JOURNAL LA LIFESCI

VOL. 02, ISSUE 02 (024-030), 2021
DOI: 10.37899/journallalifesci.v2i2.373

Understanding Farmer and Government Measure in Rat Pests Control in Rice Fields

Theuy Xuan[1], Tiuen Yen[1], Tuyet Caugh[1]

[1]*Science Faculty, Ho Chi Minh City University of Science, Vietnam*

**Corresponding Author: Theuy Xuan*

Article Info

Article history:
Received 16 May 2021
Received in revised form 4 June 2021
Accepted 13 June 2021

Keywords:
Rice Plants
Rat Pests
Control

Abstract

This paper discusses the control of rat pets through highlighting its population growth, ecosystem, types and possible mechanism to use. During extended periods of fallow, rice field rats tend to congregate in escape places (refuge regions) such as bushes, yards, or rice warehouses. Rice plants suffered damage equivalent to five times their feeding requirements when rats were present. Rats damage plants from the tiller stage to the maximal tiller stages by devouring the growth point and the soft base of the stem while leaving the other portions of the plant unharmed. Without intensive control efforts (since the start of MT1), the rat population density on MT2 is confirmed to be higher and poses a serious threat to the success of MT2 harvesting. In one rice growing season, there is one population peak so in the rice-paddy-fallow cropping pattern there are two (2) population peaks.

Introduction

Rat attacks continue to be a source of concern for the majority of farmers. Initially, it seems to be a tangible issue with a tough solution. Why? Because despite many attempts to eradicate these voracious creatures, their number continues to grow despite several eradication initiatives.

Rat pest removal using electric current traps is not only hazardous to human health and safety, but it is also detrimental to the environment. Farmers are now using electric current traps to eliminate rat pests that are interfering with rice and other food crop production (Singleton et al., 2021). This technique is not advised since it is potentially hazardous to human health and safety, particularly for agricultural workers. There are now victims, who are residents who have been electrocuted by rat traps that contain electricity.

In the course of the rice planting process, the presence of rat pests is one of the risks that may have an impact on the level of crop production. There are a variety of approaches to dealing with this pest, ranging from mechanical to chemical. Farmers are encouraged to adopt safer and more ecologically friendly techniques of pest management in the case of an assault, according to the government (Kabir & Rainis, 2015; Halimatunsadiah et al., 2016).

Control may be achieved mechanically, for example, by encouraging the use of mousetraps on agricultural land. Additionally, it is possible to do it chemically using compost by spraying it with rat poison. Only that the poison employed should not be reckless since the user has already received a dosage of poison.

It is possible that a disruption in the development of rice plants would result in a reduction in rice output, which will have an effect on the country's rice shortage. The infestation of rat pests in rice fields causes one of the most significant disruptions in the production of rice. Rat pest management is the most difficult problem for current farmers to deal with (Van den Berg & Jiggins, 2007). According to the findings of the study, rats are one of the pests that are (very) harmful to farmers. Rats have a proclivity to damage plants at night. Because of the cunning

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

nature of mice, different kinds of traps are not always the most effective means of managing them.

This is proportional to the amount of brain matter that the rat has. Rat pests are able to learn from the experiences of other mice, either directly or indirectly, and use this information to their advantage (Byers et al., 2019). According to the findings collected, rat pests may cause up to 80% of the rice plants in a single plot to die in a single night (1 day). Rats damage rice plants from the roots, stems, and leaves all the way up to the grains, preventing the plants from developing (Sarra & Peters, 2003). Farmers, of course, suffer significant losses as a result of this. Rat infestations are notoriously difficult to eliminate using conventional and repetitive methods because of their ability to communicate amongst groups of rats and their individual learning skills.

Rat Pests Characteristics and Habitats

Roughly speaking, rice field rats are nocturnal creatures that have evolved to match the phenology of rice plants. The majority of everyday activities begin at night and continue until morning. During this time, field mice investigate potential food and water sources, as well as potential shelter, and they learn to distinguish between couples and individuals from different groups. Hide among holes, shrubs, or plots of rice fields to avoid being seen during the day (when the rice is thick). If there are rice plants in the area where they live, the home range is about 30-200m, and the territory is 0.25-1.10ha.

When fallow and food sources are limited, the majority of field mice eventually migrate to locations that offer food up to 0.7-1.0 km or more away, such as towns, seed sheds, mills, and other such locations. Rice rats that had managed to survive the winter returned to the rice fields at the start of the growing season to reproduce x. The consumption of food and the manner in which one consumes food It is classed as an omnivorous animal since it is capable of surviving on a range of different types of food. It is dependent on environmental circumstances and changes during the rice growth stage as to what kind of feed is eaten. Rice, on the other hand, is the primary source of nutrition for him. Feed requirements are about 10-15 percent of body weight, with water requirements ranging from 15-30 mL per day. Rice endosperm, the base of the rice stalk, grass flakes, arthropod body parts, dicotyledonous plant parts, and other components make up the majority of the feed material that is consumed by the stomach.

Field mice feed on grass (45 percent), endosperm (31 percent), and other plant materials when fallow is sown before rice seedlings are planted (4-10 percent). The consumption of different feeds during vegetative rice was generally equal (17-25 percent), while the consumption of endosperm (51 percent), arthropods (12 percent), and non-rice plant components during generative rice was more evenly distributed (7-18 percent). When it came to eating the meal, the field rat first tasted it to see how it would respond in its body, and if it did not react negatively, it would instantly consume it. x Sexual conduct in a sexual relationship The presence of rice plants has a significant impact on the breeding success of field mice. Active reproductive circumstances are only found in generative rice, and they are not found in any other rice.

Adult field mice are not reproductively active during the transition from fallow to vegetative rice (Mulungu et al., 2015). Testicles of the rice field mouse re-enter the abdominal cavity when the animal is not active (abdominal testes), and they will return to the scrotum during the mating season (scrotal testes). The ability of a number of females to mate is restricted by dominant males who exercise authority over certain areas. x The behavior of nesting Terrestrial creatures that dig burrows in the earth to create a home for themselves. The "active hole" refers

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

to the hole where the rats are currently living. During extended periods of fallow, rice field rats tend to congregate in escape places (refuge regions) such as bushes, yards, or rice warehouses, rather than in the field. The active holes in rice are simple and shallow during the vegetative stage of the plant, but they become complex and branching during the generative stage of the plant, which is also the mating season for field mice.

In general, female mice and their young are found in the actively breeding pit. On the midst of active reproduction, male rats congregate in plots of land, where they wait for the opportunity to mate with females in their groups at night. x Social interaction Protective behavior at the territorial (territorial) and social levels are included (hierarchy). The most powerful male in a colony of rats at low to moderate population densities is the dominant male. He has the greatest control over food supplies, trails, nesting locations, and the female rats in the group. At high population densities, men that are outcompeted (subordinate) move out searching for new territory and establish new groups, which they eventually conquer. Since of this habit, the field rats are able to occupy vast regions because the population is evenly distributed across the territory (especially in endemic areas).

Population

The dynamics (increase and decrease in density) of the rice field rat population is influenced by the biotic and abiotic environment (Lewis et al., 2017). Biotic factors include feed, competition, predation, cannibalism, migration, and reproduction. While abiotic factors include habitat, water sources, weather and climate, as well as control activities by humans.

The types of rats that inhabit irrigated rice fields consist of rice field rats (98.6%), wirok mice (1.0%), and house mice (0.4%). The dominance of field rats shows that these species are most successful in adapting and becoming the main threat to the environment. The interspecific competition between the three types of mice was relatively small due to the division of space and time (spatio-temporal). Intraspecific competition (between rice field rats) occurs due to the equality of exploited resources, especially feed and nesting sites (females). Cannibalism occurs when food is scarce, strong individuals prey on the weak. The female parent also eats disabled or dead individuals in the womb. Sunchus murinus, which is often found in rice fields, does not belong to the rat race of the Order Rodentia, but is a member of the insectivorous nation (Ordo Insektivora). These animals are not pests of rice, but rather as insectivores in the rice fields. In tidal rice fields there are field mice, bush mice, and house mice. Meanwhile, dry rice fields are inhabited by field rats, and field rats. In freshly molded rice fields near the forest, field mice, field mice, and Rattus nitidus were found.

Rice field rat population density is influenced by the availability of feed (presence or absence of rice) and control activities by farmers (Lorica et al., 2020). The peak of the population occurred sometime after the post-harvest fallow due to the addition of new individuals (recruitment) resulting from reproduction at the generative stage of rice. In one rice growing season, there is one population peak so that in the rice-paddy-fallow cropping pattern there are two (2) population peaks. Without intensive control efforts (since the start of MT1), the rat population density on MT2 is confirmed to be higher and poses a serious threat to the success of MT2 harvesting. (MT: growing season).

Rats and Plant Productivity

The behaviour of rats in the field is associated with their destructive capability. As a consequence, rice plants suffered damage equivalent to five times their feeding requirements. Damage happens during the planting process as a result of the seeds being eaten or uprooted. A field mouse was able to inflict harm on about 283 seedlings each night (126-522 seedlings

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

aged 2 days). Rats damage plants from the tiller stage to the maximal tiller stage by devouring the growth point and the soft base of the stem while leaving the other portions of the plant unharmed. Approximately 80 stems each night were lost at that time span (11-176 shoots). When the rice is pregnant, the mice do about 103 stems of damage each night (24-246 shoots). Meanwhile, when rice panicles, the destructive force is 12 panicles each night, which is a significant amount (1-35 panicles). According to the number of panicles he cut, the mice only devoured a few grains of grain, with the remainder being left dispersed around the area.

Therefore, in order to manage rodent pests in rice fields or agricultural land, a mix of treatment methods is required, both from a technical viewpoint, which involves the use of mechanical equipment, and from a non-technical standpoint, which includes maintaining cleanliness. We practice sustainable rat pest management since the existence of rat pests is linked to the availability of dwellings (breeding sites) and food supplies. From the standpoint of engineering, there are many approaches that may be used to manage rat infestations, including manual, mechanical, and electrical methods of extermination.

Cleansing water channels, eliminating straw accumulation in paddy fields, using natural enemies like as owls, scarecrows, and other methods are all effective ways to combat rat pest management (Rao, 2010). Scarecrows, in addition to serving as a deterrent for rats, also serve to deter a variety of avian pests that prey on rice plants during the ripening of the grain.

Mechanical control is achieved via the use of a fire sprayer, which is directed towards rat hole (Ang & Berndt, 2014). Cooperation amongst landowners is unquestionably required for this activity (farmer groups) (Senesi et al., 2016). Additionally, putting traps and rat poison in areas that are regarded possible rat breeding grounds, such as nests, areas that are often traversed, and areas where rat pests congregate, is recommended.

Electrical control, which can be accomplished via the use of electric shock, rat repellant, which can be accomplished through the use of ultrasonic sound, and light, which can be used to irradiate the land on a regular basis. One of the mouse repellents developed by the Faculty of Agriculture at the Local University is based on ultrasonic waves, and it is one of the most effective available.

Because it generates electrical energy on its own, this rat repellant can operate continuously for 24 hours. To complement the precision farming concept, a solar panel has been placed on top of the instrument to provide electricity. The operating concept of this control system is to interfere with the hearing system of rats in the tool's reach region, causing them to feel uncomfortable being in the vicinity of the land. The Arduino Uno board is used in conjunction with an ATmega 328 microcontroller to create this system. The ultrasonic tweeter actuators are comprised of four individual components. An infrared passive resistor (PIR) with four sensors is utilized as the sensor in this application.

It is possible to create sound waves ranging in frequency from 20 to 50 kHz using the mouse repellant that has been developed. The frequency range of rat hearing is between 5 Khz and 90 Khz, with the average being 5 Khz. Those who heard noises in the ultrasonic frequency range of >20 Khz to 60 Khz, on the other hand, reported being bothered by them. Around the control system's frame are placed actuators and sensors that provide feedback. In order to assist the control system in obtaining independent electrical energy, a 50-watt peak solar panel has been placed on the control system.

The mouse repellent developed has a range of 1200 m2, while the sensor has a range of 78.53 m2 and is capable of detecting the presence of disturbances. The sensor and the source of interference must be no more than 5 meters apart at their closest point. The ultrasonic speaker

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

will activate if there is any movement in the room. The control system is capable of recognizing the problem and turning on the actuator to its full capacity. When the mouse is inside the range of the PIR sensor, the reaction time of the control system to engage the actuator is 0.12 seconds. When exposed to ultrasonic sound waves, rats have an average reaction time of 4 seconds, which allows them to avoid and remain away from bait. These findings suggest that the control system has been successful in detecting and disrupting the rat pest when it is within range of the control system's detection and disturbance capabilities.

There are Several Techniques for Controlling Rat Pests in Rice

Technical Culture Control

Technical culture control is integrated with rice cultivation. Basically, this method aims to condition the rice field environment to reduce the survival and reproduction of rats. As for the techniques that can be done, such as planting and harvesting simultaneously, setting the cropping pattern and setting the spacing.

Habitat Sanitation

This control is carried out at the beginning of planting by cleaning weeds, bushes and rat nesting places. With habitat sanitation, rats will lose shelter to breed.

Mass Composting (fumigation)

This control is carried out simultaneously at the beginning of planting using a rat composting tool. Fumigation proved effective in killing mice in their nests. To ensure that the mice died, the holes were covered with mud after composting. Closing the rat hole is also intended to prevent agricultural infrastructure (dykes, bunds and irrigation) from being easily damaged.

Trap Barrier System (TBS)

Quoted from the Agricultural Research and Development page, TBS is a mousetrap technology using traps and lure plants. This technology has proven to be effective in catching large numbers of mice from the beginning of planting to harvesting. The working principle of TBS is to attract rats from the surrounding rice fields, so that the rat population is reduced throughout the plantation. FFB consists of trap plants measuring 25 x 25 meters for 10 hectares, plastic fences as high as 60 centimeters with the bottom submerged in water and traps installed on each side of the FFB.

Linear Trap Barries System (LTBS)

One FFB unit consists of trapping plants as bait for rats, plastic fences to direct rats into traps and trap traps as a means of catching and holding rat habitat. Installation of LTBS is carried out near the habitat of rats, such as irrigation embankments and rice fields.

The pests control can be done through several steps: cleaning the whole rice planting area so that rats cannot construct nests, limiting the area of the rice field bunds to a height and breadth of about 30 cm so that rats are not free to build nests, and changing cropping patterns, particularly in irrigated rice fields, by rotating crops are some of the measures that may be taken to combat rat infestations. Planting rice at different times of the year is a good way to regulate the planting period since it reduces the amount of harm done to the rice plants (Stoop et al., 2002). It is hoped that by adjusting the spacing so that it is not too tight or by using a row of legowo planting design, we will be able to produce a bright atmosphere that rats will not enjoy since they will be afraid of natural enemies. The gropyokans are hunting rats in large groups. Using a mousetrap or rat poison as a deterrent. Spraying fire and hot air into rat holes

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

in order to cause the mice to either die or escape from their nests. Natural enemies of mice, such as owls, snakes, dogs, and cats, are used to control their populations.

If the rat population is already large, chemicals such as rodenticides are used to control it. Installation of TBS (Trap Barrier System) and LTBS (Long-Term Barrier System), as well as the placement of trap traps in nurseries. FFB is a rice plant that was planted three weeks earlier and measures 20x20 m. It is enclosed in a plastic fence as high as 60 cm that is reinforced with bamboo pegs at a distance of one meter, has traps on either side of the plastic fence with holes facing out, and is provided with a small embankment that serves as a rat entry. In order to prevent rodents from digging or creating holes in the plastic fence around the FFB, a 50 cm wide trench is maintained at all times by constant flooding. In order to decrease the rat population in the plantation, the TBS employs a strategy that involves attracting rats from rice fields and nearby regions. LBTS is a 100-meter length of plastic fence that is fitted with traps on both sides that are switched on and off alternately to allow mice to be caught from both directions

Conclusion

Rice field rats are omnivorous animals that have evolved to match the phenology of rice plants. The majority of everyday activities begin at night and continue until morning, including finding food and water sources. Rice is the primary source of nutrition for the rodents. Rice field mice are not reproductively active during the transition from fallow to vegetative rice. The ability of a number of females to mate is restricted by dominant males who exercise authority over certain areas. During mating season, male rats congregate in plots of land where they wait for the opportunity to mate with females. Rice field rats pose a serious threat to the success of rice harvesters. Rats damage rice plants by devouring the growth point and soft base of the stem while leaving the other portions of the plant unharmed. Without intensive control efforts (since the start of MT1), the rat population density on MT2 is confirmed to be higher. The use of scarecrows, owls, and other methods to combat rat pest management are all effective ways to combat rats in rice fields.

References

Ang, A. S. M., & Berndt, C. C. (2014). A review of testing methods for thermal spray coatings. *International Materials Reviews*, *59*(4), 179-223.

Byers, K. A., Lee, M. J., Patrick, D. M., & Himsworth, C. G. (2019). Rats about town: a systematic review of rat movement in urban ecosystems. *Frontiers in Ecology and Evolution*, *7*, 13.

Halimatunsadiah, A. B., Norida, M., Omar, D., & Kamarulzaman, N. H. (2016). Application of pesticide in pest management: The case of lowland vegetable growers. *International Food Research Journal*, *23*(1).

Kabir, M. H., & Rainis, R. (2015). Adoption and intensity of integrated pest management (IPM) vegetable farming in Bangladesh: an approach to sustainable agricultural development. *Environment, development and sustainability*, *17*(6), 1413-1429.

Lewis, J. S., Farnsworth, M. L., Burdett, C. L., Theobald, D. M., Gray, M., & Miller, R. S. (2017). Biotic and abiotic factors predicting the global distribution and population density of an invasive large mammal. *Scientific Reports*, *7*(1), 1-12.

Lorica, R. P., Singleton, G. R., Stuart, A. M., & Belmain, S. R. (2020). Rodent damage to rice crops is not affected by the water-saving technique, alternate wetting and drying. *Journal of Pest Science*, *93*, 1431-1442.

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

Mulungu, L. S., Borremans, B., Ngowo, V., Mdangi, M. E., Katakweba, A. S., Tesha, P., ... & Kilonzo, B. S. (2015). Comparative study of movement patterns of M astomys natalensis in irrigated rice and fallow fields in eastern T anzania. *African journal of ecology*, *53*(4), 473-479.

Rao, C. S. (2010). Ento-333 Field Diagnos Field Diagnostic Tools for tic Tools for tic Tools for Agriculture Agriculture Agriculture.

Sarra, S., & Peters, D. (2003). Rice yellow mottle virus is transmitted by cows, donkeys, and grass rats in irrigated rice crops. *Plant disease*, *87*(7), 804-808.

Senesi, S. I., Daziano, M. F., Chaddad, F. R., & Palau, H. (2016). Ownership versus management: the role of farming networks in Argentina. *International Food and Agribusiness Management Review*, *20*(1030-2017-2150), 221-227.

Singleton, G. R., Lorica, R. P., Htwe, N. M., & Stuart, A. M. (2021). Rodent management and cereal production in Asia–balancing food security and conservation. *Pest Management Science*.

Stoop, W. A., Uphoff, N., & Kassam, A. (2002). A review of agricultural research issues raised by the system of rice intensification (SRI) from Madagascar: opportunities for improving farming systems for resource-poor farmers. *Agricultural systems*, *71*(3), 249-274.

Van den Berg, H., & Jiggins, J. (2007). Investing in farmers—the impacts of farmer field schools in relation to integrated pest management. *World development*, *35*(4), 663-686.

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)