Other Behavior, Damage, And Sampling (W. G. Hudson)

Feeding

For years it was assumed that all pest mole crickets were herbivorous, but recent studies have shown this to be untrue. Examination of gut contents indicates that diet of tawny and short-winged mole crickets is mostly vegetarian. On the other hand, southern mole crickets feed mostly on animal material (Fig. 14). Little is known about the kinds of prey taken by southern mole crickets, but presumably it includes a variety of soil inhabiting insects and other small animals. Southern mole crickets eat some plant material, perhaps when animal material is in short supply.

Mole crickets feed on a wide variety of plants and have caused extensive damage to seedlings of tobacco, ornamentals, tomatoes and other vegetables, and to sugarcane. The most serious damage in recent years has been to pasture and turfgrass throughout the state. All parts of the plant are eaten. At night, crickets often leave their burrows to feed on above-ground parts, biting off stems and leaves, which are dragged into the burrows to be eaten. Roots may be eaten at any time.

Mole crickets have also been reported to feed on the underground tubers of potato, carrot, and sweet potato, and on developing peanuts.

Burrowing

There is little quantitative information on burrowing activity of mole crickets, although some general conclusions about their sub-

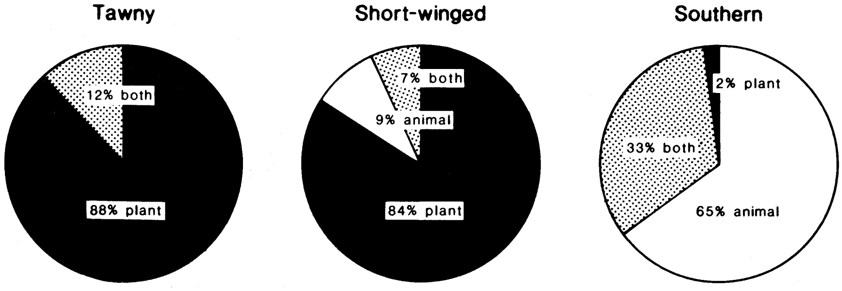

Fig. 14. Feeding habits of pest mole crickets, indicated by examination of gut contents. Note that tawny and short-winged mole crickets are mainly herbivorous, whereas southern mole crickets are mainly carnivorous.

terranean behavior can be drawn. Under most conditions mole crickets are found primarily in the top 20 to 25 cm (8 to 10 in.) of soil. This is especially true of juveniles. In areas of high population density this layer of soil is literally honeycombed with tunnels, through which the mole crickets move forward and backward with equal agility. Tunnels as deep as 75 cm (30 in.) have been recorded, but these are probably constructed only in times of extreme moisture or temperature stress. Surface burrows are usually the first indication of mole cricket activity. These burrows look much like a miniature version of the burrow of the common mole. Within turf or pasture, tawny mole crickets tend to burrow in grassy areas, while southern mole crickets prefer the bare, sandy areas. Burrowing may be so extensive that the ground feels spongy to the step.

Although there may be movement at any time during the day or night, the most active period is from late afternoon until near midnight. Mole crickets are least active during the middle of the morning.

Damage

Mole crickets damage plants by feeding on them and by tunneling. Feeding damage affects both underground and above-ground parts of the plant. Heavily damaged turf or pasture grass has virtually no root system and is easily pulled from the soil by grazing cattle or foot traffic. The green shoots are also consumed, and even the tough, fibrous stems are eaten in extreme cases. Damage to vegetable seedlings is often cutworm-like, although plants are generally severed at or beneath rather than above the soil surface. Severed seedlings are often pulled into tunnels where the foilage or entire plant may be consumed. Damage is usually most severe in seedbeds or newly transplanted fields.

Mechanical damage to plants is caused by the tunneling activity of mole crickets and may be the principal detrimental effect of southern mole crickets on grasses. There is evidence that all three mole crickets cause damage to seedlings, probably because they damage the developing root systems of the young plants by either feeding or tunneling. *Rhizoctonia* root rot also increases in seedbeds infested with mole crickets.

In most of Florida, damage to pasture and turfgrass is principally due to feeding by tawny mole crickets. Southern mole crickets may cause mechanical damage, especially in newly planted stands, but it is doubtful that they cause significant damage to established stands. The following evidence from several sources supports this conclusion.

1) Controlled experiments using known (and very high) densities of mole crickets have repeatedly shown that southern mole crickets have little effect on forage production. In no case have southern mole crickets approached the destruction caused by tawny mole crickets in the same experiments.

2) In field samples of pastures and turfgrass damaged by mole crickets, southern mole crickets are either absent or greatly outnumbered by tawny mole crickets.

3) In areas of north Florida and south Alabama where southern mole crickets have been present for years, mole crickets were not considered pests until the tawny mole cricket extended its range into those areas. Collection of mole crickets from damaged turf in Alabama have included both species, but examinations of gut contents have shown that southern mole crickets found in these incriminating circumstances are still mostly carnivorous (two-thirds contain *only* animal material) while tawny mole crickets are full of plant material.

In areas where short-winged mole crickets occur (Fig. 8), they contend with tawny mole crickets as the principal pest of grasses, and they seem to be the only species attacking St. Augustinegrass.

Damage thresholds for mole crickets in turf and pastures have been difficult to determine because of problems with sampling techniques. Sampling in damaged and undamaged pastures using soil flushing techniques (see below) has provided some idea of the population density that can damage pasture grass. Severely damaged areas of a pasture had an average sample density of 27 tawny mole crickets per m^2 ($1\ m^2 = 11$ sq.ft.). Undamaged areas of the same pasture had an average of 12 tawnies per m^2. Another bahiagrass pasture showed some damage with a density of 9 tawnies per m^2; the previous year this pasture had 33 tawnies per m^2 and had been severely damaged. A nearby bermudagrass pasture that was beginning to suffer some loss of stand had an average of 11 tawny mole crickets per m^2. Thresholds in turfgrass may be higher. Sampling with a tree spade revealed 22 to 80 mole crickets per m^2 in a heavily damaged golf course.

Population estimation

The sketchy nature of our understanding of mole cricket ecology is largely a result of problems encountered in sampling the insects in the field. The following techniques have been (and continue to be) employed, but none has yet overcome the main obstacle—how to correlate sample numbers with true population density.

Sound traps These traps attract adults to the highly amplified synthetic or recorded call of male mole crickets. A trap consists of a caller situated over a collecting device that catches the crickets as they land. The collecting device may be as simple as a child's wading pool filled with water. The record catch for a "standard" sound trap used by University of Florida researchers (with a 1.5 m diameter wading pool as a collector) is 9000 mole crickets in one night. Sound traps are effective only during the flight seasons in spring and fall (Fig. 11), and only adults are taken. The numbers captured vary widely from year to year (Table 1). Because so little is known about how often, how far, and under what circumstances mole crickets fly, it is difficult to interpret these variations. However, any lasting, drastic reduction in mole cricket populations—such as hoped for through the introduction of natural enemies (p. 23)—should be revealed in a corresponding lasting, drastic reduction in trapping-station catches.

Soil flushing The easiest and most economical method of field sampling for mole crickets is flushing the soil with an aqueous solution of dishwashing liquid or insecticide. The two produce nearly

Table 1. Long-term variations in numbers of mole crickets captured at standard sound-trapping stations at four sites.

Species and Generation[a]	Gainesville–A	Gainesville–C	Bradenton	Ft. Lauderdale
Southern mole cricket				
1978–79	2968	—	—	—
1979–80	5521	(26467)[b]	—	—
1980–81	2292	8347	1376	479
1981–82	2043	5816	528	1065
1982–83	1783	12385	223	173
1983–84	4303	17358	2449	262
Tawny mole cricket				
1978–79	651	—	—	—
1979–80	1916	(1664)[b]	—	—
1980–81	1898	1923	2313	265
1981–82	740	1037	3488	704
1982–83	2724	1800	4815	108
1983–84	10214	10265	1413	174

[a] August of the first year through July of the second. Except for southern mole crickets in south Florida, this period includes a single generation (Fig. 22).
[b] Partial count, because station was not established until 1 Jan 1980.

identical results, making dishwashing liquid the better choice because it is cheaper and more readily available. The usual procedure is to mix 15 mL of flushing agent with 4 liters of water, pour the solution on the ground, and count the crickets as they surface. Four liters of solution will cover an area about 0.5 m × 0.5 m, depending on soil moisture, soil type, and ground cover. The sample density thus obtained cannot at this point be called an estimate of true population density (the relationship between sample numbers and true density is unknown), but it is the best method available for comparing mole cricket populations between locations or over time.

Pitfall traps Linear pitfall traps have shown promise in monitoring local population levels and represent one of the few sources of live juvenile mole crickets for research use. Such traps are constructed by cutting a slot approximately 1 inch (2.5 cm) wide lengthwise in a section of 3-inch diameter PVC pipe. This pipe is then buried in the ground so the slot is at or slightly below the soil surface, with one end feeding into a 5-gallon bucket and the other end capped (Fig. 15). As with other sampling techniques, the relationship between number taken and true mole cricket density is at present unknown.

Other Tawny and southern mole crickets can be captured at light traps, sometimes in great numbers. However, lights do not attract as many crickets as sound traps, and are also restricted to the flight season. Digging after mole crickets, using tools ranging from shovels to tree spades to specially constructed soil corers, has also been used as a sampling technique but has not proved very effective. Shovels

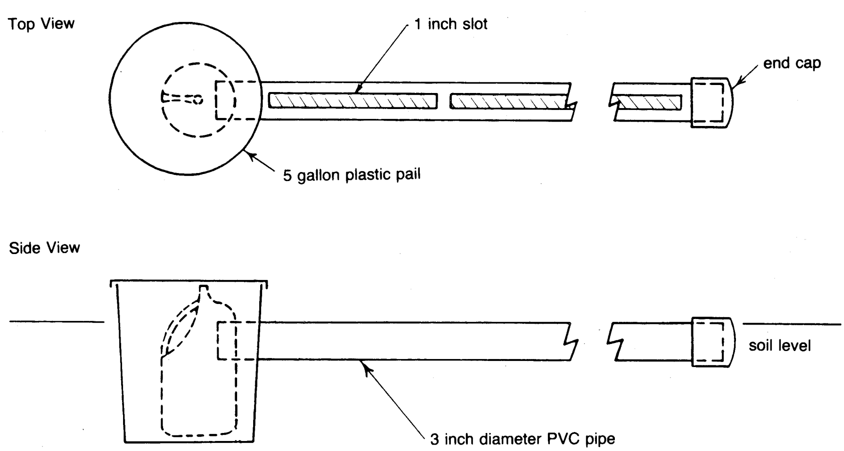

Fig. 15. Linear pitfall trap developed by K. O. Lawrence. Plastic jug (dotted) can be placed in pail to facilitate removing the crickets (and other animals).

are too slow to catch most of the mole crickets in an area, the tree spade samples are of a volume that is difficult to work with, and the core sampler provides results which are identical to soil flushing. All are expensive in terms of time, manpower, and equipment and are destructive to the pasture or turf being sampled. Estimates of tunneling activity have been used as population indicators, but so many factors affect this activity (such as species of cricket, sex, size, soil moisture, and temperature) that these estimates are of limited value.

Development of an effective sampling technique (or determining the relationship between numbers sampled with existing techniques and true density in a given area) remains a priority goal of mole cricket research. Without such a technique, study of mole cricket population ecology and scientific evaluation of potential control methods is difficult.