Abstract: Correlation between crop age and populations of soil insect pests was measured in 18 commercial sugarcane fields in Florida. *Melanotus communis* (Gyllenhal) was the most abundant and largest wireworm species found in these fields. Wireworm populations were not significantly correlated (r = -0.18) with crop age (years). *Ligyrus subtropicus* (Blatchley) was the most abundant and largest grub species found in these fields. In contrast to wireworms, grub populations were significantly correlated (r = 0.74) with crop age (years). Data presented in this study indicate the importance of old sugarcane fields in harboring grub populations and these data also suggest reduced ratooning of Florida sugarcane as a possible means of grub control.

Key Words: Sugarcane, Elateridae, Scarabaeidae

Sugarcane is Florida's most valuable field crop and is primarily grown in the Everglades area of southern Florida. Currently this crop is attacked by two major groups of soil insect pests, wireworms (Family Elateridae), which cause damage to newly planted sugarcane (Hall 1985) and several species of grubs (Family Scarabaeidae). Of these grubs, *Ligyrus subtropicus* (Blatchley), the primary species of economic importance (Gordon and Anderson 1981), in areas of high infestation has been shown to reduce harvest of sugarcane by 39% (Sosa 1984).

After being planted, Florida sugarcane is harvested at ca. yearly intervals from October to April. Florida sugarcane is allowed to ratoon after each harvest and fields remain in production for several years before being replanted. Each ratoon crop is in general less productive than the previous crop and replanting occurs when sugarcane yield drops to a level unacceptable to the producer (Alvarez et al. 1979). The objective of this study was to determine the correlation between crop age and populations of grubs and wireworms in Florida sugarcane since these data are not currently available for these important pests.

MATERIALS AND METHODS

Eighteen commercial sugarcane fields were sampled on farms in southern Florida. The 18 fields were selected from different areas and different sugarcane growers in order to obtain a representative sample of the grub and wireworm populations in Florida sugarcane fields. Fields were also selected to represent a range of crop ages so that some fields were 1 year old, 2 years old, etc. up to 5
years old. All sugarcane plants in each field were the same age since each field was planted in its entirety at the same time. Mature sugarcane is a very difficult crop in which to sample insects (Southwood 1969) and Florida sugarcane may be 3 to 4 m high before harvest. Therefore, all fields were sampled after harvest for easy access. Nine fields were sampled from October, 1985 to May, 1986 and nine fields were sampled from October, 1986 to May, 1987. Since digging and sorting grubs and wireworms is very labor intensive, the 14 month period was required to obtain a sufficient number of fields sampled for statistical analysis. Each field was sampled once and all sampling for each field was completed in 1 to 2 weeks. Each field was 5.3 to 16.2 ha and fields were sampled one at a time. Since the objective of this study was to correlate crop age (years) with grub and wireworm populations, fields were sequentially sampled so that field age (years) was randomized within the 14 month period to reduce bias due to monthly changes in population abundance. Sugarcane plants were used for sample units since most soil-dwelling pests of sugarcane become aggregated around sugarcane plants (Southwood 1969) as also occurs with Florida sugarcane grubs (Cherry 1984). One hundred sugarcane plants were randomly sampled for soil insects from each field. Sugarcane plants may merge together, especially in older fields, making separation of a plant difficult. Thus, each plant was defined by a 50 X 50 cm area and the soil was dug by hand to a depth of 20 cm. The sugarcane plant and the soil were examined for grubs and wireworms in the field. After collection, insects were taken back to a laboratory, frozen, and later identified.

Skips (denuded areas) in sugarcane fields may appear due to removal of sugarcane plants. Factors responsible for skips are field traffic, harvesting equipment, cold damage, and other factors (Eiland and Lyrene 1977). Since soil insects aggregate under sugarcane plants (Southwood 1969), skips could bias sampling since soil insects would aggregate under remaining sugarcane plants. Therefore, sugarcane plants in 100 m of plant row in the center of each field were also counted to determine if increasing crop age reduced the number of sugarcane plants left in the fields. Sugarcane plants were counted by walking along the row and counting plants, each plant was defined as a 50 X 50 cm area in the row.

Data were analyzed by regression analysis using a general linear models (GLM) procedure (SAS Institute 1985). Soil insect data were analyzed by using the total number of wireworms or grubs collected per field as the dependent variables and crop age in years as the independent variable. Crop age in years refers to the time interval from when the sugarcane was planted until the time the sugarcane field was sampled for soil insects. Fewer old fields (i.e. four and five year old) were sampled since these old fields are normally disced and replanted shortly after harvest. Data on skips were analyzed by using sugarcane plants/100 m as the dependent variable and crop age in years as the independent variable. Analysis of variance showed quadratic models did not add significantly (P > 0.05) to the predictability of linear models. I used the simpler linear models in all data analysis.

RESULTS AND DISCUSSION

The number of sugarcane plants/100 m versus crop age (years) were described by the equation, \( y = 119.5 - 4.1x \) where \( y \) equals sugarcane plants/100 m and \( x \) equals crop age in years. The low correlation coefficient of -0.23 for this equation
was not significant ($P > 0.05$). These data indicate that use of sugarcane plants as sample units was not biased by field age since the number of sugarcane plants did not significantly decrease in older fields in this study.

A total of 3,854 wireworms was collected in the 18 fields. Of these wireworms, 63.5% were *Melanotus communis* (Gyllenhal), 28.6% were *Glyphonyx bimarginatus* Schaeffer, 6.9% were *Conoderus* spp., and 1.1% were unknown. Ingram et al. (1938) described *M. communis* as the most abundant wireworm injuring sugarcane in the Everglades, but provided no data for this statement. Hall (1985) has reported on damage by *M. communis* to sugarcane during germination and early growth. In this study, *M. communis* was the most abundant and largest commonly found wireworm in Florida sugarcane fields. Wireworm abundance was quite variable between fields ranging from a high of 722 wireworms found in a field with 2 year old sugarcane to a low of 30 wireworms also found in a field with 2 year old sugarcane (Fig. 1). Wireworm populations were not significantly correlated ($P > 0.05$) with crop age as indicated by the low correlation coefficient of -0.18. The presence of moderate levels of wireworm populations in 1 year old sugarcane to a low of 30 wireworms also found in a field with 2 year old sugarcane shows that residual wireworm populations are still present in newly planted fields and/or fields are rapidly reinfested by the pests.

A total of 1,576 grubs was collected in the 18 fields. Of these grubs, 70.6% were *L. subtropicus*, 24.4% were *Cyclocephala parallela* Casey, 2.8% were *Anomala marginata* (F.), and 2.2% were *Phyllophaga latifrons* (LeConte). As noted earlier, Gordon and Anderson (1981) reported that *L. subtropicus* was the primary grub
species of economic importance in Florida sugarcane, but provided no data to support this statement. Sosa (1984) showed that this grub could reduce sugarcane yield by 39% in Florida. Grub abundance was quite variable between fields ranging from a high of 352 grubs found in a field with 3 year old sugarcane to a low of no grubs found in a field with 1 year old sugarcane (Fig. 2). In contrast to wireworms, grub populations were significantly correlated (P < 0.05) with crop age (r = 0.74). Also in contrast to wireworms, grub populations were very low in all 5 one year old sugarcane fields. These low grub populations show that few grubs are usually present in newly planted fields and fields are only slowly reinfested by the pests. In Florida sugarcane, each ratoon crop is generally less productive than the previous crop (Alvarez et al. 1979). Data in Fig. 2 suggest that increasing grub populations in older sugarcane fields is a factor in the reduced yield of older sugarcane fields. These data also suggest that grub damage can be reduced by reducing the number of years that a crop is left in a ratoon program. Reduction of ratoon crops for grub control in sugarcane has been suggested by Van Dine (1913) in Puerto Rico. Pierce (1930) and Saplala (1959) in the Philippines condemned leaving old grub infested sugarcane plants undisturbed. Mungomery (1930) considered that long ratooning fostered grub infestations in Australian sugarcane. In Burma, Ghosh (1937) found fallowing for one year and taking only one ratoon crop the only practical control against grubs in sugarcane. More recently, Veerish (1984) reported that ratoon crops must be avoided as part of the integrated management of white grubs in sugarcane fields in India. Data in this study show the importance of old sugarcane fields in harboring grub populations and suggest reduced ratooning of Florida sugarcane as a means of grub control.

\[ Y = -72.5 + 66.9X \]
\[ r = 0.74 \]

Fig. 2. Correlation of total number of grubs collected per field with crop age (years) in 18 sugarcane fields in Florida. One hundred sugarcane plants were sampled in each field.
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