Demystifying the infamous MOLE

Recreational turf, parks, and cemeteries across the country suffer mole damage each year. Reliable estimates also find 50 million single-family homes in the US and Canada are located in mole prone areas, as well as 5 million businesses in these same regions that maintain lawns on their property. If the total economic toll from moles could be calculated, it would probably be in the millions of dollars. Moles common to North America are what mammologists call "fossorial" animals. "Fossorial" means, "Equipped with limbs and feet adapted for digging," a feature of moles that makes them specialists in living underground as creatures that tunnel through the earth in search of food. Although few people have actually seen a mole, living or dead, they are relatively common pests in North America.

Mystery moles

Moles are equipped with powerful forelimbs that enable them to move 32 times their body weight and move through soil at incredible speeds. Mole species native to North America are carnivorous predators, killing and eating other animals, insects and their larvae and, most importantly, earthworms. They do not eat roots, tubers or bulbs; vegetation in any form is not considered food by a mole. Moles must forage for food and eat almost constantly to meet their needs for a high-protein diet that, incidentally, must also contain ample water. Coupled with a very high metabolic rate, moles must consume the equivalent to their body weight daily to survive.

No food meets a mole's unique dietary requirements better than earthworms, which supply a high-protein, high-energy diet and abundant water simultaneously.

Moles possess a poorly developed sense of sight. As a result, they depend on their other highly developed senses to find prey. Moles have the ability to detect even the slight seismic vibrations that earthworms and excavating insects make, and can hone in on these signals over considerable distances. This remarkable ability to use vibrations to locate food is due to specialized vibrissae on the snout, forepaws and tail, as well as stiff sensory hairs on the head that help orient them toward vibration stimuli. Specialized sensors, called "Eimer's organs," located in the nostrils, allow moles to use touch to identify and differentiate between minute surface details of objects. Add an acute sense of smell and moles possess a powerful set of navigation tools that make them efficient hunters in an underground world.

Control measures that existed before the advent of Bell's new mole bait, TALPIRID, have been relatively ineffective. Trapping has been the method of choice until now. Professional mole trappers and ambitious do-it-yourselfers testify that trapping is labor-intensive. There are a number of grain-based pelleted baits on the market. Moles do not take pelleted grain baits because grains are not part of a mole's natural diet. Consequently these products confer no genuine control. Mole experts believe most non-trapping methods to control moles that seemed to have an early, modest measure of success did so merely because the mole's routine was temporarily interrupted. Testimonials to the efficacy of grain-based baits, sonic chasers and mole repellents are merely anecdotal and not backed by solid science.

Bell Labs' biologists began to do research on moles, their behavior, biology, ecology, and physiology about six years ago. Bell's aim was to learn the mole's strengths and weaknesses and to exploit that knowledge to develop an effective control technology that could be commercialized.

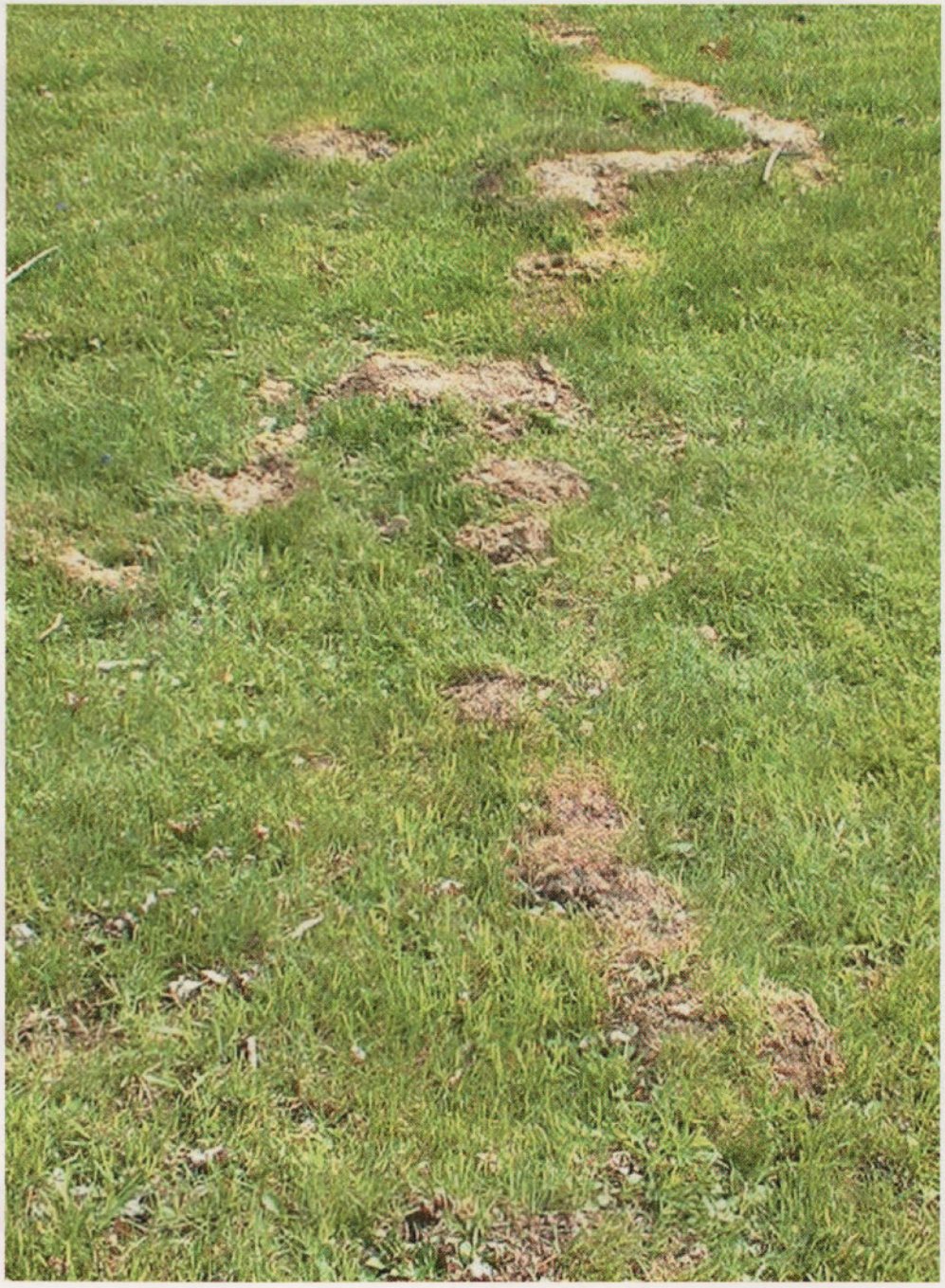
These scientists discovered how to locate active moles and then how to consistently capture moles without injury so they could be held in captivity. Bell's mole research team also tested many alternative dietary regimens and found one that maintains moles in captivity in good health.

With captive animals, the biologists began to run definitive trials on most commercially available products. They first wanted to determine whether anything already on the market had significant mole killing efficacy. A series of standard "no choice" product acceptance tests were run using pelleted grain baits already labeled for mole control. A "no choice" test means the moles were offered a diet consisting entirely of test material. The pelleted grain baits received zero percent acceptance and the

Opposite page: Mole eating TALPIRID.

test was concluded after it was clear that moles would not consume the test material. These results are not surprising, given what was learned previously about mole biology. Moles require high protein foods and are not capable of digesting grains. Gel baits were then subjected to the same "no choice" test and were likewise not identified as food by the moles.

The next step was to screen active ingredients by gavage administration (force-feeding). The purpose was to find an active that could be lethal to moles from consuming the amount of pesticide in one piece of bait. The results revealed an unexpectedly high level of resistance to the actives used in traditional rodenticides.



Turf damage from moles.

Bell concluded that bromethalin was the best selection for the active ingredient in the bait. As an energy metabolism antagonist, bromethalin provides an effective counter to the high-energy demands of the mole's active lifestyle. Consequently, TALPIRID is effective in as little as 24 to 48 hours, greatly minimizing further damage by the mole.

The challenge remained to create bait with mole-attractive features making it as readily acceptable to moles as their natural food. Many formulants, flavorants, shapes and sizes were tested over the ensuing months until the Bell Technical Department settled on a configuration that looked, felt and handled like a nightcrawler, the moles' favorite food. Moles were shown to readily accept TALPIRID even when offered natural food, i.e., they would actually consume TALPIRID even when provided earthworms.

The end result of all the hard work was the development of a new mole bait product that actually kills moles that consume a single piece of bait. This feature was confirmed under strict laboratory conditions, where TALPIRID produced 80% mortality under choice conditions against live earthworms. Field testing confirmed that TALPIRID applied in a single application at a rate of 1.41 kg /ha (1.24 lb/a) resulted in 100% reduction in the Total Assessment Ratio within three test days post baiting. This reduction was maintained throughout the entire seven-day follow up period.

Bell Labs is pleased to have taken some of the mystery out of mole control through good science. Mole damage sufferers will be glad that someone finally took advantage of modern technology to find a cure for this mysterious plague.

Bell Laboratories sponsored this article.

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