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GUT CONTENT ANALYSIS OF SOUTHERN AND TAWNY MOLE CRICKETS (ORTHOPTERA: GRYLLOTALPIDAE: *SCAPERTISCUS*)

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Two introduced species of mole crickets, *Scapteriscus borellii* Giglio-Tos, the southern mole cricket and S. *vicinus* Scudder, the tawny mole cricket cause economic damage to turfgrass in North Carolina and throughout the southeastern U.S. Previous studies indicate that *Scapteriscus borellii* primarily feed on insect material and *Scapteriscus vicinus* feed on plant material (Ulagaraj 1975; Taylor 1979; Matheny 1981; Fowler et al. 1985). There have been no additional research efforts to examine the gut content of these 2 pests as their range has expanded over the past 25 years to their northern-most habitat (North Carolina) with changes in ecology, host range, or diet. This research was conducted to determine the current feeding preferences of North and South Carolina populations of these 2 mole cricket species.

Nymph and adult *S. borellii* and *S. vicinus* were collected during the spring and summer of 2009 with soapy water flushing (Short & Koehler 1979) and individual crickets were immediately preserved in 70% ethyl alcohol. *Scapteriscus borellii* nymphs were collected from Belvedere Country Club (Pender Co., NC, 34.3675, 77.710833) on 15 Sep and adults were collected from Olde Fort Golf Course (Brunswick Co., NC, 34.0857, 78.0536) on 5 May. *Scapteriscus vicinus* nymphs were collected from Scotch Meadows Country Club (Scotland Co., NC, 34.4553, 79.2813) on 8 Oct and adults were collected from High Tech Turf (Horry Co., SC, 33.5097, 79.322) on 6 May and 12 May. All collected individuals were examined for species characteristics to ensure proper identification (Potter 1998).

The alimentary canals (crop, proventriculous, and hindgut) of 25 late instars (large nymphs) and 25 adults for each species were removed and examined. Each cricket was placed in a petri dish (8.89 cm diameter, Fisher Scientific, Pittsburgh, PA) ventral side up, and an X-Acto knife (x3201, Elmer's Products Inc., Columbus, OH) was used to remove the sterna to expose the alimentary canal. A pair of forceps was used to remove the alimentary canal. The cricket body cavity was placed into a plastic vial filled with 70% ethyl alcohol and labeled to identify each specimen. The alimentary canal remaining in the petri dish was covered with 70% ethyl alcohol to prevent desiccation. Forceps were used to tease open the crop, proventriculous, and hindgut. All gut content was noted for each cricket. The content was examined under a binocular microscope used in the 7X-30X power range and the contents were categorized as presence of plant material only, presence of insect material only, or presence of plant and insect material. Content was determined to be plant material if it was fibrous, green, or light brown in color and if it had a blade-like appearance (Castner & Fowler 1984). Content was determined to be animal material if it was dark brown or black, obviously sclerotized, or if they were a recognizable structure such as, tarsi, antennae, legs, etc (Castner & Fowler 1984). The gut content was thoroughly examined and analyzed until all pieces were identified and categorized. The contents were then removed from the petri dish with a bulb-pipette and placed in the vial with the cricket from which it was extracted. Data were analyzed by Chi-square analysis through use of Statistical Analysis System version 9.1 program (SAS Institute 2003).

Of the 25 *S. borellii* nymph alimentary canals examined 28% ± 0.46% contained only plant material, 4% ± 0.20% contained only insect material, and 68% ± 0.48% contained plant material and insect material (Fig. 1). Of the 25 *S. borellii* adult alimentary canals examined 56% ± 0.51% contained only plant material, 20% ± 0.41% contained only insect material, and 24% ± 0.44% contained plant material and insect material (Fig. 1). There is significant difference in the overall gut contents between *S. borellii* nymphs and *S. borellii* adults (Chi-square = 10.2609, $P = 0.0059$). Of the 25 *S. vicinus* nymph alimentary canals examined 60% ± 0.5% contained only plant material, 4% ± 0.2% contained only insect material and 36% ± 0.49% contained plant material and insect material (Fig. 1). Of the 25 *S. vicinus* adult alimentary canals examined, 96% ± 0.2% contained only plant material, 0% contained only insect material, and 4% ± 0.2% contained plant material and insect material (Fig. 1). There is significant difference in the overall gut content between adult *S. vicinus* and nymph *S. vicinus* (Chi-square = 9.4769, $P = 0.0088$). There is

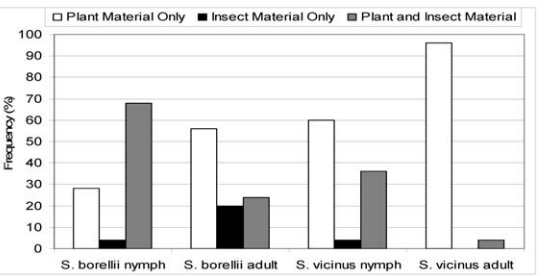

Fig. 1. The frequency of various gut contents for *S. borellii* and *S. vicinus* nymphs and adults.

TABLE 1. THE PERCENT HERBIVORY, CARNIVORY, AND OMNIVORY FOR *S. BORELLII* AND *S. VICINUS* POPULATIONS IN BRAZIL AND FLORIDA (OTHER STUDIES) AND NORTH AND SOUTH CAROLINA (THIS STUDY).

Species	Location	% Herbivory	% Carnivory	% Omnivory	Reference
S. borellii	Florida	4%	44%	8%	Ulagaraj (1975)
S. vicinus	Florida	53%	15%	21%	Ulagaraj (1975)
S. borellii	Florida	14%	90%	—	Taylor (1979)
S. vicinus	Florida	50%	61%	—	Taylor (1979)
S. borellii	Florida	6%	70%	43%	Matheny (1981)
S. vicinus	Florida	72%	1%	10%	Matheny (1981)
S. borellii	Brazil	18%	32%	12%	Fowler et al. (1985)
S. vicinus	Brazil	44%	6%	10%	Fowler et al. (1985)
S. borellii	North Carolina	42%	12%	46%	NC 2009
S. vicinus	North and South Carolina	78%	2%	20%	NC/SC 2009

also significant difference ($P < 0.05$) in the gut content between *S. borellii* (nymphs and adults) and *S. vicinus* (nymphs and adults) (Chi-square = 14.8027, $P = 0.0006$).

We determined that the gut content of North and South Carolina populations of *S. borelli* and *S. vicinus* is similar to previous findings for South America and Florida populations (Table 1). Modest changes in feeding preferences were apparent as the southern mole cricket in North Carolina appeared to be more herbivorous than previous studies in other locations indicated in the past. The differences in length between *S. borelli* and *S. vicinus* alimentary canals could be related to differences in diet. The alimentary canal of *S. vicinus* is significantly longer than in *S. borellii* (Nation 1983). The longer alimentary length seen in *S. vicinus* may reflect the greater difficulty of digesting plant cells; more area is needed for the chemical digestion to occur (Nation 1983).

The differences in gut content seen in both species between nymphs and adults could be attributed to the different developmental needs of the life stages (Forrest 1987). We found a higher percentage of herbivory in both species as adults as compared to nymphs. We also observed greater herbivory in the southern mole cricket as compared to previous reports.

Nymphs of the European mole cricket *Gryllotalpa gryllotalpa* Linnaeus (Ulagaraj 1975) that were fed on insect food completed development in 2 years, while nymphs fed on vegetable matter completed development in over 4 years (Ulagaraj 1975). The protein found in animal/insect components of diet may be important in development.

SUMMARY

The alimentary canals of 25 nymph and 25 adult *S. borellii* and *S. vicinus* were dissected to determine the gut contents in North and South Carolina mole cricket populations as compared to previous studies in other locations S. *borellii* nymphs were found to primarily consume plant and insect materials, while *S. borellii* adults were found to primarily consume only plant materials. *Scapteriscus vicinus* nymphs and adults were found to primarily consume only plant material. The results of this study were similar to those of previous studies conducted more than 25 years ago in Brazil and Florida.

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