SC078

Baits for Sampling Wireworms in Southern Florida's Agricultural Fields[1]

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Wireworms are ubiquitous soil insect pests of most crops grown in southern Florida, where at least 12 species have been found. They cause significant economic damage, especially to sugarcane grown on the muck soils of the Everglades Agricultural Area (EAA) [Hall et al., 2002]. To control wireworms, growers frequently apply soil insecticides at planting.

Cherry (1993) showed that rolled oats were a simple attractive bait that could be used for sampling *Melanotus communis* (Gyllenhal) and *Conoderus* sp. wireworms in the organic soils of the EAA. In that study, baits were left in fallow fields for 14 days. However, the effect of timing of bait exposure on wireworm numbers found at baits was not determined. Moreover, the effect of time of bait exposure on wireworm numbers found at baits has received little attention in general. Due to the importance of reducing insecticide use for wireworms while maintaining their populations below the economic damage threshold, more information is needed. The objective of the study described in this fact sheet was to determine the effect of time of bait exposure on the number of wireworms found at baits under the field conditions of the EAA.

The Experiment

All tests were conducted in 10 previously-disked fallow fields on Histosols at the Everglades Research and Education Center (EREC) in Belle Glade, Florida. Fields were surveyed by digging to determine the presence of wireworms before tests were conducted.

Each bait consisted of 200 g of rolled oats. Four baits plus two controls (= no bait) were in each replication in a 3 x 2 pattern with baits and controls 5 m apart. Ten replications 10 m apart were used in each field. Baits and controls were placed following a randomized complete block design. Holes were dug 15 cm deep, each bait poured into the hole, a flag placed through the bait to mark for recovery, and the bait covered with soil. At the time of bait placement in the field, one unbaited control sample from each replication was dug-up to represent 0 days after bait placement. Thereafter, one bait in each replication was dug-up at 7-day intervals up to 28 days. By comparing the two control samples (0 vs 28 days), it was possible to determine if wireworm population

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density changed in the plots during the tests. If the wireworm population density did not change in the plots, this would indicate that wireworm populations at baits were due to wireworm attraction to baits over time and not to changes in population levels in the plots over time.

Baits were recovered by excavating the bait and adjacent soil in a 25 x 25 x 20 cm deep sample and placing the sample in a bucket. Samples were stored in a laboratory at about 23°C. Each sample was visually examined for wireworms for 30 minutes in the laboratory. Wireworms were then stored in alcohol and later identified by microscopic examination. *M. communis*, the most important wireworm pest in the EAA, were identified using the key of Riley and Keaster (1979). *Conoderus* sp. was identified by J.B. Heppner at the Florida Division of Plant Industry, Gainesville. Other wireworm species accounted for less than 10% of the total wireworms found at baits and were not identified. Ten tests were conducted in 10 different fields from October 1992 to September 1993.

Statistical Analysis

The Model

Complete methodology and data analysis may be found in Cherry and Alvarez (1995). Since greater than 90% of the wireworms found at food baits were either *Conoderus* sp. or *M. communis*, statistical analysis was restricted to these two groups. A t-test analysis showed no significant differences ($\alpha = 0.05$) in means numbers of *Conoderus sp*. or *M. communis* at 0 versus 28 days in unbaited samples in any of the 10 fields. These data indicate that wireworms at baits over time were due to bait attraction and not changes in population densities during the tests.

Since the main objective of the tests was to determine the overall response of wireworms to baits over time, the data from the 10 fields were pooled for regression analysis. Initially, the total number of wireworms at baits was plotted against time (0, 7, 14, 21, 28 days). Visual observation indicated a quadratic function for *M. communis* and a cubic function for *Conoderus* sp. Thereafter, these models were used for the two wireworm groups using the General Linear Model Procedure (SAS, *1990)*.

The quadratic equation for *M. communis* was: $Y = a_o + a_1X_i + a_2X^2_i$, where

Y = total number of wireworms at baits,

X_i = days baits left in the field,

i = 0, 7, 14, 21, and 28 days,

a_o, a_1, and a_2 = intercept, linear term, and quadratic term, respectively.

The cubic equation fitted to the data for *Conoderus* sp. was: $Y = a_o + a_1X_1 + a_2X^2_i + a_3X^3_i$, where

a_3 = cubic term; all other terms were previously defined.

The Results

Regression results of the estimated equations are shown next:

Parameter	Equation	
	M. communis	*Conoderus sp.*
a_0 (intercept)	–0.11	16.21
a_1 (linear term)	6.65[a] (0.46)	–4.24 (9.70)
a_2 (quadratic term)	–0.15[c] (0.02)	1.08 (0.88)
a_3 (cubic term)	—	–0.03 (0.02)
R^2	0.99	0.92
Coefficient of variation	5.96	38.97

[a] Statistically significant at P < 0.005.
[b] Figures in parentheses are standard errors of estimated coefficients.
[c] Statistically significant at P < 0.01.

The equation for M. *communis* was highly predictive of the actual observed wireworm distributions over time (Figure 1).

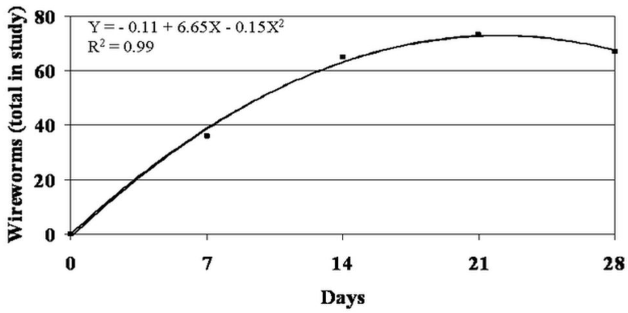

Figure 1. Regression equation for *M. communis*.

Both linear and quadratic terms show high statistical significance; furthermore, the coefficient of determination was a high 0.99 and the coefficient of variation was a low 5.96. None of the coefficients from the equation for *Conoderus* sp. were statistically significant. However, the equation is very close to the actual distribution of wireworms in the fields (Figure 2), as shown by the high coefficient of determination (0.92), but not by the coefficient of variation (39). Both equations showed that time of bait exposure was a strong predictor of wireworm numbers found at rolled oats baits under field conditions. Wireworms of both *Conoderus* sp. and *M. communis* were found in increasing numbers from 0 to 21 days and then declined in number after 21 days.

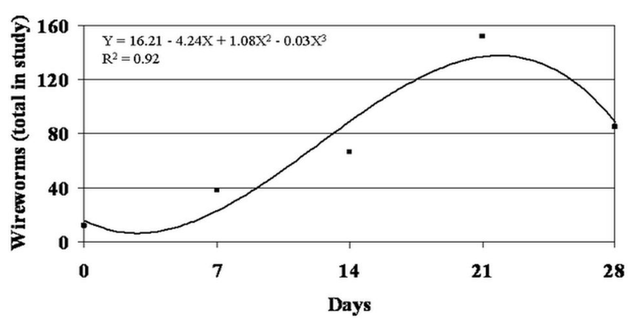

Figure 2. Regression equation for *Conoderus* sp.

The Implications

Soil insecticides are frequently applied for wireworm control when various crops are planted in the EAA. In many cases, soil insecticides are not needed since wireworm populations are too low to cause economic damage (Cherry et al., 1993). However, few growers sample for wireworms since this procedure is difficult due to digging, sorting through the soil, and low numbers of wireworms normally found. Cherry (1993) and this study have shown that rolled oats baits are attractive to wireworms in the EAA and that the time of bait exposure affects the number of wireworms found at baits. These latter two studies provide basic data for using rolled oats baits as a sampling tool to determine the necessity of applying insecticides for wireworm control when planting various crops in the EAA. Wireworms are pests of various crops, such as sugarcane, vegetables, etc., and management practices vary among Florida growers; therefore, individual growers should use data from this publication to determine how to sample for wireworms based upon their specific crops and management practices. Reduced use of soil insecticides will result in lower production costs and beneficial effects to the environment.

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