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RODENT PEST PROBLEMS ON EXPERIMENTAL RICE FARMS

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The International Rice Research Institute (IRRI) is a primary example of a situation in which intensive year-round agricultural crop production provides an ideal environment for rodents. The continuous availability of susceptible crops provides the rat its basic requirements--abundant food, water, and shelter. Although rodent populations are lower at certain times of the year, such as at the end of a dry season, survivors abound in irrigated areas that continue to provide these basic needs.

Rice research farms are usually located in areas with excellent edaphic and climatic conditions. Uncultivated areas within and adjacent to experimental farms flourish with weedy vegetation that provides shelter for rats. Adjacent land is frequently farmed with rice or other crops in which little or no rodent control is practiced by farmers. When those crops are harvested, rodent populations move to more suitable shelter--the neighboring experimental rice farm. Research farms need control recommendations that consider areas much larger than their own property lines and involve adjacent farmers. When a rodent population within an experimental farm is intentionally reduced, a vacuum or "sink" is created. Adjacent rodents, typically moving 50-100 meters per night, quickly fill this "sink," which contains extremely favorable habitat and little competition from established rats. Once established in research plots, rats do not leave.

A Philippine ricefield rat (Rattus rattus mindanensis) cuts, on the average, 70 tillers/night (West et al., 1975). In just 10 days, about 5 rats/ha would theoretically be capable of inflicting 1% damage and only 25 rats/ha could cause 5% damage (assuming 3.4 million tillers/ha). Five human factors contribute to serious rodent problems on research farms. First, there is no professional rodent research staff present at any of the international agricultural institutes nor at most national research facilities. In other disciplines such as entomology, plant pathology, or weed science, a source of research data and knowledge is readily available within most institutes to recommend control methods and guide farm operations in the management of these pest problems. Second, most rodent pests are active at night and the damage they do, particularly in rice, is not readily visible until it reaches severe levels. This hidden damage is usually not noticed; and more than likely, it has affected research results without the researchers' awareness. Third, without adequate awareness of the consequences of the effect of rat- damaged research plots, the intensive rodent control effort that is required to maintain low levels of rat damage is either not done or else it is done at a token level with few personnel assigned to the laborious task of performing rodent control. This has led to apathy; and with strained budgets, it is easy to avoid rodent control expenditures when no one is complaining. Using inappropriate rodent control methods that produce dead rats, but don't protect crops, is a fourth reason. For example, digging and flooding burrows at any time after harvest or fumigation is not an appropriate control method at IRRI (Fiedler et al., 1990). It wastes time and money that could be devoted to more effective efforts. Fifth, maintenance of methods and devices is not followed. Without maintenance, effectiveness soon turns to ineffectiveness. For example, a new electrified fence can be physically damaged, be washed out in floods, have gates left open or items left draped over the barrier to act as a bridge, or have cracked soil that permits rats to pass underneath when water levels are not maintained. At a time when rat pressure is greatest, much electrical shorting occurs due to rats being killed. A few minutes of no electricity may allow a sufficient invasion of rats to cause severe damage. Without corrective procedures, these conditions render fences useless.

Specific examples of research farm rodent problems

AUSTRALIA

The experimental research station at Kununurra in northcentral Australia was seriously affected by an outbreak of rats (Rattus villosissimus [=sordidus]) in 1983 and 1984. This rat is common only during outbreaks; during non-outbreak years, it can hardly be found. Damage to research crops was so intense in 1983, that electric fences were installed and tested for effectiveness in 1984.

BANGLADESH

One deepwater rice experiment at the Bangladesh Rice Research Institute (BRRI) that lasted 6 months was completely destroyed by rats (Bandicota spp.) when effective control recommendations were available but not used (Ahmed et al., 1987). Catling and Islam (1979) also experienced severe rat damage while conducting fertilizer trials in deepwater rice plots at a research station as well as in farmers' fields. Sweet potato, barley, and other crops planted on the Bangladesh Agricultural Research Institute (BARI) research farms have been significantly damaged by the lesser bandicoot rat (Bandicota bengalensis).

BURMA

Research farms in Burma, some newly opened, have reported serious damage problems. Rats were considered the major pest problem in Burma where "Researchers report they are unable to obtain reliable yield data from experimental plots because of extensive feeding by rats." (E. H. Glass, personal communication, 1984). An effort in 1987 to develop these farms was supposed to have included a rodent control component but, to my knowledge, did not do so.

INDIA

Several research farms in India report rodent problems. The Regional Agricultural Research Station at Aduthurai has had serious rat problems including complete loss of experimental rice (Srinivasalu et al., 1971). Also, the Indian Agricultural Research Institute at New Delhi grew wheat, barley, potato, groundnut, and sugarcane that was damaged by rats (Peswani et al., 1975). However, behavioral studies on the short-tailed mole rat (Nesokia indica) resulted in modifying baiting procedures that eliminated most of the rats on this 120-ha farm. Kulshresntha (1968) mentioned serious rat damage occurring over several years to wheat, barley, and other crops at the Regional Research Center in Kanpur. With a vigorous rodent control effort, damage was reduced. However, when control efforts declined, reinvasion occurred and rodent problems increased.

INDONESIA

The research station at Sukamandi has had overwhelming rat (Rattus argentiventer) damage problems for many years. Various control techniques have been used, including the construction of a large, deep trench dug around the experimental plots and partially filled with water.

PAKISTAN

The National Agricultural Research Centre (NARC) near Islamabad has had a sustained rodent control campaign in recent years to avert some of the losses that have plagued experimental plots (Brooks et al., 1987). At a labor and material cost of only $0.75/ha, rodent burrows were reduced 87% after 4 treatments in a 600-ha area over a 9-week period. Experimental

wheat plots that had been totally lost due to rat damage before the campaign had no such losses during the campaign. Continued surveillance of rat activity and a maintenance control program was recommended to keep costs low and effectiveness high.

PHILIPPINES

Ahmed et al. (1987) estimated the value of the International Rice Research Institute (IRRI) research data lost in 1 year due to rat damage to be about $370,000. This varied from a complete loss of data in 6.4% of experiments to a partial loss in 59.1% of experiments. Only 34.5% of the experiments surveyed experienced no loss of data due to rat damage. Location (nearness to adjacent farmers' fields) appeared to be a significant factor influencing rat damage. Neither seasonal effects, intensity of rat control methods used, nor plot size significantly influenced research data loss.

THAILAND

The Bangkhen Rice Experiment Station has had serious problems in experimental rice plots (Anon. 1967). The use of an electric fence design modified from the IRRI model (Ramos. 1967; 1970) was reported to work better than either rodenticides or fumigation.

RODENT CONTROL MEASURES USED

A variety of control methods are used at tropical research institutes. Common control methods include the use of rodenticide baits, fumigants, fences (either passive or electrified), traps, and digging or flooding burrows. Less common methods include the use of "flamethrowers" or constructing deep, partially flooded trenches around plots. The three rodent pests present at the NARC research farm in Pakistan were all burrowing rodents, and their presence was easily detected by visible burrows. Burrow baiting with rodenticides may not be useful at other research farms where rodent pests are not as fossorial. For example, burrow treatments at IRRI were shown to be generally ineffective in reducing rodent populations since only a small portion of the rodent population utilized burrows (Fiedler et al., 1990).

Ahmed (1981) and Ahmed and Fiedler (in prep) compared four control methods--two baiting techniques and two barrier techniques. A well- maintained lethal electric fence was most effective in preventing damage to rice, but was also the most expensive method ($1,284/ha). Baiting methods provided reasonable protection (no serious damage such as occurred in reference plots) at a modest cost ($26/ha).

RECOMMENDATIONS AND NEEDS

Effective rodent control at large experiment stations requires several key components explained below, including (1) administration awareness and support, (2) a professional research staff, (3) adequate operational staff, equipment, and supplies, (4) surveillance of rodent activity on the farm, (5) control techniques appropriate for the rodent pest and crops present, and (6) a maintenance program designed to keep costs low and effectiveness high. If a rat damage problem has not been defined well enough to produce effective recommendations, then a research program needs to be initiated. The dilemma, however, is that administration awareness of rodent problems may not occur until sufficient research has been conducted to properly define the problem. It usually takes highly visible damage before decision-makers are made aware of any rodent problem. In IRRI's case, administrators became aware of damage almost from the beginning of establishing field plots. Damage, however, was never examined and defined. The

focus, like with so many other rodent control programs, has always been on the number of dead rats produced.

What is needed most are rodent research programs functioning within larger tropical research institutes to provide information defining the problems, test control methods, produce recommendations, and offer guidance to implement operational control programs. Extension of this technology to smaller research institutes with similar rodent problems and, if appropriate, to farmers can be an important contribution toward increasing rice production in the Tropics.

Operational rodent control programs at research farms are usually not adequately staffed to fully implement good control recommendations, or an adequate staff may not be properly utilized. Control programs frequently lack maintenance procedures or on-going monitoring efforts. When surveillance of rodent activity is not done, operational control programs react to problems rather than anticipating and preventing them. When managers know what is presently happening and can anticipate what will be happening in the near future, rodent control can become much more efficient.

Research institutes implementing control recommendations that consider adjacent habitats, rodent behavior, and the "sink effect," in addition to concern for their own research plots, will be the most successful at reducing experimental research data losses. Perimeter control measures such as perimeter baiting (to limit immigration) or non-lethal electrified fencing (to establish a biological buffer zone of repelled rats; Reidinger et al., 1985, Shumake, et al., 1979) would seem appropriate to test. Additionally, by working with adjacent landowners, research institutes can provide rodent control recommendations and technical assistance that will benefit these farmers directly and the research farm indirectly by reducing immigration of rodents from surrounding rice fields.

SUMMARY

Intensive year-round agricultural crop production at tropical research institutes provides an ideal environment for rodent pests. Adjacent land is frequently farmed with rice or other crops in which little or no rodent control is practiced by farmers. Therefore, research farms need control recommendations that consider areas outside their own property lines. Establishing perimeter control techniques and encouraging rodent control by adjacent farmers seem appropriate. Surveillance of rodent activity combined with a rigorous, sustained rodent control schedule using appropriate proven techniques is essential for keeping costs low and effectiveness high. Priority must be given to protection of research plots, not number of dead rats.

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