

The Efficacy of Molexit™ for Reducing Damage from Eastern Moles (*Scalopus aquaticus*)

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Abstract: Two experiments were conducted evaluating the efficacy of a castor oil based mole repellent in 2000 and 2001. Five lawns located in central Kentucky were used in a pilot study conducted from April to August 2000. The following treatments were applied at each lawn: no activity, flattening hills and burrows, flattening hills and burrows with 19.5 kg/ha Molexit™, flattening hills and burrows with 39.0 kg/ha Molexit, 19.5 kg/ha Molexit, and 39.0 kg/ha Molexit. Lawns were monitored for 4 months and increases or decreases in activity were noted. There was no difference ($P > 0.05$) in burrowing activity between the treatments. All sites showed a decrease in mole activity as evidenced by burrowing activity. Possible explanations include a severe drought and product manufacturing problems. Thirty-eight lawns in central and western Kentucky were used in the second study that was conducted from February through June 2001. The treatment unit for this study was the individual lawn, not plots located within lawns. Twelve lawns were flattened, 15 were treated with 19.5 kg/ha Molexit, and 11 were treated with 39.0 kg/ha Molexit. Untreated sites were located immediately adjacent to the treated areas to determine if the moles would relocate to the untreated areas. There was no difference ($P > 0.05$) between treatments, however lawns treated with the repellent showed larger decreases in activity. There was a difference ($P < 0.0001$) in treated compared to untreated lawns. Mole activity decreased an average of 28.0 m in the flattened lawns and activity was noted in 9 of the 12 lawns. Mole activity in lawns treated with 19.5 kg/ha Molexit decreased an average of 34.0 m and no mole activity was recorded for 6 weeks. Mole activity also decreased an average of 32.8 m in lawns treated with 39.0 kg/ha Molexit and no activity was recorded for 6 weeks after application. These results indicate there is some level of efficacy in reducing mole burrowing activity using Molexit.

Key Words: Eastern mole, *Scalopus aquaticus*, castor oil, Molexit™, mole repellent, mole damage

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INTRODUCTION

Eastern moles (*Scalopus aquaticus*) may be a nuisance and cause damage to turf found in lawns, golf courses, and agricultural areas. The damage caused by their burrowing activity may result in suspended plant roots that ultimately results in plant mortality (Henderson 1994). A variety of approaches have been used to reduce or eliminate the damage caused by moles. These techniques have met with varying degrees of success and finding an easy solution to the problem has been elusive.

The most permanent and effective method of eliminating mole damage is to eliminate the culprit. In the past, harpoon trapping has been shown to be the best method for solving the problem (Loven 1988). Many homeowners, golf course maintenance personnel, and others have found that trapping is not a viable solution because it takes a certain level of proficiency in identifying active runs and properly using traps to be successful. Trapping also requires patience, and most individuals seek immediate relief from the problem. Professional nuisance wildlife control operators use trapping as their primary method to solve mole problems (Barnes 1995).

Because of the problems associated with becoming a successful mole trapper, a variety of commercial and non-commercial remedies have been used to repel moles. While fumigants and poison peanuts are labeled for below-ground use in controlling moles, these solutions may not work because moles are primarily insectivores

and would not eat poison baits. Further, it would be difficult to get poisonous gas in sufficient quantity to cause death because of the moles' extensive burrow systems. Non-commercial solutions can be quite novel and have included using castor oil or planting castor beans (Henderson 1994), moth balls, human hair, chewing gum, and gasoline or water.

Few of these commercial or non-commercial solutions have been tested to see if they work. Marsh (1987) observed that moles did not like to eat chewing gum and it did not affect their digestive system. He concluded that placing chewing gum down burrows would not deter mole burrowing activity. Dudderar et al. (1997) observed that a castor oil based repellent showed some efficacy. While this particular study lacked scientific rigor, it did provide some evidence that castor oil could be used as a mole repellent. It is known that moles are sensitive to aromatic substances, including castor oil and glandular secretions from other moles, as well as urine and fecal secretions of mustelid carnivores (Gorman and Stone 1990).

Using this information, a number of entrepreneurial companies developed mole repellents with castor oil as the active ingredient. Molexit™ is one such products that was developed in 1996. The castor oil in this product is impregnated into a 98.5% mixture of Fuller's earth and is sold in a clay pellet form (KTI Direct, 1029 South Preston, Shepherdsville, KY 40165; pers. comm.). The

manufacturer indicates the product meets the Title 40 Code of Federal Regulations, (CFR) 152.25. They also report it is environmentally friendly and is composed of 100% natural ingredients and is completely biodegradable.

While a number of castor oil-based repellents are being sold today, few have been tested to see if they actually work. The objective of this study was to determine the efficacy of Molexit™ repellent for reducing burrowing damage caused by eastern moles.

METHODS

Pilot Study

A pilot study was implemented from April to August 2000. Study sites were located by calling the local county Cooperative Extension Offices in central Kentucky and by requesting individuals with mole problems through a newspaper solicitation. Forty-eight responses were received and each lawn was then inspected for mole damage, either burrows or hills. After field inspection, 5 lawns had sufficient mole damage and were selected for study. Lawn size ranged from 0.2 to 2 ha. Grass species varied, but most had a mixture of Kentucky bluegrass (*Poa pratensis*) and various turf type fescues (*Festuca* spp.).

Each lawn was divided into seven, 7 × 17.3 m plots and one of the following treatments was randomly applied to each plot within each lawn: 1) no treatment activity, 2) flattening hills & runs, 3) flattening plus 19.5 kg/ha repellent, 4) flattening plus 39.0 kg/ha repellent, 5) 19.5 kg/ha repellent, and 6) 39.0 kg/ha repellent, and 7) no mole activity present. Treatments were applied from April - August 2000 with 60% of applications occurring in June, when mole activity is greatest (Harvey 1967). Burrows were flattened manually by foot and the repellent was spread evenly by hand.

After treatment application, each site was monitored after 7 days and then biweekly until August 30. Burrow length pre- and post-treatment was determined using a Rolatape® wheel. Burrows were measured to the closest foot and all measurements were converted to meters. The number of hills pre- and post-treatment were counted and recorded. We tested for treatment differences using Proc GLM ANOVA (SAS Institute 1985).

Experimental Study

The second study was implemented from February 2001 through June 2001. Study sites were selected using the same protocol as described in the pilot study. We received 78 responses to these solicitations. Each lawn was once again inspected and 38 were selected for study. Lawns were selected for study if they had active mole activity determined by reappearance of mole activity 5 days post tunnel flattening. Lawn size ranged from 0.2 to 2 ha. Grass species varied but most had a mixture of Kentucky bluegrass and various turf type fescues.

In this study, each lawn was considered a separate unit with one treatment application and a control area

where no manipulation occurred. One of the following treatments was randomly assigned to one lawn: 1) flattening, 2) 19.5 kg/ha repellent, and 3) 39.0 kg/ha repellent. The treatments were applied between the period February 8 to April 6 with 40% occurring in February to coincide with periods of high mole activity (Harvey 1967). Burrow length was measured and recorded as previously described. Mole hills were not considered in this trial due to low numbers. Each site was individually monitored until August 30, 2001.

Ten randomly collected soil cores, 18 inches deep × 1 inch in diameter, were taken at each lawn and sent to the University of Kentucky Regulatory Services for analysis. Samples were mixed and analyzed for organic matter, total nitrogen, percent sand, silt, and clay, and depth. We sampled for white grubs (*Cyclocephala borealis* and *Popillia japonica*) by cutting and removing three 0.09 m² turf grass samples and counting the number of grubs (Potter and Potter 1999). We tested for treatment differences and correlations using Proc GLM ANOVA (SAS Institute 1985).

RESULTS AND DISCUSSION

Five of 48 individuals (7.6%) that responded to our solicitation actually had mole damage. Inspection of the lawns revealed property owners were mistaking vole (*Microtus* spp.) and chipmunk (*Tamias striatus*) damage for mole damage. In some cases there was no visible sign of any damage. Thirty-eight of the 78 individuals (48.7%) that responded to our second solicitation had actual mole damage. Once again, property owners were mistaking other mammalian damage for mole damage. These results suggest that general population has difficulty in identifying specific types of mammalian damage or there is not as much actual mole damage that is reported to agencies.

Pilot Study

During the summer of 2000 mole activity declined in all five lawns regardless of treatment. Mean burrow length pre-treatment was 14.92 m ± 3.23 m and was reduced to 5.79 m ± 2.91 m post-treatment. The average number of hills pre-treatment (1.57 ± 1.11) did not differ (0.21 ± 0.19) from post-treatment (P = 0.73). There was no difference (P < 0.58) in the decrease in burrowing activity (9.1 ± 4.16 m) or the number of hills observed (1.35 ± 0.67) between treatments. Mean burrowing activity varied widely and burrow length decreased from 4.2 m in the 19.5 kg/ha repellent treatment to 13.3 m in the plots that received no treatment (Table 1).

There are several possible hypotheses for explaining why there were no treatment effects. One possible explanation is mole surface activity declined as the moles retreated to deep burrows in search of food (Gorman and Stone 1990) because of a severe drought in central Kentucky during the entire study period (17.75 cm below normal precipitation for this period; <http://www.agws.ca.uky.edu>). Another probable cause could be attributed

Table 1. Mean decrease (meters) in mole burrowing activity in 7.01 × 17.26 m plots located in 5 lawns, 6 weeks post treatment using the label rate (19.52 kg/ha) of Molexit™ repellent, with and without flattening; twice the label rate (39.04 kg/ha) of Molexit with and without flattening; flattening; and no flattening of mole hills and burrows at the end of August, 2000.

Treatment	N	# with decreased burrows	Burrow Activity (m)		Hill Activity (m)	
			$\bar{x}$	SE	$\bar{x}$	SE
Label rate, flattened	7	6	5.5a	2.3	0.6a	0.1
Label rate, un-flattened	7	5	10.2a	4.9	1.0a	0.1
2× label rate, flattened	7	7	13.4a	3.5	2.1a	1.4
2× label rate, un-flattened	7	6	4.2a	5.0	1.3a	0.9
Flattened	7	7	8.2a	2.7	1.7a	1.3
No treatment	7	5	13.3a	6.7	1.3a	1.3

a Values with similar letters are not different ($P > 0.05$).

Table 2. Mean decrease (m) in mole burrowing activity in 38 lawns, six weeks post treatment using the label rate (19.52 kg/ha), twice the label rate (39.04 kg/ha) of Molexit™ flattening, and no treatment of mole burrows at the end of August 2001.

Treatment	N	# with decreased burrows	Burrow Activity (m)	
			$\bar{x}$	SE
Label rate	15	14	34.0a	7.2
2x label rate	11	7	32.8a	6.9
Flattened	12	3	28.0a	7.7
No treatment ¹	38	9	1.6b	1.4

a,b Values with different letters are different ($P < 0.05$).

¹ There was no mole activity in the untreated sites as a result of movements from the treated sites.

to the large amount of variation in burrow length. Furthermore, with such small plots located in one lawn there could have been confounding treatment effects between the small plots. Finally, we were informed by the manufacturer that there was a problem with impregnating the active ingredient into the Fuller's earth that could have led to variations in the actual amount of castor oil being applied in the treatments.

Experimental Study

Mole burrowing activity declined or was completely eliminated in 63% of the treated plots. Mean burrow length pre-treatment was 38.1 m ± 84.6 m. Overall mean burrow length post-treatment varied by treatment and ranged from 0.6 m to 32.8 m (Table 2). The decrease in burrow length in the treated sites (5.9 m ± 11.9 m) was different ($P = 0.0001$) when compared to the control sites (0.7 m ± 3.03 m). There was no difference ($P = 0.83$) in burrow length between the individual treatments (Table 2). However, the decrease in burrow length was larger in sites treated with the mole repellent (28m ± 7.7m compared to 33.37m ± 7 m. Seventy-five percent of the flattened treatments continued to have some mole activity

throughout the study. Mole burrowing activity ceased in 80% of the plots treated with Molexit. Furthermore, burrowing activity resumed in 75% of the flattened treatments versus 19% in plots treated with Molexit 6 weeks after treatment. Mole activity resumed in most of the plots 6 weeks after treatment application.

During this same period the label rate of Molexit was applied to active burrow systems on a farm in western Kentucky and at the University of Kentucky Research farm in central Kentucky. Three days after application all mole activity ceased at these sites, and no mole activity was recorded for 4 weeks. Mole damage reoccurred at both of these sites after a heavy precipitation event. These observational data support the experimental data that Molexit does have some efficacy in reducing mole burrowing activity.

Burrowing activity varied between the two regions of the state. Lawns treated in central Kentucky (34.9 ± 6.1) showed a greater decrease ($P = 0.03$) in burrowing activity than western Kentucky (27.9 ± 5.4). In addition, the decrease in burrow length in treated lawns (34.9 ± 6.1) was greater ($P = 0.01$) than untreated lawns (1.06 ± 0.8) in the central region. Burrowing activity did not

differ ($P = 0.81$) between rural (29.8 ± 5.4) and urban lawns (34.4 ± 6.5). There were no relationships between burrowing activity and soil depth at eight inches ($P = 0.25$, $r^2 = 0.03$), organic matter ($P = 0.53$, $r^2 = 0.01$), nitrogen ($P = 0.42$, $r^2 = 0.01$) sand ($P = 0.15$, $r^2 = 0.05$), clay ($P = 0.78$, $r^2 = 0.00$), or silt ($P = 0.42$, $r^2 = 0.02$).

The number of grubs counted in the lawns was small ($\bar{x} = 0.26$ grubs/lawn). The number of grubs per plot varied (0.06 to 0.12 grubs/plot) and did not differ between site. Because the number of grubs encountered was small, statistical analyses could not be conducted to determine if a relationship existed between soil variables and burrowing activity. Furthermore, insufficient sample size prevented statistical analysis to determine differences in grub abundance by treatment. Grubs are usually in the early stages of infestation between mid-July to mid-August and are harder to locate in the beginning of June when we conducted our sampling (Potter and Potter 1999). Consequently we may have underestimated this potential source of food. Alternatively, grub abundance may not be related to burrowing activity because their primary food source is earthworms (Gorman and Stone 1990).

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