Unit 1
MODULE
7

RODENTS

I. Introduction

Rodents are the largest, and one of the most interesting, groups of mammals. They are important components of virtually all of the earth's terrestrial ecosystems and are important herbivores that aerate the soil by burrowing activities and assist plant propagation by consuming and disseminating seeds. They are often the most important food base for many predatory mammals and birds, acting to sustain populations of these species. However, rodents also are important vectors or reservoirs of numerous diseases that infect humans, domestic animals, and other wildlife species.

They are significant economic pests that devastate crops, gardens, orchards, or landscape plantings, and damage commercial forest plantations or impede reforestation efforts. Rodents burrow through dams and irrigation structures, gnaw through communications cables and damage electronics, and consume or contaminate stored food and other commodities. Rodents sometimes prey on the eggs or young of wild birds and compete with native wildlife species for food or habitat, and thus have become important concerns in the management and recovery of threatened or endangered species, particularly in island environments.

Rodent control describes the processes that people use to alleviate rodent damage, to prevent the spread of rodent-borne diseases, to reduce problem rodent populations, or to eliminate rodent infestations. Depending on the species of rodents involved, the kinds of environments where problems occur, the nature of the problem, and the value of anticipated damage, a variety of methods is available for controlling damage or reducing rodent populations. Usually, several methods need to be used systematically to achieve lasting results. The process of selecting, applying, and evaluating the results of such combinations of control methods in relation to the ecological and economic aspects of specific damage problems is called integrated pest management (IPM) or ecologicallybased pest management.

II. Learning Objectives

At the end of the unit, the student should able to:

1. Define rodents/rats.

2. Recall the different characteristics of rodents.

3. Describe the following damage of rats in grains, sugar cane, orchard and plantations, and stored products.

4. List the symptoms of rat infestation

5. Cite examples of rat pest management practices.

III. Pre-Test

Question

What do you think are the different signs of rat infestation in the field?

_____
_____
_____
_____

Question

What do you think is the best way to eradicate rats from the field?

_____
_____
_____
_____

IV. Discussion

Characteristics of Rodents

Because of the diverse characteristics of rodent species for which rodent control may be a concern, only a very general discussion is possible. The biology, ecology, and behavior of each species or even of the same species occurring in different environments must be examined carefully to develop successful rodent control programs. What might work effectively for rodent control in a grain warehouse or urban sewer system would have little applicability or would be impractical in an Asian rice field. However, the kinds of information needed and the principles used to develop an IPM program are the same.

There are more than 2000 recognized species of rodents (Wilson and Reeder 1993), many of which are described and pictured in Nowak (1999). A relative few of these species, perhaps less than 250 worldwide, interact sufficiently with humans to cause economic, conservation, or health concerns sufficient to warrant rodent control efforts. Biologists often rename or combine different groups of rodents to better reflect relationships as new scientific information becomes available. Whenever possible, current scientific names for rodents (Wilson and Reeder 1993) have been used when citing information from older literature.

Many readers are most familiar with "rats and mice" as the animals commonly associated with rodent control. The Norway rat (Rattus norvegicus), also known locally as the brown rat, wharf rat, sewer rat, or barn rat, has a nearly

worldwide distribution and is almost always found living in close association with humans. The roof rat or black rat (*Rattus rattus*) and the house mouse (*Mus musculus)* are also widely distributed and, together with the Norway rat, are known as commensal rodents because of their generally close association with human habitation. Rodents range in size from the South American capybara (Hydrochaeris hydrochaeris), weighing more than 50 kg, to the harvest mouse (Micromys minutus) of Eurasia, weighing 5 to 7g. Most rodent species have thick fur, although great variations in pelage occur.

The naked mole rats (*Heterocephalus glaber*) of Africa have only bare skin, while porcupine species, such as (*Erithizon dorsatum*) of North America, have highly modified coats containing spines or quills that help provide protection from predators. Hearing, smell, taste and touch are well-developed senses in rodents, but as with many mammals, particularly the nocturnal species, their vision is relatively poor and they apparently do not distinguish colors. Rodents detect sound at frequencies substantially higher than humans; some species may use ultrasound as a means of communication (Blanchard et al. 1991).

Most rodents have long whiskers or vibrissae around their muzzles that are highly sensitive and may be used in following runways or burrows. Many rodent species are excellent climbers, using their long tails for balance. Most rodents readily swim; some, like beavers (*Castor canadensis*), nutria (*Myocastor coypus*), muskrats (*Ondatra zibethicus*), and web-footed rats (*Holochilus sciureus),* have modified appendages such as flattened tails or webbed feet that facilitate their use of freshwater aquatic habitats.

Most species of rodents are born naked and helpless, but mature rapidly. Norway rats (*Rattus norvegicus*), for example, have a gestation period of about 3 weeks, become independent of the mother at about 3 weeks after birth, and can breed for the first time within another 3 weeks. Rodents are omnivorous, exhibiting choices and preferences in their diet, but often selecting the most abundant, palatable foods available. They readily learn to reject or avoid unpalatable foods or those containing toxins, which presents a problem for the development of bait materials for effective delivery of rodenticides. The front teeth, or incisors, of rodents grow continuously and are also worn continuously by gnawing on objects or food. Because of the large space or diastema behind their incisors, rodents can use these front teeth to investigate or nibble unfamiliar materials without actually taking them inside their mouths.

Common Rats in the Philippines

Rice field Rat (*Rattus argentiventer*)


Rice field rat

They have soft, yellow-brown and black fur, with gray bellies and medium-brown tails. Measuring roughly 12 to 16 inches, including their 6-to-8- inch tails, these rats are of medium size. They live in large groups with strict hierarchies; individuals will actively defend their pack's territory.

Black rat (*Rattus rattus*)


Black Rat

The appearance of the black rat is between 16–24cm in length, with a tail longer than the head and body. It grows to between 150–200g in weight. They have a pointed nose, large ears and a slender body. The life cycle of a black type rat can produce 5–10 young per litter, and have between 3–6 litters a year. The gestation period is about 3 weeks. It only takes between 12–16 weeks from birth for them to reach sexual maturity. Their habits are incredibly agile and very good climbers. Their preferred food is moist fruits. Black Rats will eat around 15g of food a day and drink 15ml. They can be found in the coastal towns and in many urban environments across the Philippines.

Rodent Populations

Because of the high reproductive capacity of rodents, their populations can grow rapidly to utilize available habitat and food. In stable environments rodents self-regulate their populations. When a population reaches the carrying capacity of an environment, reproduction declines and excess animals die (usually from disease, parasites, or predation) or they immigrate to new areas. Yet rodents survive very adverse conditions—even nuclear explosions!—by living in underground burrows (Jackson 1969) and rebuilding their populations when conditions again become favorable. Habitat disruption or climatic changes that lead to increases in food and harborage sometimes give rise to population outbreaks or irruptions of some rodent species, resulting in extremely high populations that can inflict severe damage on crops (Fiedler and Fall 1994). Libay and Fall (1976) observed densities of 1 adult rat per square meter (10 000

rats per hectare!) in a breeding population of *Rattus tanezumi* in a large marsh area in the Philippines adjacent to a rice field basin.

Symptoms

- Chopped young seedlings
- Irregular cuttings of stem
- Patches of depressions seen in the field at early stage
- Chewed developing buds or ripening grains
- Tillers cut near base at 45° angle. Cut tillers may be seen in patches.
- At ripening stage, the ear heads are cut and stored in the burrows.

Earheads are cut and stored in the burrows

Holes or depressions seen in the field

Nature of damage

Grain Crops

Rat damage to ripening rice crops in Asia, Africa, and Latin America can be an extremely serious agricultural problem, although economic losses are often difficult to estimate because of complex patterns of growth and recovery of plants related to the developmental stage when damage occurs (Fall 1977, Fall 1980, Buckle 1994). Rats can completely consume fields of growing rice and

sometimes prevent planting where crops could otherwise be grown (Wood 1994). Wheat, sorghum, maize and other grain crops are also damaged extensively by various rodent species in different parts of the world, and patterns of damage vary considerably depending on the behavior of the species involved. For example, Bandicota bengalensis in southern Asia cuts mature wheat and rice in large patches and establishes extensive underground food caches (Poche et al. 1982); Rattus tanezumi and Rattus argentiventer in the Philippines and other areas of Southeast Asia feed upon all stages of growing rice (Fall, 1977), while Sigmodon hispidus in Central America avoids wet areas in rice fields and causes damage after water is removed to dry the crop before harvest.

Sugarcane

Rodents cause extensive damage to ripening sugarcane wherever it is grown, from Asia to Africa, Latin America, the Pacific region, and Australia (Fiedler et al. 1987, Fall 1980, Tobin et al. 1990). Rats gnaw on the internodes of growing stalks, thereby killing stalks, diminishing yields, or allowing infection by bacteria or fungus, which reduces cane quality and sugar yield. Losses are difficult to quantify but can be substantial (Redhead 1980, Hampson 1984, Haque et al. 1985, Rampaud 1993, Engeman et al. 1998b). The major depredating species vary from area to area and include: Rattus rattus, Rattus norvegicus, and Rattus exulans in Hawaii; Holochilus scuireus, Sigmodon hispidus, Oryzomys palustris, Mus musculus, and Rattus rattus in North and South America; Rattus tanezumi in Southeast Asia; Millardia meltada, Bandicota bengalensis, and Bandicota indica on the Indian subcontinent; Rattus losea and Bandicota bengalensis in China; Mus caroli and Apodemus agrarius in Taiwan; Rattus sordidus and Melomys burtoni in Australia; and Rattus rattus, Arvicanthis niloticus, and Thryonomys swinderianus in Africa (Taylor 1984, Fiedler 1988, Prakash and Mathur 1988, Wood 1994).

Voles (*Microtus sp*.) cause extensive damage in fruit orchards in USA and Europe (Tobin and Richmond 1993, Guedon and Combes 1990). Populations of these rodents typically irrupt periodically and, when preferred vegetation is scarce, particularly in winter, gnaw the roots and trunks of trees for the underlying phloem and cambium tissue. The resulting damage interferes with transport of nutrients between the roots and aerial portions of the tree and increases the chance of infection by root pathogens. The resulting damage kills trees, reduces fruit production, and increases the time for new plantings to come into production. Coconuts are grown commercially in many tropical areas and are subject to damage by several rodent species, particularly *Rattus rattus and Rattus tanezumi.* These rodents climb palms of all ages, primarily to feed on developing nuts, which then fall prematurely to the ground (Fiedler et al. 1982, Wood 1994). The proportion of nuts that drop prematurely due to rat damage can be quite high. Impacts on yield may not be proportional to the number of developing coconuts that fall to the ground (Williams 1974, Reidinger and Libay 1981, Fiedler et al. 1982). Trees in some areas may compensate for early damage by increasing the size and weight of remaining nuts; in situations where rats feed on coconut flowers or damage very small nuts, yield losses may be underestimated by counts of fallen, maturing nuts.

Macadamia orchards in Hawaii and Australia sustain extensive damage from *Rattus rattus* (White et al. 1997, Tobin 1992). These arboreal rats gnaw through the hard shell to eat the developing kernel inside. Damaged nuts fall prematurely. Five to ten percent of developing nuts are damaged by rats in some Hawaiian orchards. However, the economic impact of this damage is not clear (Tobin et al. 1993), because some trees apparently partially compensate for this damage by producing additional nuts (Tobin et al. 1 997a). Rodents in Africa, Asia, South America, and the West Indies open ripening pods of cacao and either take whole beans or feed only on the mucilage which surrounds the beans, depending on the species of rodent (Wood 1994). Damaged pods are lost due either directly to rodent damage or indirectly to ensuing fungus infection. Damage often is greatest where cacao is grown in mixed culture with other crops such as coconut (Williams 1973, as cited in Wood 1994). Depredating species include *Rattus tiomanicus, Rattus tanezumi, and Callosciurus notatus in Asia, and*

Hylomyscus stella, Praomys tullbergi, Stochomys longicaudatus, Dephomys defua, and Praomys morio in West Africa (Wood 1994).

Commercial oil palm plantations in Malaysia and Africa sustain damage from rodents that feed in the crowns of trees on the oil-bearing tissue of developing fruitlets. Wood (1994) reported that populations of *Rattus tiomanicus* reached between 200 and 600 rats per hectare in Malaysian orchards where no rodent control was practiced, with estimated losses averaging about 5% of the yield. *Rattus argentiventer* and *Rattus tanezumi* sometimes also become pests in Malaysian orchards (Wood 1994). In Africa, the major rodent species causing damage to oil palms include: *Dasymys incomtus, Lophuromys sikapusi, Tatera valida, Oenomys hypoxanthus, Praomys morio, Mus minutoides, Lemniscomys striatus, and Uranomys ruddi* (Wood 1994). Up to 80% losses have been reported in Nigeria in one year (Wood 1994).

Stored Products

Rodent consumption of stored food and grain and damage to storage structures and containers, and indirect losses caused by spillage, spoilage, or contamination that results in condemnation or rejection of shipments is important economic and public health problems worldwide (Jackson 1977, Brooks and LaVoie 1990, Conover et al. 1995). The great diversity of rodent species, storage structures, and environmental conditions and the difficulty in estimating incremental or indirect losses help mask the economic impact of the problem. Since most rodent species involved in stored product damage are nocturnal, heavy infestations may persist unnoticed without careful inspection of stores or premises (Jackson 1990). In many situations, careful grain handling procedures, indoor and outdoor sanitation, immediate disposal of spillage and garbage, frequent inspection for rodent signs, and maintenance control programs are important ways to prevent the development of more serious and difficult problems.

Management to Prevent and Control Rats

Prevention

In rice field, you may apply flooding, digging or fumigating rat burrows to prevent the rice field rats in the area or you may use dog to locate active rat burrows. Keep area around fields, homes, and villages clean no piles of wood or brush, no garbage heaps, no weedy areas. Keep grain stores and surrounding area clean.

Control

- Physical control includes hunting, rat drives, digging, and exclusion.
- Narrow bund maintenance (45 × 30 cm).
- Digging burrows during the off season and killing, poison baiting with zinc phosphide or bromadiolone 3 to 4 weeks after planting, and setting up of Thanjavur or bamboo bow traps (100 nos/ha) are to be followed in sequence.

- Locate the burrows opened by the rats and insert two pellets each of 0.5 or 0.6g of aluminium phosphide per burrow as deep into the burrow as possible and plug the entrance with a mud ball.

- Poison bait at 1 part zinc phosphide with 49 parts popped corn/rice/dry fish or bromodialone 0.25 w/w (1:49) at 0.005%. Mix one part of bromodialone + 49 parts of bait and keep inside the field.

- Warfarin 0.5% 1 part with 19 parts of popped corn/rice/dry fish and keep in field.

- Setting up of owl perches at 40 - 50/ha.

- Wildcats, snakes, and birds are predators of rice field rats.

V. Activity

Republic of the Philippines
Bulacan Agricultural State College
San Ildefonso, Bulacan

Name: _____ Date: _____
Year & Course: _____

General Physiology and Toxicology
Laboratory Exercise No. 4
Rodent Characteristics and Behavior

I. Introduction:

Rodents are serious pests in various crops in the developing countries of the world. Riceland rats are essentially active during the night time, although they also move during the day when conditions are quiet. Rats have poor vision; however their senses of smell, touch and hearing are extremely strong. Their whiskers and guard hairs guide them in the dark

II. Objectives:

To study the different example of destructive rats

III. Methodology:

1. Search for different examples of rats in the Philippines
2. Enumerate and describe each destructive rat.
3. Search and explain different management on rats

VI. Summary

- Rodents are an important and ubiquitous group of mammals that occur as indigenous or introduced species throughout the world.
- The populations of a relatively few species that live in close association with humans sometimes cause economic damage or become threats to the health of humans or domestic animals.
- When rodent control efforts are contemplated, the type of problem and the objectives of these efforts should be carefully defined.
- Successful management of rodent problems depends upon correct identification of the rodent species involved and on obtaining information on the biology, ecology, and behavior of the species in the ecological setting where the problem occurs.
- Analyzing the economic costs of potential damage or assessing the risks of failure or inaction can assist in the selection of appropriate combinations of control methods to employ.
- Progress in rodent control programs should be monitored regularly and success should be measured against the achievement of appropriate objectives (for example, prevention of crop damage or prevention of rodent infestations in warehouses or feed mills), not by counting the numbers of rodents killed or the amount of poison bait applied.
- No single method of rodent control will be predictably effective in all situations; IPM programs that apply several methods appropriate to the species and the environment where a problem occurs offer the best prospects for long term success.

VII. References

Tobin, M. E., & Fall, M. W. (2004). Pest control: rodents.

Internet Source

http://www.agritech.tnau.ac.in/expert_system/paddy/cpnonrat.html