to find wireworms, especially smaller wireworms. If more than one person was involved, observation time was divided by people present. Wireworms were collected and stored in alcohol. Based on the author's experience, it was thought that this methodology and sample number would generate reasonable numbers of wireworms collected for analysis. Taxonomic identification of wireworms was later conducted with microscopes in a laboratory. All samples were pooled and the mean number of wireworms of different species in each of the 3 sample areas (under stool, etc.) was analyzed with a Least Significant Difference (LSD) test (SAS 2006).

Seasonal Population Dynamics

A commercial 2-year-old sugarcane field on muck soil in southern Florida was sampled for wireworms. The previous spatial distribution study showed that most wireworms were found under sugarcane stools. Hence, soil samples were taken as previously described except that samples were taken only under stools. Five samples were taken monthly from Jun 2004 to Jun 2006. Based on the author's experience, it was thought that this methodology and sample number would generate reasonable numbers of wireworms collected for analysis. Wireworms were collected, immediately stored in alcohol, and identified as described previously. Wireworm length also was measured to determine possible seasonal changes in wireworm size. Samples from the 2 years were pooled for analysis. Also, in order to determine possible seasonal differences in wireworm populations, samples from 3-month periods were pooled. For the purposes of this paper, winter is defined as Dec, Jan, and Feb, spring is Mar, Apr, and May, summer is Jun, Jul, and Aug, and fall is Sep, Oct, and Nov. These definitions correspond to seasonal definitions for the North Temperate Zone (Guralnik 1982). Mean differences in wireworm population abundance and wireworm size between seasons was determined by the Least Significant Difference (LSD) test (SAS 2006).

Results and Discussion

The spatial distribution of wireworms around sugarcane plants is shown in Table 1. Similar numbers of *Conoderus* spp. were found under the stool and between stools in the row with significantly fewer between rows. Likewise, similar numbers of *Glyphonyx bimarginatus* Schaeffer were found under the stool and between stools in the row with significantly fewer between rows. In contrast, significantly more *M. communis* were found under stools than between stools in the row or between rows. Of the three habitats samples, 65% of *M. communis* were found directly under sugarcane stools versus 41% for *Conoderus* spp. and 44% for *G. bimarginatus*. These data show that *M. communis* aggregates more at sugarcane stools than *Conoderus* spp. or *G. bimarginata* for reasons unknown.

Significantly more total numbers of wireworms were found under sugarcane stools than in the other 2 habitats. These data show that the sugarcane stool was an appropriate sample unit for studying seasonal population dynamics in this study. Similarly, Cherry (1984) reported that third instar grubs of two scarab pests, *Cyclocephala parellela* Casey and *Ligyrus subtropicus* Blatchley were found in highest density under stools in Florida sugarcane. These data are consistent with Southwood's (1969) observation that most soil dwelling pests of sugarcane become aggregated around sugarcane plants.

Table 1. Spatial distribution of wireworms around sugarcane plants.

	Under stool[a]	Between stools in row[a]	Between rows[a]
Conoderus spp.	1.1 ± 1.1 A	1.1 ± 1.3 A	0.5 ± 0.7 B
G. bimarginatus	2.4 ± 2.4 A	2.3 ± 2.4 A	0.8 ± 1.1 B
M. communis	3.4 ± 2.5 A	1.0 ± 1.4 B	0.8 ± 0.8 B
Total	6.9 ± 4.0 A	4.4 ± 2.6 B	2.1 ± 1.7 C

[a]Means ± SD. Means in a row followed by the same letter are not significantly different (alpha = 0.05) based on the Least Significant Difference test (SAS 2006).

The seasonal population dynamics of wireworms in Florida sugarcane fields is shown in Fig. 1 and statistical analysis is given in Table 2. Combining all seasons shows that *M. communis* was the most abundant wireworm found. Hall (1988) reported that *M. communis* is an important soil pest of Florida sugarcane and that insecticides are routinely applied at planting time for control. *Conoderus* spp. was second most abundant. Hall (1988) reported 4 *Conoderus* species commonly associated with Florida sugarcane. However, *Conoderus* species were not determined in this study. *Conoderus* have been reported to be pests of sugarcane in Louisiana (Bynum et al. 1949) and Hawaii (Stone 1976). The third most common wireworm was *G. bimarginatus*. Hall (1988) reports *G. bimarginatus* to be small wireworms often present in Florida sugarcane. Unlike *M. communis*, the pest status of *Conoderus* spp. and *G. bimarginatus* has not been determined in Florida sugarcane.

The greatest number of *Conoderus* spp. and *G. bimarginatus* were found in the summer and fall for reasons not fully understood. It is interesting to compare *Conoderus* data in this study with *Conoderus* data obtained in sweet potato fields in the adjacent state of Georgia (Seal et al. 1992). Analogous to this study, wireworm numbers were high in summer months and decreased in the fall. *Melanotus communis* were at their lowest number in the summer followed by a large upsurge in numbers in the fall. This is explained by noting that many *M. communis* pupate in the spring with maximum flight activity during the summer (Genung 1972; Cherry & Hall 1986) and maximum oviposition during Jun (Cherry & Hall 1986). Hence, few *M. communis* larvae are present in the summer and because of summer oviposition there is a large increase in larval populations in the fall. The total number of wireworms was significantly less in the summer than the other seasons primarily due to the large decrease of *M. communis* in the summer

Seasonal size of wireworms in Florida sugarcane fields is shown in Table 3. In *Conoderus* spp., variation in size was not great between seasons with no season being significantly different from all other seasons. Likewise, in *G. bimarginatus*, no season was significantly different from all other seasons. In contrast, *M. communis* were significantly smaller in the fall than in all other seasons. These smaller larvae were probably new larvae from the main period of *M. communis* oviposition which takes place May to Jul in southern Florida sugarcane fields (Cherry & Hall 1986). Unfortunately, ovipositional data for *Conoderus* spp. and *G. bimarginatus* in Florida sugarcane are not known. The average size of all wireworms

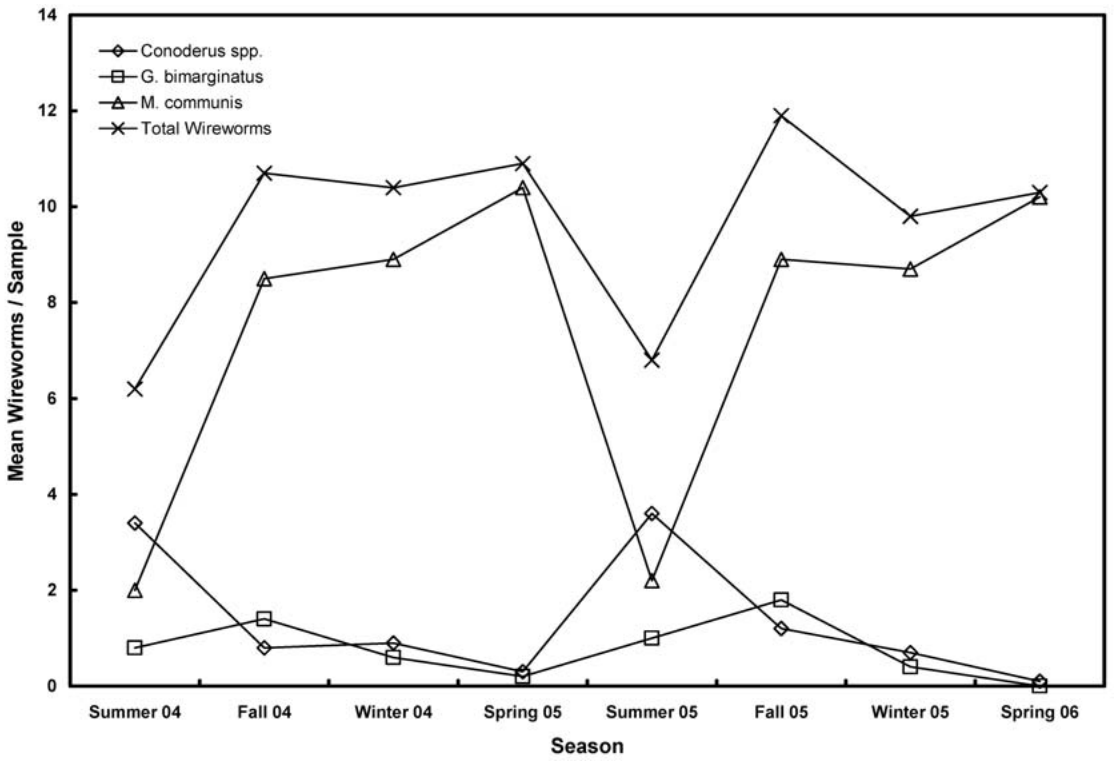

Fig. 1. Seasonal population dynamics of wireworms in Florida sugarcane fields.

TABLE 2. SEASONAL POPULATION DYNAMICS OF WIREWORMS IN FLORIDA SUGARCANE FIELDS.

	Conoderus spp.[a]	*G. bimarginatus*[a]	*M. communis*[a]	Total[a]
Winter	0.8 ± 1.4 B	0.5 ± 1.0 BC	8.8 ± 5.9 A	10.1 ± 5.2 A
Spring	0.2 ± 0.6 B	0.1 ± 0.2 C	10.3 ± 4.3 A	10.6 ± 4.4 A
Summer	3.5 ± 4.8 A	0.9 ± 1.4 B	2.1 ± 2.0 B	6.6 ± 6.9 B
Fall	1.0 ± 1.3 B	1.6 ± 1.6 A	8.7 ± 5.1 A	11.3 ± 4.9 A

[a]Means ± SD. Means in a column followed by the same letter are not significantly different (alpha = 0.05) based on the Least Significant Difference test (SAS 2006).

TABLE 3. SEASONAL SIZE (MM LENGTH) OF WIREWORMS IN FLORIDA SUGARCANE FIELDS.

	Conoderus spp.[a]	*G. bimarginatus*[a]	*M. communis*[a]	Total[a]
Winter	9.7 ± 2.5 AB	9.2 ± 1.7 A	17.3 ± 4.4 A	16.3 ± 4.9 AB
Spring	9.0 ± 1.6 AB	10.0 ± 2.0 A	17.6 ± 7.0 A	17.3 ± 4.1 A
Summer	8.9 ± 3.2 B	7.8 ± 2.7 A	16.7 ± 7.0 A	11.1 ± 6.0 D
Fall	10.7 ± 4.1 A	7.8 ± 2.0 A	14.5 ± 4.4 B	13.1 ± 4.8 C

[a]Means ± SD. Means in a column followed by the same letter are not significantly different (alpha = 0.05) based on the Least Significant Difference test (SAS 2006).

(total number) was significantly smaller in the summer than in any other season.

Various temporal manipulations of crops have been used to reduce insect damage. These include providing trap crops at suitable times, crop rotations, using fast growing varieties, and adjusting planting times so that susceptible crop stages occur during periods of low pest incidence (New 2005). This study shows that the total wireworm complex was least abundant (Table 2) and wireworms were smallest (Table 3) in the summer in Florida sugarcane. Interestingly, Bynum et al. (1949) also reported decreased wireworm damage in Louisiana sugarcane planted in the summer as compared to the fall. Both the Bynum et al. (1949) study and this study are consistent in showing expected decreased wireworm feeding on sugarcane during the summer. Data in this study should be useful to southern Florida growers in understanding expected wireworm damage at different times of the year.

REFERENCES CITED

BURRAGE, R. 1963. Seasonal feeding of larvae of *Ctenicera destructor* and *Hypolithus bicolor* (Coleoptera: Elateridae) on potatoes placed in the field at weekly intervals. Ann. Entomol. Soc. Amer. 56: 306-313.

BYNUM, E., J. INGRAM, AND L. CHARPENTIER. 1949. Control of wireworms attacking sugarcane in Louisiana. J. Econ. Entomol. 42: 556-557.

CHERRY, R. 1984. Spatial distribution of white grubs (Coleoptera: Scarabaeidae) in Florida sugarcane. J. Econ. Entomol. 77: 1341-1343.

CHERRY, R. 1988. Correlation of crop age with populations of soil insect pests in Florida sugarcane. J. Agric. Entomol. 5: 241-245.

CHERRY, R., AND D. HALL. 1986. Flight activity of *Melanotus communis* (Coleoptera: Elateridae) in Florida sugarcane fields. J. Econ. Entomol. 79: 626-628.

GURALNIK, D. 1982. Webster's New World Dictionary. Simon and Schuster, New York.

GENUNG, W. 1972. Seasonal occurrence of click beetles (Coleoptera: Elateridae) in the Everglades as measured by two types of traps. Florida Entomol. 55: 35-41.

HALL, D. 1985. Damage by the corn wireworm, *Melanotus communis* (Gyll.) to plant cane during germination and early growth. J. Amer. Soc. Sugar Cane Tech. 4: 13-17.

HALL, D. 1988. Insects and mites associated with sugarcane in Florida. Florida Entomol. 71: 130-150.

HALL, D. 1990. Stand and yield losses in sugarcane caused by the wireworm *Melanotus communis* (Coleoptera: Elateridae) infesting plant cane in Florida. Florida Entomol. 73: 298-302.

KEASTER, A., G. CHIPPENDALE, AND B. PILL. 1975. Feeding behavior and growth of the wireworms *Melanotus depressus* and *Limonius dubitans*: effect of host plants, temperature, photoperiod, and artificial diets. Environ. Entomol. 4: 591-595.

LEFKO, S., L. PEDIGO, W. BATCHELOR, AND M. RICE. 1998. Spatial modeling of preferred wireworm (Coleoptera: Elateridae) habitat. Environ. Entomol. 27: 184-190.

NEW, T. 2005. Invertebrate Conservation and Agricultural Ecosystems. Cambridge Univ. Press, New York. 354 pp.

ROBERTSON, L., AND G. SIMPSON. 1989. The use of germinating-seed baits to detect soil insect pests before crop sowing. Australian J. Exper. Agric. 29: 403-407.

SAS INSTITUTE. 2006. SAS Systems for Windows. SAS Institute, Cary, NC.

SEAL, D., R. MCSORLEY, AND R. CHALFANT. 1992. Seasonal abundance and spatial distribution on wireworms (Coleoptera: Elateridae) in Georgia sweet potato fields. J. Econ. Entomol. 85: 1802-1808.

SOUTHWOOD, T. 1969. Population studies of insects attacking sugarcane, pp. 427-461 *In* J. R. Williams, J. R. Metcalfe, R. W. Montgomery, and R. Mathes [eds.], Pests of Sugarcane. Elsevier, New York. 690 pp.

STONE, M. 1976. Notes on the biology of the introduced elaterid *Conoderus exsul* (Sharp) (Coleoptera: Elateridae). Pan Pacific Entomol. 52: 304-310.

TOBA, H., AND J. TURNER. 1983. Evaluation of baiting techniques for sampling wireworms (Coleoptera: Elateridae) infesting wheat in Washington. J. Econ. Entomol. 76: 850-855.