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MOLES

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Fig. 1. Eastern mole, *Scalopus aquaticus*

Damage Prevention and Control Methods

Exclusion

Generally not practical, except in very small, high-value areas where an aboveground and underground barrier (sheet metal, brick, wood) might restrict moles.

Cultural Methods

Packing the soil destroys burrows, and sometimes moles if done in early morning or late evening.

Reduction in soil moisture and food source removal by the use of insecticides discourages moles and generally results in lower populations.

Frightening

Ineffective.

Repellents

None are registered.

Toxicants

Strychnine alkaloid.

Chlorophacinone is registered in some states.

Fumigants

Aluminum phosphide.

Gas cartridges.

Trapping (most effective control method)

Out O' Sight® Trap.

Bayonet trap or harpoon trap (Victor® Mole Trap).

Nash® (choker-type) mole trap.

Easy-set mole eliminator.

Cinch mole trap.

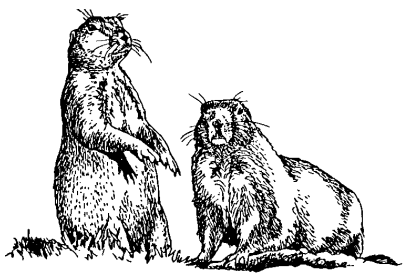
Death-Klutch gopher trap.

Shooting

Not practical.

Other Methods

None tested have proven effective.



PREVENTION AND CONTROL OF WILDLIFE DAMAGE — 1994

Cooperative Extension Division
Institute of Agriculture and Natural Resources
University of Nebraska - Lincoln

United States Department of Agriculture
Animal and Plant Health Inspection Service
Animal Damage Control

Great Plains Agricultural Council
Wildlife Committee

Identification

Yates and Pedersen (1982) list seven North American species of moles. They are the eastern mole (*Scalopus aquaticus*), hairy-tailed mole (*Parascalops breweri*), star-nosed mole (*Condylura cristata*), broad-footed mole (*Scapanus latimanus*), Townsend's mole (*Scapanus townsendii*), coast mole (*Scapanus orarius*), and shrew mole (*Neurotrichus gibbsii*).

The mole discussed here is usually referred to as the eastern mole (*Scalopus aquaticus*). It is an insectivore, not a rodent, and is related to shrews and bats.

True moles may be distinguished from meadow mice (voles), shrews, or pocket gophers—with which they are often confused—by noting certain characteristics. They have a hairless, pointed snout extending nearly 1/2 inch (1.3 cm) in front of the mouth opening. The small eyes and the opening of the ear canal are concealed in the fur; there are no external ears. The forefeet are very large and broad, with palms wider than they are long. The toes are webbed to the base of the claws, which are broad and depressed. The hind feet are small and narrow, with slender, sharp claws.

Average Dimensions and Weight

Males :

Average total length, 7 inches (17.6 cm)
Average length of tail, 1 1/4 inches (3.3 cm)
Average weight, 4 ounces (115 g)

Females:

Average total length, 6 5/8 inches (16.8 cm)
Average length of tail, 1 1/4 inches (3.3 cm)
Average weight, 3 ounces (85 g)

Range

Out of the seven species that occur in North America, three inhabit lands east of the Rocky Mountains (Yates and Pedersen 1982). The eastern mole

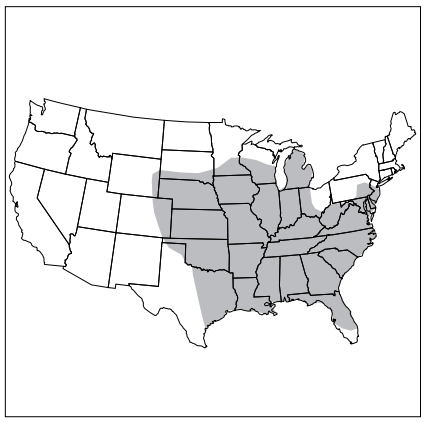


Fig. 2. Range of the eastern mole in North America.

is the most common and its range is shown in figure 2. The star-nosed mole is most common in northeastern United States and southeastern Canada, sharing much of the same range as the hairy-tailed mole. The remaining four species are found west of the Rocky Mountains. The Townsend mole and the coast mole are distributed in the extreme northwest corner of the United States and southwest Canada. The broad-footed mole is found in southern Oregon and throughout the coastal region of California excluding the Baja peninsula. Finally, the shrew mole is also found along the West Coast from Santa Cruz County, California, to southern British Columbia (Yates and Pedersen 1982).

Habitat

The mole lives in the seclusion of underground burrows, coming to the surface only rarely, and then often by accident. Researchers believe that the mole is a loner. On several occasions two or even three moles have been trapped at the same spot, but that does not necessarily mean they had been living together in a particular burrow. Networks of runways made independently occasionally join otherwise separate burrows.

Because of their food requirements, moles must cover a larger amount of area than do most animals that live underground. The home range of a male mole is thought to be almost 20 times that of a male plains pocket gopher. Three to five moles per acre (7 to 12 per ha) is considered a high population for most areas in the Great Plains.

Deep runways lead from the mole's den to its hunting grounds. The denning area proper consists of irregular chambers here and there connected with the deep runways. The runways follow a course from 5 to 8 inches (12.7 to 20.3 cm) beneath the surface of the ground. The chambers from which these runs radiate are about the size of a quart jar.

Most of a mole's runway system is made up of shallow tunnels ranging over its hunting ground. These tunnels may not be used again or they may be re-traversed at irregular intervals. Eventually, they become filled by the settling soil, especially after heavy showers. In some cases, moles push soil they have excavated from their deep runways into the shallow tunnels. These subterranean hunting paths are about 1 1/4 to 1 1/2 inches (3.2 to 3.8 cm) in diameter. Moles usually ridge up the surface of the soil, so their tunnels can be readily followed. In wet weather, runways are very shallow; during a dry period they range somewhat deeper, following the course of earthworms.

Moles make their home burrows in high, dry spots, but they prefer to hunt in soil that is shaded, cool, moist, and populated by worms and grubs. This preference accounts for the mole's attraction to lawns and parks. In neglected orchards and natural woodlands, moles work undisturbed. The ground can be infiltrated with runways. Moles commonly make their denning areas under portions of large trees, buildings, or sidewalks.

The maze of passages that thread the soil provides protective cover and traffic for several species of small mammals. Voles (meadow mice), white-footed mice, and house mice live in and move through mole runways, helping themselves to grains, seeds, and tubers. The mole, however, often gets blamed for damaging these plants. Moles "swim" through soil, often near the ground surface, in their

search for worms, insects, and other foods. In doing so, they may damage plants by disrupting their roots (Fig. 3).

Food Habits

The teeth of a mole (see Fig. 1) indicate the characteristics of its food and general behavior. In several respects moles are much more closely related to carnivorous or flesh-eating mammals than to rodents. The mole's diet consists mainly of the insects, grubs, and worms it finds in the soil (Table 1). Moles are thought to damage roots and tubers by feeding on them, but rodents usually are to blame.

Moles eat from 70% to 100% of their weight each day. A mole's appetite seems to be insatiable. Experiments with captive moles show that they will usually eat voraciously as long as they are supplied with food to their liking. The tremendous amount of energy expended in plowing through soil requires a correspondingly large amount of food to supply that energy. Moles must have this food at frequent intervals.

Table 1. Stomach contents of 100 eastern moles:

Food item	Number of stomachs
White grubs	64
Earthworms	49
Beetles	67
Beetle larvae	44
Other larvae	25
Centipedes	25
Ants	19
Wasps	7
Flies	2
Plant fibers and rootlets	2
Seed pods or husks	43
Crickets	10
Insect fragments	31
Puparia	21
Cocoons	10
Spiders	23
Grasshoppers	2
Bugs	3
Skin of grain or roots	3
Hairworm	1

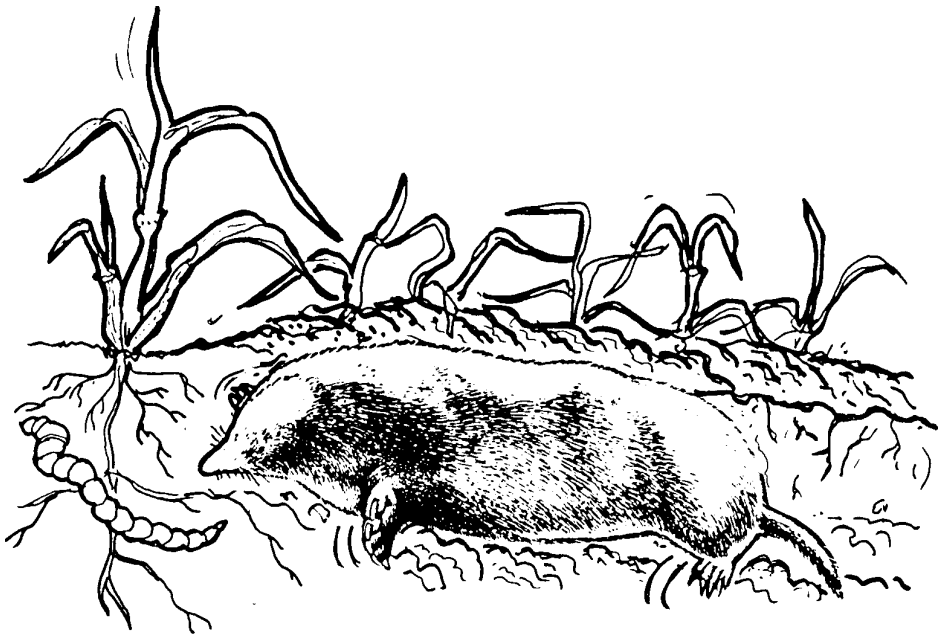


Fig. 3. Moles "swim" through soil, often near the ground surface, in their search for worms, insects, and other foods. In doing so, they may damage plants by disrupting their roots.

General Biology, Reproduction, and Behavior

Moles prefer loose, moist soil abounding in grubs and earthworms. They are most commonly found in fields and woods shaded by vegetation, and are not able to maintain existence in hard, compact, semiarid soil.

The mole is not a social animal. Moles do not hibernate but are more or less active at all seasons of the year. They are busiest finding and storing foods during rainy periods in summer.

The gestation period of moles is approximately 42 days. Three to five young are born, mainly in March and early April.

The moles have only a few natural enemies because of their secluded life underground. Coyotes, dogs, badgers, and skunks dig out a few of them, and occasionally a cat, hawk, or owl surprises one above ground. Spring floods are probably the greatest danger facing adult moles and their young.

Damage and Damage Identification

Moles remove many damaging insects and grubs from lawns and gardens. However, their burrowing habits disfigure lawns and parks, destroy flower beds, tear up the roots of grasses, and create havoc in small garden plots.

It is important to properly identify the kind of animal causing damage before setting out to control the damage. Moles and pocket gophers are often found in the same location and their damage is often confused. Control methods differ for the two species.

Moles leave volcano-shaped hills (Fig. 4a) that are often made up of clods of soil. The mole hills are pushed up from the deep tunnels and may be 2 to 24 inches (5 to 60 cm) tall. The number of mole hills is not a measure of the number of moles in a given area. Surface tunnels (Fig. 4b) or ridges are indicative of mole activity.

Pocket gopher mounds are generally kidney-shaped and made of finely sifted and cloddy soil (Fig. 4c). Generally, gophers leave larger mounds than moles do. Gopher mounds are often built in a line, indicative of a deeper tunnel system.

Legal Status

Moles are unprotected in most states. See state and local laws for types of traps, toxicants, and other methods of damage control that can be used.

Damage Prevention and Control Methods

Exclusion

For small areas, such as seed beds, install a 24-inch (61-cm) roll sheet metal or hardware cloth fence. Place the fence at the ground surface and bury it to a depth of at least 12 inches (30 cm), bent out at a 90° angle (Fig. 5).

Cultural Methods

In practice, packing the soil with a roller or reducing soil moisture may reduce a habitat's attractiveness to moles. Packing may even kill moles if done in the early morning or late evening.

Milky-spore disease is a satisfactory natural control for certain white grubs, one of the mole's major food sources. It may take several years, however, for the milky-spore disease to become established. Treatments are most effective when they are made on a community-wide basis. The spore dust can be applied at a rate of 2 pounds per acre (2.3 kg/ha) and in spots 5 to 10 feet (1.5 to 3m) apart (1 level teaspoon [4 g] per spot). If you wish to try discouraging moles by beginning a control program for white grubs, contact your local extension agent for recommended procedures.

Because moles feed largely on insects and worms, the use of certain insecticides may reduce their food supply, causing them to leave the area. However, before doing so, they may

Fig. 4. Mole sign

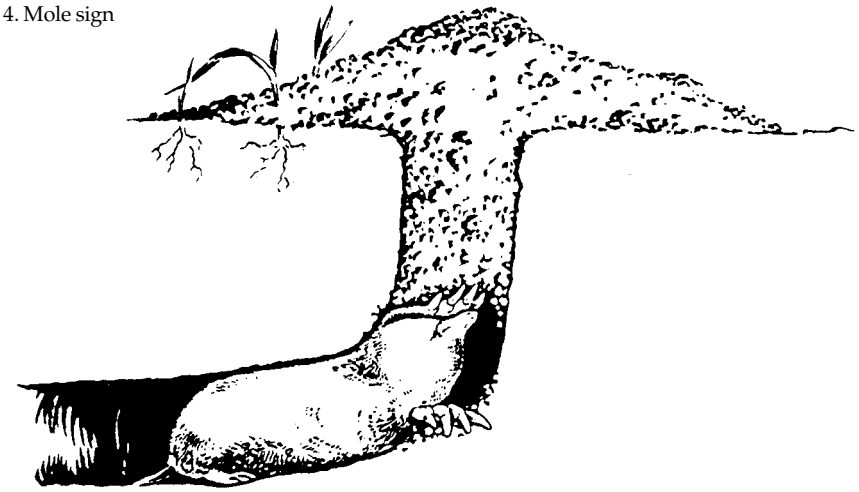


Fig. 4a. Moles push dirt through vertical tunnels onto surface of ground.

Fig. 4b. Ridge caused by tunneling of mole under sod.

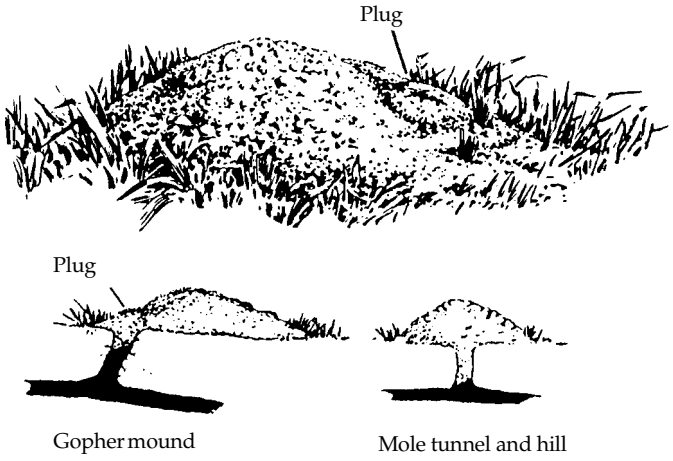


Fig. 4c. Comparison of gopher mound and mole hill.

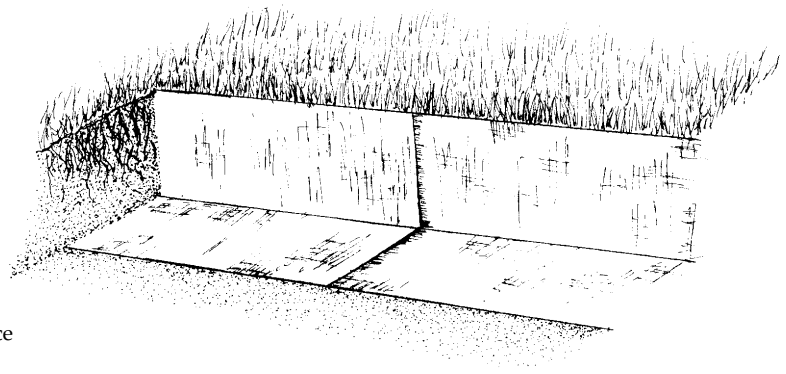


Fig. 5. Mole fence

increase their digging in search of food, possibly increasing damage to turf or garden areas. Check local sources of insecticides for controlling grubs. Follow the label instructions for use.

Frightening

Some electronic, magnetic, and vibrational devices have been promoted as being effective in frightening or repelling moles. None, however, have been proven effective.

Repellents

No chemical products are registered or effective for repelling moles. Borders of marigolds may repel moles from gardens, although this method has not been scientifically tested.

Toxicants

Since moles normally do not consume grain, toxic grain baits are seldom effective. Two poisons are federally registered for use against moles. Ready-to-use grain baits containing strychnine are sold at nurseries or garden supply stores.

Recent work by Elshoff and Dudderar at Michigan State University reported on the use of Orco Mole Bait, a chlorophacinone pellet which is used in Washington and some other states under 24(c) permits for mole damage control. Even though the researchers stated the use of this toxicant is a highly effective and easily applied mole control technique, there are disadvantages. Two or more successive treatments are often required. An average of 21 1/2 days was required to achieve zero damage on treated dry soil and 39 days on treated irrigated soils.

Fumigants

Two fumigants, aluminum phosphide and gas cartridges, are federally registered for use against moles (see **Supplies and Materials**). Aluminum phosphide is a Restricted Use Pesticide. These fumigants have the greatest effectiveness when the materials are placed in the mole's deep burrows, not in the surface runways. Golf course owners, however, report that moles can be repelled from surface tunnels by placing aluminum phosphide pellets in them. Since state pesticide registrations vary, check with your local extension or USDA-APHIS-ADC office for information on toxicants and repellents that are legal in your area. Care should be taken when using chemicals. Read and follow label instructions when using toxicants and fumigants.

Trapping

Trapping is the most successful and practical method of getting rid of moles. There are several mole traps on the market. Each, if properly handled, will give good results. The traps are set over a depressed portion of the surface tunnel. As a mole moves through the tunnel, it pushes upward on the depressed tunnel roof and trips the broad trigger pan of the trap. The brand names of the more common traps are: Victor® mole trap, Out O' Sight®, and Nash® (choker loop) mole trap (Fig. 6). The Victor® trap has sharp spikes that impale the mole when the spikes are driven into the ground by the spring. The Out O' Sight® trap has scissorlike jaws that close firmly across the runway, one pair on either side of the trigger pan. The Nash® trap has a choker loop that tightens around the mole's body. Others include the Easy-Set mole eliminator, Cinch mole trap, and the Death-Klutch gopher trap.

These traps are well suited to moles because the mole springs them when following its natural instinct to reopen obstructed passageways.

Success or failure in the use of these devices depends largely on the operator's knowledge of the mole's habits and of the trap mechanism.

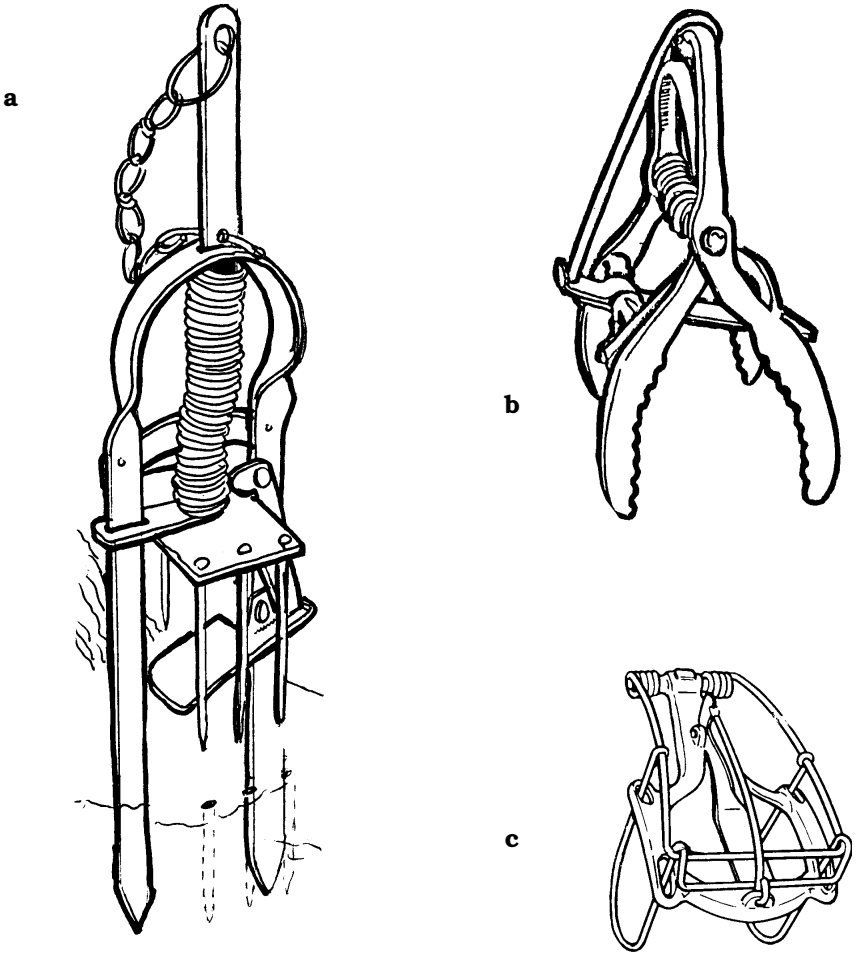


Fig. 6. Mole traps: (a) Out O' Sight® (scissor-jawed), (b) Victor® (harpoon), and (c) Nash® (choker loop).

To set a trap properly, select a place in the surface runway where there is evidence of fresh mole activity and where the burrow runs in a straight line (Fig. 7). Dig out a portion of the burrow, locate the tunnel, and replace the soil, packing it firmly where the trigger pan will rest (Fig. 8).

To set the harpoon or impaling-type trap, raise the spring, set the safety catch, and push the supporting spikes into the ground, one on either side of the runway (Fig. 9). The trigger pan should just touch the earth where the soil is packed down. Release the safety catch and allow the impaling spike to be forced down into the ground by the spring. This will allow the spike to penetrate the burrow when the trap is sprung later. Set the trap and leave it. Do not tread on or disturb any other portion of the mole's runway.

To set a scissor-jawed trap, dig out a portion of a straight surface runway, and repack it with fine soil. Set the trap and secure it by a safety hook with its jaws forced into the ground. It should straddle the runway (Fig. 10a) until the trigger pan touches the packed soil between the jaws. The points of the jaws are set about 1 inch (2.5 cm) below the mole's runway and the trigger pan should rest on the portion as previously described. Care should be taken to see that the trap is in line with the runway so the mole will have to pass directly between the jaws. In heavy clay soils be sure to cut a path for the jaws (Fig. 10b) so they can close quickly. The jaws of this trap are rather short, so be sure the soil on the top of the mole run is low enough to bring the trap down nearer to the actual burrow. Set the triggers on both traps so that they will spring easily (Fig. 11). Remember to release the safety hook before releasing the trap. Be careful when handling these traps.

To set a choker trap, use a garden trowel to make an excavation across the tunnel. Make it a little deeper than the tunnel and just the width of the trap. Note the exact direction of the tunnel from the open ends, and place the set trap so that its loop encircles this course (Fig. 12). Block the

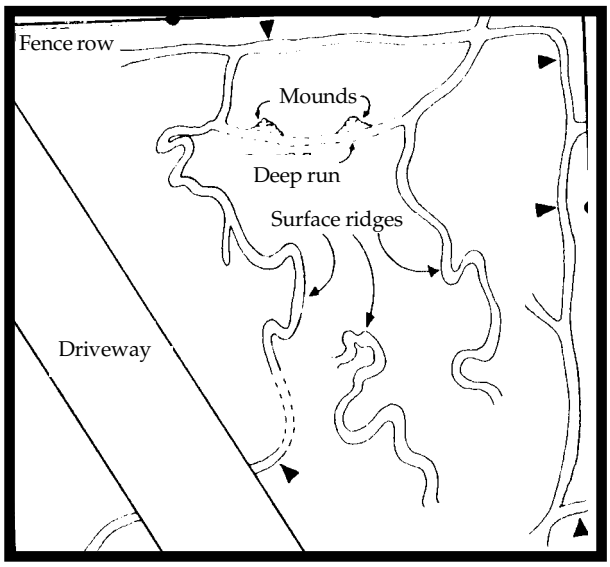


Fig. 7. A network of mole runways in a yard. The arrowheads (▲) indicate good locations to set traps. Avoid the twisting surface ridges and do not place traps on top of mounds.

Fig. 8a. Excavation of a mole tunnel is the first step in setting a mole trap.

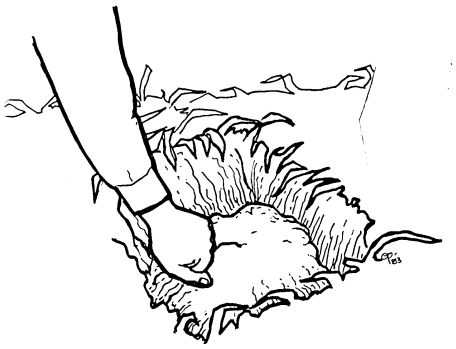


Fig. 8b. Replace the soil loosely in the excavation.

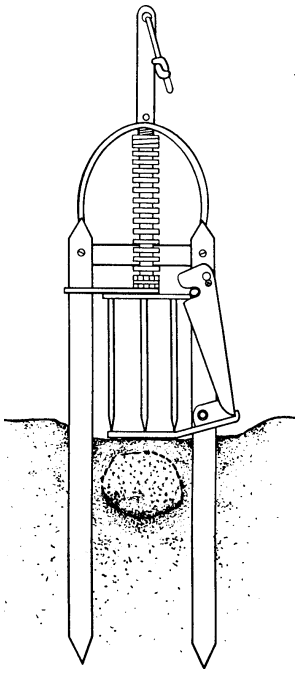


Fig. 9. Set the harpoon-type trap directly over the runway so that its supporting stakes straddle the runway and its spikes go into the runway.

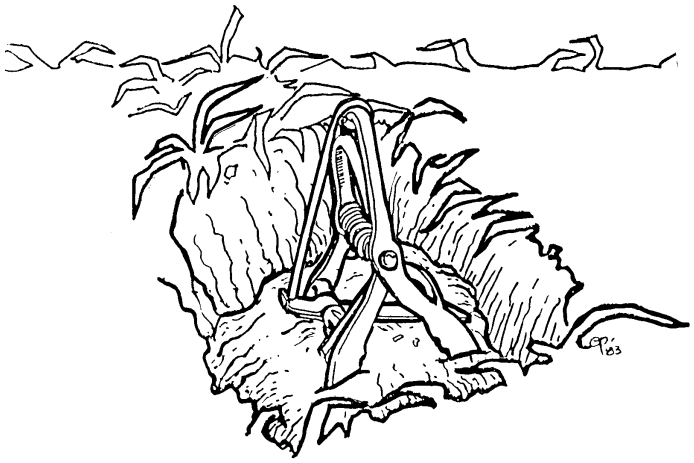


Fig. 10a. Set the scissor-jawed trap so that the jaws straddle the runway.

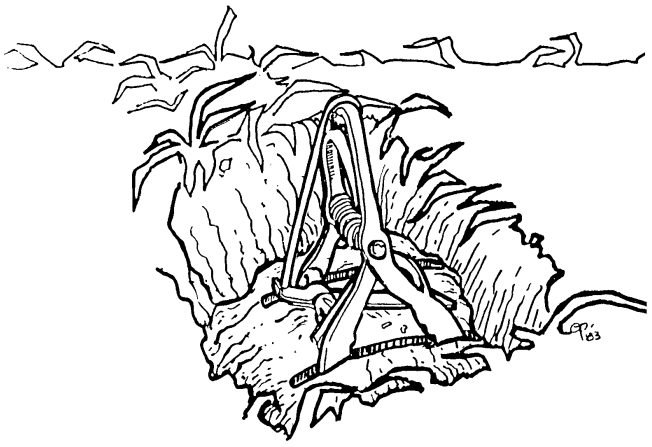


Fig. 10b. In heavy soils, make a path for the jaws to travel so they can close quickly.

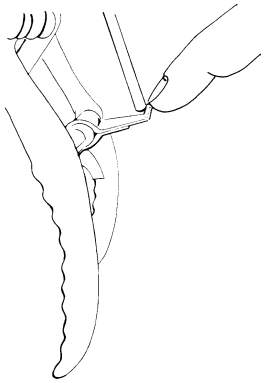


Fig. 11. Set mole trap triggers so they will spring easily. A hair-trigger setting on the scissor-jawed trap is shown here.

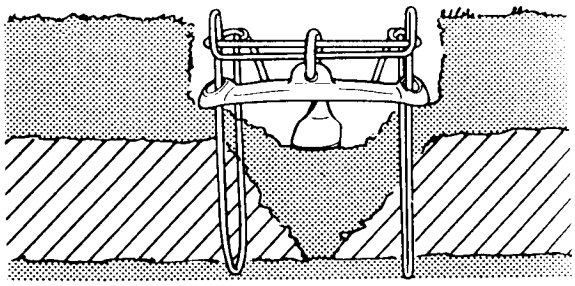


Fig. 12. The choker loop trap is set so that the loop encircles the mole's runway.

excavated section with loose, damp soil from which all gravel and debris have been removed. Pack the soil firmly underneath the trigger pan with your fingers and settle the trap so that the trigger rests snugly on the built-up soil. Finally, fill the trap hole with enough loose soil to cover the trap level with the trigger pan and to exclude all light from the mole burrow.

If a trap fails to catch a mole after 2 days, it can mean the mole has changed its habits, the runway was disturbed too much, the trap was improperly set, or the trap was detected by the mole. In any event, move the trap to a new location.

If one cares to take the time, moles can be caught alive. Examine tunnels early in the morning or evening where fresh burrowing operations have been noted. Quietly approach the area where the earth is being heaved up. Quickly strike a spade into the ridge behind the mole and throw the animal out onto the surface. A mole occasionally can be driven to the surface by flooding a runway system with water from a hose or ditch. Another method is to bury a 3-pound (1.4-kg) coffee can or a wide-mouth quart (0.95 l) glass jar in the path of the mole and cover the top of the burrow with a board (Fig. 13).

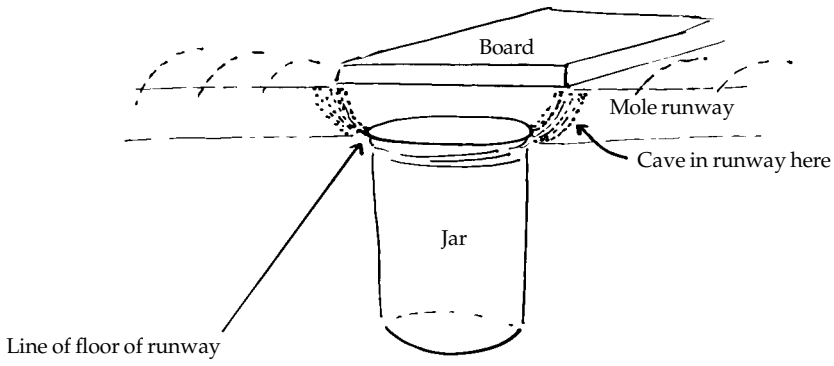


Fig. 13. A mole can be live-captured in a pit trap. Be sure to use a board or other object to shut out all light. Cave in the runway just in front of the jar on both sides.

Other Methods

Nearly everyone has heard of a sure-fire home remedy for controlling moles. In theory, various materials placed in mole tunnels cause moles to die or at least leave the area. Such cures suggest placing broken bottles, ground glass, razor blades, thorny rose branches, bleaches, various petroleum products, sheep dip, household lye, chewing gum, and even human hair in the tunnel. Other remedies include mole wheels, pop bottles, windmills, bleach bottles with wind vents placed on sticks, and similar gadgets. Though colorful and sometimes decorative, these gadgets add nothing to our arsenal of effective mole control methods.

Another cure-all is the so-called mole plant or caper spurge (*Euphorbia latharis*). Advertisers claim that when planted frequently throughout the lawn and flower beds, such plants supposedly act as living mole repellents. No known research supports this claim. Castor beans are also supposed to repel moles. Caution must be used, however, since castor beans are poisonous to humans. Several electromagnetic devices or "repellers" have been marketed for the control of rats, mice, gophers, moles, ants, termites, and various other pests. Laboratory tests have not proven these devices to be effective. Unfortunately, there are no short cuts or magic wands when controlling moles.

Economics of Damage and Control

Perhaps more problems are encountered with moles than with any other single kind of wild animal. Unfortunately, people lack an appreciation of the importance of moles and the difficulty of gaining complete control where habitats are attractive to moles.

Before initiating a control program for moles, be sure that they are truly out of place. Moles play an important role in the management of soil and of grubs that destroy lawns. Moles work over the soil and subsoil. Only a part of this work is visible at the surface. Tunneling through soil and shifting of soil particles permits better aeration of the soil and subsoil, carrying humus farther down and bringing the subsoil nearer the surface where the elements of plant food may be made available.

Moles eat harmful lawn pests such as white grubs. They also eat beneficial earthworms. Stomach analyses show that nearly two-thirds of the moles studied had eaten white grubs.

If the individual mole is not out of place, consider it an asset. If a particular mole or moles are where you do not want them, remove the moles. If excellent habitat is present and nearby mole populations are high, control will be difficult. Often other moles will move into recently vacated areas.

Acknowledgments

Figures 1 and 4 from Schwartz and Schwartz (1981).

Figures 6, 8, 9, 10, 11, 12 and 13 adapted from various sources by Jill Sack Johnson.

For Additional Information

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