GOPHER CONTROL IN ALFALFA

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The common valley pocket gopher (T. bottae) is becoming a serious alfalfa pest in many irrigated regions along the lower Colorado River. The development of this problem has been the subject of several research efforts and can be correlated to the history of geologic events and land use patterns in this region.

Gopher populations are characteristically restricted to perennial water sources in desert regions. The Colorado River is one such water source that has both permitted the colonization and movement of gophers adjacent to its banks and has periodically decimated these populations during periods of flooding prior to the construction of dams to prevent this occurrence. Biological surveys of the region in the early 20th century (Grinnell, 1914) indicated that extensive populations of pocket gophers could be found only near Yuma on the California side of the river. Only one gopher was found in the Parker Valley and no specimens were found in the Palo Verde Valley of California until 1934 (Grinnell and Hill, 1936). These same regions are heavily populated by gophers today.

The factors that have contributed to this occurrence are clearly the damming of the river, the proliferation of intensive irrigated agriculture and the placement of inland water courses and roadways. Gopher populations are now relatively free from the flooding which previously kept their numbers in check, have perennial and abundant sources of food and the dispersal channels in which to reach these channels.

The pest is of relatively minor importance in flood irrigated alfalfa fields where it most seriously effects ditch banks and other water containment structures. It is a serious pest, however, in sprinkler irrigated alfalfa fields where population levels in excess of 200 gophers per acre have been recorded. Significant reductions in yields and extensive damage to harvest machinery have been reported in these regions.

Pocket gophers are of interest to wildlife ecologists who have intensively studied their taxonomic make-up, species diversity and geographic placement. New information on these topics has continually been developed over the past 25 years. Comparatively little advancement has been made, however, over this same period of time concerning the control of this pest in agricultural fields. To the contrary, higher levels of control using a larger and more diversified arsenol of chemical tools have been reported prior to the early 1970's. Several factors may be responsible for this situation.

The concern about toxic pesticides and environmental contamination of the early and mid 1960's has stimulated government regulation and an emphasis upon integrated pest management. Many of the compounds that were available in the mid 1900's are no longer available or are severely restricted. New and effective materials to replace these compounds have been slow in coming. The high cost of developing and registering a new compound today has been aggravated by the fact that gopher control does not presently represent a high volume market for chemical manufacturers. Most of the compounds that have been used in the past have been developed for other purposes and were adapted for this use.

Strychnine has been perhaps the most widely used toxicant for gopher control over the past several years. This toxicant has a characteristic taste and rapid mode of action. This has led some researchers to speculate that a taste aversion and temporary tolerance have developed from successive sublethal feedings. The fact that the repeated use of the same pesticide over a long period of time results in diminished control has been demonstrated in other areas of pest control. New and different chemicals for gopher control have not been appearing on the market.

Many techniques have been utilized over the years to control the pocket gopher in alfalfa fields. These include exclusionary techniques, trapping, and a variety of toxic fumigants and baits. Hand baiting and trapping are feasible only where the infestation is light or confined. The major challenge in gopher control has been to find an effective technique where heavy and widely distributed infestations are present.

The last major development in meeting this challenge occurred in 1958 when Walter Howard and Robert Kepner developed the mechanical bait applicator. This machine offers an economically feasible method for controlling heavy infestations of pocket gophers. Our work over the past three years has concentrated upon finding an effective toxicant and bait to use in this machine.

Reliable information concerning the efficacy of commercially available gopher baits has been lacking. A major reason for this deficiency have been the practical problems encountered in developing a rapid and accurate method for measuring gopher control. Several researchers have counted new signs of activity, i.e. mounds and earth plugs, as a means of estimating gopher activity. Another method involved probing and opening a hole in the subterranean gopher runway. The control index is, in this case, based upon the number of holes left open or closed. Both indices were used in our early tests and subjected to correlation analyses. A correlation coefficient of .48 indicated that one or both of these indices was a poor measure of activity.

It is our feeling that mounds and earth plugs are indirect and poor indications of gopher activity that may be of value only when used over a large area and long period of time. Burrowing activity is influenced by many factors including season, sex, the availability of preferred foods and an acceptable mate. Additionally, gophers do expand their systems without creating above ground mounds. The open hole technique was felt to be a more direct and accurate indication of control and was used in our evaluations.

Table 1 is a summary of our efficacy tests conducted over the last three years in Yuma County, Arizona. The figures in this table substantiate what farm managers in the desert regions of Arizona have been reporting for the past few years; that available gopher baits do not currently achieve acceptable levels of control in heavily infested alfalfa fields.

Toxicity studies have indicated that these compounds are, in fact, toxic to the common valley pocket gopher. We have made the assumption then that sufficient quantities of the baits used in these studies were not being consumed by the targeted animals. They were either not finding the bait or were rejecting it.

The mechanical bait applicators manufactured by the Elston and Blackwelder companies are unusually sensitive farm machines. They require careful adjustment and continuous monitoring to construct a sufficient artificial burrow. It must be emphasized that the burrow constructed must be clean, solid and at the proper depth. Control cannot be achieved unless a good burrow is constructed.

We found that both machines required modification to build a good quality burrow in the sandy soils where most of the heavy gopher infestations were encountered in Yuma County. Alfalfa roots are not firmly rooted in these soils and the machine was dislodging whole or parts of plants, dragging them along and digging a furrow rather than a clean, solid burrow. This problem was rectified by replacing the 12-inch rolling coulter with a 22-inch coulter.

The second modification was necessitated because the Elston machine was designed to apply milo or some other small grain at the rate of 1.5 to 6 pounds per acre depending upon the number of shim plates added under the snap type feeding mechanism and the burrow spacing. Most bait application recommendations are made independent of the degree of gopher infestation. We encountered infestation levels of less than 10 per acre to more than 200, however.

A standard plate type planter was put on the Elston machine to allow us greater flexibility in bait application. This modification allowed us to deposit different bait materials and amounts at variable spacings from continuous to every 14 inches.

Mechanical bait applicator modifications were made that allowed us to deposit high rates of commercially available baits into burrows that were well constructed. Acceptable levels of control still were not achieved. Bait rejection was suspected.

A preliminary bait acceptance test was conducted in controlled laboratory type conditions to test our bait rejection theory. Ten adult pocket gophers, 5 male and 5 female, were individually housed in covered cages with 4 inch PVC pipe available for cover.

TABLE 1: RODENTICIDE COMPARISON - GOPHER CONTROL

Chemical	Concentration (%)	Bait	Distributor	Application Rate		Number of Tests	Average Control (%)
				Before Modification	After Modification		
Strychnine	.35	Wheat	U. S. Fish & Wildlife Service 3/	6.5	6.0	6	8
Strychnine	.35	Milo	U. S. Fish & Wildlife Service	10.4	7.0	8	12
Strychnine	.35	Milo (Peanut flavored)	- 2/	10.4	7.0	2	10
Strychnine	.3	Wheat (with attractant)	Cooke Laboratory Products "Gopher Probe Bait"	6.5	6.0	3	13
Strychnine	.3	Wheat, Barley, Raisin Mix (attractant)	Cooke Laboratory Products "Gopher Mix"	5.0	6.0	3	12
Strychnine	.5	Tablets (Attractant)	Cooke Laboratory Products "Gopher Tabs"	2.5	5.0	3	18
Strychnine	.5	Oats	U. S. Fish & Wildlife Service	1.6	2.5	8	5
Strychnine	1.8	Milo	Wilco Distributors Inc. "Gopher Bait"	10.4	7.0	1	25
Zinc Phosphide	1.82	Wheat	U. S. Fish & Wildlife Service	6.5	6.0	2	10
Zinc Phosphide	2.0	Pellets	Bell Labs "Gopha Rid"	5.8	5.0	6	22
Zinc Phosphide	2.0	Milo	U. S. Fish & Wildlife Service 3/	10.4	7.0	6	13
Zinc Phosphide	2.0	Cracked Corn	FMC Mouse Bait 200	7.5	8.0	2	17.5
Zinc Phosphide	2.0	Grain Mixture	FMC Mouse Bait 201	7.5	8.0	2	12.5
Zinc Phosphide	2.0	Peanuts	- 2/	- 1/	6.0	3	17
Zinc Phosphide	2.0	Diced Carrots	- 2/	2.5	3.0	1	10
Zinc Phosphide	10.0	Tracking Powder	Bell Labs "ZP Tracking Powder"	- 1/	7.3	1	5
Diphacinone	.005	Nuggets	Velsicol "Ramik Green"	- 1/	3.5	2	5
Diphacinone	.005	Nuggets	Velsicol "Ramik Brown"	4.8	5.5	2	7.5
Chlorophacinone	.005	Wheat (Attractant)	Chempar Chemicals "Rozol"	6.5	6.0	3	0
Chlorophacinone	.005	Paraffinized Pellets (Attractant)	Chempar Chemicals "Rozol"	6.0	5.8	3	0
Chlorophacinone	.005	Paraffinized Pellets (Attractant)	ArChem Corp. "Parapel"	- 1/	3.8	1	0
Brodificoum	.005	Pellets	ICI Americas "Talon"	5.8	5.0	3	13
Brodificoum	.005	Milo	ICI Americas "Talon"	10.4	7.0	1	17.5

1/ Not possible to apply this material with the Elston Burrow Builder as delivered from the factory

2/ Mixed by us for experimental purposes.

3/ Mixed for experimentation only.

The gophers readily adapted to these conditions although it should be emphasized that gophers are very sensitive to their environment and their behavior under these conditions may poorly represent their behavior under field conditions.

Twenty-five different bait materials were offered to this group of ten gophers over a period of three months. Fresh, whole alfalfa plants and water were always kept available. The bait materials offered included grain (milo, wheat, oats, barley) sunflower seeds, peanuts, alfalfa pellets, dried fruit (apples, apricot, peach, pear, raisin) candy, cheese, fresh vegetables (carrot, green onion, turnip, lettuce, bean sprouts, celery, potato) and fresh fruit (orange, apple, grape, grapefruit).

The results of this limited and preliminary study indicated that the gophers bait preference behavior was complex and influenced by many factors including deprivation level, dehydration, the animals sex, the animals previous experiences and other factors. Although all baits were equally excessible the gopher sometimes grabbed the first material encountered. Some useful observations can be made, however.

The gophers appeared to prefer fresh alfalfa over almost all bait materials offered. The least preferred were the most commonly used baits; milo, wheat, oats and barley. These were not accepted when fresh alfalfa was available. Of the other materials, the order of preference seemed to be potatoes, followed by fresh fruit, vegetables, candy, cheese, dried fruit, nuts and seeds, alfalfa pellets and finally grain. No standing water was consumed and the animals appeared to satisfy their moisture requirements from the baits and alfalfa.

There has been ample evidence that the artificial burrows were used by gophers in all tests where the mechanical bait applicator operated correctly. This machine still appears to offer the most potential where heavy infestations are present. The challenge now is to find the best bait/toxicant combination. Until we find an acceptable bait material we will not be able to determine the efficacy of the various commercially available toxicants. Crop rotation with a crop that is unable to support large gopher populations, is presently the best recommendation for controlling heavy infestations of the pocket gopher.