MOLE AND WOODRAT CONTROL

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MOLES

In regions where moles thrive, lawns in golf courses, parks, cemeteries and home yards are often made unsightly by dirt mounds and ridges pushed up by the active little animals. In cultivated land, moles may cause considerable economic loss through their burrowings.

Mole control can be divided into six basic categories: exclusion, repellents, gases, toxic baits, reduction of food supply, and trapping. Unchanged over the years, trapping is still considered the most reliable of all methods of control, however, under certain conditions or situations, the other methods of control may be extremely useful.

EXCLUSION

Where practicable, exclusion will provide the most lasting control. It can be used most effectively to protect small areas.

Seed beds and small garden plots can be protected from moles by burying a fence of galvanized hardware cloth of ½ inch or smaller mesh. Hardware cloth, 36 inches wide, can be bent out four inches at the bottom to discourage the mole from digging under. The fence should be burried so as to leave about 3 inches exposed above the surface of the soil. More permanent barriers made of concrete have also been used instead of wire mesh fences.

Foresighted gardeners will sometimes construct wire mesh baskets to insert into the soil in which they plant bulbs or other ornamentals to prevent disturbance or damage from moles as well as gophers.

Some temporary field protection from moles can be had by making a ditch or trench 12 to 18 inches deep around an entire field. While this is not a lasting barrier to burrowing animals, it checks them to some degree and makes it possible to detect more readily the entrance of moles. These intruders should then be immediately trapped.

REPELLENTS

Placing various materials or substances into the moles runway to repel them from an area is of doubtful value, however, it is occasionally used by some gardeners.

Frequently, lye, paradichlorobenzene "PDB", or napthalene are mentioned in mole control literature as repelling substances. Almost any noxious material; whether it be lye, ashes, broken glass, or tacks, when placed in the runways, will repel the mole to the degree of causing them to reconstruct their runway a short distance away or to bury the foreign matter in repairing the existing runways. Putting offensive materials into the burrows in no way assures the gardener that he will be free of the pest.

No scientific evidence exists to substanciate the theory that so-called "mole plants" such as castor bean, milkweed and others have any significant effect in ridding a garden of moles.

GASES

A number of gas producing bombs are on the market and are sold for the control of moles as well as other burrowing animals. Various degrees of control have been reported with their use. A number of gases have been explored through the years for mole control.

Chlorpicrin has been sold for mole control. With the use of a probe or pointed stick, the runway is located and 4 to 6 cc. of chlorpicrin is poured

into the burrow every 10 to 15 feet, and the probe hole is plugged with earth. Chlorpicrin is toxic to plants and endangers plants with roots in close proximity to treated burrows.

Calcium cyanide, when pumped in powdered form into the damp burrows, produces hydrocyanic acid gas which gives some degree of mole control.

Two ounces of carbon bisulfide injected, with a demon rodent gun, at several locations in a moles main runways will sometimes give satisfactory kills.

Carbon monoxide piped from an exhaust into a mole burrow system has, on occasion, achieved desirable results.

Methyl bromide gas, released into the burrow system at approximately every 10 to 15 feet, will give a fair degree of control. One pound cans, equiped with a relatively inexpensive dispenser, are easily handled in the field. Presently, in California, methyl bromide is used quite frequently, on a limited scale, for mole control in such places as golf courses, parks and cemeteries. Methyl bromide, as is chlorpicrin and carbon bisulfide, is toxic to plants in concentrations and will kill plants with roots close to runways or points of injection.

The gases mentioned, and others, have been given considerable attention over the years. Experiments, including field trials, have indicated that general control with the use of gases is not dependable; and, with few exceptions, the cost is greater than the results normally justify. When gases are employed, manufacturer's directions and precautions should be followed.

TOXIC BAITS

Poisoning is rather difficult because the principal diet of moles consists of live earthworms, insects and their larvae with only a small portion of their diet consisting of vegetable matter.

A number of prepared toxic baits are commercially available for controlling moles or for the dual purpose of controlling moles and gophers. These preparations are often purchased by the home gardeners to rid their garden of one or two individual moles. Gardeners have varying opinions as to the effectiveness of the baits.

Peas, peanuts, various cereals, fresh ground meat, earthworms, raisins and other dried fruits comprise a partial list of the baits used for moles. Baits containing lethal dosages of strychnine, arsenic, red squill, thallium sulfate, or sodium fluoroacetate (1080) have been used. Commercial mole baits sold in California are generally strychnine treated and non perishable.

"Ground meat or earthworms dusted with strychnine and placed in the runways have been tried for control of moles in England with some success." (Storer, 1958) Red squill, when used in a similar fashion, has been reported to give satisfactory results.

Peanuts, treated with 1% thallium sulfate, are commercially available in some states for mole control and have received favorable comments. Literature on the subject indicates that in the East thallium peanuts are most successful after the spring or fall rains when mole runways are most evident and can be easily located (fig. 1) with a probe. About 3 treated peanuts should be placed in the runways (fig. 2) at four or five foot intervals, closing the opening with sod after each bait placement. Thallium treated peanuts have been tried to a limited extent in California. Senior Inspector Donald Shaw, of the Santa Cruz County Department of Agriculture, reported some encouraging results with their use, however, more extensive trials need to be conducted before any general conclusion can be drawn as to their effectiveness on the mole species of California. Thallium treated peanuts are extremely appealing to children and should be stored out of their reach.

Earthworms treated with sodium fluoroacetate (1080) have been used by the County Departments of Agriculture in both Del Norte and Humboldt Counties with good results. Several species of earthworms may be used but they should weigh about 1 gram each. The ideal length would be about 3 inches. The worms should be washed thoroughly in cold water to remove all foreign material and drained of excess water. Two to three hundred worms can be treated by soaking 1 or 2 hours in a toxic solution comprised of 10 grams of sodium fluoroacetate in 400 cc. of cold water. Best results are obtained when toxic worms are used immediately after treatment. Mole runways should be located with a probe and 2 to 3 earthworms dropped into the runways at intervals of about ten feet. Press the earth gently over the probe hole to close the opening and avoid covering the bait with loose soil. Baited fields should be checked after 1 or 2 days and any remaining active systems should be retreated. Richard Dana of the California Department of Agriculture was responsible for many of the early trials in California with this type of bait.

Both thallium sulfate and sodium fluoroacetate (1080) are highly toxic materials, therefore, their characteristics should be fully understood by those who employ them in control work. In California, the use of thallium sulfate and sodium fluoroacetate is restricted for field pest control to governmental officers or employees in their official capacities. (California Agriculture Code, sections 1080.5 and 1080.6)

Pea seed or raisins soaked over night, or longer, in a solution of strychnine sulfate (1/8 ounce of strychnine to one quart of hot water) and used for mole control have been claimed by some California gardeners to give satisfactory kills.

A number of mole species range throughout parts of the country; many vary to some extent in food preferences. This species difference is the main bases

for a specific toxic bait to be effective in one locality or region but not in another. Many authorities in the field of vertebrate pest control agree that generally moles are more difficult to control with toxic baits than are gophers.

INDIRECT CONTROL

If moles are deprived of their food supply, they will be forced to seek another area. Several insecticides are capable of reducing the population of earthworms and soil insects to a point where the soil no longer provides sufficient food to fulfill the mole's daily requirements. The effect on the moles cannot be expected for several weeks following treatment. This method of control is most suitable for turf areas and will often serve a two-fold purpose by also ridding the lawn of harmful insects or larvae which may destroy the grass or by controlling nuisance insects which are found in lawns. Chlorinated hydrocarbons such as aldrin, dieldrin, chlordane, and DDT have been recommended for the control of earthworms and soil insects. In addition to these, lead arsenate is occasionally suggested for use.

Indirect mole control, through the reduction of food supply, is a comparatively expensive measure; but it is useful on turfs where moles are a constant threat.

TRAPPING

Trapping is the most universally applicable and dependable method of mole control. Time, patience and a knowledge of the moles habits and the capabilities of the trap are prerequisites for successful trapping.

A number of different mole traps are available at hardware stores, nurseries, or direct from the factory. Most mole traps are designed utilizing the theory that a mole will push his way into a soil block in its tunnel. For this reason, set traps generally straddle the runway (fig. 3), encircle it or are

suspended above it and are usually sprung by the pressure of the moles body or the movement of soil against a triggering plate.

Before setting any traps, it is necessary to determine which runways are in current use. To determine activity, stamp down short sections of runways and mole hills and observe daily; restamp any raised sections or mounds. Moles dig a system of deep tunnels as well as a network of surface runs. Some of the surface tunnels are only temporary runs dug in search of food and may not be reused, while the deep runways are more or less in permanent usage. The deeper runways may be located by probing downward with a pointed stick, slender metal rod or a standard gopher probe; between, or next to, a fresh mole hill. Success in locating the deeper runs is determined when a sudden give is felt as the probe breaks into the burrow. The selection of a main, or frequently used, runway in which to set a trap is of prime importance in obtaining results.

In California, the Out-o'-Sight and the Reddick are the two traps most often seen in use (fig. 4), however, other kinds and types of mole traps are employed. If properly set in runways, many moles have been caught with Macabee gopher traps. Trap manufacturers often provide detailed instructions for the use of their particular mole trap. For best results, these directions should be followed explicitly. As moles are active throughout the year, they may be trapped at any time, however, the opportune time is when fresh signs of mole activity are evident. Trapping is the most reliable method of mole control; and in California it is probably used more than any other single method of control. With some experience, a trapper can become extremely proficient.

Fig. 1. Locating mole runway with steel probe.

Fig. 2. Placing thallium sulphate treated peanuts through probe hole into mole runway.

Fig. 3. Jaw type mole trap set in excavated hole to straddle mole run.

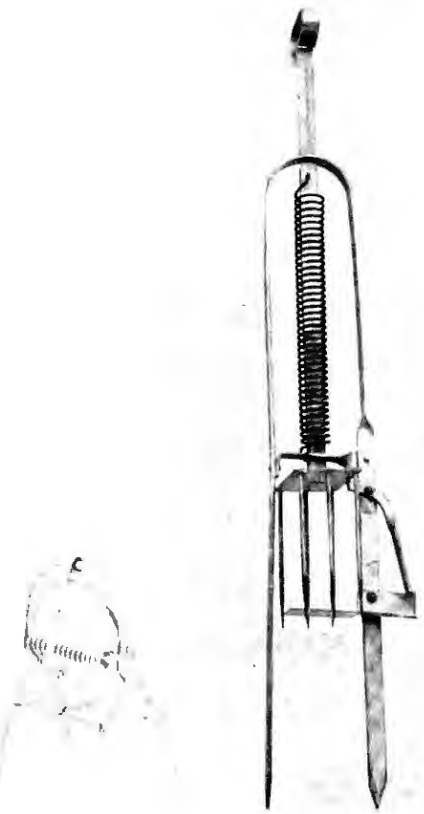

Fig. 4. Mole traps as set for use. Left, lateral-jawed (Out-o"-Sight); right, Spear type (Reddick).

Photos by author.

LITERATURE CITED

Anon. 1960. Moles and Their Control. U. S. Dept. Interior Wildlife Leaflet 421 : 1-4.

Dixon, J. 1929. Control of Pocket Gophers and Moles in California. Calif. Agri. Extension Service Cir. 29 : 15.

Eadie, W. R. 1954. Animal Control in Field, Farm, and Forest. The Macmillan Company, New York. 8-11.

Eadie, W. R., and W. J. Hamilton, Jr. 1959. Control of Small Animals in Homes and Gardens. New York State College of Agri. Bull. 729 : 11-13.

Gunderson, H., and E. S. Raun. 1955. Control of Lawn Pests. Iowa State College Agri. Extension Service IC-341 : 1-2.

Halazon, G., and E. H. Herrick. 1956. Controlling Damage Caused by Animals. Kansas State College Exp. Sta. Cir. 328 : 13-14.

Henderson, F., and E. L. Craig. 1932. Economic Mammalogy. Charles C. Thomas, Springfield. 190-193.

Scheffer, T. H. 1910. The Common Mole. Kansas State College Exp. Sta. Bull. 168 : 1-36.

Scheffer, T. H. 1922. American Moles as Agricultural Pests and As Fur Producers. U. S. Dept. Agri. Farmer's Bull. 1247 : 1-20 (Revised).

Scheffer, T. H. 1936. Rodents And Moles As Pests In Bulb Plantings. U. S. Dept. Agri. Cir. 381 : 4-12.

Silver, J., and A. W. Moore. 1941. Mole Control. U. S. Dept. Agri. Conservation Bull. 16 : 1-17.

Storer, T. I. 1933. Control of Injurious Rodents in California. Calif. Agri. Extension Service Cir. 79 : 32-34.

Storer, T. I. 1958. Controlling Field Rodents in California. Calif. Agri. Extension Service Cir. 434 : 35-36. (Revised).

Treece, R. E., and E. M. Mills. 1957. Mole Control. Rutgers College of Agri. Extension Service Leaflet 214 : 1-3.

WOOD RATS

The native wood rat (genus Neotoma), also locally named pack rat, trade rat, mountain rat, brush rat and cave rat, is the typical rat in most respects resembling, superficially, the common house rat.

The habits of all species of wood rats are in general very similar, differing in details according to regions and local environments. Wood rats do not frequent towns or cities as do their cousins the Norway rat, but often live in the vicinity of farmhouses, mountain cabins or summer homes and occasionally become a nuisance by invading dwellings and other buildings to construct nests or search for food. The animals are also known to carry plague and are suspected of carrying other diseases of public health significance.

Though not often injurious to crops and agricultural enterprises, occasionally they become numerous enough to do limited damage to crops in fields and gardens. In some regions they have been known to inflict injury to orchard trees. Valuable nut crops are sometimes carried off by the rodents. In the northwest portion of California some damage has been attributed to wood rats in young timber plantings.

Compared to other devastating rodents of California, the wood rat ranks as a pest of minor importance. Troublesome wood rats may be out witted or discouraged through exclusion, destruction of dens, or the use of repellents. Population reduction, when necessary, is most often accomplished by trapping or by using toxic baits.

EXCLUSION

The exclusion of the native rat involves, primarily, the proper construction and maintainance of buildings to prohibit their entrance. Pack rats may be permanently excluded from buildings and stored food by the same methods directed towards the common Norway rat.

REPELLENTS

Some of the available commercial repellents used against rabbits and other animals may, in some situations, prove effective in reducing wood rat damage to young trees.

Endrin treated seed, used in direct seeding reforestation programs, has apparently been partially effective in reducing losses attributed to wood rats as well as other rodents.

TRAPPING

Pack rats that frequent or live in buildings can be taken through the use of ordinary wooden snap type rat traps. The traps should be baited with a whole dried prune, raisin or nut meat tied on the trigger. Place traps across the travel ways of the rats, or between boxes or other obstacles tending to form a pathway to the trap. Live catch traps, such as a Havahart No. 2, are also effective in catching pack rats. Wood rats are among the easiest animals to trap.

SHOOTING

Shooting can probably be labeled a sport rather than a control, however, it is occasionally done on a limited scale. Kicking or stomping on nests located on the ground will often cause the rat to scurry for the nearest tree where it becomes a challenge to any hunter's skill.

DESTRUCTION OF DENS

In areas where wood rats are a particular menace, foresters and ranchers will sometimes burn their dens. Naturally, this practice is conducted with extreme care to avoid accidental fires.

TOXIC BAITS

Wood rats are not difficult to control with toxic baits. Rolled or potted barley, steam rolled or lightly crushed oats and steel cut or lightly rolled oat groats are generally considered among the most acceptable grain baits used in California. Raisins, dried prunes, dried apricots, and walnut meats have proven valuable as have, in certain instances, freshly cut and cubed apple and carrot baits.

The active ingredient used on baits normally consists of one of three acute poisons; zinc phosphide, thallium sulfate, and sodium fluoroacetate (1080).

Anticoagulant rodenticides developed in recent years which have become widely accepted in rodent control have contributed to effective wood rat reduction. Anticoagulant baits have the decided advantage of reducing hazards associated with the acute toxic baits. While anticoagulant baits have been prepared at a ratio of 1 part anticoagulant (0.5%) to 16 parts bait, effective control has also been achieved with the standard 1 to 19 ratio normally used in domestic rat control. It was found that the wood rats had less tendency to carry off and store the smaller grains or bait particles. For this reason, the smaller grains, such as steel cut oat groats, should be selected if they prove acceptable to the rats.

Through usage, it was determined that when closed box type anticoagulant bait stations were employed in the field, they were often filled by the rats with sticks and other debris. Open bait containers, protected by inverting a

wooden lettuce crate, or something similar over the bait, proved more practical. Bait stations should be located near existing rat runways and generally spaced no further than 100 feet apart.

Anticoagulant baits mixed with melted paraffin and molded into blocks have proven to give desired wood rat control when placed in invaded dwellings or buildings. The advantage in this type of bait is two-fold; first, a more lasting bait is provided, and second, the bait cannot be readily packed off and stored by the rats.

Of the acute toxic agents, zinc phosphide is probably the most often employed. Steam rolled oats or oat groats treated with 1% zinc phosphide, utilizing soybean lecithin singley or in combination with mineral or corn oil as a carrier, has given excellent control.

Five grams of this bait, scattered on the ground to cover an area at least one foot square in the runway near the entrance of the den, can be expected to produce wanted control within 48 hours. It has been demonstrated that field kills of wood rats do not improve the longer the bait has been exposed. It is generally believed that little control is achieved after the second night of bait exposure. Often insects or other small rodents will remove or consume the bait prior to the nocturnal feeding by the wood rats. This loss can be decreased by baiting during the late afternoon.

Sodium fluoroacetate (1080) treated grain (4 oz/cwt) will give excellent control. Baits of half that strength have also been employed but with some reduction in effectiveness. Thallium sulfate treated grain (14 oz/cwt) or fruit baits have produced good results. Baits should be exposed in the same manner as those treated with zinc phosphide. All baits used in the field should be brilliantly off-colored to deter seed eating birds. Since the use of sodium

fluroacetate (1080) and thallium sulfate is restricted by law in California, their use in wood rat control is somewhat limited and should never be used by inexperienced operators.

LITERATURE CITED

Anon. 1947. Plague Reports From Three Counties. California's Health : 227.

Eadie, W. R. 1954. Animal Control in Field, Farm, and Forest. The Macmillan Company, New York. 161-163.

Elliott, N. H. 1953. Wood Rats. U. S. Fish and Wildlife Service, Branch of Predator and Rodent Control. Misc. Publication.

Henderson, F., and E. L. Craig. 1932. Economic Mammalogy. Charles C. Thomas, Springfield. 280-281.

Howell, A. B. 1926. Anatomy of the Wood Rat. The Williams & Wilkins Company, Baltimore. 8-10.

Marsh, R. E., and L. F. Plesse. 1960. Semipermanent Anti-coagulant Baits. Calif. Dept. of Agri. Bull. Vol. XLIX No. 3 : 195-197.

Nettleton, H. I. 1957. Wood Rats Damage Young Douglas-Fir. Journal of Forestry. Vol. 55.

Storer, T. I. 1933. Control of Injurious Rodents in California. Calif. Agri. Extension Service Cir. 79 : 46-47.

Vestal, E. H. 1938. Biotic Relations of the Wood Rat (Neotoma Fuscipes) in the Berkeley Hills. Journal of Mammology 19 : 1-36.

Vorhies, C. T., and W. P. Taylor. 1940. Life History and Ecology of the White-Throated Wood Rat, Neotoma Albigula Albigula Hartley, in Relation to Grazing in Arizona. Ariz. Agri. Exp. Sta. Tech. Bull. 86 : 455-527.