FIELD TRIAL OF MUTIPLE BAITING WITH ZINC PHOSPIDE TO PROTECT GROWING RICE FROM DAMAGE BY RATS
(*RATTUS RATTUS MINDANENSIS*)

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FIELD TRIAL OF MULTIPLE BAITING WITH ZINC PHOSPHIDE TO PROTECT GROWING RICE FROM DAMAGE BY RATS (*RATTUS RATTUS MINDANENSIS*)[1]

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ABSTRACT

Three intensive baitings along dikes in growing rice with bait containing 1% zinc phosphide did not cause a measurable effect on the rat populations or reduce damage. Inked tracking tiles were used to index animal abundance in six, nine-paddy blocks, each centered in a different 20-hectare area that was baited three times during the study, and in six similar blocks where control was left to the discretion of the owners. The mean percentage of tiles showing tracks was not significantly reduced with any of the baitings. Surveys of cut tillers at harvest showed damage was as great in the 54 test paddies (average 5.0 percent) as in the 54 reference paddies (average 5.3 percent). The baiting technique was inexpensive and incorporated several refinements of methods presently used by farmers, but appeared to be no more effective than the aggregate of local control methods. Bait acceptance may be a major factor limiting the effectiveness of acute toxicants as now used for rodent control in Philippine ricefields.

One control method presently suggested for reducing rat populations in ricefields is baiting with acute toxicants during the dry season followed with chronic toxicants during the growing season (Sumangil *et al.*, 1970). Because of the labor and material costs of using chronic toxicants throughout the period when plants are susceptible to rodent damage and because the results of the toxicant application are not visible immediately, many farmers rely on emergency use of acute toxicants, such as zinc phosphide, after rodent damage appears in their paddies. Preliminary studies were conducted at this laboratory to evaluate the effectiveness of baiting during the growing season with polished rice treated with acute toxicants. After single baitings, trap success for ricefield rats (*Rattus rattus mindanensis*) was generally reduced about 65 percent — not an adequate population reduction to prevent substantial crop damage before harvest. The present study was conducted to determine the effectiveness of multiple baitings with zinc phosphide-treated bait in reducing rat populations and preventing damage to growing rice.

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MATERIALS AND METHODS

Six 20-hectare study sites were selected within a continuous area of several hundred hectares of irrigated riceland between Sta. Cruz and Lumban, Laguna. All sites were at least 100 m apart. Within each site, rodent activity was censused by placing tracking tiles in a central block of nine contiguous rice paddies; the blocks averaged about 1.5 ha. each. For each census, vinyl floor tiles (23 cm x 23 cm), simliar to those described by Lord et *al.* (1970), were partially covered with printer's ink and placed for 2 nights along the paddy borders; one at the paddy corners and two along each side, for a total of 64 tiles per nine-paddy block. Tiles were checked and cleaned in early morning, then reset in late afternoon to avoid daytime disturbance. Rat activity was expressed as percent of tiles showing tracks.

The first census was conducted in each site 5-10 weeks after transplanting of the rice (befor panicles emerged and before rat damage began). After the second day's census, the entire site was baited in the afternoon with a test preparation of polished rice treated with zinc phosphide (1.0% by weight) and homemade coconut oil (0.5% by weight). Bait was placed in 6-g piles at 5-m intervals along dikes, beside all dike intersections, and near all noticeable burrow entrances and runways; this resulted in an approximate bait application rate of 1 kg/ha. Earlier studies indicated that about 0.75 g of this bait would be lothal to most adult rats (*R. r. mindanensis*); thus, each bait pile contained at least eight lethal doses. Weathering tests indicated the bait would be adequately toxic for 2 or 3 days, even if exposed to rain.

The fifth and sixth days after baiting, a census was again conducted at each site. The seventh day, the entire site was baited with 1-cm^3 chunks of fresh, mature coconut dusted with zinc phosphide (1% by weight), placed in the same manner as the rice bait. Again, a census was conducted the fifth and sixth days after baiting. Within 2 weeks of harvest, a fourth census was conducted and, because activity remained high, all of the six 20 hectare sites were baited again with the initial preparation of zinc phosphide-treated rice. A fifth census was conducted the fifth and sixth days after this third baiting.

Six blocks of nine contiguous paddies, each corresponding to a baited area but at least 100 m from it, served as reference plots. Censuses were conducted on these plots, in the same manner as on the treated plots, before the first, after the second, and before the third baiting on the corresponding treated area. The censuses between the first and second baitings and after the third baiting were eliminated because reference estimates had been made only 5 days earlier. At harvest, 100 randomly selected hills (10 hills from each of 10 rows) in each of the 108 paddies (treated and reference) were examined to determine the percent of the rice tillers cut by rats.

RESULTS AND DISCUSSION

Although many farmers attempt some rodent control with rice baits and acute toxicants, the baiting method we tested incorporated several refinements not generally used. These included uniform baiting on a relatively large area (owned by several farmers), baiting before the appearance of rat damage, alternating bait bases, using coconut oil to increase the weatherability of bait, and placing additional bait near noticeable sites of rat activity.

However, the data indicate that even this intensive baiting did not appreciably reduce the population or prevent rice damage (Table1). Only the census following the first baiting in replicates 1, 2 and 4 showed significantly ($P < .05$) less rodent activity in the treated than in the reference plots. Alhough damage at harvest was significantly ($P < .05$) less in the treated than in the reference plots in two of these replicates (1 and 4), it was significantly higher in the third plot (2). Because the mean percentage of tillers cut in all treated and reference plots was almost identical (5.0% vs. 5.3%), we must conclude that the baitings had no important influence on damage.

Many factors probably contributed to the unsatisfactory results of this multiple baiting. Fernando *et al.* (1967) reported that ricefield rats (*Gunomys*) in Ceylon have developed increasing bait shyness to the traditional rodenticides. Wood (1971) noted that in Malaysia the commonly adopted control procedures using zinc phosphide on grain generally spare enough rats for damage to continue. In the Philippines, farmers do considerable individual baiting; bait acceptance could be one of the largest single factors reducing the success of crop protection practices using acute toxicants.

It should be noted that damage estimates for most of the treated and reference areas were relatively low. The owners of virtually all of the 54 reference paddies used some form of chemical control to protect their rice. Damage in the reference plots may have been considerably higher had this not been the case. The baiting method tested thus appeared to offer no improvement over the aggregate of local methods the adjacent farmers were employing; its effectiveness was not compared with situations in which no local control existed.

There was no apparent correlation between damage and tracking tile use at any growth stage, indicating that tracking tiles could not presently be used to predict damage. Previous work at this laboratory has shown a similar lack of correlation between trap success and damage in rice, and work by personnel of the U.S. Bureau of Sport Fisheries and Wildlife (G. A. Hood *et al.*, 1968 unpublished report Denver Wildlife Research Center) showed no correlation between trap success or activity boards with damage by rats (*Rattus* spp.) to sugarcane in Hawaii. Although the reasons for this lack of correlation are not known, variation in the

Table 1. Effect of multiple batiing with zinc phosphide on activity of *R. r. mindanensis* as indicated by censuses with tracking tiles, and on damage to rice at harvest.

Replication	Time of Baiting (Weeks After Transplanting)			Percent Activity (tracking tiles)					Percent of Rice Tillers Cut (9-Paddy Ave.)
	1st	2nd	3rd	Before 1st Baiting	Between 1st and 2nd Baiting	After 2nd Baiting	Before 3rd Baiting	After 3rd Baiting	
1. Treated	10	11	16	87.7	48.4	39.8	57.0	51.8	6.0
Reference*				83.6		77.2	58.6		14.5
2. Treated	5	6	13	77.6	44.5	63.2	52.3	63.8	12.1
Reference*				75.8		83.2	78.9		4.1
3. Treated	6	7	14	30.2	41.9	24.2	63.3	82.7	4.0
Reference*				41.7		44.7	50.0		1.5
4. Treated	9	10	14	75.4	42.0	82.0	57.6	65.6	1.7
Reference*				84.4		63.3	54.3		3.8
5. Treated	6	7	13	91.4	88.3	66.7	86.5	68.1	2.7
Reference*				89.4		93.3	86.7		3.8
6. Treated	6	7	13	76.6	66.4	76.2	82.0	65.5	3.4
Reference*				98.4		93.8	74.8		3.9
Mean									
Treated				73.1	55.2	62.0	66.4	66.2	5.0
Reference				78.8		75.9	67.2		5.3

*Activity estimates on the reference areas were not made between the first and second, and after the third baitings because reference estimates had been made only 5 days earlier.

response of different populations to growing rice and the lack of precision in census methods probably contribute. Tracking tile use was generally lower in mature rice than in young rice. We suspect this reflects the rats' establishment and use of more definite paddy runways and a decrease in the use of dikes as the rice ages.

The method of baiting used in this study requires little effort and expense. The cost for each treatment was about ₱2.65 per hectare; ₱1.00 for 1 man-hour of labor, ₱1.30 for 1 kg of polished rice or coconut, and ₱0.35 for 10 g of zinc phosphide. The low cost of toxicant was a major reason for these low figures; this is, of course, the only direct expense if a farmer furnished his own bait and labor. While effectiveness remains the most important criterion for evaluating Philippine rice protection methods, the direct cost and personal labor required of small farmers are also major considerations in developing workable approaches.

We suspect that bait acceptance is a major factor limiting the effectiveness of acute rodenticides as now used for crop protection in Philippine ricefields; methods to improve acceptance need further investigation. Some possible approaches are baiting in the paddy, use of bait stations, and pre-baiting. Use of non-chemical approaches such as habitat management, either alone or with acute and chronic toxicants, should also be investigated. However, these approaches will add costs that may prove excessive for the improvements in effectiveness gained. The potential problem of genetic resistance to anticoagulant rodenticides (Jackson, 1969) may further impair effectiveness if one material is used repeatedly over an extended period. Both bait acceptance and genetic resistance to toxicants should be considered in the design and testing of improved control programs.

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