

The Rodents (Mammalia: Rodentia) – Gnawing Away on Crops and Options for the Integrated Pest Management at Field

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Abstract

This document is meant to outline the rodent's damage to several crops, components of a rodent control plan, and to guide growers to use local resources to help them to formulate such strategy. Rodents, as one of the major important vertebrate pests are directly related to the production, storage and processing of the agricultural crops and their eventual utilization by man and his livestock for food, fiber and protection. The rodent's damage to several annual and perennial crops includes invasions of cereal, vegetable, fruit, plantation and other cash crops. The life profile of rat and mouse pests is very strange, their life span is about twelve to eighteen months, these breed constantly all over the year, male and female are sexually mature at six to eleven weeks, and females give birth to five to twenty young at one time and reproduce four to six times within a year. So, the rodents should not be tolerated in and around crops because several effective and low hazard options are available to eliminate rodents. Growers in susceptible areas should implement a rodent management plan to maintain yield and minimize damage to plantation. The most important steps in controlling of rodents involve sanitation, exclusion and elimination of their home or nest sites. These methods of control should be taken place before any population control efforts are made. Rodent control using Integrated Pest Management (IPM) may rely that the county should monitor the facility and use several techniques to reduce the favorable environmental factors that promote rodents and their ability to thrive (food sources and harborage). Integrated pest management approach to rodents management minimizes reliance on chemical pesticides. The three basic rules of a control program are to deny pests access to the establishment; deny pests food, water and a hiding or nesting place; and work with qualified pest management professionals to eliminate pests that are in the establishment. For effectiveness, any rodent control plan must be diligent and consistent in a time frame determined by the extent of the rodent pressure in the general cropping areas.

Keywords

Crop, Pest, Rat, Mouse, Muridae, Control, Agricultural Pests, Rodent

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1. Introduction

Agricultural pests, such as rodents may cause significant damage to crops and reduce growers' ability to provide agricultural commodities to the market. When this occurs, the broader economy may suffer due to the reduced production and fewer commodities for processing and sale. If the agricultural sector plays a major role in the economy, the

multiplier effects of this type of damage may be adverse since the agricultural sector typically provides inputs to almost all other sectors of the economy (e.g., manufacturing, retail trade, and accommodation and food service) (Desoky, 2014 a). Rats are a costly, unhealthy nuisance, virtually everywhere they spread disease, destroy crops in the field, destroy stored food, damage household property, and damage forest and fruit trees. Rats consume and destroy million tones

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of field crops, and million tones of grains in storage around the world annually with their urine, parasite carrying, feces, hairs, and secretions. Pest rodents can be a serious problem in a restaurant where they can contaminate food supplies as well as damage to facilities. More importantly, they can also contribute to foodborne illness and other diseases. Pesticides are often used to control pests but pesticides alone are not the solution of the problem. A better solution is to have an integrated pest management program (IPM) as part of food safety program (Sarwar et al., 2011; Sarwar, 2015 a; 2015 b).

Rodents are implicated in many types of damage, including crop and tree damage, structural property and cable damage, disease transmission, and significant predation on native species of animals and plants in states to which rodents have been accidentally introduced. Rodents can cause also damage by chewing wood and other items (Witmer et al., 1998). To combat this damage, growers often use a variety of pest control measures including pesticides, trapping and exclusionary fencing. These methods are costly but they reduce damage and they contribute to the general economy, as growers purchase pesticides, fencing material or traps (Shwiff, 2009).

2. How to Spot a Rat Infestation

Because rats are active throughout the year, periodically check for signs of their presence should be taken. Once rats have invaded garden or landscaping, unless the house is truly rodent proof, it is only a matter of time before peoples find evidence of them indoors. Experience has shown that it is less time consuming to control rodents before their numbers get too high, and fewer traps and less bait may be required if control is started early.

The yard and home may be inspected thoroughly, if the reaction to any of the subsequent queries is surely then the area may have a rat problem. This includes finding of rat droppings around dog or cat dishes or pet food storage containers, hearing of noises coming from the attic just after dusk, found remnants of rat nests when dismantling firewood stack, and if dog or cat brings the dead rat carcasses to home. Further, is there an evidence that rodents are feeding on fruit or nuts that are in or falling from the trees in yard, burrows are seen among plants or damaged vegetables when working in the garden, rats are seen traveling along utility lines or on the tops of fences at dusk or soon after it, found rat nests behind boxes or in drawers in the garage, there are smudge marks caused by the rats rubbing their fur against beams, rafters, pipes and walls, burrows seen beneath compost pile or beneath the garbage can, there are rat or mouse droppings in recycle bins, have ever removed a drowned rat from

swimming pool or hot tub, and seen evidence of something digging under garden tool shed or doghouse, are signs of rodents occurrence.

3. Threshold of Concern

Control efforts should be made when unacceptable rodent activity is observed in the working areas and damage to the growing crops. Unacceptable levels of rodent activity include; any visible signs of rodent activity within a habited building (shop, office) or an uninhabited building area (shed, garage) and agricultural crops. Unacceptable levels of rodent activity in unoccupied areas will be tolerated unless there is visual sighting of rats in the daytime (activity that implies high populations in the area) or harborage (nest) is found. One rat or mouse or evidence of rodent presence (e.g., fresh droppings, gnaw marks) justifies setting of traps, improving sanitation and rodent proofing in the buildings. Rodent populations can be reduced by population management (i.e., use of rodenticides) or by habitat management (i.e., vegetation management, barriers and land uses) that reduces the area's carrying capacity for rodents.

4. Population Control

An appropriate recognition of the rodents species being controlled is a vital aspect in the accomplishment of victory or collapse of the control process used. When food, water and shelter are available, rat populations can increase hurriedly. While the most permanent form of control is to limit food, water, shelter, and access to buildings, then direct population control often is necessary. For controlling rats indoors, using traps is best practice to adopt. When rodenticides (toxic baits) are used in structures, rats can die in inaccessible locations such as within walls or ceilings. In hot weather, the stench of a dead rat can be unbearable and can necessitate cutting a hole in the wall to remove the carcass. Also, ectoparasites such as fleas and mites often leave dead rat carcasses and can infest the entire house if the carcass is not removed promptly.

4.1. Trapping

Trapping is the safest and most effective method for controlling rats in and around homes, garages, and other farm structures. Because snap traps can be used over and over, trapping is less costly than poison baits but is more labor intensive. Traps can be set and left indefinitely in areas such as attics where rats have been a problem in the past. The simple, wooden rat-size snap trap is the least expensive option, but some peoples prefer the newer plastic, single-kill rat traps, because they are easier to set and clean. Snap traps with large plastic treadles are especially effective, but finding

the best locations to set traps is often more important than what type of trap is used. Generally, young rats cannot be trapped until they are about a month old, which is when they leave the nest to venture out for food.

Nutmeats, dried fruit, bacon, or a piece of kibbled pet food can be attractive bait for setting traps. Fasten the bait securely to the trigger of the trap with light string, thread, or fine wire, so the rodent will spring the trap when attempting to remove the food. Even glue can be used to secure the bait to the trigger. Soft baits such as peanut butter and cheese can also be used, but rats sometimes take soft baits without setting of the trap. Set traps properly so the trigger is sensitive and will spring easily.

The best places to set traps are in secluded areas where rats are likely to travel and seek shelter. Droppings, gnawing, and damage indicate the presence of rodents, and areas where such evidence is found usually are the best places to set traps, especially when these areas are located between their shelter and food sources. Place traps in natural travel ways, such as along walls, so the rodents will pass directly over the trigger of the trap.

Field rats-Bamboo bow and arrow traps, pot traps and break-back bans are useful for catching field rats, also break-back traps, as their name implies, are deadly useful. Spring traps and multiple cage traps are common for protecting food in field crops. However, the ecology and behavior of roof rats differ significantly from that of Norway rats and native rats. These ecological and behavioral differences are important to consider when implementing control methods. For Norway rats, set traps close to walls, behind objects, in dark corners, and in places where rat signs, such as droppings, have been seen. Position traps along a wall so that they extend from the wall at right angles, with the trigger end nearly touching the wall. If traps are set parallel to the wall, they should be set in pairs to intercept rodents traveling from either direction. For roof rats, the best places for traps are off the ground in locations where rats might be coming down from their nests to find food such as on ledges, shelves, branches, fences, pipes, or overhead beams where they can be fastened with screws or wire. In homes, the attic and garage rafters close to the infestation are good trapping sites. In areas where children, pets, or birds might contact traps, place the trap in a box or use a barrier to keep them away.

4.1.1. Electrocution Traps

Traps that kill rats by electrocution (e.g., Rat Zapper or Victor Electronic traps) are considerably more expensive than other traps, but some homeowners, managers of commercial buildings and pest control companies have found them to provide good results. As with snap traps, for existing rodent populations, it is important to use enough traps to

achieve control in a timely manner. These traps need to be checked frequently, and dead rodents should be removed for disposal.

Do not touch rodents with one's bare hands, and wash thoroughly after handling traps. Use disposable gloves to handle dead rodents. Dispose of dead rats by burying them or by placing them in a sealed plastic bag and putting them in the trash.

4.1.2. Glue Boards

Glue traps, which work on the same principle as flypaper, are not recommended for controlling rats, as they are much less effective for rats than for mice. A major drawback with glue boards and other live-catch traps is that the trapped rat might not die quickly, and it will need to kill it by delivering a sharp blow to the base of the skull using a sturdy rod or stick. Rats caught in glue traps can struggle for quite some time, often dragging the trap as they try to escape. When used indoors, cats and dogs can get into the glue and track it around the house and outdoors; also glue traps can capture lizards, birds and other non-target wildlife.

4.1.3. Live Traps

Live traps are not preferred, because trapped rats must be either humanely killed or released elsewhere. Releasing rats outdoors is not recommended, as they can cause health concerns to peoples, pets, and other domestic animals. Because neither the roof rat nor the Norway rat is native to the several states, their presence in the wild is very detrimental to native ecosystems.

4.2. Other Control Methods

Rats are wary animals, easily frightened by unfamiliar or strange noises, however, they quickly become accustomed to repeated sounds, making the use of frightening devices including high frequency and ultrasonic sounds are ineffective for controlling in stores. The rats can be drowned or flushed from their burrows by flooding them with water from a crop or garden and then closing the holes with soil is a good practice.

4.2.1. Barriers to Rodent Movement or Burrowing

The ability of rodents to construct and maintain burrow systems could be reduced by heavy compaction of the site's soil where vegetation occurs over it. Alternatively, a substrate (e.g., gravel, very fine sand) is less supportive of intact burrows and could be used. Another possibility would be a layer of mesh or woven material placed over the surface that would allow grass to grow through, but would not allow rodents to move between the surface and the subsurface. Finally, a barrier (e.g., cement or metal flashing) could be

established at the perimeter fence, extending at least 25 cm (10 inches) above and below the soil surface to restrict rodent dispersal (Witmer et al., 2000).

4.2.2. Rat Destruction

When fields are flooded during monsoon, rats remigration takes place and concentrate near residential areas for food and shelter. As well, rats tend to breed during the rainy season. Therefore, though rats should be controlled throughout the year, trapping and poisoning rats during the monsoon is most effective. Trapped rats should be drowned in their cages in a water pond.

4.2.3. Biological Control Measures

Outdoors in rural and suburban environments, rodents face many natural enemies including predators such as raptors, coyotes, dogs and cats. The predators, especially cats and owls, eat rats and mice, but some house cats do not have the ability to prey on adult rats, so, may not be able to keep rodent numbers below levels that are acceptable to most peoples. The cats (*Felis chaus nilotica*) as naturally occurring biological control agent are used in grain storages. The percentage of reduction during their presence is recorded as 90.91%, after 6 months the reduction % by the predator is 33.33%. The decreased in the efficiency of cats in reduction rodent population after six or seven months may be due to the predation prey efficiency of cats. Also, the feeding habits of the cats to prey upon variety of preys, switch their attention for one to other prey species according to the relative abundance. This switching behavior has two important effects, it allows the predator to survive when a particular prey species is low in numbers and it helps to keep it in check.

One common biological method for controlling rodent populations is to attract rodent predators, most frequently by using owl boxes. Because they are relatively inexpensive and can be populated for a long time, owl boxes are being employed in greater numbers as part of a rodent management program. The principle is simple, the higher the owl population the fewer the rodents.

4.2.4. Bait Application

The test bait evaluated in a study is a rolled oat bait formulated to contain an estimated concentration of 250 ± 25.0 mg/ kg microencapsulated (to prevent taste aversion) imidacloprid. Prior to use, two batches of bait are mixed and analyzed for imidacloprid concentration using High Performance Liquid Chromatography following the methods of Liu et al., (2005) and Baskaran et al., (1997) modified for rodent bait. The mean imidacloprid concentration in the rodent bait of the first batch is determined to be 272.4 ± 7.2 mg/ kg and the imidacloprid concentration of the second

batch is determined to be 246.5 ± 4.8 mg/ kg. Bait is applied to treatment plots at rates of 60 g per active burrow using measuring cups. Bait is applied to each burrow on each treatment plot every 3rd day (day 0, day 3, and day 6) for the first six days and at weekly intervals thereafter (day 13, day 20 and day 27). On each baiting day after the initial baiting (day 0), bait is applied to burrows where there is evidence that bait has been consumed.

Read all label directions on the bait and place it only in areas that are specified on the label. Put bait in locations out of the reach of children, pets, domestic animals, and nontarget wildlife or in tamper-resistant bait stations as required by the product label. In many cases, bait stations must be resistant to destruction by dogs and by children and must be constructed in a manner that prevents a child from reaching into the bait compartments and getting the bait. If bait can be shaken from stations when lifted or tipped, stations must be secured or otherwise immobilized. As an applicator is with any poison, take care to ensure safety to children and pets by limiting their access to the bait. Clearly label all bait stations with appropriate warnings, and store unused bait in a locked cabinet or another area inaccessible to children and domestic animals.

5. Pets and Rat Control

Many of the methods and materials used to control rats can affect pets as well. All rodent baits are toxic to dogs and cats, so be cautious when using these products. Because anticoagulants are cumulative and slow acting to various degrees, depending on whether it is multiple or single feeding, dead rats can contain several lethal doses of toxicant, and secondary poisoning of pets and wildlife is possible if they eat several rat carcasses over a few days. While this secondary poisoning is possible, it is not common with the first-generation anticoagulants. Most fatalities in pets involve dogs and are due to the animal eating the bait directly (primary poisoning) or a combination of direct bait consumption and secondary poisoning. Concerns about both primary and secondary hazards of second-generation anticoagulant baits lead to restrict their retail sale, making them available only to agricultural users and professional pest control personnel. When such baits are in use, extra caution is needed, as exposure to even a single dead rodent might be enough to poison a pet. The best precaution is to keep pets away from bait and dead or dying rodents. Dispose of dead rodents by burying them or by placing them in a sealed plastic bag and putting them in the trash, but do not handle them with bare hands.

Use as many traps as are practical so trapping time will be short and decisive. A dozen or more traps for a heavily

infested home might be necessary and place rat traps about 10 to 20 feet apart. If a rat sets off a trap without getting caught, it will be very difficult to catch the rat with a trap again. To reduce the likelihood of trap shyness, one strategy is to leave traps baited, but unset until the bait has been taken overnight. To avoid using too few traps, if bait is taken from all traps, double the number of baited traps exposed, and keep doing so until some traps remain with bait untaken; then bait and set all traps (Sarwar, 2015 c).

6. Management Strategies for Rodents

A successful rodent's management strategy may include; 1. Rodent control strategies must consider economics as well as ecology. 2. The differences in species composition of rodents depending on locality, habitat type and preferred food. 3. Population dynamics must also be taken into account; including intrinsic density-dependent and extrinsic density-independent factors. 4. High population density of rodents occurred in spring causes an increased activity. 5. However, the lowest density is during winter season. 6. It is of interest to point herein that grey and green color of rodent baits can be used effectively in preparation of rodenticides baits. The rodent species prefer the vegetable baits in the traps. This can be useful to prepare rodent baits to capture rodents. 7. The control of rodents depends upon the locality, neighboring and available food. 8. Mechanical, biological and chemical control methods can be used effectively in an Integrated Pest Management Approach (IPMA) for the regulation of the rodents population density. This approach will allow us to predict rodent outbreaks and the effects of climatic variability more accurately (Desoky, 2014 b).

7. Cleanup Precautions

Because dead and dying rodents can cause odor and fear, monitoring and control devices should be checked on a daily basis. The risk of contact with rodent-associated pathogens and allergens increases when cleaning areas that have been infested with rodents. Maintain good ventilation and avoid stirring up dust. Wetting down the site with a 10 percent bleach solution is recommended for hantavirus prevention. Wear the appropriate protective equipment including full-face masks with filters because a toxic gas will be produced by use of bleach solution.

8. Conclusion

The rodent population should be carefully monitored with a standardized protocol so that direct population control can be

quickly implemented, if necessary. Fall and spring are the most active time for rodents and they seem to be the worst seasons for damage, thus any management program must focus on these seasons. The best approach for rodent control takes an integrated pest management (IPM) approach that includes sanitation, exclusion, lethal control and occupant education. While inspecting pest, listen for scratching, and look for droppings, damage, urine (using a black light) and rub marks. Rodents will forage on a variety of items, so sanitation in addition to exclusion is critical. For rodent management action plan, an integrated approach must be taken to reduce rodent damage to crops and equipment. This plan must involve reducing acceptable habitats for rodents close to the field and may involve trapping or poisoning to control active populations. In addition, the dripline itself can be protected using the repellent effect of some pesticides and slightly acidifying the soil around the lines. In some cases, it will be necessary to experiment with approaches on a small scale to see which will be most effective and practical in a specific setting. Management of rodent populations on agricultural land generally falls into the habitat modification and exclusion to reduce population pressure, proper drip line installation practices, biological control, use of repellents to deter invasion and protect equipment, and extermination categories. Many growers have implemented successful plans for rodent management on their fields by protecting the investment in their irrigation system and improving crop yields.

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