

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

**Executive Summary**

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Studies during 1998 focused on four specific areas. These include: 1.) defining high risk areas for mole cricket infestations, 2.) determining the impact of soil moisture on oviposition and mole cricket development, 3.) investigating the effect of irrigation and specific environmental parameters on insecticide (both conventional and biological) performance, 4.) documenting the repellent response behavior of mole crickets to insecticide applications.

**Defining high risk areas for mole cricket infestations:** The field portion of this study was completed in 1998 year as a Masters student research project. The results of this study are currently undergoing statistical analysis and the measurement of the soil texture is still underway in the laboratory. However, preliminary findings indicate there is some degree of separation between those sites most commonly inhabited by tawny and southern mole crickets.

**Determining the impact of soil moisture on oviposition and mole cricket development:** Greenhouse studies to document the impact of soil moisture on oviposition have been completed by a Ph.D. candidate student. These studies conducted in 7.5cm diameter by 15cm deep PVC cylinders filled with a uniform mixture of Kureb fine sand maintained at specific soil moistures conclusively demonstrated that crickets lay eggs more quickly and in higher numbers when soil moisture is maintained above 7% (Figure 1). This effect helps explain the annual variation we observe in mole cricket oviposition and egg hatch in the field, not only on a calendar basis, but also based on degree day accumulations.

**Investigating the effect of irrigation and specific environmental parameters on insecticides (both conventional and biological) performance:** Soil dissipation studies in association with insecticide rate and irrigation regimen treatment plots indicate that irrigation may play less of a role in positioning the insecticide than it does in affecting mole cricket behavior. This area is scheduled for additional investigation.

**Documenting the repellent response behavior of mole crickets to insecticide applications:** Field studies have examined a wide range of insecticide rates, formulations, and soil moisture levels for short and long-term control effects. Similar studies have been conducted for biological control (*Beauveria bassiana*). Results indicate that reverse rate responses often occur with higher rates providing less control. This may be the result of avoidance behavior associated with higher rates.

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**A PROGRESS REPORT TO THE U.S. GOLF ASSOCIATION**

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Studies during 1998 focused on four specific areas. These include: 1.) defining high risk areas for mole cricket infestations, 2.) determining the impact of soil moisture on oviposition and mole cricket development, 3.) investigating the effect of irrigation and specific environmental parameters on insecticide (both conventional and biological) performance, 4.) documenting the repellent response behavior of mole crickets to insecticide applications.

**Defining high risk areas for mole cricket infestations:** The field portion of this study was completed in 1998 year as a Masters student research project. Conducted over a two year period, this project sought to define soil parameters most commonly associated with tawny and southern mole cricket infestations. Soil parameters (moisture, pH, texture, color, and organic matter) were measured across more than 80 sites and mole cricket populations were monitored every three weeks through the summer. Mole cricket populations were monitored using 2 one square meter soapy water flushes per site.

The results of this study are currently undergoing statistical analysis and the measurement of the soil texture is still underway in the laboratory. However, preliminary findings indicate there is some degree of separation between those sites most commonly inhabited by tawny and southern mole crickets. Sites also indicate some soil differences between those areas most heavily infested and those areas with minimal infestations. Additional analysis of these data is underway and will allow a more critical comparison of these apparent differences.

**Determining the impact of soil moisture on oviposition and mole cricket development:** Greenhouse studies to document the impact of soil moisture on oviposition have been completed by a Ph.D. candidate student. These studies conducted in 7.5cm diameter by 15cm deep PVC cylinders filled with a uniform mixture of Kureb fine sand maintained at specific soil moistures conclusively demonstrated that crickets lay eggs more quickly and in higher numbers when soil moisture is maintained above 7% (Figure 1). This effect helps explain the annual variation we observe in mole cricket oviposition and egg hatch in the field, not only on a calendar basis, but also based on degree day accumulations. Drier soil conditions in the greenhouse delay oviposition and this effect has been confirmed in our field studies from 1994-1997 by reviewing rainfall weather data in conjunction with soil temperatures.

**Investigating the effect of irrigation and specific environmental parameters on insecticides (both conventional and biological) performance:** Studies on the effect of irrigation timing, irrigation volume, and soil moisture on insecticide efficacy have proven inconclusive, but the data are still under analysis. Soil dissipation studies in association with insecticide rate and irrigation regimen treatment plots indicate that irrigation may play less of a role in positioning the insecticide than it does in affecting mole cricket behavior. This area is scheduled for additional investigation. Nighttime behavior as influenced by moonlight and its affect on control was also investigated. These studies also produced results that are somewhat inconclusive. Our studies indicate that soil moisture and mole cricket behavior are critical factors in affecting efficacy.

**Documenting the repellent response behavior of mole crickets to insecticide applications:** This study has utilized both greenhouse and field studies to verify laboratory radiographs which indicate mole crickets avoid insecticides in the soil. Greenhouse studies utilized the placement of insecticides at the bottom of large plastic chambers filled with untreated soil, at the soil surface of such containers, and mixed through the soil. Mole crickets living in the soil were monitored weekly and data indicate a distinct ability to avoid areas treated with insecticides and little, if any, mortality if crickets can find food without contacting treated soil.

Field studies have examined a wide range of insecticide rates, formulations, and soil moisture levels for short and long-term control effects. Similar studies have been conducted for biological control (*Beauveria bassiana*). Results indicate that reverse rate responses often occur with higher rates providing less control. This may be the result of avoidance behavior associated with higher rates. Formulations of insecticides on ammonium sulfate carriers seem to show this repellancy less often and may be a reflection of the carrier acting as a masking agent for the insecticide. These initial studies on this concept appear to be an area worthy of further investigation and additional studies in minimizing this avoidance response to both conventional and biological controls will be initiated in 1999.

Additional studies with wax castings have further confirmed the "Y" shaped tunnel structure of mole cricket tunnels and are being investigated for use in monitoring mole cricket behavior. Mole cricket mating flights were monitored again in 1998 and flights were later than normal and tawny mole cricket catches were lower than normal. However, soil moisture was above normal at oviposition and soap flushes to monitor development revealed the earliest appearance of adult mole crickets recorded in the past five years (2<sup>nd</sup> week of August).

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