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Technical Innovation Brief
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Rodents – gnawing away at crops, stored grain and our health

Grant Singleton

Rats and mice have adapted well to the diversity of agricultural habitats created by humans. Some 42% of all mammal species are classified as rodents (animals that have continually growing incisor teeth and no canine teeth). Although fewer than 10% are significant agricultural pests, this still leaves over 200 species to manage. Rodents are an enigma in that they are the ultimate mammalian weed, living in almost every habitat on earth, yet they also play a pivotal role in nutrient cycling and water flows in many ecosystems and therefore the non-pest species need to be protected.

Trapped ricefield rats. – Grant Singleton

Rodents have three major impacts. The first is the substantial damage they can cause at any stage of the growing crop. The second is the losses they cause post-harvest to stored grain and vegetables. The third, and often overlooked, impact is on the health of smallholder farmers – rodents are carriers of at least 20 severely debilitating human diseases (see Meerburg et al. 2009).

Taking food from our table

Across Asia, pre-harvest losses of rice alone range from 5% in Malaysia to 17% in Indonesia (Singleton 2003). A loss of 6% in Asia is enough rice to feed 220 million people—roughly the population of Indonesia—for 12 months. Rat damage is often patchy in space and time, and family rice plots are small, so it is not uncommon for farmers or villagers to lose half of their entire rice crop to rats. Many Asian farmers do not rate rats among their most important pests simply because they feel – misguidedly – that rats are a problem they have least control over and therefore they have to accept the losses. They focus instead on the insect pests and weeds that they can control. In Africa, rodents cause significant losses to maize and root crops but there is an urgent need for more research (see http://www.nri.org/projects/ecorat/ for more details).

Taking food from our table: Rat damage in the field (left) and on maize cobs (right). – G. Singleton

CGIAR Systemwide Program on Integrated Pest Management (SP-IPM) is a global partnership that draws together the diverse IPM research, knowledge and expertise of the international agricultural research centers and their partners to build synergies in research outcomes and impacts, and to respond more effectively to the needs of farmers in developing countries.

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Rodents have a potentially enormous economic impact on stored grain in developing countries but there are few quantitative data. Rats need to eat 10-15% of their body weight each day and contaminate much more with their droppings. In one year, 25 adult rats would eat and damage about half a ton of grain and produce about 375,000 droppings! Rodents damage more food than they consume and cause major damage to the structure of grain stores, which in turn leads to increased weather and insect damage.

Innovative solutions are emerging

In the 1960s a wide range of chemical rodenticides became available on the global market. Research then focused on the toxicity of the poisons, on making them more palatable to the pests and less attractive to non-target species. Ecological studies of rodent pest species were an exception. With the development of resistance and increased tolerance of rodents to the rodenticides, and an increased awareness of ecological and human health issues associated with their use, attention in the mid-1990s turned back to ecology. People realized that we knew so little about the behavior, breeding ecology and habitat use of rodents that together drove their population dynamics. Ecologically-based rodent management has now taken center stage in Asia, Australia, and eastern Africa.

The ecology of rodent pests is strongly influenced by the agricultural practices of smallholder farmers. And rodents are highly mobile, so if only a few farmers implemented good management practices, their crops would soon be reinvaded by rats from neighboring fields. Effective and sustainable ecologically-based rodent management therefore requires communities to become involved. Moreover, our understanding of the ecology of major pest species, such as the ricefield rat, *Rattus argentiventer*, indicates that community management must be conducted much earlier than whatever farmers had been doing.

Integrated actions to manage the ricefield rat in lowland irrigated rice

In Indonesia, ecological studies in lowland irrigated rice fields provide the following MUST DO activities at a community level for effective management of the ricefield rat in rice.

- Synchronize planting of crops within 2 weeks of one another; otherwise the breeding season of the ricefield rat is extended, leading to exponential population growth;
- Conduct community campaigns before the ricefield rat breeding season using local methods, such as trapping and fumigation, to control rats within 3 weeks of planting the crop; these community actions usually focus on village gardens, main irrigation channels, and roadsides;
- Keep irrigation banks less than 30 cm wide to make it difficult for rats to build nests;
- Clean up any grain spills at harvest and practice good hygiene around houses and gardens.

Additional technology if chronic losses are greater than 10%

One simple technology added to the armory of rice farmers is a trap-and-fence system known as the Community Trap Barrier System. It comprises a plastic fence surrounding a small rice crop (20 x 20 m) planted 2-3 weeks earlier than the surrounding crop, with traps set into the plastic. At night, rats follow the line of the plastic until they reach a hole, which they enter to reach the rice but instead are caught in a trap.

Community Trap Barrier System. – G. Singleton

The economic benefits of this management approach in Indonesia are impressive (see Singleton et al. 2005). Affordable rodent-proofing of stored grain structures has also proved effective. However, the bottom line is that each rodent species has a different ecology and this needs to be understood before effective management strategies can be developed.

Further reading

Meerburg, G.M., Singleton, G.R., and Kijlstra, A. (2009). Rodent-borne diseases and their risks for public health. *Critical Reviews in Microbiology* 35: 221–270. *DOI: 10.1080/10408410902989837*

Singleton, G.R. (2003). Impacts of rodents on rice production in Asia. IRRI Discussion Paper Series No. 45, 30 pp, Los Baños, The Philippines.

Singleton, G.R., Sudarmaji, Jacob, J. and Krebs, C.J. (2005). Integrated management to reduce rodent damage to lowland rice crops in Indonesia. *Agriculture, Ecosystems and Environment* 107, 75-82. DOI: 10.1016/j.agee.2004.09.010

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