

Executive Summary

Improved Mole Cricket Management Through the Application of an Enhanced Ecological and Behavioral Data Base

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The use of a fiberglass resin material to make castings of mole cricket tunnels has helped differentiate between the behavior of the two species, the tawny mole cricket, *Scapteriscus vicinus*, and the southern mole cricket *S. borellii*. The behavioral differences provide insight into the differences observed in damage and the success of specific management approaches. The placement of fungal pathogens in the soil may influence the effectiveness of the product. The avoidance behavior observed appears to be an evolutionary adaptation to avoid high concentrations of pathogens.

Much of the research activity this year involved analysis of data and manuscript preparation. The current tally of research publications in print or under review associated with this research project includes fifteen refereed publications. Several other trade journal articles have also been developed as a result of the research findings from this project.

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The final phase of this project has focused primarily on two critical components of mole cricket ecology that have direct implications on mole cricket management. Field studies in North Carolina continued efforts to differentiate ecological aspects of behavior for the tawny mole cricket (*Scapteriscus vicinus* Scudder) and the southern mole cricket (*S. borellii* Giglio-Tos). Laboratory studies in New York investigated the mechanism involved in the repellency to biological control agents.

FIELD STUDIES: Based upon previous studies initiated within the context of this overall project the use of fiberglass resin to develop castings of tawny mole crickets was further utilized. These castings revealed a consistent pattern of Y-shaped tunnels which paralleled results from radiograph laboratory studies. However, radiograph studies on the southern mole crickets indicated a different tunneling pattern. Based upon our knowledge of the feeding habits it was not unexpected to see variation in tunneling structure. Since the use of the fiberglass resin traps the cricket within the casting, identification of the species responsible for the tunnel was simplified.

Turf areas were selected that were infested with both tawny and southern mole crickets. Fiberglass resin castings were made from a large number of tunnels created by large nymphs and adults. Once the castings had hardened the structures were dug from the soil. The mole cricket is typically trapped in the casting and this permits identification of cricket species. The tunnel

structures were classified by vertical and horizontal branching and total tunnel length.

Results indicate southern mole cricket tunneling in the field do not produce the typical AY \cong shaped tunnel so typically observed in the tawny crickets. The tunnels from the southern mole cricket represented a pattern that appeared to be more random. This is indicative of a pest that searches for food as a predator rather than as a root-feeder. These studies that help us further understand the concerns over differential species responses to insecticides. While we have documented through previous studies that some direct differences in cricket susceptibility exist, it is apparent that behavior may also affect differences in control.

LABORATORY STUDIES: The findings of avoidance behavior in mole crickets suggest that placement of fungal pathogens in the soil profile may influence the effectiveness of a product to control mole cricket damage to turf. The avoidance response seen in these experiments may be evidence of an evolutionary adaptation to avoid infected insects and areas of soil with high concentrations of fungal spores. Avoidance behavior may explain the inconsistent results found in the field with high doses and surface applications of fungal pathogens. Subsurface applications of fungal pathogens may lengthen the time a pathogen remains viable compared to pathogen survival after surface application

OTHER RESEARCH (PUBLICATIONS): Also included in this report is a listing of refereed publications resulting in part from USGA funding. The citations include publications already published, in press, under review and those in preparation. Data analysis and manuscript preparation comprised a significant portion of the time devoted to this project in its final phase. Several trade journal articles were also written focusing on the timely delivery of relevant problem-solving research information developed as a result of this research project.

Refereed Research Articles Funded in Part from the USGA Sponsored Research Program

1. **Brandenburg, R. L.** and J. E. Bailey. 1996. Mole cricket management support with computerized weather stations. p. 1102-1105. In Sixth International Conference on Computers in Agriculture. Cancun, Mexico. F. S. Zagueta (ed.). Amer. Soc. Agric. Eng., St. Joseph, MI 1168p.
2. **Brandenburg, R.L., M. G. Villani,** and P.T. Hertl. 1998. Integration and adoption of a mole cricket management program in North Carolina, USA. International Turfgrass Society Research Journal. Vol. 8., Part 1. pages. 1973-80. Univ. Printing Serv. , Univ. Of Sydney, New South Wales 2006., Australia. 1133 pages.
3. **Brandenburg, R. L.,** P T. Hertl and **M. G. Villani.** 2000. Improved mole cricket management through an enhanced understanding of pest behavior. Amer. Chem. Soc Symposium Series 743. Fate and Management of Turfgrass Chemicals. J. M. Clark and M. P. Kenna (eds.). Amer. Chem. Soc. 397-407.
4. Xia, Y., and **R. L. Brandenburg.** 2000. Effect of irrigation on the efficacy of three insecticides for controlling mole crickets (Orthoptera: Gryllotalpidae) on golf courses. J. Econ. Entomol. 93:852-857.
5. Xia, Y., P. T. Hertl, and **R. L. Brandenburg.** 2000. Surface and subsurface application of *Beauveria bassiana* against two species of mole crickets (Orthoptera: Gryllotalpidae) in golf courses. J. Agric. Urban Entomol. (Under review)
6. Gilmer, R.S. and **R. L. Brandenburg.** 2000. Effect of soil characteristics on the occurrence of southern and tawny mole crickets (*Scapteriscus borellii* and *S. vicinus*) (Orthoptera: Gryllotalpidae) on golf courses in southeastern North Carolina. J. Agric. Urban Entomol. (Submitted)
7. Xia, Y., **R. L. Brandenburg,** and **M. G. Villani.** 2000. Fiberglass resin for determining tunnel structure of mole crickets (Orthoptera: Gryllotalpidae). J. Kan. Entomol. Soc. (Submitted).
8. Xia, Y., **R. L. Brandenburg,** and M. A. Fidanza. 2000. Movement and residual activity of deltamethrin in a golf course fairway under two irrigation timings. Fla. Entomol. (Submitted).
9. Xia, Y., R. L. Brandenburg, and A. W. Johnson. Meterjet® spray gun for insecticide bioassays against mole crickets (Orthoptera: Gryllotalpidae) and other turfgrass insects in the laboratory and greenhouse. Fla. Entomol. (Submitted).
10. Hertl, P.T., **R. L. Brandenburg,** and M. E. Barbercheck. 2000. The effect of soil moisture on ovipositional behavior in the southern mole cricket *Scapteriscus borellii* Giglio-Tos (Orthoptera: Gryllotalpidae). Environ. Entomol. (Under review).
11. Xia, Y., and **R. L. Brandenburg.** 2000. Collection of mole crickets (Orthoptera:

- Gryllotalpidae) for laboratory and greenhouse research by soapy water flush. Fla. Entomol. (Submitted)
12. Xia, Y., and **R. L. Brandenburg**. 2000. Mortality response of two species of mole crickets Orthoptera: Gryllotalpidae) to three insecticides. J. Turfgrass Management. (Submitted)
 13. Xia, Y., P. T. Hertl, D. L. Cox, and **R. L. Brandenburg**. 2000. Toxicity of thiamethoxam against mole crickets (Orthoptera: Gryllotalpidae) in the field and greenhouse bioassays. J. Entomol. Sci. (Submitted).
 14. Allee, L.L., L. Preston-Wilsey, N. Consolie, Y. Xia, **R. L. Brandenburg**, and **M. G. Villani**. 2000. Use of Radiography and Soil Casting for Observing Mole Cricket Behavior in Soil. American Entomologist. (Under review).
 15. Hertl, P. T., **R. L. Brandenburg**, and C. B. Williams III. 2000. Flight Activity of *Scapteriscus vicinus* Scudder and *S. borellii* Giglio-Tos (Orthoptera: Gryllotalpidae) in Southeastern North Carolina. (Under review)