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RODENT CONTROL IN WHEAT AND RICE: A LARGE-SCALE CONTROL DEMONSTRATION IN GUJRAT, PHASE I

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A technology for control of rodent damage to wheat and rice is ready for transfer to farmers in Pakistan. Here, the main rodents attacking these crops are the lesser bandicoot rat, *Bandicota bengalensis*; the short-tailed mole rat, *Nesokia indica*; the house mouse, *Mus musculus*; the soft-furred field rat, *Millardia meltada*;, and the Indian gerbil, *Tatera indica* (Beg and Rana 1978; Beg et al. 1980; Fulk et al. 1980).

All of these species are susceptible to the commonly used rodenticides. A combination of these poisons, both acute and chronic , and burrow fumigants (aluminum phosphide) were used on the campus of the National Agricultural Research Centre (NARC), Islamabad, in a successful programme to reduce rodent populations (Brooks et al. 1987). Active rodent burrows were reduced by 87% in this programme in a 4-month period on a 600 ha area.

Both zinc phosphide and coumatetralyl (Racumin) can be mixed into an easy to use ready-made biscuit bait (Smythe and Khan 1980). This bait was readily accepted by farmers for use in rodent control in Bangladesh (Adhikarya and Posamentier 1987). Burrowing rodents in wheat fields were found to have limited home ranges (Poche et al. 1986) and baiting nearby or into the burrow openings was found to be effective in reducing damage to the crop (Brooks, et al. 1985). This developed technology is ready to be transferred to farmers growing grain crops.

To demonstrate how the technology could be transferred and to evaluate the socioeconomic acceptability of the technology, we started a large-scale control demonstration in a wheat- and rice-growing area in Gujrat District. As part of the control demonstration, we used a mini multi-media information and awareness campaign, following some of the principles as outlined by Adhikarya and Posamentier (1987). As they state in their book, "In many spheres of rural development, such as in agriculture, public health, nutrition, population control and environmental protection, ... farmers' participation is an essential ingredient for success. Without an effective information, education and communication (IEC) programme which can create or increase farmers' awareness and motivation, as well as teach them the necessar skills required in rural development activities, active cooperation may not be forthcoming". This control demonstration was planned to do just that, over a period of three crop seasons, wheat-rice-wheat, from January 1989 until May 1990.

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METHODS

Selection and Description of the Area

The area selected lies approximately 9 km west of the city of Gujrat. It is bounded on the north by the Gujrat-Sargodha highway, on the east by the Upper Jhelum canal, and on the west and south by paved roads (Fig. 1). The area is comprised of 11 villages and covers approximately 2200 ha. It lies within the project area of the Crop Maximization Programme (CMP), a PARC/NARC project funded by the Italian Government. The CMP maintains a workshop near the large village of Kunjah, which was utilized as a place where ready-made baits could be left for farmers to purchase. The CMP has operated in the area since 1985 and has a good relationship with, and knowledge of, the local farmers. Wheat comprised about 60 to 70 % of crops grown during the period January to May 1989, along with sugarcane, lucerne and tobacco. By May, all the sugarcane fields had been harvested. Rice will be the next crop to follow and will be grown from July until November.

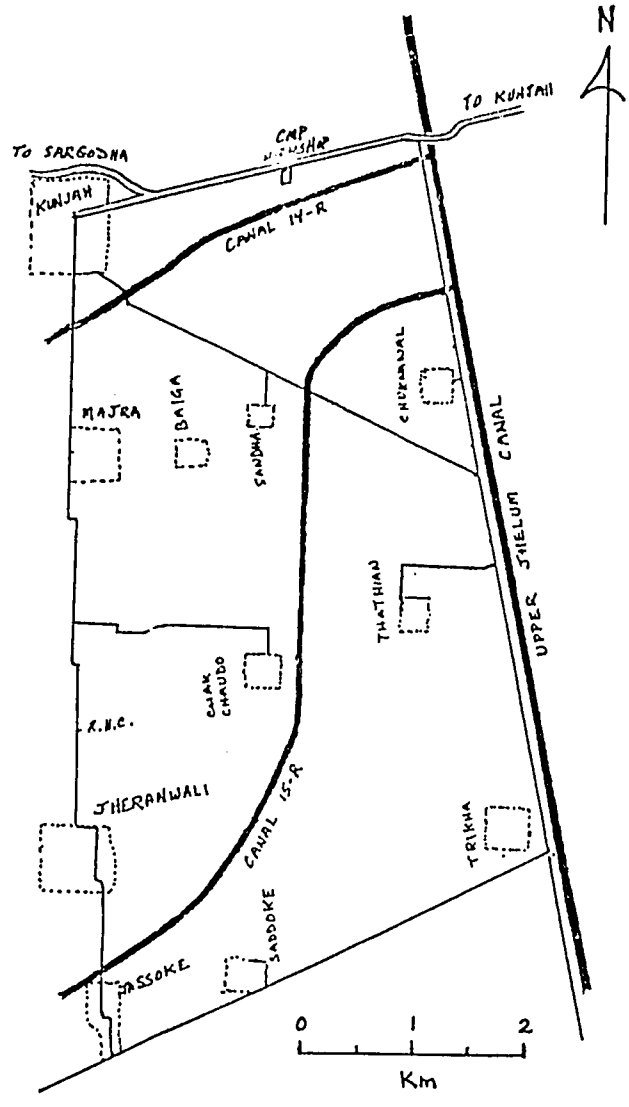

Fig. 1. Map of the Kunjah area, Gujrat District.

Mini-Media Information and Awareness Campaign

We planned on transferring the rodent control technology in several ways: 1) providing a supply of ready-made baits of both zinc phosphide and coumatetralyl, in 100 g packets to be sold at our one rupee cost; 2) by providing awareness and knowledge training directly to farmers at their villages; and 3) providing some media materials to create awareness and information re-

garding the availability and uses of ready-made baits to reduce damage to wheat and rice. These were in the form of posters and handbills.

The mini-campaign was planned with the objectives of 1) informing farmers that rodents can damage their crops and decrease crop yields, 2) that ready-made baits and other control methods can reduce crop damage , 3) ready-made baits and instructions on how to use them were available at inexpensive cost at the CMP workshop near Kunjah, and 4) motivate farmers to take individual action on rodent control in their fields.

Fig. 2. Placing the posters.

The campaign strategy used several media in attempting to inform and mctivate farmers. A poster, in Urdu language, depicting a rat cutting wheat stems and saying "Kill the Rats - Save the Crop", was put up at prominent places in the 11 villages. In all, 315 posters were placed in late January (Fig. 2). A reduced version of the poster was prepared as a farmers handbill and on the reverse side were given the instructions on how to use the several kinds of ready-made baits available (Fig. 3). These handbills were distributed by the researchers while in the fields taking the damage assessment data (Fig. 4) and copies were given to farmers when they purchased baits. Several training sessions were given to farmers at villages in the area to explain methods of rodent control to decrease damage to the wheat crop. Posters and handbills were available at these training sessions and an Urdu-language video cassette was presented depicting rodent control and the rodents responsible for crop damage.

Fig. 4. Personal contact with farmer.

Ready-Made Baits

The campaign strategy relied on having a supply of ready-made baits available for farmers to purchase and use. Two forms were provided: a 2% concentration of zinc phosphide in a wheat flour- cornmeal biscuit bait and a 0.0375% concentration of coumatetralyl (Racumin) in a broken rice bait. Both were

packed in 100 g amounts in polythene bags with Urdu language labels and instructions and were to be sold at our cost, one rupee per package. The two types of baits were available for purchase at the CMP workshop, and in March a second supply was placed with the Secretary of the Union Council at Jheranwali.

Damage Assessments

Rodent damage to wheat was measured at several crop growth stages; tillering, panicle-formation, and ripening. Fields were selected at random using each of the 10 smaller villages as a reference point. (Kunjah was not used since it is a small town and lies on the northwest corner of the control area. This would make it difficult to sample and the effect of the town extended outward more than several hundred meters). Transects were followed using the four cardinal compass directions of north, south, east and west. Starting from the village periphery, a transect was walked for 200 m and the first field lying nearest to that point was selected; another was taken after another 100 m, and a third after an additional 100 m. The longer interval was used near the village to avoid the "village effect", where the vegetable gardens and fodder crops predominate. At each village, 12 fields were sampled, except for Chak Baiga where it was possible to use only 3 of the 4 transects due to the extreme proximity of another village to the west.

At each field, one observer started at the corner, took 10 steps, and entered the field using either 1, 5, or 10 steps, respectively in the 3 fields to be sampled on the transect. A second observer walked 20 or more steps from the corner and repeated the procedure of entering the field. Generally 3 quadrats were selected crossing the field in each direction, giving 12 quadrats per field. Quadrats were wooden frames, 50 by 50 cm. These were placed into the crop at the point where the observers right foot came to rest. All wheat stems were counted inside the quadrat, both cut and uncut and totaled.

Rodent Activity Measures

Rodent activity in the fields was measured by counting the number of active burrows, either open burrows or fresh burrow mounds. In some ways, this is a cumulative measure, especially in the case of bandicoot burrow mounds, but generally, the burrows from the previous month were obliterated, rain-washed, or obviously old and were not counted.

It was intended also to set inked tracking tiles each trip to measure activity but constraints of time and manpower precluded this measure. This may be attempted in the Phase II program in rice-growing season.

Evaluation of the Control Demonstration

The effectiveness of the media materials, training, and ready-made baits were to be evaluated by interviewing farmers at the end of each harvest season. Further, a comparison was planned of rodent damage reduction in fields where farmers did control versus those that did no control. In the 1989 wheat season, damage was negligible until the very last 4 weeks before harvest; consequently very few farmers took action. We also planned to take crop-clipped samples of the wheat from in the fields in order to estimate individual field yields. However, the farmers objected to this and we did not argue the issue.

RESULTS

Damage to Wheat, 1989

Data from three damage assessments made in March, April and May are given in Table 1. At tillering growth stage in early March, damage was just starting. It accelerated rapidly in the 4 weeks between the April damage assessment and the final one just

Table 1. Rodent infestations and rodent-damaged stems in wheat fields near Kunjah, Gujrat District, 1989

Month	No. fields examined	Rodent infested fields	Rodent damaged fields	Cut stems/ total	Percent damage
March	117	33	5	15/74473	0.02
April	117	76	53	438/72018	0.61
May	117	77	71	2216/67739	3.27

Teble 2. Rodent-damage (percent of cut stems) to wheat fields by village in the Kunjah area, 1989

Village	March	April	May
Chak Chaudo	0.00	0.53	2.99
Chak Baiga	0.00	1.46	2.37
Majra	0.00	0.23	3.37
Trikha	0.00	0.04	3.08
Jheranwali	0.00	0.44	2.9=
Thathian	0.10	0.89	3.14
Chuknawali	0.01	0.63	3.48
Sandha	0.01	0.76	3.49
Saddoki	0.09	0.58	1.77
Jassoki	0.00	0.72	5.71
Mean damage	0.02	0.61	3.27

before harvest in May. Damage was fairly uniform by harvest, with 8 villages showing damage in the 2 to 3% range, while only Saddoki showed less (1.77%) and Jassoki, where it was maximum (5.71%) (Table 2).

Rodent Species Present

The several rodent species recorded during the three damage assessments are detailed in Table 3.

Table 3. Frequence of occurrence of several rodent species in wheat fields (n = 117)

Rodent species	March	April	May
Lesser bandicoot rat	22	47	71
Indian gerbil	5	6	11
House mouse	4	4	3
Soft-furred field rat	2	17	3
Short-tailed mole rat	2	5	3

Lesser bandicoot rats were the predominant species in wheat fields right from tillering/booting stage on, but greatly increased in abundance during the subsequent two months. The other species fluctuated at various times but only the Indian gerbil showed an actual increase until harvest.

Rodent Activity

Rodent activity in the wheat fields was measured by the change in number of active burrows or mounds from one assessment to the next. This information is summarized in Table 4. Except for lesser bandicoot rats and Indian gerbils, there were not enough burrows of the other species from which to draw conclusions. The average number of lesser bandicoot burrows

Table 4. Average number of burrows or mounds of lesser bandicoot rats (*Bandicota bengalensis* and Indian gerbils (*Tatera indica*) in wheat fields near Kunjah, 1989.

Month	Average No. of burrows/ infested fields		Average No. of burrows for all fields (n = 117)	
	Bandicota bengalensis	*Tatera indica*	*Bandicota bengalensis*	*Tatera indica*
March	5.5	3.2	1.1	0.1
April	5.8	2.2	2.1	0.1
May	21.1	1.9	11.4	0.1

increased little from March to April in infested fields but doubled in all fields. In May the average number of bandicoot burrows increased sharply in both infested fields and in relation to all fields. In contrast, *Tatera indica* burrows decreased steadily in infested fields from March to May and never averaged more than 0.1 per field for the entire area.

Plant Density and Rodent Infestation

Plant density (number of stems or tillers/sq meter) was highest in March and decreased regularly until near harvest in May. Rodents showed no preference for fields with higher plant

Table 5. Plant density and rodent infestation in wheat fields near Kunjah, 1989

Month	Infestation/Density class*	1	2	3	4	5	6	7	Totals
March	Infested	0	1	9	10	10	2	1	33
	Not infested	1	8	22	29	15	5	3	83
	Totals	1	9	31	39	25	7	4	116
April	Infested	0	6	23	31	15	1	0	76
	Not infested	2	5	12	15	5	2	0	41
	Totals	2	11	35	46	20	3	0	117
May	Infested	0	11	27	33	4	2	0	77
	Not infested	2	5	20	8	5	0	0	40
	Totals	2	16	47	41	9	2	0	117

* Density classes: 1 = 50-99 stems/m^2; 2 = 100-149, 3 = 150-199; 4 = 200-249; 5 = 250-299; 6 = 300-349; 7 = >350.

densities, as judged both by rodent-damaged and rodent-infested fields. A summary of the plant density and rodent-infested fields for March, April and May is given in Table 5. A chi-square test for each month revealed that there was no significant shift into higher-density fields in April and May (chi-square = 6.53 and 12.1, respectively; p = 0.75 and 0.25, respectively).

Farmers Interview Evaluation

Altogether, 111 farmers were interviewed. To the question, "What types of pest problems do you find in wheat?', 98 answered rodents and 66 answered weeds, while only 14 said birds, 7 said insects, and 2 named porcupines. There was some overlap since sometimes several pests were given. To the question, "Are rats a problem?", 80% said yes and 20% said no. The levels given of rodent damage to wheat varied from none to 80%; most reported 1 to 10%. Many farmers agreed that there was much less damage this year as compared to previous years. Farmers doing rodent control

this year or in past years were 73% of the total. Of those doing control, poisoning was done by 89%, watering (pouring water into burrows or irrigating the field) was done by 12% and 11% used Quranic exorcism. (A local holy person repeats certain Quranic verses over sand. The farmer then takes the sand and spreads it in the field. The rats desert the field due to the influence of the Quranic sayings carried on the sand.). Many farmers believe in this method. Digging out rodent burrows and the use of cats and dogs as predators were practiced by a few farmers.

The media-awareness mini campaign was reasonably successful. One-third of the farmers were aware of the availability of the ready-made baits and, of these, 65% had learned of them through the posters. Handbills, personal contact and learning of baits at the CMP workshop or the Jheranwali Union Council office made up the rest.

Eleven (10%) of the farmers had used the ready-made baits. Ten of the eleven reported the baits were effective. Nine of the 11 thought the price (RS. 1.00/packet) was alright, one said cheap and one said expensive. Most farmers used the baits at tillering and booting growth stage.

Fifty-six percent of the farmers thought that wheat and rice were equally damaged by rodents, while 24% said rice was more damaged. Ten percent thought wheat received more damage and 9% said sugarcane was the most damaged crop in the area.

DISCUSSION

Despite the availability of ready-made baits, very few farmers took any rodent control actions during the wheat-growing season. Much of this inaction can be attributed to the low level of rodent damage to wheat until after the first week of April. Then, as grain filling and ripening set in, rodent damage drastically increased. At this point it was virtually too late to do anything effective.

Another reason for lack of control activities is that farmers in many cases, did not believe their fields were being damaged, until we showed them the burrows and the cut stems. A failure to promptly and properly inspect their fields was evident.

We think the drastic increase in tiller cutting took place mainly because of one factor. The sugarcane fields were in process of being harvested from January onward, but harvest essentially was completed by late April. The cutting of cane left many bandicoot-infested sugarcane fields bare and the rats living there simply moved out into adjacent wheat fields. The steady increase in bandicoot infestations from March until May supports this contention.

The amount of rodent damage recorded, 3.27% for the total area, is consistent with previous damage assessment data reported

by Fulk et al. (1980) in Pakistan. They estimated that least 2 to 3% was lost to rodents country-wide in the two years of 1978 and 1979. Obviously this was a minimal damage year in this area of Gujrat. Rodent damage to wheat may vary year to year. For example, Beg and Khan (1977) surveyed the 1977 wheat crop in Faisalabad District and found 7.5% of the tillers cut by rats. In 1978, they found that rat-cut tillers in Faisalabad averaged 6.8% at 20 days before harvest (Beg et al. 1978). In other districts they surveyed that year, damage varied from 2.6% (Sargodha) to 4.2% in Jhang. Damage varies due to the seasonal effects of climate on rodent populations.

The mini awareness and motivational campaign was reasonably successful. To have 33% of the farmers in the area aware of the availability of ready-made baits was considered a good achievement, considering the limited efforts that were made. The posters, obviously, had been seen, since 65% of the farmers who knew of the baits had learned of it from the posters. Handbills were not nearly as effective but they had had limited distribution. It was heartening that for this first effort 10% of the farmers interviewed had used the ready-made baits. This proportion of users would have been greater if the farmers had perceived the rat damage to wheat as being serious, as it apparently was in previous seasons. We didn't stress enough in the farmers training that they should inspect their fields for rodent damage every week of so during the growth stages from booting on th ripening. Many farmers were unaware of rodent damage to their fields until it was pointed out to them.

Conclusions and Recommendations

The mini awareness and motivational campiagn was considered a minor success. Room for improvement was noted in the use of the poster, however. We used a rather conventional approach and a standard saying, "Kill the rats - Save the crop". Some farmers said they saw the rat cutting the wheat on the poster but couldn't read the Urdu words. But the poster failed to bring out the curious response we had hoped for. It was too straightforward. For the second phase campaign we plan a "ridicule poster" (Adhikarya and Posamentier 1987), to make illiterate farmers ask a friend what it means. A large rat sitting on a protesting farmer or a group of rats dining with some children who are crying and have empty bowls might be used.

The same comments go for the handbill. More of these should have been distributed. A handbill needs to be designed that conveys a message to the person who can't read. More graphic illustrations are needed.

Whereas we reached 33% of the farmers in the awareness of ready-made baits, we found that only 10% of the farmers had purchased and used them. This provides us with a baseline. During the second phase in the rice-growing season, we will try to reach at least 40% of the farmers with an awareness message and have at least 20% of the total purchase and use the baits.

More farmers training will be given. Our target is to give training to at least 100 farmers in the area. Part of the training will be given to the importance of inspecting the grain fields for rodent damage on a weekly basis.

Another idea we will use is to annouce the availability of ready-made baits from the mosques at the several villages in the area.

The Punjab Department of Agricultural Extension will be involved in the second phase. We will have them put on several farmers field days in the area.

A video cassette on farmers' methods of rodent control in rice fields will be prepared and shown as part of the farmers training.

The second phase of the control demonstration will build upon the findings of the first phase, both mistakes and successes. A better attempt will be made to reach persons who do not read. More forms of verbal communication will be used, such as audio cassettes with music and dialogue. More graphic illustrations will be used in posters and handbills. Direct training sessions for farmers will be increased. It is hoped that these measures will better reach the target audience.

Summary

A large-scale control demonstration of rodent control in wheat and rice was initiated in January 1989, to run for at least three crop cycles, until May 1990. Ready-made rodenticidal baits were made available to farmers at a nominal cost. A multi-media awareness and motivational campaign was held duyring the first wheat season. This was done to acquaint farmers with ready-made baits, their uses, and the need to reduce rodent damage to wheat to increase crop yield. Posters, handbills, video cassettes, personal contact, and farmers training sessions were used to try tc transfer awareness and motivation to use the new technology.

Wheat damage by April 1989 was minimal (0.61%), consequently very few farmers did rodent control. By May 1989, just at harvest, damage had increased to 3.27%, largely, it was thought, due to an influx of rats from harvested sugarcane fields.

One-third of the farmers questioned in evaluation interviews had heard about the ready-made baits, mainly through the posters. Ten percent of the farmers interviewed had used the ready-made baits in their fields. Ten out of eleven said the baits were effective.

Recommendations are made for strengthening the control demonstration in the second phase, rice-growing season, from July to November 1989.

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References

Adhikarya, R. and H. Posamentier. 1987. Motivating farmers for action; how strategic multi-media campaigns can help. Schriftenreihe der GTZ, No. 185. 209 pp.

Beg, M. A. and A. A. Khan. 1977. Rodent damage to wheat crop in Faisalabad district. Pakistan J. Agric. Sci. 14: 37-44.

Beg, M. A., A. A. Khan and M. Yasin. 1978. Some additional information on rodent damage to wheat in central Punjab. Pakistan J. Agric. Sci., 15:105-106.

Beg, M. A. and S. A. Rana. 1978. Ecology of the field rat, *Rattus meltada pallidor* in central Punjab. Pakistan J. Zool. 10(2): 163-168.

Beg, M. A., M. Yasin and S. A. Rana. 1980. Pattern of rodent abundance in field crops near Faisalabad. Pakistan J. Zool 12(2): 183-187.

Brooks, J. E., E. Ahmad and I. Hussain. 1987. Rodent control at the National Agricultural Research Centre, Islamabad. Vertebrate Pest Control Project, NARC, Islamabad. Unpublished Technical Report No. 11. 12 pp.

Brooks, J. E., P. Sultana and R. M. Poche'. 1985. Damage by *Bandicota bengalensis* to growing wheat in Bangladesh and methods of control. Acta Zool. Fennica 173: 135-137.

Fulk, G. W., M. T. Akhtar, S. A. Salam and A. C. Smiet. 1980. Rodent damage to the 1978 and 1979 wheat crops in Pakistan. Pakistan J. Agric. Res. 1(1): 19-23.

Poche', R. M., M. Y. Mian, R. Sterner, M. E. Haque and P. Sultana. 1986. Rodent movements in wheat fields. Mammalia 50(2): 165-172.

Smythe, W.R. and A.A. Khan. 1980. An effective zinc phosphide bait cake for field rodents. Pest Control, 28-32.