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CONTROL OF THE EUROPEAN MOLE, Talpa eruopaea

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ABSTRACT: Common methods for mole control are baiting with earthworms impregnated with thallium sulphate or strychnine, gassing with pellets developing phosphine, and trapping. Seasonal cycles in burrowing activity make it difficult to evaluate results of expensive control campaigns and may give a false impression of efficiency.

BIOLOGY OF THE MOLE

In appearance and biology the European mole is very similar to the Scapanus and Scalopus species of the United States. One of the main differences seems to be that Talpa is strictly carnivorous, never feeding on plant material, whereas up to 20% of the food of the American species is of plant origin (Kuhn, 1970). The food consists primarily of earthworms supplemented by millipeds, insect larvae, snails, and now and then a frog or a litter of young mice. Deep permanent tunnels serve as pitfall traps, and the mole, when first established, does normally not burrow to find its food. In the night the mole may spend considerable time above ground, licking dew from the plants and feeding on earthworms. This nocturnal activity is primarily revealed by the frequent presence of mole remains in the pellets of the tawny owl and barn owl, reaching a peak in late summer, when young moles are repelled from the nest and try to find unoccupied land.

Burrowing activity is closely connected with the number of earthworms (especially Lumbricus terrestris and L_. rubellus) as the mole extends its tunnel system, when food is scarce. When food is abundant earthworms are stored in the burrows, most often close to the nest, making it possible for the female mole to stay with her small young for longer periods. The worms are immobilized for some weeks by a damaging bite at the anterior end.

Surface runs may be very numerous, especially on drilled fields in the spring. Most are temporary runs used either for feeding or for a male to locate a female. As early as in 1923 Hisaw found that Scalopus raises the molehills by pushing with one hand, but not until 1958 (Skoczen) this was found to be true for Talpa as well.

Like most other insectivores the mole is highly territorial, each individual defending on an average 2000 m^2. On pastures very rich of food a territory may be reduced to 200 m^2. Even the sexes keep separate, apart from one or two days in the mating season. Accordingly, population density is low, and so is reproduction rate, as only one litter with about four young is produced each year.

DISTRIBUTION

The mole is found in most parts of Europe with the exception of Norway, Ireland, most of Sweden, regions close to the Mediterranean Sea and most smaller islands. The species prefers lowland forests, plains and pastures with not too heavy or sandy soils. Very acid or stony soils with a poor invertebrate fauna are completely avoided. In dairy pastures where moles usually are most abundant the total length of their tunnels may be 20-30 km per ha or 2-3 m per m^2.

DAMAGE

The types of damage caused by the European mole are quite similar to those inflicted by the American species. As our mole does not feed on plants all the damage is caused by the burrowing activity, especially the molehills.

The most frequent complaints are about:

1) The reduction of grazing area by molehills. In parts of Czechoslovakia 8-10% of permanent grass-fields are taken up by molehills each year, and the heaps are not fully overgrown until 3 years later. Furthermore, the plants that invade the heaps are often less suitable as animal food (Grulich, 1959).

2) Damage to harvesting equipment. Especially when cutting clover and grass very close to the ground for the production of silage or fodder pellets, knives may be broken by stones in molehills.

3) Fouling of silage by earth from the heaps.

4) Damage to newly seeded pastures and fields with sprouting grain, beets or vegetables, especially caused by surface tunnels pushing up young plants. In a Czechoslovakian study up to 25% of the plants were destroyed in such fields.

5) Molehills spoiling the neat surfaces of golf-courses and garden lawns. Such complaints tend to be the most numerous, but economically they are less important.

A common feature for these types of mole damage is the problem of getting even rough figures on their economic importance. Other burrowing animals like rodents may also be present in the field, partly being responsible for the damage to silage or harvesters. The evaluation of the mole as a pest is complicated by the fact that its activity is considered an advantage in forests because of the airing and draining of the soil, and because regeneration of forests is favoured by the heaps.

CONTROL METHODS

The most widely used method is the placing of poisoned earthworms in the burrow systems of the mole. In Europe the toxicant is either strychnine (England) or thallium sulphate (Denmark). Previously raw meat was used instead of worms resulting in the accidental poisoning of foxes and dogs, digging out the baits from the burrows. The main disadvantage by using worms is, apart from the fact that moles prefer fresh, live worms to dead, poisoned ones, that they are often difficult to obtain in the necessary quantities at the right time. The most favourable time for mole control is the early spring before the moles have reproduced, and before the vegetation makes the location of the molehills more difficult. In many European countries this is the dryest period of the year where the worms are deep in the soil and more or less inactive. Consequently, in Denmark worms obtained at more favourable seasons are deep-frozen and used as replacement. The unfrozen worms do not keep for many hours and are not readily accepted by the moles in natural conditions.

Recently another method of control has been tested in Denmark and found to be more effective than thallium-worms. Pellets weighing 0.6 g and containing 56% aluminiumphosphide are placed in the deeper tunnels (three pellets for every 2-3 m of tunnel in use). In contact with the moisture of the soil 0.2 g phosphine per pellet is developed. In Table 1 the results of a recent test comparing the effect of thallium-worms and phosphine-pellets are given.

Apart from the fields with sprouting grain and numerous surface runs, where no effect could be observed, the number of burrow systems in use was reduced by 31% in the fields treated with poisoned worms and with 65% in the phosphine-treated fields.

As the use of thallium has been very much restricted in Denmark in 1975, the phosphine-pellets no doubt will be the main method of control in the near future.

In England phosphine-pellets were found to have a better effect than other gasses in a mole-proof compound, but the results from field tests were not satisfactory, as the moles seemed to avoid the treated systems, until the gas had gone after about 24 hours. The number of pellets used per ha were, however, not reported.

The use of phosphine-pellets presents some obvious advantages compared with thallium-worms. They are always available, no acceptance problems exists, and there is no risk of secondary poisoning or contamination of the soil.

Carbon monoxide piped from the exhaust of tractors or cars is locally used with some success by farmers and garden owners, but the method is difficult to use in more extensive mole control.

In Holland, where moles are very abundant, a method resembling that applied to gophers in USA has been in use for a couple of years. Artificial drains are made by a special torpedo-shaped plough at a depth of about 10 cm, and dry pellets containing 0.1% crimidin are automatically released every meter of the drain. The pellets are of animal origin and claimed to be well accepted by the mole. As a rule one drain is made around the field in question, and other drains are spaced 10 m apart over the field. The method itself, and the palatability of the pellets, has not yet been tested in Denmark.

Common for all baiting methods is the fact that the areas have to be retreated a few days after the first treatment to obtain satisfactory results.

Experts in Europe as well as in USA generally agree that trapping is the most reliable method for mole control, particularly in gardens and other limited areas. The cheapest and most effective type of trap used in Europe seems to be the scissors-jaw trap, which is very easy to set.

In Denmark some municipalities pay 4-5 DKr. (appr. 80 cents) for each mole-tail delivered, and in some cases 15,000-20,000 moles have been trapped in a single municipality during one season. It seems obvious that a species with such a low reproductive rate as the mole must be severely influenced by this predation. If, on an average, each ha of farmland is inhabited by 5 reproductive moles, a municipality with about 100 km^2 of farmland may have a total population of 50,000 moles, a number that theoretically could be eliminated by 3 years of trapping!

In England about 100 acres of pasture were completely cleared of moles in the course of experimental work in 1967, it proved, however, extremely difficult to preserve the mole-free state by a single trapping period each of the following years (in 1967: 265 moles; in 1968: 32; in 1969: 131.) (Pest Infestation Laboratory, 1973).

ORGANIZATION OF MOLE CONTROL

In most European countries mole control is carried out by pest control companies on request from private persons. In Denmark, the mole and the rat have a particular status among the vertebrates as their control is subject to special laws. If "important economic interests" are threatened by the activity of moles, a single or several adjoining municipalities may be ordered by the Ministry of Agriculture to organize systematic control campaigns all over the municipality except for forests. Such an order has not been given for some years, but the existence of the law has had the consequence that 239 out of a total of 254 municipalities organize and pay some sort of mole control. The most common method is the use of thallium-worms (205 municipalities), some use trapping alone or combined with worms (48) and a few (19) use also other methods like carbon monoxide, sulphur-gas producing bombs, etc. In 1975 the Danish municipalities spent appr. 8 million DKr. (1.3 mill Dollars) on mole control, or more than was spent on rat control. An interesting fact is that 195 of the 243 municipalities carry out the control sporadically on request, and that a high percentage of these requests come from garden owners, not included in the original law on mole control.

THE EVALUATION PROBLEM

The majority of the municipalities finds that mole control with thallium-worms is effective. This is in contrast to what has been revealed by experiments, where a reduction in mole activity by about 30% is seldom achieved. There is no reason to believe that a better effect is obtained by the average operator, so the question is why farmers and local authorities find the results satisfying.

The answer seems to involve psychological as well as biological aspects, which may be important for the evaluation of other control campaigns. Primarily the farmer or garden owner feels a certain satisfaction by the mere sight of the control operator treating their mole-infested fields or gardens. They realize that the local authorities are involved in their problem, and that part of their tax money returns to their own pockets - and they are favourably disposed towards the results. This psychological aspect is closely connected with the particular biology of the mole. The molehills are not produced regularly during the year, as the burrowing activity shows intensity cycles from season to season. In late winter moles may be forced to retire from wet areas by extending their burrow-systems to more elevated localities. At this time food is scarce and difficult to obtain so new tunnels must be burrowed, resulting in more molehills. A few weeks later the male searches for a female in heat often producing molehills on one straight line. This is, however, just the time for most mole control campaigns to be started. After 6-8 weeks the campaigns have finished, and the results are "obvious"! Vegetation now covers part of the heaps, and very few new ones are made by the well-established mole at a time when food is abundant.

Table 1. The effect on moles of phostoxin-pellets or earthworms impregnated with 2% thallium sulphate (see text).

Plot No.	Type of field	Size in ha (estimated)	No. of burrow-systems (estimated)	No. of sites treated	No. of burrow systems estimated 5-6/5.	No. of mole-hills 5-6/5.	Subjective evaluation of effect
1	Old grass-field	1/2	3	113	1	9	Activity restricted to one of the field boundaries
2	"	1/4	3	73	1	4	Very little activity within the field
3	"	1/2	3	93	0	0	No activity
4	sprouting grain	2	7	361	8	Mostly run-ways	No effect
5	Old grass-field	2	5	60	2	6	Marked reduced activity
6	"	1 1/2	7	164	3	11	Reduced activity but new systems active
7	"	1	5	168	2	2	Marked reduced activity in most of the field
	TOTAL	7 3/4	33	1,032	17		

Table 1. Continued.

	Plot No.	Type of field	Size in ha (estimated)	No. of burrow-systems (estimated)	No. of sites treated	No. of burrow systems estimated 5-6/5.	No. of mole-hills 5-6/5.	Subjective evaluation of effect
WORMS WITH THALLIUM SULPHATE	1	Old grass-field	2	7	479	9	39	No effect. More activity than before
	2	sprouting grain	2	10	306	11	Mostly run-ways	No reduction in activity
	3	New grain field	2 1/2	5	172	4	43	Some reduction in activity
	4	Old grass-field	1/4	8	84	3	1	Half of the field without activity
	5	"	2	4	95	0	0	No activity
	6	"	1 1/2	4	68	3	16	Reduced activity in part of the field
	7	"	3	10	355	7	62	One third of the field without activity
		TOTAL	13 1/4	48	1,559	37		
NON-TREATED CONTROL	1	sprouting grain	2	11		19	Mostly run-ways	
	2	"	2	9		14	Mostly run-ways	
	3	New grain field	1	4		6	47	
	4	Old grass-field	2	9		8	87	
		TOTAL	7	33		47		

This lack of activity lasts until late in summer and in the early autumn when large numbers of new molehills are again visible everywhere. They are partly produced by young moles expelled from their native burrow and now digging their own separate tunnel systems, and partly by other individuals which are disturbed by the ploughing of fields and have to establish themselves in new areas. And this is the time for the next control campaign to start, which ends up with the same "obvious" effect as the first one.' In late autumn the number of new molehills decreases because the subadult moles as well as the adults now have settled down for the winter in the new tunnel systems. The fact that heaps are as numerous as ever next spring does not seem to bother most of those involved in mole control.

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