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BARRIER/TRAPS SYSTEM TO PREVENT RODENT DAMAGE TO FIELD CROPS*

Graeme R. Quick
Head, Agricultural Engineering Division
International Rice Research Institute
P. O. Box 933, 1099 Manila, Philippines

INTRODUCTION

Rodents have an impact on rural life in much of the rice world. They influence seasonal activities, consume and contaminate stored products and are vectors of disease. Rodent damage is not confined to rice, of course, but whatever the crop, in the literature it is difficult to find accurate measures of field crop damage due to rodents because their attacks tend to highly variable in place and time. These omnipresent pests have caused some farmers to adopt combative measures with serious long-term consequences. Reliance on the more common control measures, such as rodenticides, faces constraints in Asia, such as community apathy, unavailability of the chemicals, or user reluctance due to the side effects of rodenticides on domestic animals or even humans using rodents as food. For researchers, damage to field trials by rodents is a serious issue, especially with valuable genetic materials.

RODENTS AT IRRI

Rice field trials used to be grown year-round at IRRI until 1991. These plot trials provided a continuous source of food for pests and necessitated very costly control measures. The principal rodent causing problems at IRRI has been *Rattus rattus mindanensis.* In 1988 IRRI's rodent patrol involved a team of 160 people working two shifts daily. They monitored bait stations, maintained barriers: some of which were electrified, used flamethrowers, and were constantly working to reduce rat refugia. The metal-over-mesh rat fences around field trials became a characteristic of IRRI plots at Los Baños and elsewhere. The cost of rodent control at the time was estimated by the research farm to exceed one-third of a million dollars annually.

Rodents not only caused damage to highly-valuable genetic seed stocks but considerable loss of field trial data which increased variability. Some scientists were even reluctant to maintain field trials at Los Baños because of continuing problems with rodents. In spite of the manpower input, the fences were often breached and there was not a lot of confidence in that approach. Changes in managing the rodent problem were commenced in 1989. Today the distinct metal fences at IRRI are practically all gone. The night shift patrol was abolished in May 1991 and currently the rat patrol numbers 38 people. The reappraisal of IRRI's approach to rodent pest management over the past four years has resulted in:

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1. Major habitat modification including the installation of underground drainage, and the rework of field levees to reduce rat habitat and facilitate weed management. Rodents prefer a weedy environment.

2. Establishment of seasonal procedures to produce just two crops per year, with two fallow periods in May and December to reduce pest pressures.

3. Removal of the metal fences eliminated a major installation and maintenance operation.

4. The introduction of the Barrier/Traps System by IRRI Agricultural Engineering Division.

The table below summarizes researchers' assessment of damage to field plots over the years. The results of a survey that was undertaken in 1981 are included. The figures show that the respondents were suffering a steady level of severe damage in their trials through to 1990 but that a profound change took place after that.

Table 1. Rodent damage to research trial plots. Results of surveys of researchers conducting field trials at IRRI.

PERCENTAGE OF RESPONDENTS

Year	Severe	Medium	No Damage
1981	**20.5**	53.9	**25.6**
1988	31.25	50.0	18.75
1989	31.58	47.37	21.05
1990	22.73	36.36	40.91
1991	**0**	25.00	**75.00**

Notes: *The data for 1981 was extracted from the survey conducted at IRRI by M. S. Ahmed and L. Fiedler. The 1988-91 data comes from the survey by Quick (1992) from 27 respondents.*

LETHAL ELECTRIFIED WIRES AROUND FARMERS FIELDS

Rice farmers in the vicinity of Laguna de Bay near IRRI are concerned enough about rodent losses -- losses in excess of 50% occur sporadically in some ricefields in the district -- that a number have resorted to using illegal electric *mains-powered* wires positioned just above the water around their paddy fields (Figure 1). This approach works to some extent, but it is lethal to humans and livestock. In the field survey IRRI Engineering staff have learned about the deaths of fifteen people who stumbled unaware on these electrified barriers.

Electrified wires can kill rats -- the results are clearly visible -- but the procedure is lethal to humans and livestocks, only partly effective, and definitely illegal. *IRRI has never encouraged the use of mains-powered electric wires for rodent control.* The electric fences previously used at IRRI were all driven by battery-powered fence energizers and *were not mains-powered.* Since the experience with these fences was less than satisfactory, electrified barriers are now a thing of the past at IRRI.

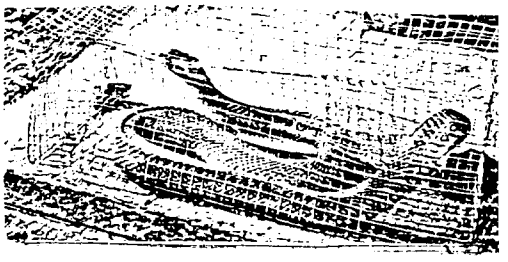
The *awareness of the magnitude of rodent losses* in the riceworld, the *concern of IRRI researchers about the destruction of their field test data* by rats, and *the desperation of farmers*, motivated staff of the Agricultural Engineering Division to seek ways to improve rat control technologies. The Barrier/Traps System has been the main involvement.

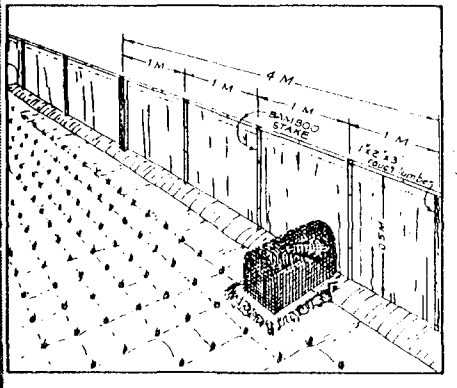
Figure 1. Lethal mains-powered electrified wires encircling a paddy field in Luzon, Philippines. The sign warns that there is current in the wire. Such signs are ineffectual for children, or those moving about in the dark, or domestic animals.

THE ACTIVE BARRIER SYSTEM (ABS)

The principle of drift fences using traps with a barrier to capture animals has been around for a long time, perhaps for centuries, but it was MARDI researchers in Malaysia who put the principle of combining fences with traps to work to encircle and protect large rice fields. Mr. Y. M. Lam of MARDI reported on this work, undertaken since 1985, at the Expert Panel Meeting on Rice Rodent Control which was held at IRRI September 1990. This system was assessed then modified by IRRI Engineering, being labeled then as an Active Barrier System (ABS). An ABS consists of a plastic barrier perforated at regular intervals with holes that open into live traps. The principle behind the ABS takes advantage of the exploratory behavior of rodents. Rodents seeking to attack a rice crop or field trial are deterred by the barrier, which they explore, seeking an entry point. Openings are provided at intervals with a small ramp to encourage entry. Immediately behind the opening in the plastic fence is a trap with the non-return entrance. The capture of one rat in the live trap does not deter others from

entering. It may even attract others. In IRRI tests up to 15 rats have been caught in one trap in one night. Mr. Lam's work, using larger traps with heavier infestations, has yielded up to 129 rodents in one trap in a night. Rats are removed from the traps each morning and humanely disposed of. Beneficial species (toads, birds, snakes, lizards) are also captured from time to time but these can be released unharmed. There is a demand at IRRI for the rodents for food in neighboring barangay. Unfortunately this interest includes native species -- and some of our traps.





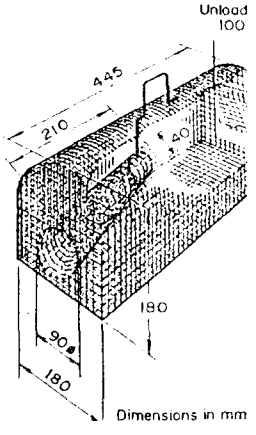


Fig. 2. Active Barrier System in the field and in schematic. Beneficial species are also captured (inset) but can be released unharmed.

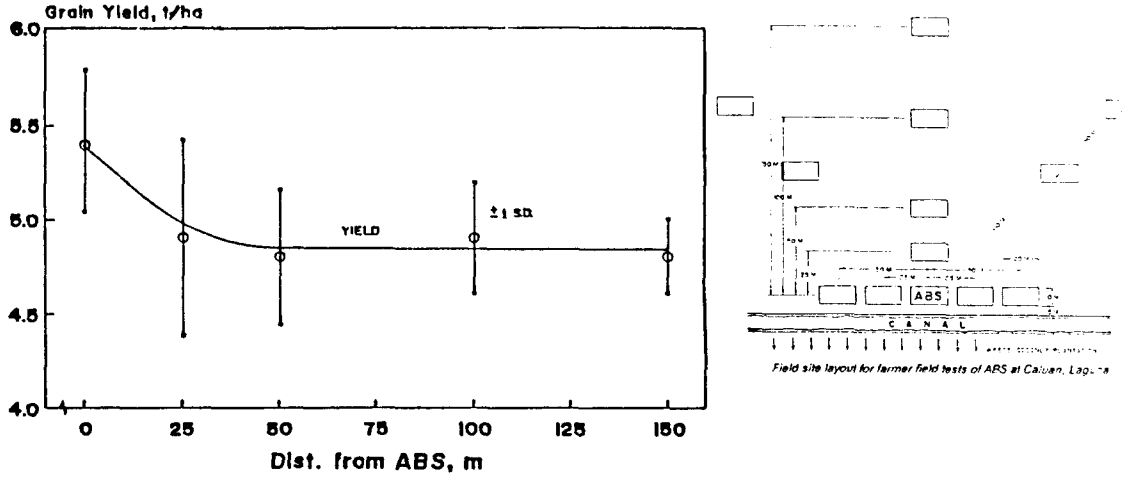
4. RESULTS FROM FIELD TRIALS WITH THE ABS

The ABS was introduced to IRRI late in 1990. At harvest in the 1991 DS the damage in that first trial was less than .05%, while adjacent areas suffered severe rodent damage. Rodent catch declined after the first week. It was observed that the proportion of the adult to juvenile rats caught was higher earlier in the test. Furthermore, rats caught in the cages later in the season were smaller. The ABS experiment was successfully repeated at other research sites. There were 57 ABS installations of varying sizes in the 1991 WS. For the 1992 DS there were 36 ABS installations and in the 1992 WS. In 1993 DS there were 35 installations,

enclosing 26 ha of the Research Farm. Researchers using the ABS reported practically complete protection of their trials. The ABS may not prevent entry in every case, since the height of the barrier and materials used are a compromise between cost and protection. There was some crop damage for example where there was loss of traps which had been stolen. Nevertheless, our survey assessments indicate that IRRI researchers now can have confidence in a method that can provide practical and complete protection: they are now beginning to use the ABS in outreach sites. Habitat management is an important factor, *but not sufficient on its own*. For example, the Engineering experiment at one site where there was a coconut plantation and creek nearby -- an abundant source of rodents -- successfully deployed an ABS for two crop seasons. Rodent damage was small even in the area adjacent to the ABS. In the third season the ABS was deliberately removed to see if modification of the habitat alone would keep down rodent depredations. It was found that rodent numbers built up again within a few months and crop damage was severe. The ABS was reinstalled with success in the fourth successive crop.

"HALO" EFFECT?

The phenomena of reduced crop damage in the immediate vicinity of the ABS was investigated further in farmer's field experiments on five farms at a nearby town, Calauan. In summary, field data from those sites indicated that within 25 m of the ABS, crop damage was significantly lower and yield diminished with distance away from ABS, becoming asymptotal after 50 m distance. Damage inside the ABS was zero in each of these field trials. It was concluded that rodents have a limited home range; and that the ABS serves as a "sink," causing a temporary lowering of population in the immediate area around the ABS. It was even possible that an ABS of just 200 sq m could provide a reasonable degree of protection for 1 ha. Furthermore, an ABS can be installed after crop establishment if rodent attack has been noted. The ABS has also been used successfully at several sites on farms as a line barrier or drift fence between a known habitat and rice crop, also in totally protecting seedling nurseries (night watching was no longer needed), and as a "trap crop" control procedure.



Field site layout for farmer field tests of ABS at Calauan, Laguna

Fig. 3. Yield estimates; average from four farm sites Calauan, Laguna. Samples taken at successive distances from the ABS. Rodent damage (cut tillers) inside the ABS was zero.

COST

The plastic sheeting is the most expensive component of the ABS -- at about $1/m at IRRI for new plastic. With judicious use, however, the plastic can be recycled for two or more seasons. We are currently working with a method that has some potential to reduce costs further, namely, second-hand plastic from rice or cement sacks, sown end to end. The cost can be brought down to around $.3/m for an ABS, depending on the area enclosed. Field trials with farmer cooperators continue. Success in protecting IRRI trials, nurseries and small commercial rice areas has been the first outcome, repeating the excellent results from the Malaysian work by MARDI. We estimate now that any loss level to rodents of over 10% could easily give a return on its worth in the system in one season, using recycled plastic.

CONCLUSION

The Barrier/Traps System has proven to be a reliable component of rodent management. Its impact extends outside the barrier. The system has the psychological advantage of providing visible results and is useful for monitoring rodent movement. It has been well proven on large areas by Malaysian researchers and it is finding its way into commercial enterprises. The system is perceived by some to be expensive, however, and there is understandable reluctance for adoption by the farmers who are dealing with a pest that is mobile and highly variable, both spatially and temporarily. The system is not typhoon-proof, the live traps are attractive to thieves and the traps also catch non-target creatures. Nevertheless the impact on the IRRI research farm has been substantial and the savings considerable. IRRI Engineering is conducting research to further reduce the cost and improve the acceptability of the system.

Studies are now underway with telemetry and other procedures to better understand rodent movement, population dynamics, and the halo effect in relation to a Barrier/Traps System; and to further disseminate the technology.