Mole Cricket Sensory Perception of Insecticides

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Objectives:

1. Determine the type, location, and abundance of different sensilla on the antennae and mouthparts of *S. vicinus* and *S. borellii.*
2. Demonstrate the physiological effect of insecticides on the mole cricket nervous system and/or ability of mole crickets to detect chemical stimuli.
3. Demonstrate the behavioral response of mole crickets to sub-lethal insecticide doses.

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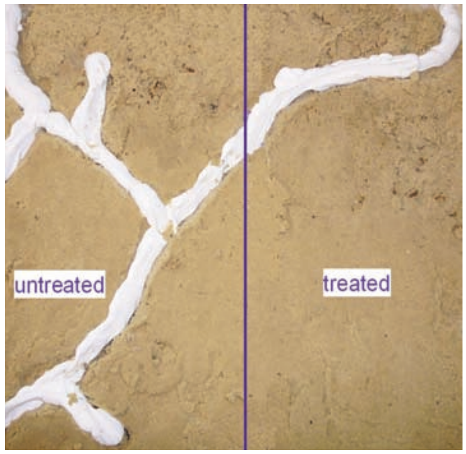
Mole crickets (*Scapteriscus spp.*) are mobile subterranean insects that damage grass by their subsurface tunneling and root feeding. Mole crickets avoid areas treated with insect pathogens, but their response to insecticide-treated soil is poorly understood.

The sensitivity of insects to chemical stimuli is affected by the presence and abundance of chemosensory structures (sensilla) on their bodies. We collected 10 adult males and females each of tawny and southern mole crickets from sound and linear pitfall traps in spring 2007, examined their antennae and mouthparts with a scanning electron microscope (SEM), and identified and counted the sensilla present. Southern mole cricket adults had ~80 flagellomeres (antennal segments), and tawny mole crickets had ~70. Females had more flagellomeres than males for both species.

Two-dimensional laboratory assays were conducted to demonstrate if tawny and southern adult mole crickets could detect acephate, bifenthrin, fipronil, and indoxacarb. Behavioral observations occurred for the first 90 minutes in the dark under red light, and the amount and length of tunneling within 24, 48, and 72 hours were recorded.

Tunneling initiation points were chosen randomly by either mole cricket species in the acephate experiment. The amount of tunneling in the acephate treated arenas did not significantly differ from the control for tawny mole crickets. However, southern mole cricket tunneling after 72 hours was significantly reduced by the high rate of acephate. At the lowest rates, southern mole crickets tunneled less in the treated areas.



Tawny mole cricket nymphs tunneled less in areas treated with bifenthrin and fipronil (¼ of labeled rate), than in untreated sand.

Tunneling initiation was random in arenas with all rates of bifenthrin and the control. During the first 90 minutes, mole crickets in bifenthrin-treated sand made more tunnel branches, closed more tunnels, and had rapid, erratic movements compared to the controls. However, by 72 hours, tunneling activity was greater in untreated compared to treated sand. Avoidance of treated areas was not observed, and the overall length of tunneling in treated areas did not differ from the length of tunnels in untreated areas.

In arenas with the full rate of fipronil, 80% of mole crickets started tunneling into the untreated area, which indicated a potential repellent effect. Tunneling initiation was random at the two lower rates. The total amount of tunneling by 72 hours in the control was greater than in arenas treated with any of the three rates of fipronil. Most mole crickets (about 70%) that tunneled through fipronil-treated sand and then entered untreated sand did not return to the treated sand. After exposure to the full fipronil rate, adults made tunneling leg movements, but remained in one place, making existing tunnels wider. Exposure to fipronil did not result in increased tunneling.

Responses of tawny and southern mole crickets to indoxacarb were similar. Tawny and southern mole crickets closed ~30% and ~40% of their tunnels during the first 90 minutes, respectively. After 90 minutes of exposure, mole crickets tremored and had erratic leg and wing movements. After ~48 hrs of exposure, mole crickets were motionless, but responded with kicks and tremors if disturbed. Total amount of tunneling by 72 hours was significantly reduced in arenas with the highest rate of indoxacarb for both species. Mole crickets started tunneling predominantly in the untreated area and most (~90%) egg laying occurred in untreated sand. However, mole crickets tunneled equally on both treated and untreated halves of the arenas.

All mole crickets survived in control arenas. Mortality was 90% after 48 hours for the full rates of acephate, bifenthrin, and fipronil. Mortality of both species was 60% in the arenas treated with the highest rate of indoxacarb. In general, southern mole crickets tend to move faster in tunnels than tawny mole crickets and make more tunnels during the first hour of a test.

Summary Points

- Southern and tawny mole cricket antennae and palps have similar numbers and types of sensilla, but southern mole crickets have more flagellomeres, and thus may be more sensitive to chemical stimuli.
- Females of both species have more flagellomeres than males, possibly because males are more aggressive and clip off antennae.
- All of the insecticides tested reduced overall tunneling activity if evaluated after 3 days. However, females preferred to lay eggs on untreated areas within arenas, not in treated sand.
- Tawny mole cricket nymphs tunneled less in areas treated with bifenthrin and fipronil (¼ of labeled rate), than in untreated sand. Avoidance to other insecticides was not observed.