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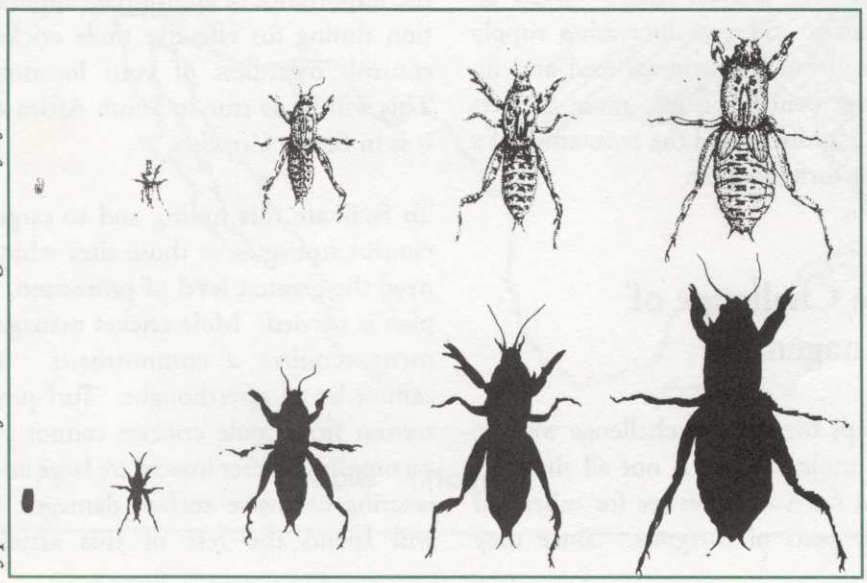
Managing Mole Crickets: Developing a Strategy for Success

by Rick Brandenburg
North Carolina State University

Mole Crickets: The Problem

Mole crickets have firmly established themselves as a major turfgrass pest, not only in the Southeastern United States, but throughout the world. Concerns over the potential damage from this pest range from Spain and Italy in Europe to South Africa and Southeast Asia. While different species are responsible for these infestations, they all-regardless of where they occur-are capable of causing severe damage and are difficult to control.

The consistent themes of serious damage and expensive control measures have moved this pest to the number one status for many turfgrass managers in affected areas. In the United States, the problem extends from eastern Texas across Louisiana, Mississippi, Alabama, Georgia, and Florida and north up the coast through South Carolina and North Carolina. Small pockets of infestation have been reported in other southern states further to the west.



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Phone: 202-483-TURF • Fax: 202-483-5797 • Internet: 76517.2451@CompuServe.com

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Maria L. Haber
Publisher
Dr. Richard J. Hull
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TurfGrass TRENDS
1775 T Street NW
Washington, DC 20009-7124
Phone: 202-483-TURF
Fax: 202-483-5797
76517.2451 @ CompuServe.com

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The predominant species throughout the southeastern United States have been the tawny mole cricket (*Scapteriscus vicinus*) and the southern mole cricket (*Scapteriscus borelli*). In addition, South Florida also has to deal with the short-winged mole cricket. Throughout the rest of the United States, turfgrass managers will on rare occasions have to battle the northern mole cricket (*Neocurtilla hexadactyla*).

The tawny mole cricket feeds primarily on turfgrass roots and is very destructive through its feeding and tunneling activities. Southern mole crickets are more a predator and most of their diet consists of other creatures in the soil. The southern mole cricket is still quite damaging due to its extensive tunneling for food just below the surface.

The fact that the northern mole cricket is native to the U.S. and rarely causes serious turf damage is important. The other mole cricket species are not native to the U.S. They were accidentally introduced approximately 95 years ago. Like other insects introduced to the United States from abroad, they have gained pest status because they had no natural enemies when they arrived here. Given an abundant and ever increasing supply of high quality turfgrass feed and no natural control agents, mole crickets have rapidly earned the reputation of a major turfgrass pest.

The Challenge of Management

Perhaps the greatest challenge we face with mole crickets is not all that different from what we see for other soil insect pests of turfgrass. Since they reside mostly in the soil, we do not know what they are doing, and it is more difficult to manage control of the pest. This major difference between insect pests that reside in the soil and those that spend much of their time on the foliage means a different approach must be taken for effective management. Since much of a soil insect's activity occurs out of sight, we need to have a solid working knowledge of its biology and ecology. This is true for mole crickets, but is an essential component for the effective management of any turfgrass soil insect pest. By knowing what the pest is doing in the soil, we can apply control strategies at the most susceptible stage of the insect life cycle and maximize our chance of success. This is, of course, what everyone desires. Given the difficulty in obtaining effective mole cricket control, it is essential that we have this understanding.

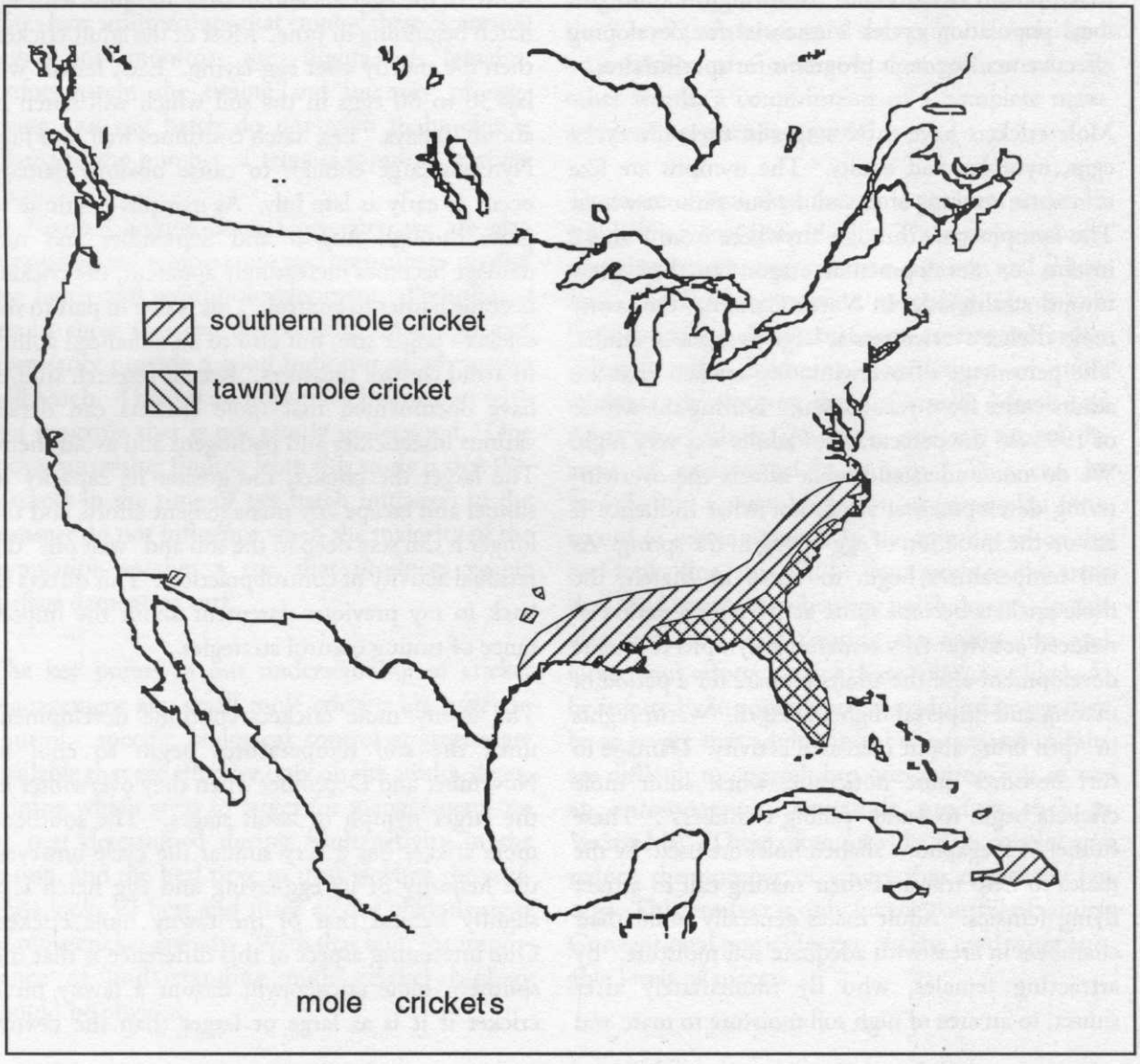
The three most important aspects of mole cricket management are: the timing of application, the timing of application, and the timing of application. While this may sound like a rather silly overstatement of common knowledge, I cannot overemphasize the importance of appropriate application timing for effective mole cricket control, regardless of your location. This will be as true in South Africa as it is in South Carolina.

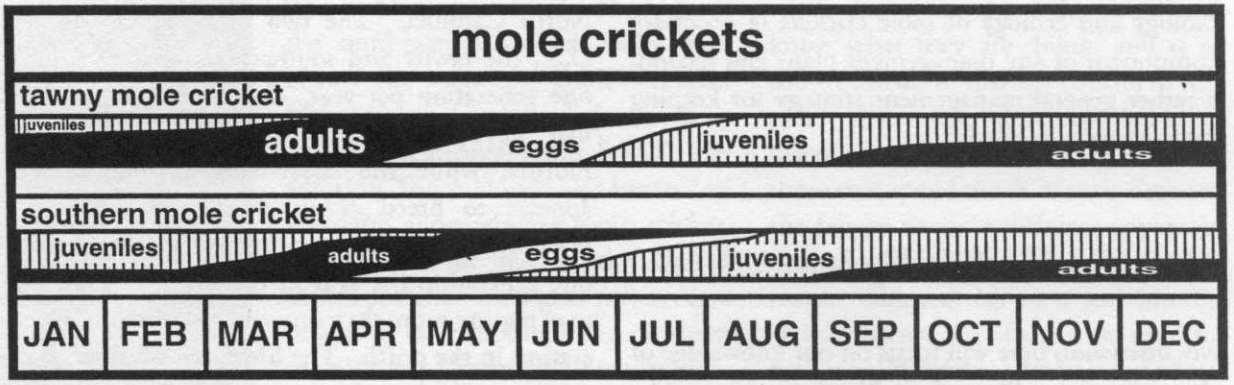
To facilitate this timing and to target control strategies to those sites which need the greatest level of protection, a plan is needed. Mole cricket management requires a commitment. It cannot be an afterthought. Turf protection from mole crickets cannot be accomplished after insects are large and creating extensive surface damage. I will spend the rest of this article

focusing on two areas: first, our knowledge of the biology and ecology of mole crickets (a necessary component of any management plan) and second, a rather general management strategy for keeping mole crickets in check.

Mole Cricket Life Cycle

My discussion here will focus on our knowledge of the mole cricket life cycle in North Carolina. The exact dates of specific stages will vary slightly throughout the southeastern U.S., but the basic life cycle is generally the same. For example, spring flights begin a month earlier in Florida than in North Carolina. The two major species in the U.S., the tawny and southern mole cricket, have one generation per year. Southern mole crickets may have two generations per year in South Florida, while the short-winged mole cricket appears to breed continuously with all stages present at all times. The northern mole cricket has one generation per year in the southern U.S. but may require more than one year to complete a generation in the north. The life cycles of other mole cricket species in various parts of the world are generally not as well understood, especially as relate to their presence in turfgrass and the use of this information to manage their control. However, this





does not mean that they cannot be managed effectively. A simple technique, that will be discussed shortly, allows an individual to monitor cricket development rather easily. Knowing the timing of local population cycles is essential for developing effective management programs for specific sites.

Mole crickets have three stages in their life cycle: eggs, nymphs, and adults. The nymphs are like miniature versions of the adults but without wings. The nymphs pass through anywhere from 7 to 12 instars, or developmental stages, as they grow toward adulthood. In North Carolina, the tawny mole cricket overwinters as large nymphs or adults. The percentage of overwintering crickets that are adults varies from year to year. During the winter of 1995-96 the percentage of adults was very high. We do not understand what affects the overwintering developmental stage, nor what influence it has on the initiation of egg-laying in the spring. As soil temperatures begin to warm in March, the mole crickets become quite active after a period of reduced activity. Any remaining nymphs complete development and the adults prepare for a period of mating and dispersal flights in April. Warm nights in April bring about increased activity. Damage to turf becomes quite noticeable when adult mole crickets begin to build "calling chambers". These funnel or megaphone shaped holes are used by the males to help transmit their mating call to attract flying females. Adult males generally build their chambers in areas with adequate soil moisture. By attracting females, who fly immediately after sunset, to an area of high soil moisture to mate and lay eggs, they probably ensure a better chance of egg and small nymph survival.

Most of the eggs are laid in May and June with egg hatch beginning in June. Most of the adult crickets then die shortly after egg-laying. Each female will lay 30 to 60 eggs in the soil which will hatch in about 20 days. Egg hatch continues well into July. Nymphs large enough to cause obvious damage occur as early as late July. As nymphs continue to grow through August and September and turf damage becomes increasingly apparent, the crickets become harder to control. This is due in part to the cricket's larger size, but also to an enhanced ability to avoid control measures. Recent research studies have documented that mole crickets can detect various insecticides and pathogens and avoid them. The larger the cricket, the greater its capacity to tunnel and escape any management efforts and the longer it can stay deep in the soil and "wait out" the residual activity of control practices. This directs us back to my previous statement about the importance of timing control strategies.

The tawny mole crickets continue development until the soil temperatures begin to cool in November and December when they overwinter in the larger nymph or adult stages. The southern mole cricket has a very similar life cycle-however, the majority of its egg-laying and egg hatch lags slightly behind that of the tawny mole cricket. One interesting aspect of this difference is that the southern mole cricket will devour a tawny mole cricket if it is as large or larger than the tawny.

Since the two species often coexist, this predation could have a significant effect on the abundance of the more damaging tawny mole cricket. However, since the tawny crickets appear to get a head start on their southern cousins, this probably minimizes the impact of such feeding. What it does create is a rather extended period of egg hatch for the combined species which will be considered in our management plan.

Many attempts have been made to forecast or predict the egg hatch and development of mole crickets. In the spring, adult males produce a buzzing mating call that attracts the females. This sound can be produced synthetically to attract females during their spring flight. Studies in several states have utilized traps that employ these electronic callers to monitor the flights of females. Unfortunately, the timing and intensity of egg-laying and egg hatch do not seem to be closely related to the number of females captured in these traps.

At North Carolina State University, we are also measuring soil temperature and moisture to predict egg hatch and nymph development. Preliminary results show that soil temperature alone does not necessarily provide a good indicator of when eggs will hatch. There is an important interaction with soil moisture that is not clearly understood. One rather surprising finding from this study is that differences in the time of egg hatch initiation in the summer do not influence when the majority of the population reaches a size that produces visible surface damage to turf.

The key points in our understanding of cricket management are: small mole crickets are easier to control, specific biological control strategies are available that are effective only on the adults, determining which areas to target for management can be best determined during adult activity in the spring, and the best time to treat is when the turfgrass looks its best and there are no obvious signs of mole cricket activity. With that said, the importance of understanding mole cricket biology should be obvious.

A Mole Cricket Management Plan

When we talk about a mole cricket management program, one should note that it is indeed a program. There are many facets to this program and it is not something you do one time per year. It is also important to realize that in most situations no single control strategy will produce acceptable results. In addition to the difficulty of controlling this pest, one must put the problem in the context of pest abundance. Soon after egg hatch, we have encountered populations as high as 25 mole cricket nymphs per square foot. Assuming a particular control strategy provides 90% control, that would still leave 18 mole crickets per square yard. That number far exceeds the 3 or 4 per square yard that might be tolerated on a fairway of a modest budget golf course. In other words, a commitment to a complete management program is essential.

There are several steps to such a program and each will be discussed individually. These steps include: mapping, monitoring selection, timing, and follow up. The first component, **mapping,** serves two basic functions. Many turf areas are not uniformly infested with damaging populations of mole crickets. By scouting the turf area in March and April when adults are active, one can record the areas of greatest adult activity. This can be recorded on a map, blueprint, or green plan for a record of insect activity. In the summer when the turf looks fine, this will be your guide to the areas that need treatment when egg hatch occurs. In this way, you can avoid treating the entire area and target your efforts toward those sites most likely to be infested. In some years, the adult damage may be so severe that adult control is necessary. Adults are difficult to control, but one approach is to use an entomogenous nematode product such as Vector MC. These often provide 50% control and reduce the number of adults that eventually lay eggs. This product is only for the control of adults. Conventional pesticides can also be used with variable levels of success.

In addition, mapping helps you to be efficient in your **monitoring** of egg hatch. Rather than sampling randomly, you can target those areas where eggs were most likely laid (areas of adult activity in early spring). This monitoring begins in late May in North Carolina. The tool used for monitoring is called the "soapy water flush." This consists of a sprinkling can filled with two gallons of water and two tablespoons of lemon-scented liquid dishwashing detergent. This mixture acts as an irritant to the newly-hatched nymphs and causes them to come to the soil surface where they can be readily observed. The soapy water should be sprinkled over a square yard area and then observed closely for the next several minutes. It is not advisable to leave and return to the site after a few minutes because the small crickets often do not move after emerging and are difficult to detect unless seen actually moving.

The monitoring technique should be used on at least a weekly basis in several locations that were previously mapped. Once small nymphs are observed you should begin preparations for implementing your control program. This means **selection** of the product you want to use. Make this selection based upon your own personal experiences, the experiences of people you trust, and recommendations from your state turf entomologist. A lot of options and products are available, so choose carefully and consider the individual characteristics of each product. Some may not be appropriate for your specific set of environmental concerns. Also, be aware that as soil types and the environment change so does the performance of many products. If you hear a success story about a product with which you are unfamiliar, you may want to proceed with caution and treat only a small area until you become more confident of its performance.

As previously mentioned, **timing** is the critical component in mole cricket management. The most common mistake is to let the mole crickets get ahead of you and then finding yourself in a position of trying to control large crickets while they are causing serious damage. On the other hand, treating too early can result in the residual activity of the insecticide diminishing before all eggs have hatched. In situations where both the tawny and southern mole crickets exist together, this period of egg hatch is even longer. In North Carolina, our general rule-of-thumb is to wait about three weeks from the time the first mole crickets are found using the soapy water flush to initiate control strategies. This avoids the problem of putting out treatments too early, yet still targets the treatments to begin control before any crickets get too large or visual turf damage occurs. It is important to note that insecticides having short residual activity are not the best choice for this initial application. Soil moisture is important for obtaining good mole cricket control. Do not treat if the soil is extremely dry. Preirrigating the areas to be treated the previous evening often proves useful for enhancing insecticide performance.

We have worked extensively with subsurface application equipment for mole cricket control. This equipment is designed by placing the insecticide (either liquid or granular formulations) just below the soil surface. Our trials have shown a general trend for improved mole cricket control, but it is not always significant. You should carefully consider your specific site needs and investigate all the options available before investing in this technology.

Finally, we come to the **follow up** phase of the mole cricket management program. Within two weeks of the initial application, return to the treated areas and determine the level of control by using the soapy water flush technique. If areas of high mole cricket populations are observed, note this on your map. If desired control in these areas is not obtained within three or four weeks, re-treatment should be considered. The presence of crickets in treated areas may not indicate a pesticide failure, but rather as previously mentioned, simply may be a reflection of a very high initial cricket population. The more time you spend identifying those areas that require a follow up treatment, the better you will be able to target and treat only those areas still supporting potentially damaging cricket populations. Total eradication is not a practical goal, but any area that still contains more than 5 or 6 crickets per square yard emerging

from a soapy water flush will probably suffer damage if not re-treated.

In the months of August and September, surface damage becomes quite obvious. Examine the turf frequently during these months. Note areas of damage and spot-treat as soon as possible. There is no sense in letting the cricket do more damage and grow larger, only to become more difficult to control. Once we enter October and November, mole cricket control is not quite impossible, but it is getting very close. The bottom line is that a good turfgrass manager who maintains a complete mole cricket management program should never be in the position of having serious mole cricket problems late in the season.

Mole cricket control is difficult. These pests can be effectively managed, but only if one commits to a program similar to the one outlined. Mole crickets in other parts of the world-where a one year life cycle is common-will best be managed by a similar approach. If one can determine when adult activity-mating and flying-is occurring, she can begin with soap flushes a short time later to determine egg hatch. Some refinements may be necessary for local conditions.

The name of the game for mole cricket control is commitment. Develop a game plan and stick with it. Commitment to a plan can help ensure that turfgrass managers everywhere can win the mole cricket battle.

Dr. Rick L. Brandenburg is a Professor of Entomology and Extension Entomologist at North Carolina State University. He has degrees in entomology from Purdue University and North Carolina State University. His research and extension interests include the use of biological control techniques, innovative insecticide application technology, pest forecasting, and public education on pesticides and the environment.

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Five Steps to Effective Mole Cricket Management

1. Mapping: Determine where the adult mole crickets are in the spring. This provides insight into the preferred sites for egg laying and helps you focus your egg hatch monitoring program.

2. Monitoring: This effort requires the use of the soapy water flush technique to obtain information on egg hatch and nymph development during the summer. Such information is critical to time effectively the application of mole cricket control measures.

3. Selection: Pick the appropriate materials for your specific site. Take into account local environmental concerns. Also, consider the products of choice, their particular qualities, (i.e. persistence in the soil) and the timing of use (i.e. Orthene works best when applied in the evening).

4. Timing: Based upon observations from the soapy water flush techniques, time most treatments for application about three weeks after the first major hatch occurs. This ensures that most of the eggs have hatched, yet will prevent the earliest hatching crickets from causing serious damage.

5. Follow up: If mole cricket infestations are severe, few if any products will provide the desired level of control with a single application. About a month after treatment, begin examining the turf for signs of tunneling. Use the soapy flush technique on these areas to confirm the presence of life crickets. Map those areas requiring retreatment (usually the whole area will not need to be retreated, but rather small areas of high density should be targeted). Do not wait to treat if damage is visible and live crickets are present, because crickets become more difficult to control as they grow.

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Call Up 'Mcricket' for Answers

How can you tell the 10 species of mole crickets in the United States apart?

It's much easier to identify the adults than the young (nymphs)to the species level. One way to identify them is to use a computerized knowledge base called Mcricket. This knowledge base not only has graphics that let you identify the mole crickets, but it also has information about their life cycles and behavior. It also has information about control methods, including tutorials. Mcricket was developed by University of Florida entomologists Tom Fasulo, Howard Frank and Don Short with extension agents Harold Jones and LaRue Robinson.

Mcricket: Alternative Methods of Mole Cricket Control including the software (three diskettes, Program 089) and manual (Circular SW-089) can be purchased as a package from: University of Florida, IFAS Software Support, P.O. Box 110340, Gainesville, FL 32611-0340. Phone: (352) 392-7853. Mcricket costs $30 for Florida residents (add sales tax) and educational institutions, $40 for all others. Prepayment by check or Visa/MasterCard is required. Checks should be made out to the University of Florida.

However, if you know how to surf the World Wide Web from your computer, you can access Mcricket free at:

http://gnv.ifas.ufl.edu/~ent1/mcricket/index.html

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