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WHICH MOLE CRICKETS DAMAGE BAHIAGRASS PASTURES?

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ABSTRACT

Scapteriscus vicinus, a herbivore, and *S. acletus*, a carnivore, are reputed to damage severely Bahiagrass (*Paspalum notatum*) pastures, yet no direct evidence conclusively implicates either species. Major damage might be caused by either, both, or neither species. We assayed the effects of the 2 species by augmenting populations at sites in 3 pastures. Releasing ca. 16,000 *vicinus* or ca. 9,000 *acletus* adults at the centers of circular plots had little, if any, effect on Bahiagrass stand during the next 7 months.

RESUMEN

El herbivora *Scapteriscus vicinus* y el carnivora *S. acletus* tienen fama de causar daño considerable a las pasturas de la hierba "Bahiagrass" (*Paspalum notatum*), aunque no existe evidencia conclusiva que implique a ninguna de los dos especie. La mayoria del daño puede ser causado por una de las dos, ambas, o ninguna de las dos especies. Ensayamos los efectos de ambas especies aumentando sus poblaciones en sitios de tres pasturas. El esparcimiento de cerca de 16,000 *vicinus* adultos o cerca de 9,000 *acletus* adultos en los centros de estos lotes circulares tuvo poco o ningún efecto sobre la estancia de la hierba "Bahiagrass" durante los 7 meses consecutivos.

Two mole cricket species, *Scapteriscus vicinus* and *S. acletus* (Orthoptera: Gryllotalpidae) are considered major pests of Bahiagrass (*Paspalum notatum*) pastures in Florida. For example, Koehler (1977) stated, "In recent years 30 percent of Bahiagrass pasture has been seriously damaged . . . and 4 percent completely destroyed. . . ." More currently, Short and

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Reinert (1982) wrote that these mole crickets are "the most destructive insect pests of . . . bahia pasturegrass in Florida. . . ." The reputation of *vicinus* and *acletus* as Bahiagrass pests is based chiefly upon finding dense populations of mole crickets in Bahiagrass pastures that show serious loss of stand.

Two new developments prompted us to investigate experimentally the roles of *vicinus* and *acletus* in destroying Bahiagrass. First, extensive studies of crop contents by Matheny (1981 and personal communication) confirmed and extended the results of Ulagaraj (1975) and Taylor (1979), viz. *vicinus* feeds almost exclusively on plant material, including grass blades, and *acletus* feeds chiefly on animal matter, with insect parts frequently making up a major proportion of the recognizable crop contents. Second, Walker and Nickle (1981) showed that *acletus* and *vicinus* were introduced from South America and suggested that their abundance in Florida stems from their escaping specialized enemies that occur in their homelands. Nickle (personal communication, 1981) suspected that U.S. *vicinus* is native to coastal South America near Buenos Aires and Montevideo while *acletus* comes from inland areas, such as Paraguay or northwestern Argentina.

The first development indicates that *vicinus* and *acletus* may affect Bahiagrass differently, and the second implies that the 2 species could be controlled by introducing their natural enemies from South America but that the enemies would come from different geographical areas. Either *vicinus* or *acletus* could be negligibly involved in damaging Bahiagrass pastures; if only one species merits control, it is important to know which one before spending large sums for biological control studies in 2 areas of South America.

METHODS

We established 3 stations in each of 3 contiguous Pensacola Bahiagrass pastures at the Animal Science Department's Sandhill Farm, University of Florida, Gainesville (Fig. 1). The soil was excessively drained Blichton fine sand; the Bahiagrass had been established for at least 10 years. Grazing by cattle during the study was light to moderate. Electronically synthesized mole cricket calls were used to attract large numbers of flying *vicinus* to "V" stations and *acletus* to "A" stations (Walker 1982). Broadcasts began nightly at sunset and lasted 2 h. Output of the battery operated call synthesizers was 107-113 dB at 15 cm. Crickets landing in 1.5-m-dia. pools beneath the synthesizers were sexed, counted, and released outside the 2.5 x 2.5-m-pens that protected the stations from cattle (Fig. 1C). Calling songs were broadcast during the main flight season for each species: 21 February to 3 April 1980 for *vicinus* and 9 April to 22 June 1980 for *acletus*. The few *vicinus* trapped at the A stations and the few *acletus* caught at the V stations were transferred to the proper station before release. Trapped *acletus* were marked prior to release (Ngo and Beck 1982). Control ("C") stations were identical to the others, but no calls were broadcast and no crickets released.

Effects of attracted mole crickets and their progeny (if any) on Bahiagrass stand were measured in 24 quadrats arranged 6 per concentric ring at 5, 10, 20, and 40 m about each station (Fig. 1B). The location of each 0.5 x 0.5-m-quadrat was staked to facilitate repeated measurements. A wooden

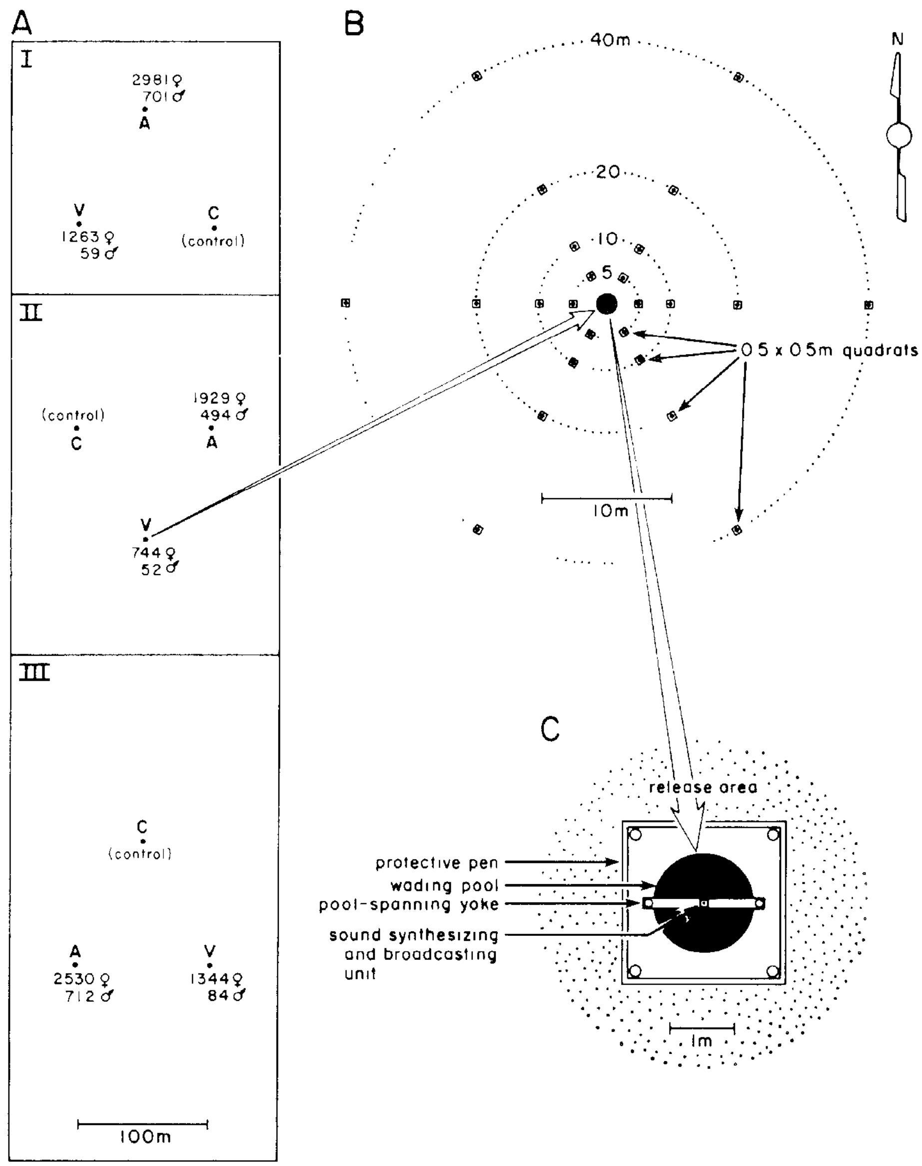

Fig. 1. Experimental layout, Sandhill Farm, University of Florida, Gainesville. A. In each of 3 adjoining pastures (I, II, III), 3 trapping stations (V, A, C) were established 100 m apart in an equilateral triangle. At V stations, *vicinus* were attracted to synthesized calling songs of *vicinus; acletus* were similarly attracted to A stations. Numbers trapped and released are shown by each station. Numbers attracted were 3-13 times more than those trapped. B. Twenty-four 0.25 m² quadrats for assaying forage quality were positioned at 60° intervals on circles of 5, 10, 20, and 40 m radius centered on each station. C. Trapping station and release area. Unit that emitted synthetic calling song was held by a steel yoke over a 1.5 m diameter wading pool. Cattle were excluded by a 2.5 x 2.5 m pen. Trapped mole crickets were released within the circumference of a 2.5 radius circle centered on the sound unit.

square divided by strings into 25, 0.1 x 0.1-m-squares aided estimates of stand: for each small-square-equivalent that had no Bahiagrass, the estimate was reduced 4%. Quadrats (n=216) were read 26 March, 2 May, 26 June, 27 August, and 13 November. Damage during the first 2 or 3 readings seemed likely because of the thousands of adults we anticipated attracting and releasing. However, we were particularly interested in damage that might be revealed by the last 2 readings, since these would be at the time of year that loss of Bahiagrass stand in commercial pastures is often attributed to mole crickets. Mole crickets reducing stand at that time would be the near-mature progeny of adults attracted the previous spring.

Results

A total of 3546 *vicinus* (94.5% female) and 9347 *acletus* (79.6% female) were trapped and released at the V and A stations respectively (Fig. 1). Approximately 7.5% of *vicinus* and 36% of *acletus* landing at synthetic calls are captured by a 1.5-m-diam. pool (Matheny et al. 1982). Consequently, augmentation of cricket populations was ca. 13.33 and 2.78 times the numbers above and in Fig. 1.—i.e. average augmentation per site was 15,800 for *vicinus* and 8,700 for *acletus*.

Bahiagrass cover increased during the experiment, regardless of treatment, from ca. 83% to 93% (Fig. 2).

Analysis of variance was applied to the data to test for effects of distance from point of release. Separate analyses were conducted for each species at each reading date with the fields considered as blocks. The analyses showed no evidence of difference in stand due to proximity to the point of release of *acletus*. For *vicinus* average stands in the ring nearest the point of release were numerically lower than averages in the 3 outer rings for May, August, and November (Fig. 2). However, comparisons of the inner ring versus the average for the 3 outer rings were never more than marginally statistically

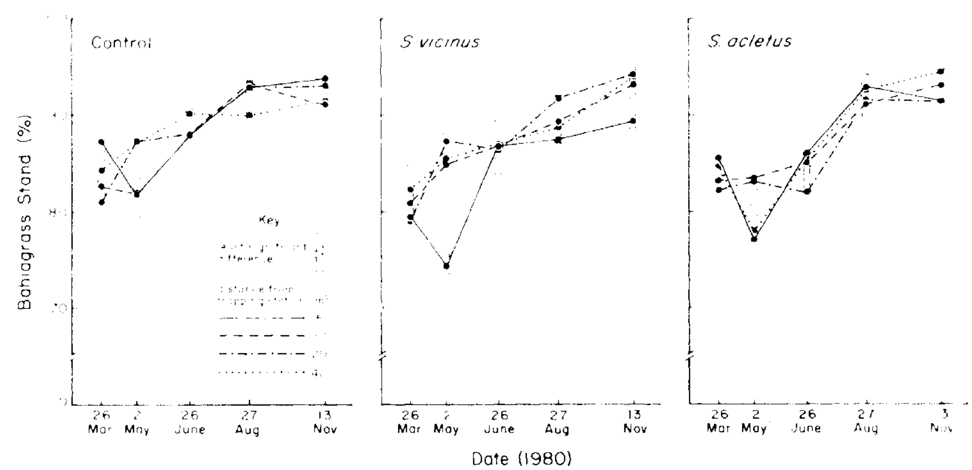

Fig. 2. Mean Bahiagrass stand in 4 concentric rings about 3 types of trapping station. Vertical bar for each group of 4 points indicates least significance difference (P = 0.05) between points. No significant difference exists between rings for any treatment on any date (except for the control in March) nor between any 2 treatments on any date.

significant: May, P=0.06; August, P=0.11; and November, P=0.08. The results, at best, are inconclusive in view of the inherent variability of measurements of stand (c.v.'s ranged from 13% to 44%). Further, several statistical tests were conducted, thereby increasing the probability of declaring a difference significant when in fact it is not, i.e. of making a type I error (as is the case for the difference between 5- and 20-m-quadrats for the March readings of the control: Fig. 2).

We attempted to account for some of the variability in the data, by an analysis of covariance (Steel and Torrie 1960: 305), taking the initial April damage reading as the covariable. This procedure, however, failed to reduce the error and gave results essentially equivalent to the analysis of variance. The data were also analyzed as a split plot in time (Steel and Torrie 1960: 242) in an effort to combine results across dates and check month x distance interaction. This procedure also gave results consistent with the analysis of variance at each date.

Discussion

If released mole crickets or their progeny had any effect on Bahiagrass stands around the trapping stations, our measurements failed to detect it. Yet our methods would surely have detected any important loss of stand.

Failure of mole crickets to damage the study sites does not, of course, prove that mole crickets never destroy Bahiagrass pastures. We may even have failed to increase the existing population levels of mole crickets—either because the crickets attracted soon flew away or because they were killed by pathogens or predators taking advantage of the unnatural concentrations.

Our original experimental design included measurement of the population density gradients established by our operations; however, efforts to develop a sampling device for mole crickets did not succeed until the experiment had ended (Williams and Shaw 1982). Our hopes of correlating levels of damage with particular densities of the 2 species of mole crickets were frustrated both by failure to produce damage and inability to measure densities!

Previous efforts to study experimentally the damaging effects of mole crickets on Bahiagrass yielded similarly negative results (S. Walker 1979). One of S. Walker's 2 experiments was more elaborate than ours: he had 2 sites (one on excessively drained Astatula sand; the other on poorly drained Pomona sand), each divided into irrigated and non-irrigated subsites, and 4 replications of 4 treatments at each subsite. The treatments were 1) control, 2) mole crickets eliminated by toxic baits, 3) clipped-wing *vicinus* released, 4) clipped-wing *acletus* released. His release rates, 3-6 crickets per m^2, were much lower than our 86-242 per m^2. (Our rates were calculated for 5-m-radius landing and release areas, and we assumed that 7.5% of *vicinus* and 36% of *acletus* that landed were trapped—Matheny et al. 1982).

If mole crickets seriously damage Bahiagrass pastures, they do it under circumstances different from those in the experiments completed thus far. Other agents (e.g. pathogens, white grubs) may be causing the losses of grass stands attributed to mole crickets. (Since the associated mole crickets have not been identified, it is possible that they are *acletus* taking advantage of improved foraging opportunities associated with thinning sod.)

Our emphasis on loss of stand in Bahiagrass pastures stems from economic concerns of cattlemen. Florida turf growers also consider mole crickets a major threat and in one year applied for their control ca. 133 metric tons of active ingredient of Dursban, Baygon, and other insecticides, costing $11,700,000 (P. G. Koehler and D. E. Short, personal communication, 1980). Damage to turf is attributed both to feeding and to uprooting during tunneling (Short and Reinert 1982). No experimental studies have been made to partition the damage between the 2 modes or between the 2 species.

The best case for mole crickets being primary agents of damage is for vegetable crops; in seed beds and in newly transplanted fields injury from mole cricket tunneling and feeding are directly observable. In 1940, damage to vegetable crops in central peninsular Florida was so extensive that the USDA undertook an emergency control program culminating in the spreading of 1064 metric tons of bait, laced with 85 tons of calcium arsenate, to protect 12,438 ha of fall crops (Schroeder 1941). This outbreak evidently was caused by the first-time spread of either *S. acletus* or *S. vicinus* or both into the region (Walker and Nickle 1981). Again, no effort was made to partition the destruction between the 2 species or between feeding and tunneling injury.

Although the question posed as the title of this paper is unanswered, its importance is clarified and reinforced: a search for natural enemies to introduce for biological control of *vicinus* and *acletus* can be directed more rationally if we learn the roles of the 2 species in causing the damage we are attempting to alleviate.

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MICROBIAL CONTROL OF THE CITRUS RUST MITE WITH THE MYCOACARICIDE, MYCAR®

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ABSTRACT

Mycar®, a mycoacaricide produced by Abbott Laboratories as a wettable powder or dust was effective in stimulating premature fungal epizootics in citrus rust mite, *Phyllocoptruta oleivora* (Ashmead) (Family Eriophyididae) populations in 'Valencia' orange groves located in central and south Florida in 1979 and 1980. *Hirsutella thompsonii* (Strain: Fla. CBS 556. 77b), the active ingredient of Mycar was established on treated fruit and foliage via the particulate residue which supplied a substrate for mycelial growth and subsequent conidiogenesis by the fungus. Excellent crop protection was achieved with Mycar and a Mycar-oil combination in field trials. Oil, Dacagin®, Nu-Film 17®, Plyac® and Ortho X-77® at recommended rates had no detrimental effect on the germination of primary conidia of *H. thompsonii* and Nu-Film 17 was an excellent spreader-sticker for Mycar formulated as a wettable powder.

RESUMEN

Mycar®, un micoacaricida producido por Abbott Laboratories que se puede usar como o polvo seco o polvo indisoluble, fué efectivo en el estímulo de epizoóticos fungosos prematuros en poblaciones de ácaros de roya cidral *Phyllocoptruta oleivora* (Ashmead) (Familia Eriophydidae) en naranjales de tipo 'Valencia' de la Florida central y sureña en 1979 y 1980. *Hirsutella thompsonii* (Strain: Fla. CBS 556. 77b), el ingrediente activo de Mycar, se estableció en frutos y follajes tratados via el residuo de particulas que proveyeron un substrato para el crecimiento micológico y la subsecuente