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ABSTRACT: Preliminary trials suggest that the delivery system or unit described may prove to be a highly selective and effective system for delivering drugs or chemicals to coyotes. The goose egg-size unit's selectivity and effectiveness relies heavily on a newly developed synthetic olfactory coyote lure based on trimethylammonium decanoate (TMAD). The coyote is attracted to the unit, which is placed at ground level, by this highly selective scent lure which elicits a biting and chewing behavior. When a coyote bites or chews the exposed part of the unit, it punctures a plastic reservoir packet containing 10 to 15 ml of viscous sucrose liquid, which serves as a taste attractant, a carrier (diluent) of the active ingredient (i.e., toxicant, chemosterilant, etc.), and as a way of diluting the toxicant, since the amount of active ingredient consumed depends upon the amount of liquid consumed. The sucrose is avidly consumed by coyotes, insuring that coyotes will ingest most of the active ingredient.

INTRODUCTION

Several devices, including the coyote-getter, the M-44, and the toxic collar, have been either used or researched as a means of delivering various chemicals (primarily toxicants) to depredating coyotes (Canis latrans). However, all involved in animal damage control know that other alternative delivery approaches, especially if they are highly selective, effective, relatively inexpensive, and easy to use, are still needed.

During the past several years we have developed and evaluated a number of types of delivery units or devices. The principle of the delivery system described herein still needs much research and field testing before the most ideal units or devices can be decided upon. An example of one such unit is shown in Fig. 1.

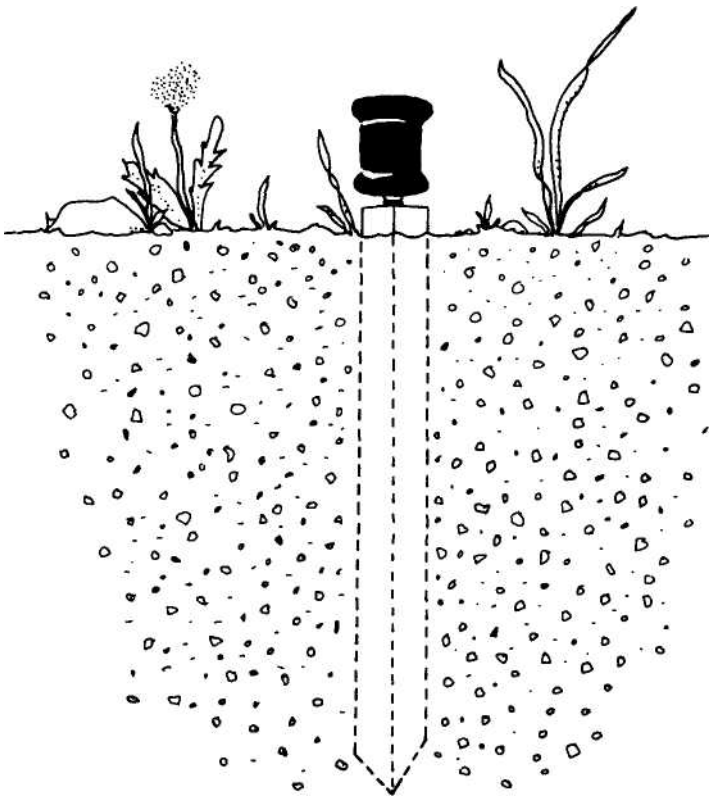

Fig. 1. One type of experimental unit positioned in the field. Research is under way to improve the efficacy of this unit.

The objective of our study has been to develop a passive system for delivering a variety of chemicals selectively to wild coyotes. A series of physical and biological parameters had to be met, including high acceptance by coyotes, yet be of only minimal interest to all or most nontarget species. The delivery system proposed represents a composite of ideas which have evolved through considerable laboratory and field testing over several years. In addition to satisfying the biological aspects, we think a unit of the type we are proposing will also be economical and practical.

The proposed delivery system has the theoretical capability of selectively delivering chemosterilants, rabies vaccine, biological marking agents, aversive conditioning agents, tranquilizers, and medications, although it has been tested only with placebo loads in the field and several toxicants in our pens. Since the main interest in such a delivery unit lies with its proposed use with toxicants, the current emphasis of our research is directed toward its potential use in coyote control with sodium fluoroacetate (1080) and/or other predacides.

COMPONENTS OF THE DELIVERY SYSTEM

An iron or wooden stake about 12 inches (30 cm) in length is used to hold (anchor) the delivery unit in the proper position at ground level. The stake is the only reusable part of the device.

We have experimented with many delivery techniques and types of units. The goal is for a finished unit's head to be about 2 or 2 1/2 inches (5 or 6 cm) long and 1 1/2 to 2 inches (3 to 5 cm) thick. The head component and the various ingredients discussed below can be assembled in many different ways, and one of our current research projects is to develop one or more types of units which meet our criteria for efficacy and selectivity. We are constantly making improvements.

THE W-U LURE

The effectiveness of the delivery unit relies heavily on the use of an olfactory lure that attracts coyotes and elicits a biting-licking response. Lures which attract coyotes to the control site but do not elicit the desired behaviors will not activate the unit, thus be ineffective. Based on nearly 10 years of research in another USDA-supported project conducted in cooperation with one of the authors (Teranishi) and his colleagues at the U.S. Department of Agriculture's Western Regional Research Center at Berkeley, California, we have developed a lure which appears to hold promise for making the system both highly selective and effective (Fagre et al. 1981).

The lure, which is named the W-U lure (incorporating the first initials of Western Regional Research Center and the University, to represent the organizations of the two research teams), is a synthetically produced lure based on the compound TMAD (trimethylammonium decanoate). Though TMAD itself is highly attractive to coyotes and quite coyote-specific, a number of minor additives (sulfides) have been developed which enhance the action of the basic compound. Others are still being researched. These have been incorporated into the W-U lure. The lure has been tested extensively on penned coyotes and also subjected to about two man-years of field testing with wild coyotes. It is highly attractive to coyotes, yet does not appear to exhibit meaningful attraction for other forms of wildlife as long as other parts of the unit's head are not attractive. Tests by one of our assistants in Animal Science at Davis showed that domestic livestock are not attracted by the lure (K.A. Hill, unpublished report).

The W-U lure has a highly repulsive odor which is persistent and highly unpleasant to people. By diluting the W-U lure to recommended levels and incorporating it into the proper matrix for field use, including weather-proofing, the odor is made tolerable to the user. The disagreeable odor, however, definitely provides a measure of safety in the field, for it will discourage any unwanted handling of the units once they have been placed in the field and activated with the lure. The odor can contaminate clothes and automobiles, so the device is not likely to be picked up and carried on one's person or in a vehicle for any length of time unless placed in an airtight container. The repulsive odor of the lure will certainly discourage any human from consuming the contents of the reservoir packet.

When compared to other lures, both natural and synthetic, the W-U lure has been found to elicit an extraordinary amount of biting-licking behavior as opposed to the rubbing-rolling behavior elicited by many other lures we tested. Additionally, the W-U lure shows a high rate for consistency of attraction, except for the summer period when lures in general are not as appealing to coyotes (Fagre et al. 1981).

THE UNIT HEAD

The head of the unit, which contains the various ingredients, needs to be designed with several objectives in mind: 1) to provide a physical makeup (size) and configuration (shape) which is acceptable to coyotes, yet without the lure be essentially unattractive to all species of animals; 2) to provide protection from any accidental puncturing of the packet containing the active ingredients; and 3) to permit secure anchorage to the stake, thus preventing removal of the intact reservoir packet from the placement site.

The shape of the head with its wrappings must be able to protect the packet of sucrose liquid, which contains the active ingredient and dyes, in such a way that the coyote must bite, chew or gnaw before the packet is punctured. Both the odor of the W-U lure and then the sweet taste of the active ingredient carrier are essential to hold the coyote's interest. A few coyotes have abandoned their first efforts before piercing the reservoir packet and consuming the ingredients with some of our test units. This sacrifice in efficacy can be tolerated, we think, as it is in favor of increased selectivity, thus providing an additional safeguard to nontarget predators. We think that some of these coyotes will puncture the packet on subsequent visits, but this has not been confirmed in the field.

Disturbance of the units by cattle, sheep or deer can be minimized by a design which allows for considerable downward and sideward pressure which normally would result from incidental trampling. Calves and yearlings, because of their curiosity, seem to be most prone to investigating the units, especially if we clear a meter-wide circle around the devices so we can read the tracks of animals that approach, ignore, or investigate the units.

THE PLASTIC PACKET AND ITS CONTENTS

The plastic reservoir packet we have used, which holds from 10 to 15 ml of diluent/chemical mixture, is formed from 1 1/2 inch (3.8 cm) wide plastic tubular stock 2 mil in thickness. One end is heat sealed to form the 4-inch (10 cm) long bag to hold the viscous sucrose carrier, the active ingredient (i.e., toxicant), a biological tracer (Rhodamine B), and a compatible discoloring pigment (lamp black powder). All of the ingredients are dissolved or suspended in the viscous sucrose carrier which is measured into the open packet, then the top is heat-sealed.

A sucrose solution the consistency of thick syrup, i.e., food-grade corn syrup, is used as a carrier because previous observations and tests have demonstrated that coyotes have a high preference for such sweet liquids. The high viscosity of the syrup is important because of the design of the delivery system. If the carrier is too thin, then when the packet is punctured the liquid will quickly run out onto the ground, leaving inadequate time for the coyote to lick it from the unit. If the carrier is too thick, it will not flow at all and this is undesirable because the punctured packet may not provide a sweet taste to the coyote rapidly enough to hold its interest to the point where it will consume much of the contents. Once the packet is punctured by the coyote, the animal in a sense "milks" the packet to obtain the sweet syrup contents, and/or eats the plastic packet. We have not tested it in extremely cold conditions, but expect that glycerine could be added to the sucrose syrup to prevent freezing without sacrificing efficacy. More research is needed on this aspect.

The viscous carrier has characteristics which make it quite versatile for various kinds of active ingredients. Water-soluble active ingredients can be dissolved in it and most insoluble powdered materials can be suspended in the liquid. The viscosity of the carrier also plays a role in deactivation of the unit should the packet for some reason be punctured or burst while placed in the field. If the contents are not licked up, e.g., by a coyote, they slowly drip into the soil below and decompose. Rain or snow, which is common in the season when the units will mostly be used, will further dilute any spilled liquid carrier.

A biological tracer/marker, Rhodamine B, is a bright red dye which is highly water soluble and will readily stain the skin and various other tissues when used at 0.2% w/w in the diluent syrup. In addition to the visual red color, it fluoresces a reddish-orange color under black light, even when it may not be detected under normal light. We add 1.5% (w/w) lamp black powder to the syrup to change the bright red color to a dark brownish color to provide a visual color screen of the Rhodamine B while in the reservoir packet. This does not affect its value as a biomarker in the animal or environment.

When Rhodamine B is used in association with a toxicant, it will be easier to confirm in the field when a coyote is killed by the toxicant. If a coyote or nontarget animal is found dead, but it contains no dye in the mouth or intestinal tract, its death would likely be attributable to something other than the toxicant. The use of a biomarker is a valuable adjunct to the unit because it helps substantiate the coyote kills and will provide "tattletale" evidence should the delivery system fail and affect some nontarget species such as a dog.

PREDACIDE--SODIUM FLUOROACETATE

The predacide sodium fluoroacetate (1080) is used as an example of the capability and efficacy of the delivery system. It has long been recognized that 1080 is one of the most efficacious predacides known, and in the prescribed amounts 1080 is more specific to canids because of their unusually high susceptibility than, for example, strychnine, and far less potentially hazardous to avian predators or humans (Robinson 1948, Atzert 1971, Rammell and Fleming 1978).

The delivery system's versatility, however, would permit the use of several other kinds of predacides or mammalian toxicants. For example, as part of another project in studies using confined coyotes, the rodenticides diphacinone and fluoroacetamide were both fatal to adult coyotes (ranging from 20 to 30 pounds [9 to 14 kg] in weight) when delivered by the unit at doses no greater than 10 and 60 mg respectively of active ingredient per packet.

Ten-eighty is dissolved in a small amount of hot water and then added to the sucrose syrup in the prescribed amounts prior to sealing the packet. The high susceptibility of coyotes to 1080 permits extremely low doses to be used. Ten-eighty used at from 5 to 10 mg per packet has been effective in limited tests with confined coyotes. In regions where coyotes are lighter or heavier in weight, the amount of toxicant can be adjusted accordingly.

The future use of 1080 as a predacide in this type of delivery system will depend on its re-registration for that purpose by the Environmental Protection Agency (EPA) and the various state pesticide regulatory agencies.

A large number of tests using our various delivery units have been conducted for several years with placebo packets (i.e., with all the ingredients except the toxicant) using penned coyotes as well as on rangeland in Mendocino and Stanislaus Counties of California, where coyote depredations were

commonplace. Thus, to date, the selectiveness of this delivery approach for coyotes has only been verified by using it without any toxicant.

WRAPPING AND COATING THE HEAD

Various techniques have been tried for encompassing the packet of chemicals securely to the head of the anchor stake. Rabbit skins were tried but they attracted small rodents. Other materials we are testing include plastic webbing, small pieces of a wool rug, fiber-reinforced pressure-sensitive binding tape (such as used to wrap packages), tough elastic bandage-type self-adhering tape (Vetrap), and dipping the finished head several times into melted paraffin. To obtain a grayish-black appearance we have added 2% w/w lamp black to the paraffin. Further tests are needed to determine the most suitable paraffin for the various temperature extremes.

METHODS OF FIELD USE

Field tests of various passive delivery systems over several years have provided us with information upon which a common-sense list of guidelines for their use could be assembled. The following abbreviated guidelines for field use of such units are provided:

1) Select (based on sign, terrain, location of livestock, source of depredating coyotes, etc.) the most ideal site for locating the unit, taking into consideration potential hazards to humans, livestock, and other nontarget species including dogs.

2) Drive the stake component into the ground, leaving the top protruding just above ground.

3) A preassembled loaded head is secured onto the anchor stake.

4) A small amount of paste-type coyote lure (W-U lure) is then smeared onto the head.

5) Each unit and the property where used is posted with appropriate warning signs.

6) Units must be checked periodically (frequency depends on the situation) to determine if heads have been deactivated (consumed) by a coyote. Spent heads or heads which show defects which may influence their future efficacy for coyotes or safety for nontarget species should be replaced with new heads.

7) Units which have been in the field for several weeks, if still needed, may require fresh coyote lure.

8) The delivery systems should be spaced as the coyote problem demands; however, except under special circumstances, they should not be placed closer together than about 100 yards (100 m). This reduces the possibility of a single coyote taking more than one unit.

9) When the project is complete, all heads are removed and properly stored or disposed of. The field warning signs should also be removed.

10) The stakes may be pulled and removed from the field or left and periodically prebaited with placebo heads of the lure and syrup diluent so that if coyote depredations reoccur, and control is needed, heads containing active ingredient can be substituted at these "prebaited" sites.

DISCUSSIONS AND CONCLUSIONS

In the development of this delivery system, considerable attention has been paid to making it as selective (i.e., coyote-specific) as possible. Natural materials such as fur or fetid scent lures have purposely been omitted from the units makeup in favor of synthetic materials. Test evidence to date points to an increased selectivity to coyotes if only synthetic materials are used and the W-U lure is applied to initiate the desired behavioral traits to activate the unit.

The selective nature of the device can be theoretically increased, along with increased efficacy, by placing placebo heads (i.e., heads which have been prepared with all components and ingredients except the toxicant) in the field. This would be similar to prebait and would get the coyotes used to the unit and how to puncture the packets for the reward of sweet syrup.

Once the unit at a specific locality is visited and deactivated by a coyote, the spent placebo head can be replaced with a new one containing the toxicant. Whenever sign indicates that animals other than coyotes have visited or tampered with the unit, the unit should be removed and located elsewhere.

Stray or roaming dogs and unrestrained dogs of trespassers are believed to be at some potential risk whenever the unit contains a toxic predacide. However, the risk to dogs is believed to be below that of coyotes because dogs often do not respond behaviorally to the lure in the same way as coyotes. Dogs larger than coyotes will be protected to a degree by the small dose of toxicant used, but synthetic TMAD used as the lure is known to be attractive to some dogs.

Dogs on leashes or within visual sight and voice call would not likely be in jeopardy even if they approached the unit because of the time required to puncture the packet and consume the active ingredient. There would be time to pull or call the dog from the unit.

As a precaution, farm dogs such as sheep or cattle dogs could be trained to avoid the units through aversive conditioning as is done for some other control methods such as the M-44. To accomplish this, the packets could be loaded with red pepper or hot sauce. After a few unpleasant experiences, the dog would learn to avoid all units scented with W-U lure.

An encapsulated overview of the important factors contributing to the selectivity of the unit to coyotes, when used with the predacide 1080, is as follows:

1) Placement and positioning of the unit in the field.

2) The highly selective lure (synthetic coyote attractant).

3) Configuration of the unit's head.

4) Predacide carrier (sucrose syrup diluent) and its containment (reservoir packet).

5) Protective covering or overlay wrappings around packet.

6) Predacide: characteristics, species susceptibility, and amount used.

Human safety is paramount with any control method, and the following factors about the unit, when used to deliver a toxicant such as 1080, are believed important in safeguarding people:

1) Unit placement where coyote depredation occurs in remote areas away from houses and populated areas.

2) The highly persistent and obnoxious odor of the lure.

3) The generally unattractive and camouflaged appearance (shape, color, texture) of the unit when placed in the field.

4) The unattractive dark brownish color and sticky nature of the carrier (diluent) should a packet be accidentally broken.

5) Its relatively secure anchorage in the field.

6) The labeling of the active ingredient packet in accordance with existing pesticide regulations.

7) Posting with appropriate warning signs at all access routes to the property where units are set and also near each unit.

Although effective, this delivery system is only one of several possible types of passive systems which could be developed. It is not intended to be the ultimate answer to solving coyote-livestock depredations problems, but rather it is just another control tool. Such a unit's usefulness will depend much on the situation, livestock-grazing practices, and the habitat occupied by a depredating coyote. The professional biologist who has the responsibility of animal damage control will be the one to determine how, when, and where this delivery system approach will best fit into the overall coyote control strategy.

The units with the active ingredient should be field tested for both efficacy and selectivity, and improvements or modifications made, if needed, before putting them into wide use. When possible, ideas and suggestions from other researchers and USF&WS ADC personnel will be incorporated to continue to improve upon the units.

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LITERATURE CITED

ATZERT, S.P. 1971. A review of sodium monofluoroacetate (Compound 1080), its properties, toxicology, and use in predator and rodent control. USDI, Fish and Wildlife Service, Special Scientific Report - Wildl. No. 146, Washington, D.C. 34 pp.

FAGRE, D.B., B.A. BUTLER, W.E. HOWARD, and R. TERANISHI. 1981. Behavioral responses of coyotes to selected odors and tastes. In: Worldwide Furbearer Conf. Proc, Vol. II (J.A. Chapman and D. Pursley, Eds.), pp. 966-983. Frostburg, Maryland.

RAMMELL, C.G., and R.A. FLEMING. 1978. Compound 1080, properties and use of sodium monofluoroacetate in New Zealand. Animal Health Div., Ministry of Agric. and Fish., Wellington, New Zealand. 112 pp.

ROBINSON, W.B. 1948. Thallium and Compound 1080 impregnated stations in coyote control. J. Wildl. Manage. 12(3):279-295.