POCKET GOPHER (*ORTHOGEOMYS HISPIDUS HISPIDUS*) DAMAGE IN SUGARCANE FIELDS IN THE STATE OF VERACRUZ, MÉXICO

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ABSTRACT: Information concerning hispid pocket gopher (*Orthogeomys hispidus hispidus*) damage to sugarcane and the efficacy of sodium monofluroacetate (Compound 1080) treatments for control of this pest were obtained for the State of Veracruz, Mexico. Pocket gophers represent one of the major vertebrate pests based on the severity of economic losses caused to the sugarcane industry in this state. Pocket gophers cause significant damage in over 200,000 ha of sugarcane fields. In this study, a total of 66,560 stalks were examined for damage. Total percentage damaged was 20.67. Economic loss caused by pocket gopher was estimated at approximately $951 in one grower processor's crop based on the 1998-99 price for raw sugar ($25 dollars/ton). Losses due to this pest species are probably underestimated because many sugarcane industries could not or did not provide loss estimates.

KEY WORDS: Hispid pocket gopher, *Orthogeomys hispidus hispidus*, damage in sugarcane, vertebrate pest, Mexico

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INTRODUCTION

In this paper I will discuss hispid pocket gopher (*Orthogeomys hispidus hispidus*) control programs using sodium monofuroacetate (Compound 1080) and damage surveys in the sugarcane growing areas of the La Concepcion sugarcane mill. I will provide information on how and why the program started, how it has changed, and the results of the program.

The hispid pocket gopher is the second largest species in the Geomyidae family, having an average weight of 551 ± 124 g. Sisk and Vaughan (1984) summarized the impacts of species of the genus *Orthogeomys* on agriculture, and described some aspects of its natural history in Costa Rica. Goodwing (1946) and McPherson (1985) reported on damage to agricultural crop such as banana, yucca, and dairy pastures. Damage to sugarcane results from pocket gophers gnawing on sugarcane stalks and roots resulting in death of the plant. Sugarcane growers attempt to eradicate pocket gophers from sugarcane fields and surrounding areas. The hispid pocket gopher also causes serious damage to crops like corn, beans, potatoes, carrots, avocado plantations, coffee, and others (Hall 1963), and to the agricultural landscape.

History of Pocket Gopher Infestations in Veracruz

Sugarcane production is the principal economy of Veracruz. The state produces almost 30% of the sugar production of Mexico. About 70% of the population of Veracruz live in rural areas and are engaged in agriculture. Sugarcane is the most important crop, followed by corn, rice, coffee, mango, and banana plantations.

Damage by the hispid pocket gopher in the state of Veracruz has a long history. Despite this and the importance of sugarcane to the region, there have been no quantitative studies of the damage and economic impact caused by gophers. Flores (1985) reported that pocket gophers were the most significant pest with about 200,000 ha (40%) of the sugarcane plantations infested. Sugarcane plantations may be completely destroyed as a result of gopher burrowing activity and their gnawing on stems and roots. The most severe damage occurs in non-irrigated sugarcane fields adjacent to non-crops lands that favor proliferation and survival of pocket gophers.

Small-time landholders use traps to control gophers. In the absence of alternatives, growers frequently apply as rodenticides other compounds with high mammalian toxicity (e.g., certain organochlorine and organophosphide insecticides) contrary to the regulatory approval of the compounds concerned. From December 1998 to February 1999, sugarcane growers applied Compound 1080 in about 1,550 ha of affected areas of sugarcane. It was used without care or protection and without any previous dosage test. In Mexico, Compound 1080 is banned by the Federal Government, however, it is sold by unauthorized people, thus causing indiscriminate use. Growers treat burrows with sugarcane stalks treated with 5 drops of Compound 1080 (10 g/l, 90% active ingredient). Compound 1080 is applied to stalks via four small holes in a fresh sugarcane stalk. The baited stalks are attached to sticks and introduced into each burrow system. Growers leave the baited stalks without precaution and do not assess efficacy.

The aims of this study were to provide sugarcane growers safety procedures to manage the 1080 compounds, to assess the efficacy of Compound 1080, and to give some insights into sugarcane losses due to pocket gophers.

MATERIAL AND METHODS

The study was undertaken in the La Concha sugarcane mill district, 12 km north of Jalapa City, Veracruz. The district has approximately 3,332 hectares of sugarcane plantations. The soil is fertile and has variable depth; the topography is gently rolling, elevation varying from 800 to 1,200 m above sea level. The climate is predominantly subtropical and hot, with monthly rainfall in the range of 78.1 to 90 mm. The region is an agricultural mosaic of sugarcane crops, native forest and grasslands, swamps, drainage channels, and improved pastures. Habitat consists of cane fields of

varying age (0 to 13 months) separated by heavily vegetated gulches.

Two sampling sites were selected, based on a history of pocket gopher damage on slopes in the Tepetlan and San Pablo growing areas. These areas are bounded by coffee plantations and separated by at least 50 km. The study area has a moderate native plant species diversity and exotic grass species are abundant. The sugarcane crop grows in summer and early autumn. Harvest is in winter with burning prior to harvest and the ground is bare until the sugarcane shows new growth.

Description of Signs

The pocket gophers on the study area make two types of ground surface signs: mounds and earth plugs. Mounds are piles of soil pushed to the surface of the ground by pocket gophers as they feed and develop or extend their underground systems. Earth plugs are holes that have been filled with soil. In coming to the soil surface, pocket gophers open a hole from underground tunnel to the surface. When the animal returns to the burrow system, this hole is plugged with soil to keep the system closed.

Sampling Areas

Sugarcane crops of 12 months of age were chosen for damage assessment in the Tepetlan and San Pablo production areas. Four sampling areas of 1.5 ha each were established. Surveys were conducted during the period December 1998 to February 1999 to evaluate the number of damaged and undamaged stalks.

Damage Assessment

I estimated average stalk density by counting the number of stalks in 62 randomly-placed 10 m transects within undamaged crops. Age of the crop, sugarcane variety, and harborage availability (coffee plantation or grassland area) were recorded. Sugarcane stalk count was expressed as the number of healthy stalks per 10 m.

In order to quantify pocket gopher damage, I selected damaged crops with similar characteristics to undamaged areas. All stalks were counted in 62 randomly-placed 10 m transects. Damage due to pocket gophers was expressed as the percentage of stalks missing per 10 m standing stalks.

Assessment of Efficacy

In order to assess the efficacy of the control program, I selected 40 sites of 1.5 ha from sugarcane cultures in Tepetlán and San Pablo areas. A week prior to each of three Compound 1080 treatments, I counted the number of fresh mounds and burrow systems and opened them to look for evidence of pocket gopher activity. Eight days following each treatment, I examined treatment plots for pocket gopher activity. Mounds, earth plugs, and burrow systems were counted and reopened to look for evidence of pocket gopher activity. I checked to ensure that pocket gophers had eaten the poisoned stalks. An area was recorded as positive for gopher activity if a pocket gopher plugged the tunnel hole with soil. Conversely, if the burrow system remained open for 24 h, the sample plot was considered inactive. I calculated the percent change in pocket gopher activity between pre-and post-survey for each treatment.

RESULTS

Damage

A total of 6,847 undamaged sugarcane stalks were counted in the two sampled areas. There was no significant difference between areas ($F=1.22$, $d.f.=6.375$, $P>0.05$). The undamaged sugarcane stalks were distributed homogeneously within the sampled areas. Sugarcane growers estimated 104.75 sugarcane stalks per 10 m. Our mean of 102.9 is not very different.

There was a significant difference in damaged stalks between areas ($F=455$; $d.f.=3,120$; $P<0.05$). The mean number of damaged sugarcane stalks in the Tepetlán area was 18.2 ± 12.5 and in San Pablo 22.3 ± 12.3. Total damage was 20.7%. Economic loss due to pocket gophers was estimated at approximately $951 dollars in one grower's crop based on the 1998-99 mean price for raw sugar $25 dollars/ton.

Efficacy Assessment

Mound production in the Tepetlán and San Pablo areas before and after treatment were significantly different ($F=2.35$; $d.f.=3,240$; $P<0.05$). Average mound production before treatment in the Tepetlán area was 78% active mounds. After the first treatment, mound production decreased to 42.6% active mounds; after the second treatment to 23.6% active mounds; and after the third treatment to 11.45%. In the San Pablo area average mound production before treatment was 72% active mounds. After the first treatment, mound production decreased to 31.56%; after the second treatment to 32.34%; and after the third treatment to 15.14% active mounds. There was a significant difference between first and second treatments ($F=16.13$; $P<0.0001$) and between the second and third treatments ($F=92.85$, $P<0.001$).

DISCUSSION

Pocket gophers have been a pest in the Mexican sugar industry since the late 1950s. The first researcher describing the pocket gopher problem was Flores (1970) who considered that the pocket gopher problem causes 8% of yield sugarcane. Efforts to reduce the pocket gopher problem were done using acute poisons (zinc phosphide, dieldrin, 2,4-D; Thallium sulfate and sodium fluoracetate).

Currently, the hispid pocket gopher is probably the most serious pest in the state of Veracruz. There is not an adequate means of control available to the people owning small areas of land who depend on the crop from their land to feed themselves and their family. Traps, poisons, and fumigants are rarely available, expensive, and not very effective. When the depredations of gophers become serious enough, men stand motionless, sometimes for hours, before a gopher opens its burrow, ready to impale the animal with a machete (Hall 1968). Trapping campaigns using traditional pocket gopher traps have little success. Burrow fumigation is impractical because of the porous and rocky nature of most soils in the area. Modification or destruction of non-crop habitats to reduce

reservoir pocket gopher populations is economically unfeasible and environmentally undesirable. Sugarcane growers have occasionally used second-generation anticoagulant rodenticides, but the bait rapidly deteriorates due to soil humidity (Porres 1991). It is clear that effective pocket gopher control requires large-scale, longer-term programs that integrate a variety of control techniques. Currently, control actions are generally taken only when damage or the pest animal becomes visible to the farmers.

Sugarcane is a susceptible crop; during the early crop cycle, the sugarcane stalks stand erect, the crop canopy is open, and most of the fields have little ground cover. Some pocket gophers live in the edges of the crop, but few venture into the interior until the cane is between 8 to 12 months old. At about this time, sugarcane stalks become lodged and dead leaves begin to accumulate. This results in a rich vegetative layer on the ground and provides protective cover where pocket gophers establish infield burrows. Adjacent sugarcane fields and surrounding non-crop areas are a ready source for invasion. Pocket gopher populations increase slowly at first, but then escalate rapidly. Control is frequently carried out in response to public or political pressure without consideration of the behavior, reproduction, and natural history of this subterranean rodent.

In my study, crop damage was not uniform throughout the sampled sites, with the highest damage near coffee and grassy areas surrounding sugarcane fields. Mounds were more abundant beneath coffee plants than in shrub vegetation. Damage assessments showed 20.67% of sugarcane stalks were attacked by pocket gophers. Cost of pocket gopher damage sugarcane fields in La Concha was approximately 19.9 tons with a value of $951 dollars. I found that in burned areas and after harvest, damage surveys were relatively easier, nevertheless I consider that damage surveys need to be done throughout the sugarcane cycle and before and after each Compound 1080 treatment.

Growers have been applying Compound 1080 according to previous experiences of other growers. I considered that Compound 1080 is suitable, but it is essential that it must be tested before being accepted for use. My study showed a considerable reduction in pocket gopher mound productions following Compound 1080 treatment. It was relatively easy to assess efficacy between treatments because pocket gopher mounds are easy to recognize, and burrow entrances were easily located under damaged stalks. I considered that in the dry season, pocket gophers select fresh sugarcane stalks and, therefore, readily eat poisoned stalks. The control campaign had undeniable success in achieving the immediate objectives of reducing the level of mound production and damage due to pocket gophers. Unfortunately, though, growers often stop treatments because of the cost and labor needed. The result is increased infestations from surrounding areas.

Safety Recommendations

In order to minimize the hazards to public health, environment, and wildlife, and to maximize the efficacy of control and long-term usefulness of the toxicant, it is necessary to:

1. Determine the acute toxicity of Compound 1080 to pocket gophers.
2. Train people in safe laboratory practices for preparing Compound 1080.
3. Protect people who mix and apply the product with:
   (a) full-length pants and long-sleeves shirt,
   (b) waterproof gloves made from natural rubber or latex,
   (c) goggles to protect the eyes,
   (d) a disposable paper dust mask to protect lungs and respiratory tract, and
   (e) keep pesticide-contaminated clothing away from all other laundry (e.g., store it in a plastic bay until it can be laundered). Do not handle contaminated clothing with the clothes you use in your every day life.
4. Accidental skin contamination should be washed off at once. At no time and under no circumstances the containers should be used for other toxic compounds or for other purposes (Marer 1980).

CONCLUSIONS

The large pocket gopher population reported by growers was a consequence of a favorable habitat combined with the failure to control gophers using traps. The present number of pocket gophers reflects the carry capacity of the sugarcane fields and surrounding plantations like coffee cultures. Only two rodenticides are available for pocket gopher control. Sugarcane growers have been using several poisons including zinc phosphide, anticoagulants, and banned poisons like Compound 1080. The danger is that people may use it without following safety recommendations and without knowledge of the correct dosage rate needed. This study provides important information about the number of treatments needed, but laboratory efficacy tests are needed.

RECOMMENDATIONS

I am not recommending that all pocket gophers be eliminated from sugarcane fields, but rather control those individuals in areas of cultivation to minimize the potential damage. Results from this study have implications for field testing of other candidate rodenticides in sugarcane fields.

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