Gaining Ground on Turf's Top Enemy

Figure 1. *Mole cricket damage is often quite severe and effective control can often times be a frustrating and expensive endeavor.*

Practical Use of New Research for Effective Mole Cricket Control

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The southeastern United States, and Florida in particular, seem to be blessed (or cursed) with an abundance of turfgrass insect pests. The list ranges from cutworms to mole crickets, fire ants to sod webworms, chinch bugs to white grubs. Many of these pests are troublesome every year and often persist for long periods of time during the warmer months. In addition, several of the pests such as fire ants and mole crickets offer special challenges as we attempt to control them in an environmentally and economically sound manner.

While fire ants present their own special challenges, just not in terms of effective control, but also from the health risk they produce, in this article we will restrict our comments to mole crickets. The underground nature of this insect, its presence near water, and several behavioral characteristics of this pest make it a particular challenge (*Fig. 1*).

The majority of this article will focus on recent research that helps us better understand what the mole cricket does under the soil and how this information ma be useful in helping us manage this pest.

The first advantage that mole crickets have working in their favor is the very fact that they are a soil insect. This works to their advantage in two ways.

First, we can't see what the insect is doing when its below the soil surface. This obviously works to the insect's advantage. We don't know where the pest is concentrated, its developmental stage, or even its general abundance prior to serious damage to the turfgrass.

Secondly, the soil and associated organic matter (such as thatch) work against our efforts to deliver the insecticide or other control agent directly to the insect pest. Many insecticides are bound tightly to organic matter in the soil and this results in less availability of the product to the insect. The soil itself somewhat buffers the insects from any application of an insecticide. As a result, control of soil insects such as mole crickets is a great challenge that often requires a significant investment in time and money.

These challenges in mole cricket management have resulted in a number of research projects through the years to help us better understand the biology

Figure 2. The southern (left) and tawny mole crickets are similar in appearance, but differ in their biology and ecology.

and ecology of this pest. Our program at North Carolina State University has been studying this pest for about 15 years and a very significant effort has been under way for the past 10 years. A portion of this work in collaboration with Dr. Mike Villani at Cornell University has been funded for seven years by the United States Golf Association.

The major focus of our research has been studying the biology and behavior of mole crickets and how this affects our efforts to manage this pest. We have studied both the southern and tawny mole crickets (*Fig. 2*). While there are many similarities between the two species, there are also some distinct differences.

The southern mole cricket is more of a predator feeding on soil organisms and the tawny mole cricket feeds more on the root systems of the turf. Each will modify its feeding behavior somewhat under unusual or less than optimal conditions. However, the very predatory nature of the southern mole crickets actually allows them to attack and feed upon tawny mole crickets that are the same size or smaller.

Fortunately for the tawny mole crickets, their biology gives them a leg up on the southern mole cricket. Tawny mole cricket adults typically lay eggs earlier than the southern mole cricket and as a result the tawny mole crickets are often a little larger, offering them a level of protection from the southern mole crickets. It is quite possible that some of the earliest hatching southern mole crickets do consume a few of the later hatching tawny mole cricket.

When we consider the management implications of this difference, the length of egg hatch is going to be considerably longer in areas where the two species coexist. This makes good control more difficult since the timing and residual activity of the insecticide must cover a longer period of time than the situation where only one species is present. The combination of the two species in one location usually gives us a bit more of a problem in our efforts to obtain maximum control.

In addition to the fact that we can have two different species present in one location, we are finding that there are some rather significant regional differences in mole crickets.

For example, in a particular year, a mole cricket population in north Florida may enter into the winter months with about 80% of the nymphs having completed their development to the adult stage. In North Carolina we may see as high as 90% of the population overwinter as adults.

We don't know why we see advanced development in an area with cooler spring and fall temperatures and where the eggs may hatch a month later. There also

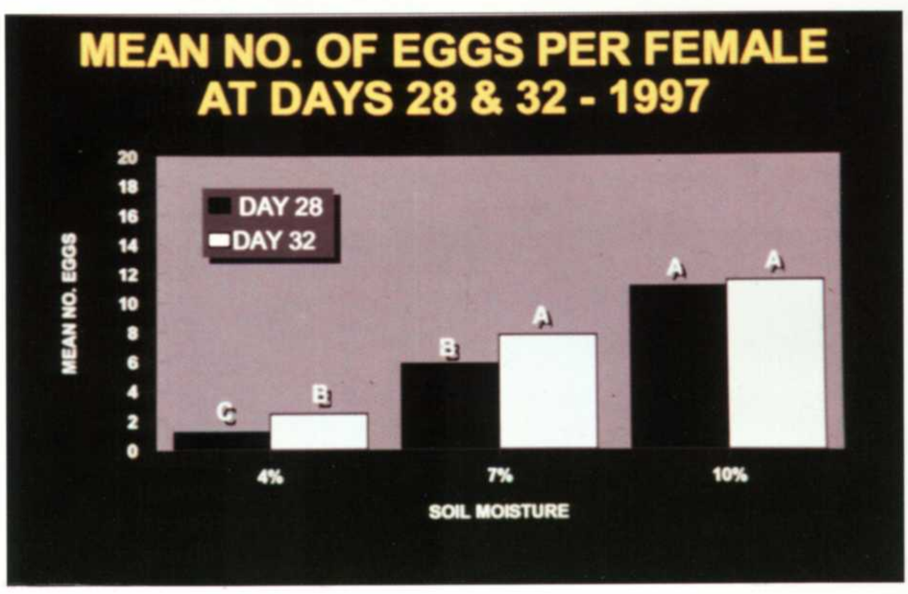

Figure 3. Effect of soil moisture on the egg laying of mole crickets in a greenhouse study (North Carolina).

appear to be some differences in the susceptibility of mole crickets to particular insecticides from various parts of the Southeast.

Are all of these differences a reflection of different environments (i.e. soil types, rainfall, temperature), the result of years of exposure to different insecticides, or is it that the various populations of mole crickets that found their way to the U. S. came from different points of origin in South America?

I don't think we have a clear answer for this yet, but it does caution us in accepting data from far removed locations as the gospel. The way a product stacks up in North or South Carolina may or may not be the same as it performs in south Florida. Local testing and on-site trials are critical with this pest.

One aspect of mole cricket ecology that does appear to be consistent across its range is that it is a creature of habit. By this, I mean that the mole cricket population generally finds an area that it is suitable and populations tend to occur there year after year.

Much of this is the result of the fact that the adult male mole cricket seeks sites that are suitable for making attractive calling chambers to attract the females for mating in the spring. These same sites are often good for egg laying, which the females frequently utilize soon after mating. In effect, the signs of adult activity in the spring are actually a very good indicator of where significant egg laying will occur and represents a site where monitoring of egg hatch should be focused.

This is not to say mole crickets don't spread to new areas because they certainly can and do. By mapping and monitoring these sites of springtime adult activity, superintendents can use their time most effectively and feel confident that they can accurately monitor egg hatch. Defining those areas and closely observing egg hatch is the first step to an effective control program.

Soil moisture greatly affects mole cricket behavior. Female mole crickets like good soil moisture in which to deposit their eggs (*Fig. 3*). Our research has shown that females may lay their eggs a little bit earlier if a good rainfall occurs and a little bit later if the soil is dry.

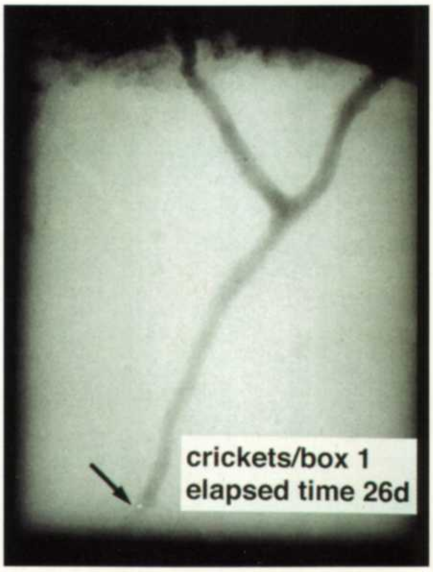

Figure 4. *Typical "Y" shaped tunnel of a tawny mole cricket in the soil as observed through an X-ray image.*

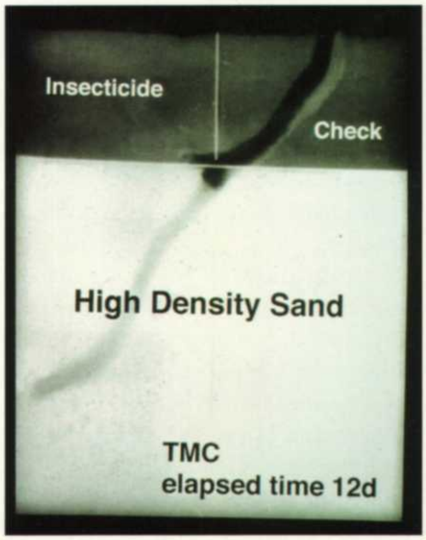

Figure 5. *Indications of avoid behavior by tawny mole crickets to the presence of an insecticide in the soil as observed through an X-ray image.*

I believe the effect of soil moisture is one reason why we have not been able to accurately predict egg hatch based upon soil degree days. This desire for higher moisture area to initially deposit the eggs may well explain the reason for the consistency in the sites in which they show up each year. Once hatched, the nymphs may migrate to drier areas as we often see them around bunkers and on mounds.

Under drier soil conditions, the mole crickets also have a tendency to be a little deeper in the soil. This is why it is more difficult to use the soap flush to get them to the surface when it is dry.

Dry conditions also make it more difficult to control mole crickets. The dry soil and organic matter make it more likely that much of the pesticide will be bound to it rather than moving to the target site. In addition, the cricket is simply residing down deeper in the soil and is less likely to contact the insecticide.

I have observed on several occasions a situation where superintendents are ready to throw in the towel on a particular treatment. A treatment is applied in a timely manner, but under dry soil conditions. Time passes and it remains dry. During this dry period the mole crickets are still feeding and growing larger, but there is little evidence of surface damage.

Then we enter a period where we receive some good soaking rains and suddenly mole cricket damage appears everywhere, including the treat areas (regardless of the insecticide used). Immediately we feel that the treatment has failed.

What has most likely happened is that with the rains, the crickets moved to the surface and it's the first time the crickets have actually been exposed to the insecticide. If the insecticide has sufficient residual activity it will then begin to control the crickets. One must remember, however, that the crickets are larger and it may take up to several weeks before the damage begins to subside and the mole crickets die.

Mole crickets have two other unique behavioral characteristics that affect our ability to control them in an effective manner. Studies conducted in collaboration with Dr. Mike Villani at Cornell University has helped us to better understand behavior in the soil.

The tawny mole cricket typically makes a "Y" shaped tunnel in the soil that may go as deep a 3 or 4 feet in the soil during cold weather (*Fig. 4*). This "Y" shaped tunnel structure is found in some other soil insects and is consistent with other species of mole crickets such as the African mole cricket which is found in heavy clay soils in South Africa.

It is obvious this "Y" shaped structure plays an important role in mole cricket biology. It appears the tawny mole crickets feeds extensively on the turfgrass root system between and near the branches of the "Y". The southern mole cricket tunnel structure has the appearance of more random movements, such as might be expected from an insect that is seeking prey. This different tunnel structure most likely affects the effectiveness of certain treatments against each species.

The other behavioral response of the mole crickets is that they appear to be able to detect and avoid conditions that are detrimental to the cricket. Our research indicates that mole crickets are able to detect and even avoid insecticides applied to soil (*Fig. 5*).

The mole cricket may go deeper in the soil and stay away from the treated area for a considerable time. The larger the mole cricket, the longer it can stay deeper in the soil and thus avoid contact with the insecticide. This is one more reason why treatments directed against smaller crickets are usually more effective.

In many cases our initial observations of mole cricket control may be simply a reflection of repellence, rather than actual control. We have even observed a similar avoidance response with biological control agents. Unfortunately our understanding of this behavior is still too limited to develop means to overcome it. However, we do know that the rate of application, as well, as environmental conditions can influence this avoidance behavior.

Hopefully this information will prove useful in your understanding of mole crickets and how to most effectively manage them. There is a lot we know about this pest that space doesn't permit us to discuss in this article, but the points highlighted here are of great importance.

At the same time there is still a lot of room to improve our knowledge of this pest and our program will continue to seek additional answers. I will keep you posted of new information as it is developed.

Should you have questions or feel I can be of assistance, please feel free to contact me. I also hope that in the future we'll have an opportunity to address some of these issues face to face in workshops or seminars.

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