Biology and Management of Riceland Rats in Southeast Asia

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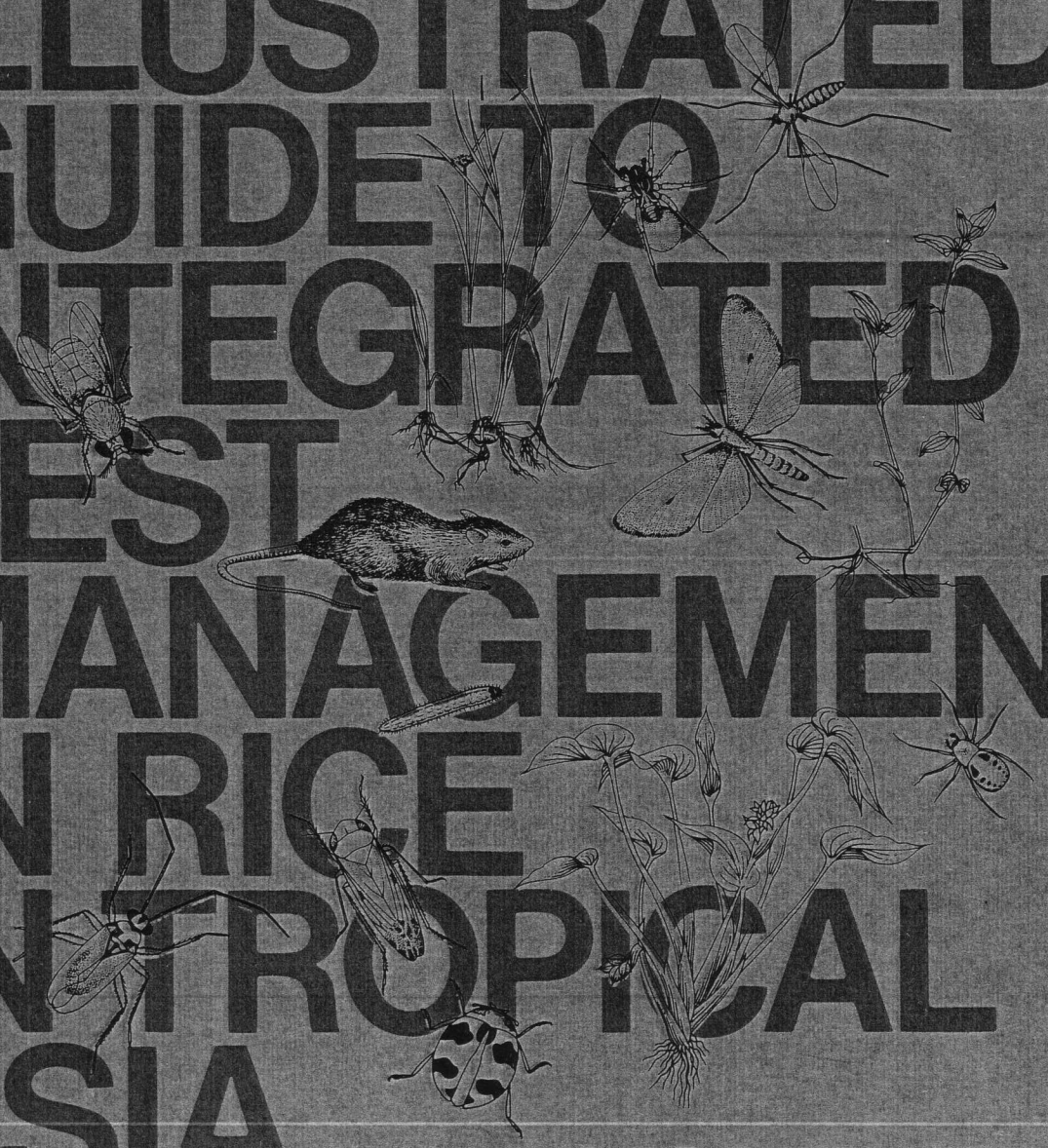
ILLUSTRATED GUIDE TO INTEGRATED PEST MANAGEMENT IN RICE IN TROPICAL ASIA



International Rice Research Institute

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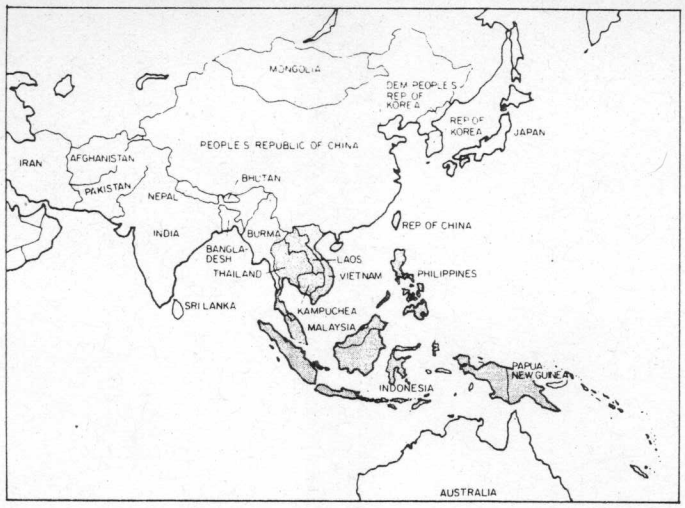
Biology and Management of Riceland Rats in Southeast Asia

Rats occur in almost all rice fields in Southeast Asia and frequently cause estimated yield losses ranging from 5 to 60%.

The most common and serious species in Southeast Asia are *Rattus argentiventer, Rattus r. mindanensis,* and *Rattus exulans.*

These three rat species are called "riceland rats." The habits, damage, and control techniques are similar and so it is not necessary to separately identify them.



Other species of rats present in South Asia and parts of Southeast Asia are *Bandicota bengalensis* and *B. indica.*

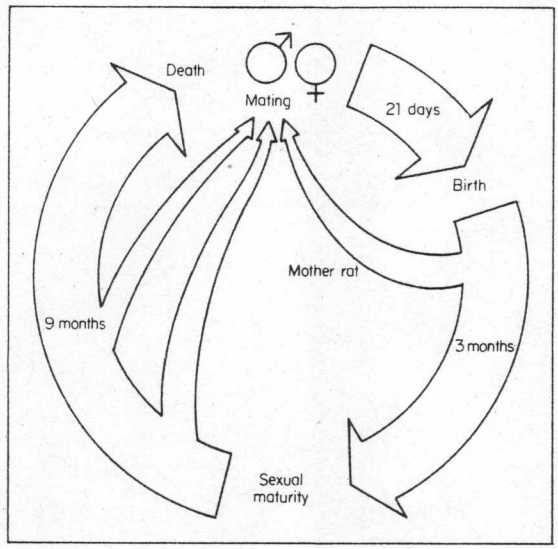
These species differ from riceland rats in biology, habits, and the crop damage they cause. Management techniques for control of these two species are still being developed.

The following sections on biology and control apply only to riceland rat species.

BIOLOGY OF RICELAND RATS

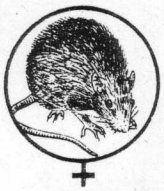
General life cycle

- Rats can live for one year or longer.
- Females may reproduce up to 4 times a year, averaging 6 rats/litter.



Reproductive potential

- The potential number of offspring produced and weaned by one female rat in one year is 24.
- The potential number of rats produced by one pair and their offspring in one year is more than 500.
- Disease, predation, competition, and availability of food and water limit the actual number of offspring that reach maturity. The net reproductive potential is therefore much less.



Month		Subtotal	Accumulated total
1	3 ♀ + 3 ♂	6	6
4	12 ♀ + 12 ♂	24	30
7	48 ♀ + 48 ♂	96	126
10	192 ♀ + 192 ♂	384	510
13	768 ♀ + 768 ♂	1536	2046

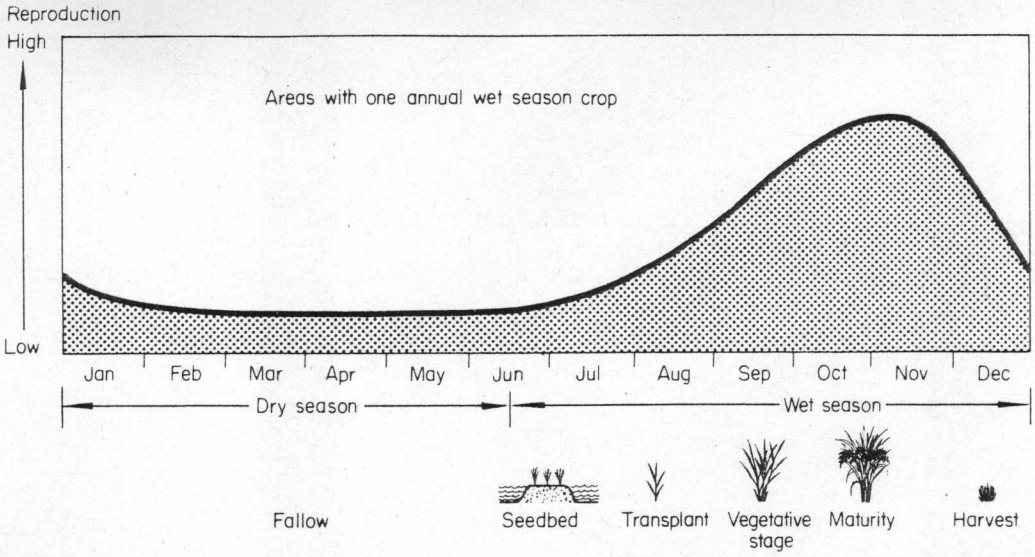
Relationship to damage

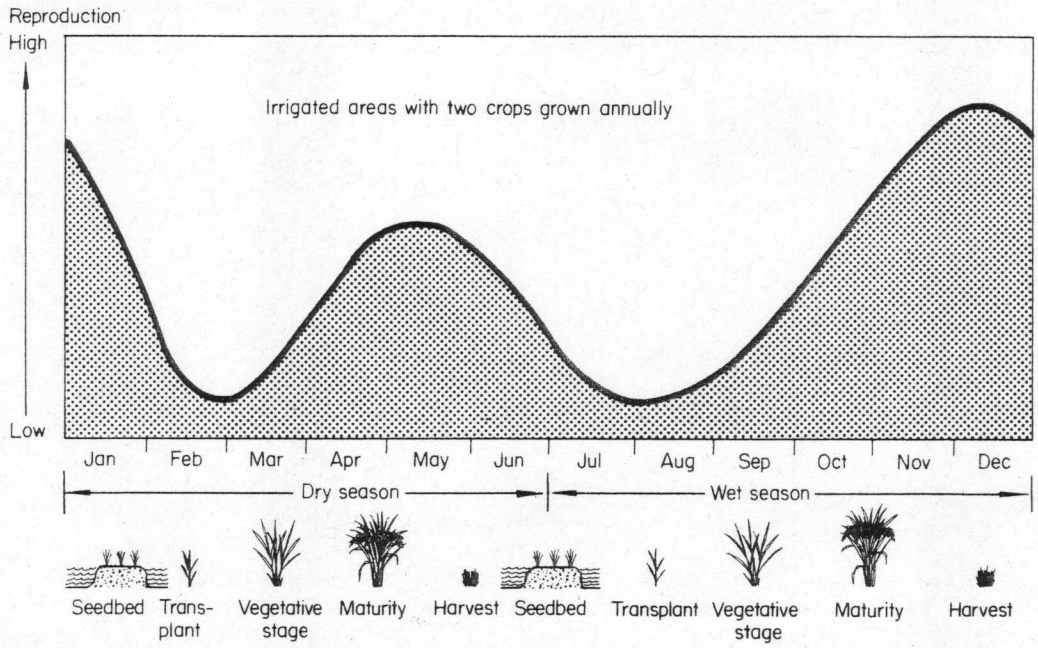
- The reproductive cycle of riceland rats and the relative amount of damage are closely associated with crop growth and development.

  Both rat reproduction and crop damage:

  1. Occur at all stages of rice growth but reach their peak while grain is maturing.
  2. Are greater during the wet season than during the dry.

More food, water, and shelter provide optimal breeding conditions.

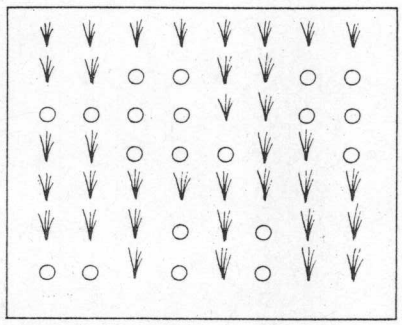


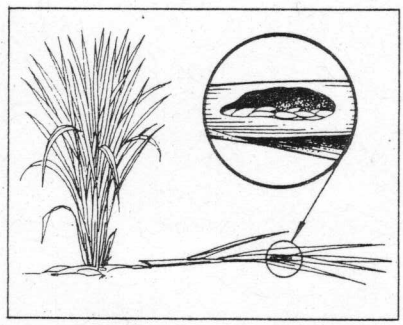


Damage

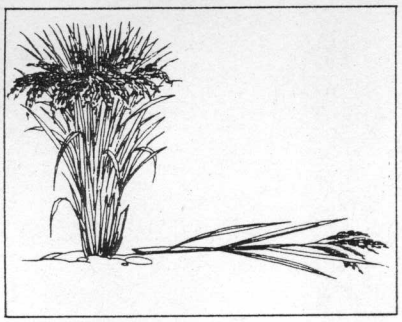
Damage in the seedbed can be due to rats consuming seeds directly or pulling up germinating seeds later on.

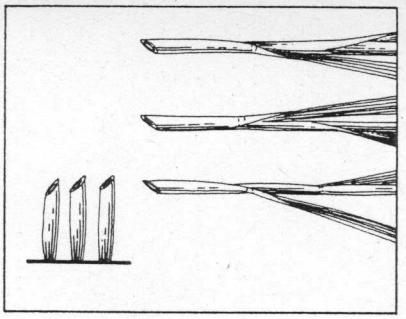
- Rats cut or pull up recently transplanted seedlings. The result is missing hills.
- The rats cut or bend older tillers to reach the developing panicles. The eaten or chewed area on the stem may resemble insect damage.





- As the crop matures, rats cut or bend tillers to eat the ripening grain.
- Damaged tillers are cut near the base at a 45° angle.

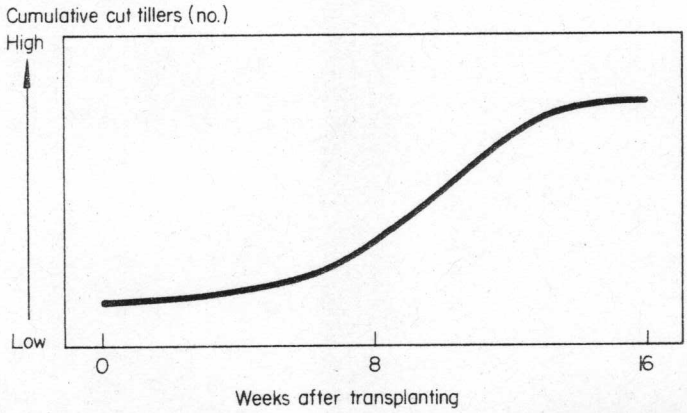




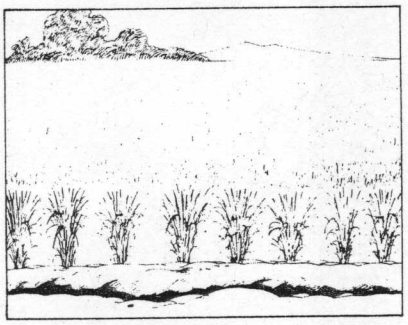
- The rate or number of tillers cut per rat per night is dependent on the season and crop stage. Generally it is high in the wet season and the vegetative stage, lower in the dry season and ripening stage.

Season, stage	Relative tiller cutting rates per rat per night	
	Higher	Lower
Wet season	X	
Dry season		X
Vegetative stage	X	
Ripening stage		X

- Damage is usually low during the vegetative stage, increasing rapidly after the flowering stage. The increased damage results from the greater number of rats due to increased cover (rice plants, weeds, etc.) and food (rice).

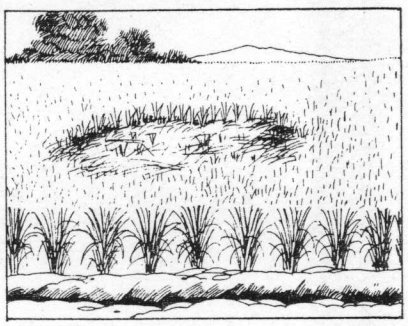


- A low or moderate population of rats will cut tillers randomly throughout a field. Damage will not be visible from a distance until more than 15% of the tillers are cut.



- Rats feed at night.

- When high rat populations occur, damage may be concentrated near the center of the paddy. From a distance the damage will be visible. Retillering of cut stems will produce a younger stage area that is surrounded by more mature rice.

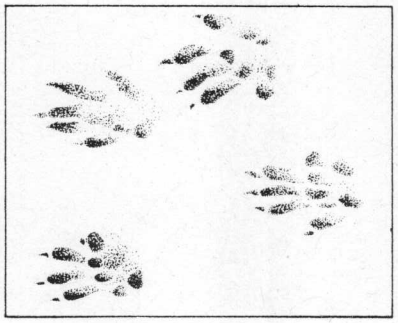


It is not always helpful to monitor rat populations or activity when crop protection is the primary objective. Whether rat activity is high or low will not change the following recommended management techniques. However, monitoring may be desirable to provide additional information in special situations such as for research or for a demonstration of management techniques.

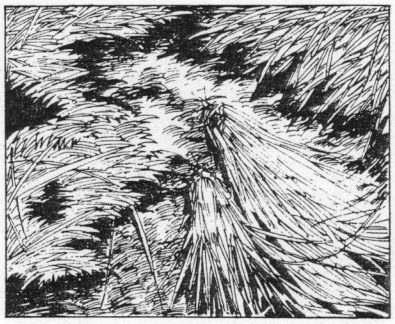
Monitoring

- Riceland rats spend the daytime in vegetation, weeds, or maturing rice fields. They are not readily seen; only their runways and footprints in muddy areas are visible.
- The general level of rat activity in a rice field can be observed by inspecting the area for signs of activity.

- Active burrow



- Footprints in mud.

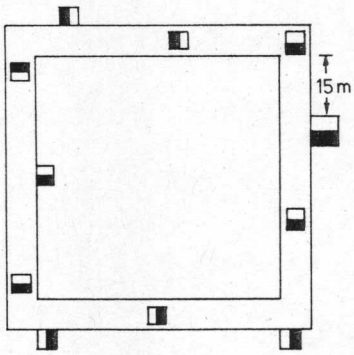


- Runways in grassy areas

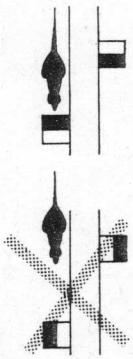
Using tracking tiles

- A more exact way of measuring rat activity is the use of tracking tiles to record footprints.
- Tracking tiles are 15- × 15-cm square of white linoleum or vinyl, one-half coated with printers ink.
- During the dry season a small amount of vegetable oil is added to the ink to prevent drying.
- If a tracking tile is not available, the paddy mud can be raised immediately adjacent to the dikes to form platforms with smooth tops capable of recording footprints.

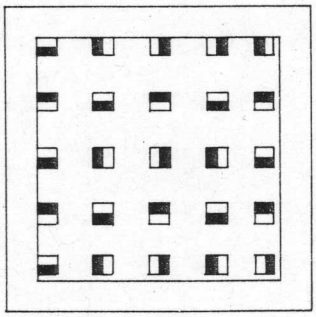
Arrangement of tracking tiles in the field



- Tiles may be placed on or against the edge of levees in flooded paddies and spaced 15 m apart.



- Tiles along the edges of levees can be placed on top of a pile of mud to raise them above the water level.

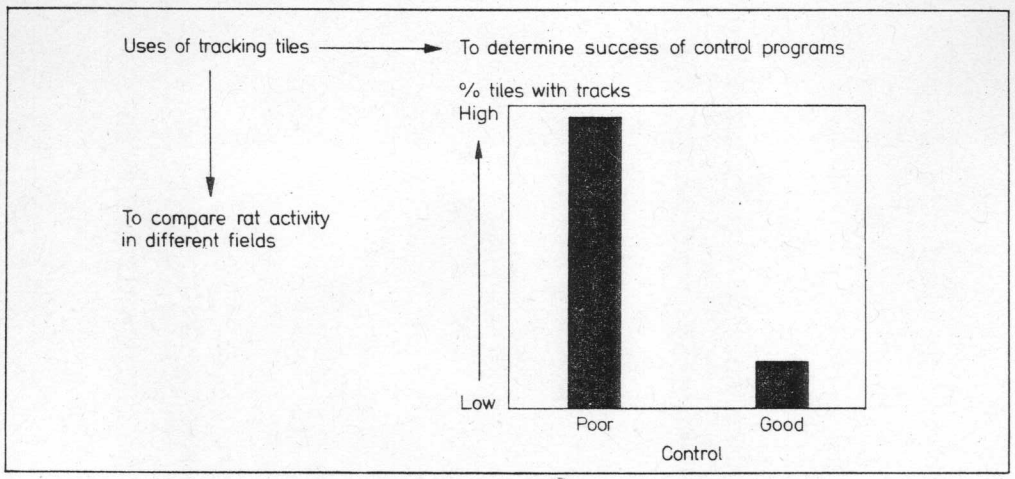


- In a dry field, space tiles evenly at the rate of 50/ha.

- Examine the tiles each morning and record the number of those with rat footprints. Clean the non-inked half with acetone and recoat the inked side with fresh ink before the tiles are returned to the field.
- Set the tiles out for 3 consecutive nights.

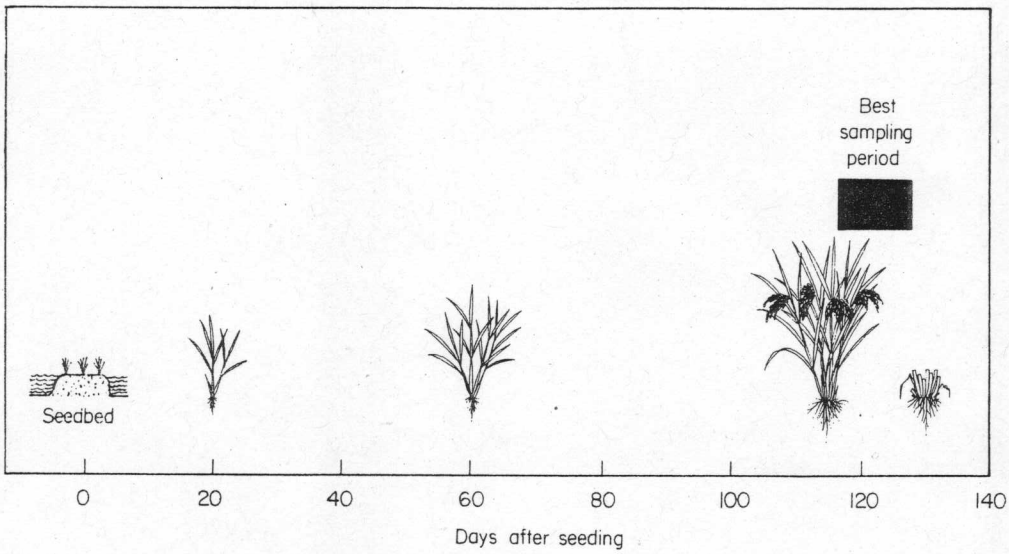
$$\text{Rat activity} = \%\ \text{positive tiles} = \frac{\text{total tiles marked}}{\text{total tiles set}} \times 100$$

10% or less = low rat activity
30% or more = high rat activity



- Other visible signs such as runways, burrows, or damaged tillers will usually confirm tracking tile results.

Estimating crop loss
The sampling period for estimating damage should be within 2 weeks of harvest. Sampling may be done earlier, but additional damage would occur and the results would not reflect damage at harvest.

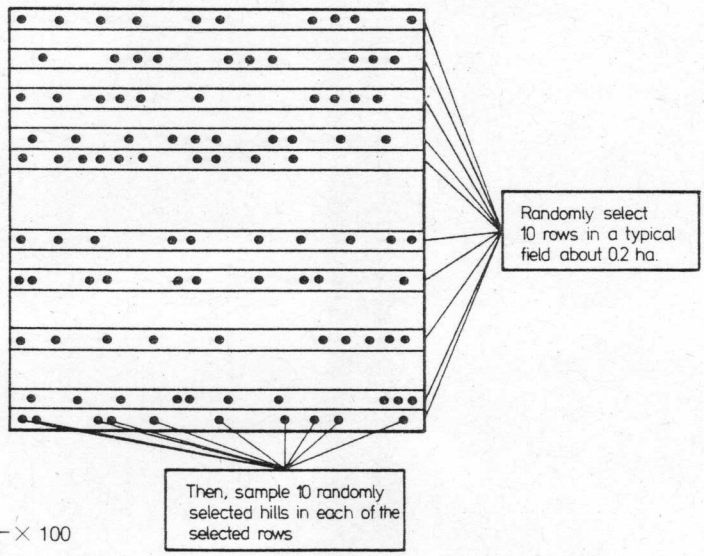


Sampling method. The percentage of cut tillers in a paddy can give an estimate of crop damage due to rats. This information can be used to determine if rat control was adequate during crop growth.

For transplanted rice that is grown in rows the following method can be used.

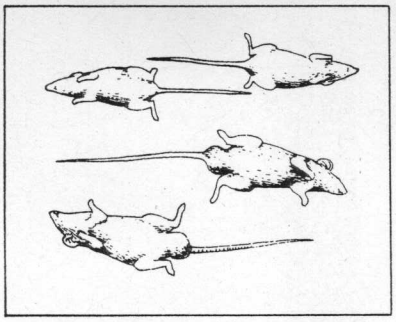
Examine every tiller in each of the 100 selected hills and record the number of cut tillers and the number of uncut tillers.
Calculate:

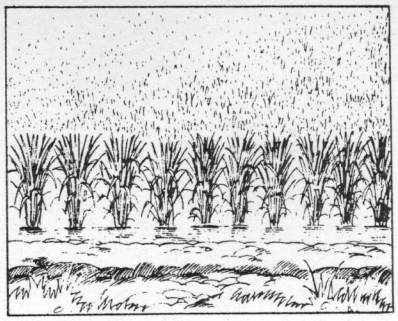
$$\%\ \text{cut tillers} = \frac{\text{total cut tillers}}{\text{total tillers examined}} \times 100$$



Control
The effectiveness of a rat control program is judged by the amount of crop damage caused by rats as observed at harvest.

- The number of dead rats observed is not important.



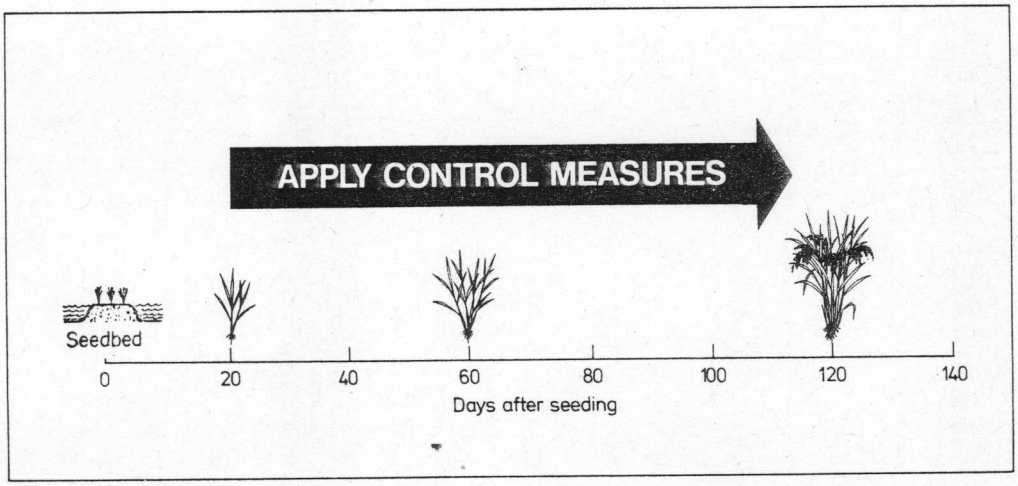


- Reinvasion or immigration of rats can occur quickly; therefore, a continuous or sustained baiting program is necessary.

- When rats are gradually controlled over the entire cropping season, large numbers of dead rats are not seen. However, this method is more effective than other control strategies in preventing crop damage.

Timing control programs

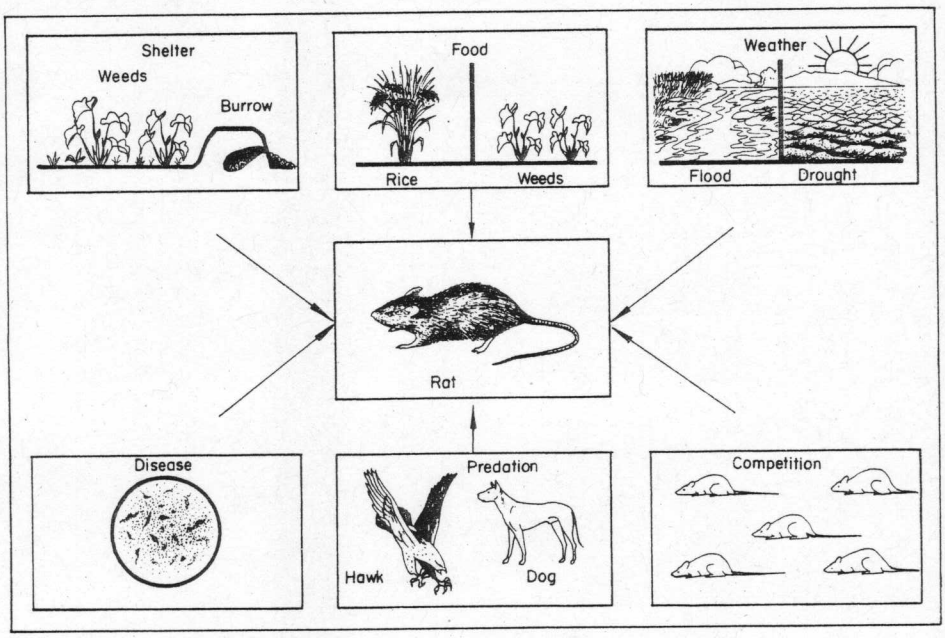
- Rat control efforts must begin within 2 weeks after transplanting and continue until the grain matures.
- Do not wait until the grain matures to begin control. By then the rat population could already be high and difficult to control, with severe crop damage occurring.
- Rat control is most effective when all farms use sustained baiting and cultural control practices.



Cultural control practices
Rat control can best be achieved by being aware of the rats' basic needs such as food and shelter and then limiting those factors which favor rats. There are several cultural practices that can be used to limit rat population growth.

It is difficult to control all these factors in a rice-growing area.

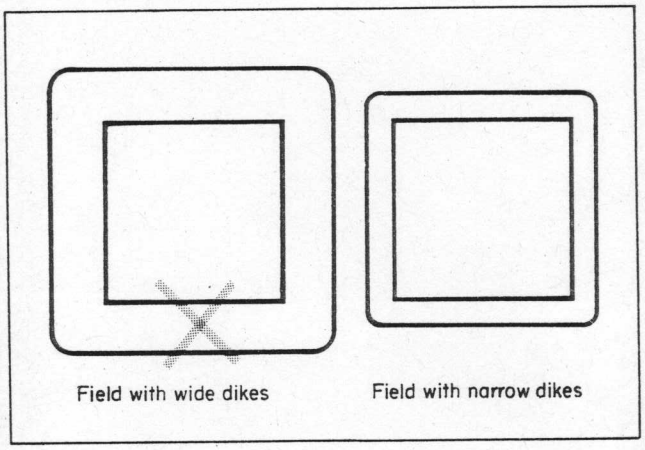
- With some cultural control measures, however, we can limit food and shelter, which are the most important factors that determine rat population levels.



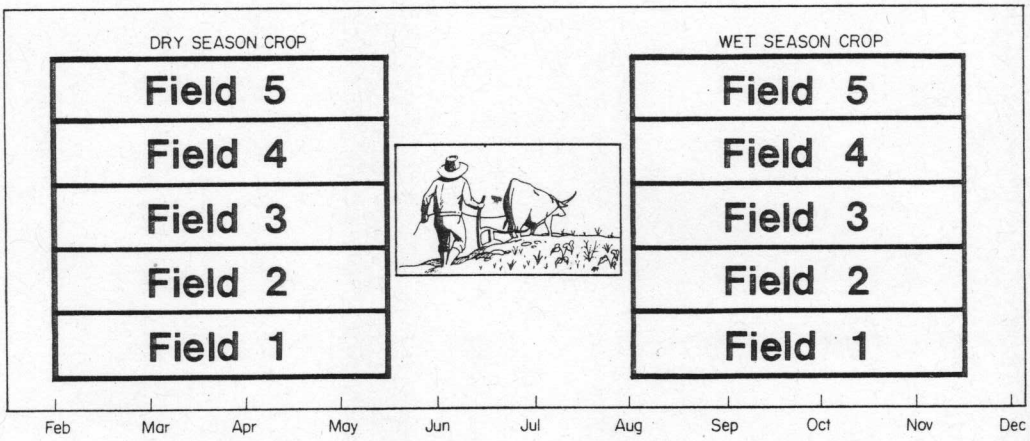
- Cut down or remove weeds on dikes and surrounding areas. This will reduce shelter or daytime resting areas.
- A weed-free rice field will provide less shelter and therefore a less favored rat habitat.

- Paddies flooded to just below dike level will fill rat burrows with water and eliminate nesting sites. Because rats are excellent swimmers, temporary flooding will not destroy them, but will force them to higher ground.

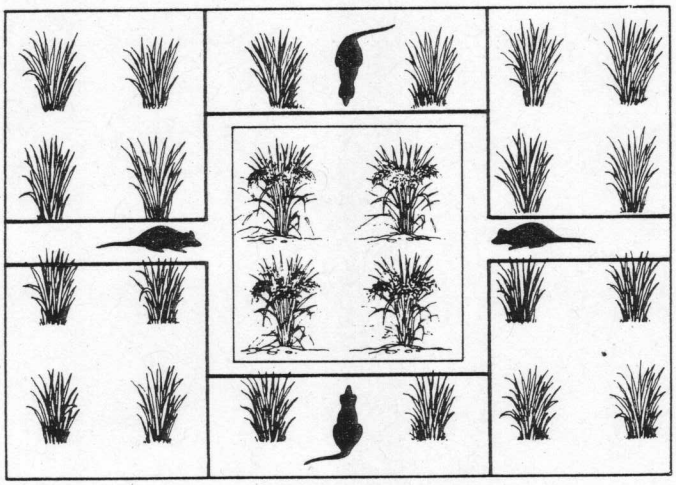
- Completely remove or destroy rice straw piles after harvest. They provide a place for rats to burrow, nest, and produce young rats.
- Reduce the size and number of dikes to limit burrowing sites and places for weeds to grow.



- Plant fields in the same area at the same time. Large areas transplanted at the same time will sustain less damage than areas with staggered planting times.



- In areas where planting is staggered, rats may concentrate and severely damage early and late planted fields during the ripening stage.

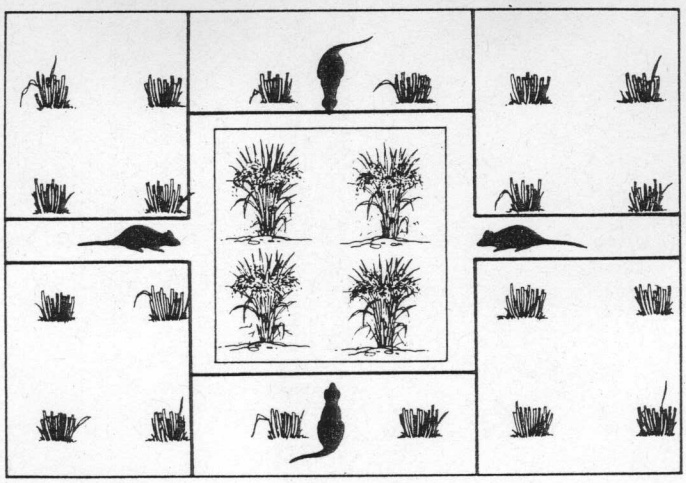


Early planted field

- Rats in harvested fields move to the remaining unharvested fields because food and shelter are abundant.

In many cases a farmer's rice field is surrounded by others in which rats are not controlled. Under these circumstances, the rice farmer using these recommendations can still protect his crop from high rat damage.

When all farmers in a given area control rats the individual costs are reduced and effectiveness increased. Large-scale programs can rapidly increase yields and extend management techniques over a wide area.

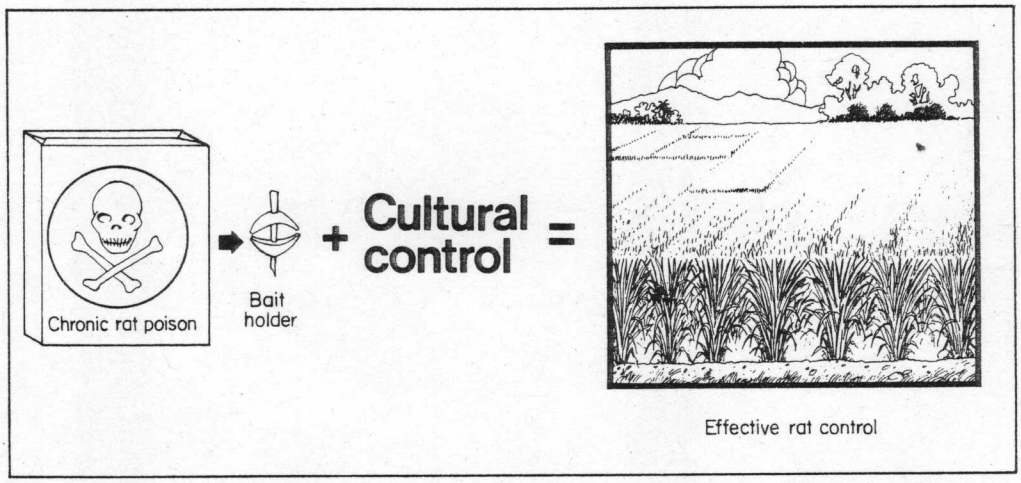


Late planted field

Chemical control

Cultural control often will not adequately control rats. If these cultural practices are used in combination with chemical baiting, the effectiveness of an integrated rat control program will be increased.

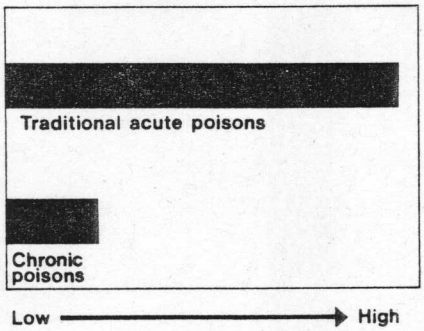
Many kinds of rodenticides are available. They can be separated into two basic groups: acute (quick kill) and chronic (slow kill). The older or traditional acute rodenticides are cheaper and more readily available but are not preferred for rat control in rice. The chronic or anticoagulant rodenticides are effective only with several feedings. This is because they cause internal bleeding which occurs over several days. Some anticoagulants now being introduced require only a single feeding, but they are not as yet readily available to the small farmer.

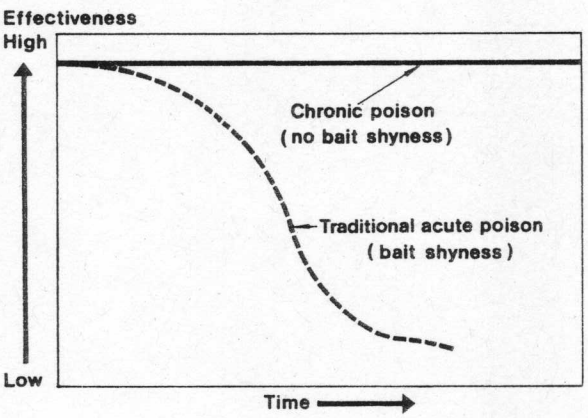


Effective rat control

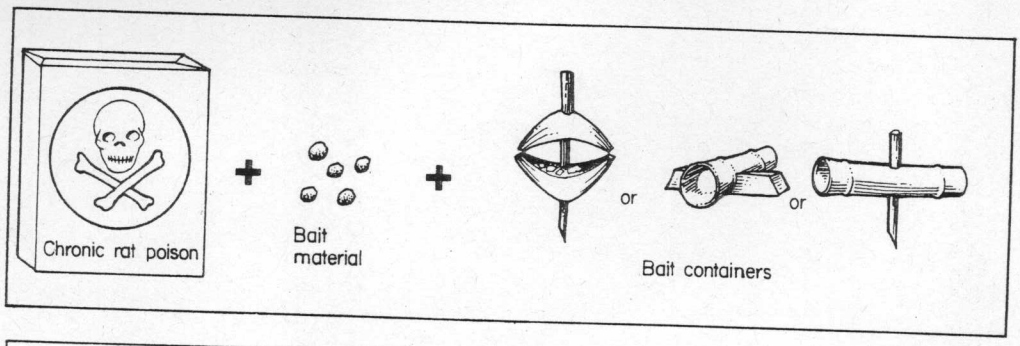
Compared with traditional acute rodenticides the chronic anticoagulant rodenticides are less hazardous to humans and beneficial animals.

Traditional acute rodenticides become less effective with time because many rats survive after eating small amounts of bait, and learn to associate their illness with the bait (bait shyness).



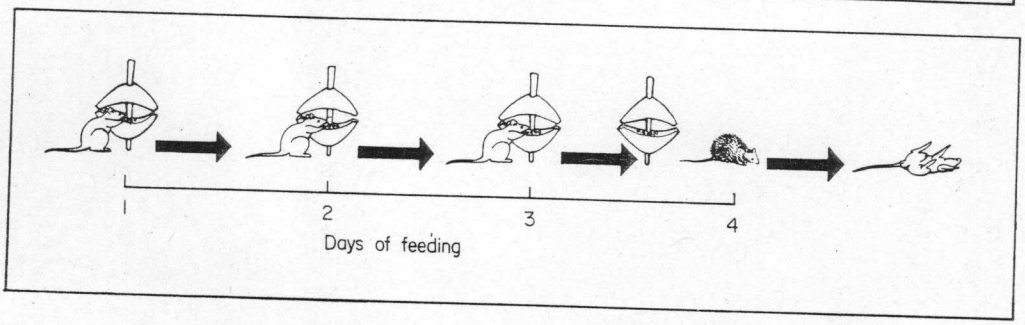


Materials used in a baiting program. Chronic anticoagulant baiting programs require a rodenticide, a bait material readily accepted by rats, a suitable bait holder, and frequent visits to the field.

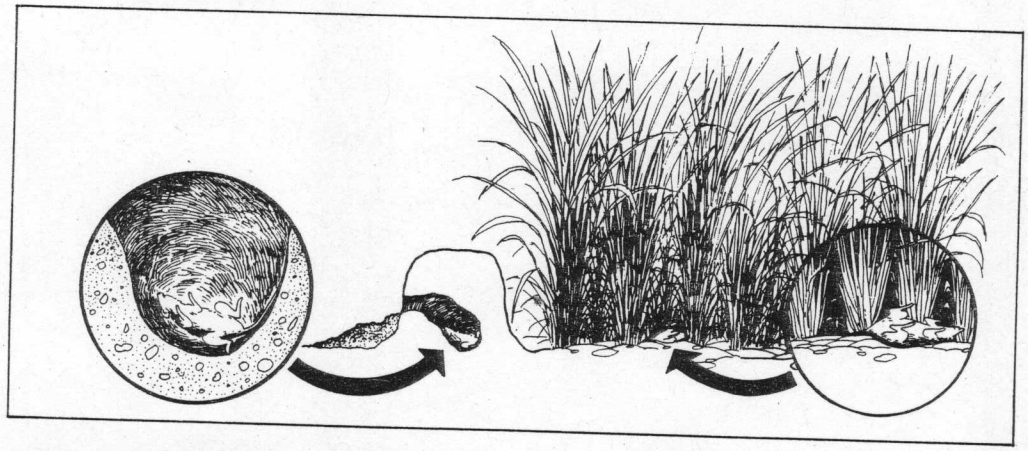


When chronic anticoagulant rodenticides are used, rats must feed two or three times before death will occur.

After 3 days rats stop feeding and become sick. Six to 10 days after initial feeding they die.

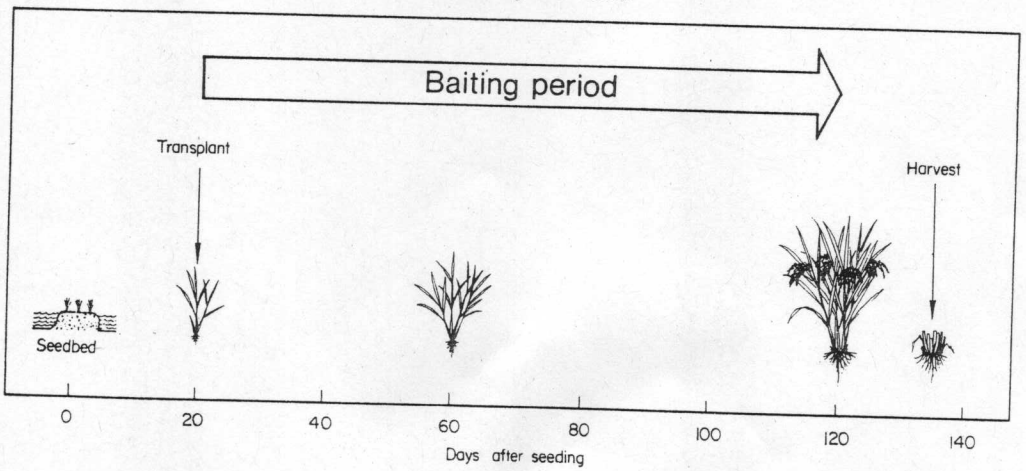


- Since chronic poisons kill slowly, rats may die in burrows or in other areas where dead bodies are not visible.



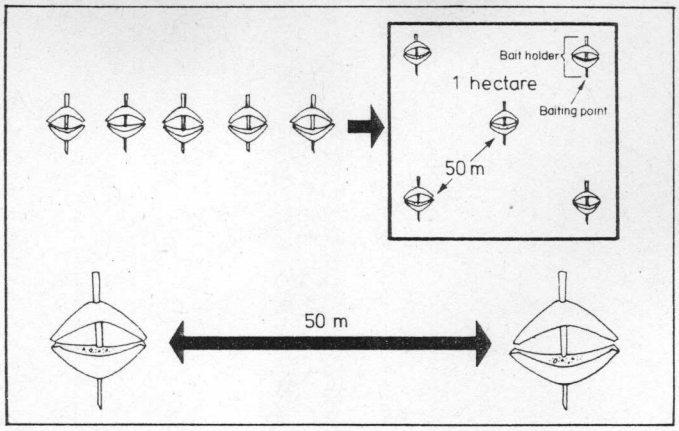
General procedures for sustained baiting

- Read the directions on the container carefully before mixing the poison with the bait material.
- Any low-cost available material such as low-grade milled rice or broken rice can be used as bait. However, rats must like it.
- Local materials such as bamboo, oil cans, or coconut husks can be used as bait holders.
- Begin baiting soon after transplanting and continue through the ripening stage.
- Establish five baiting points in each hectare.
- Check baiting points twice a week.

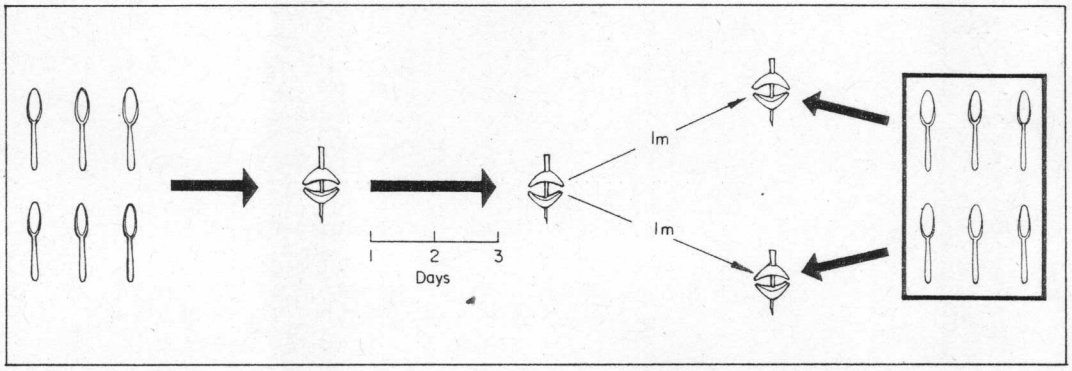


Density and spacing of baiting points (location of bait holders)

- Use five baiting points for each hectare of rice field.
- Baiting points should be about 50 m apart.
- The best location for the baiting point is within the paddy, at least one meter from the dike.

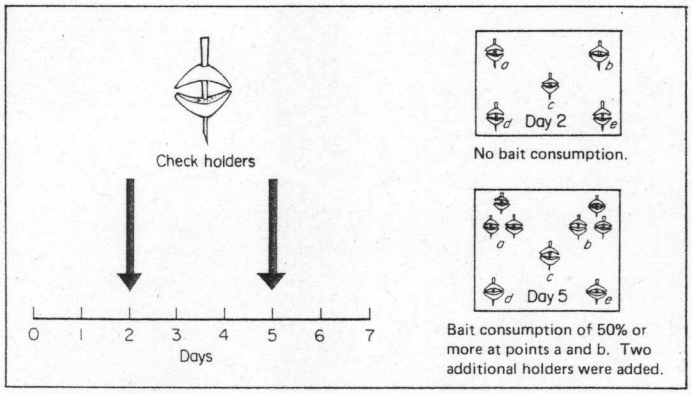


- Put 6 tablespoons of poisoned bait in each holder.
- Check holder after 3 days.
- If one-half of the bait is gone at any holder, set out 2 more holders 1 m from the first in a cluster.
- Put poisoned bait in each holder.



Maintaining bait holders during the season

- Check holders at the 5 baiting points twice a week throughout the season and add bait holders and bait when necessary.
- Always add enough bait so that holders never become empty.

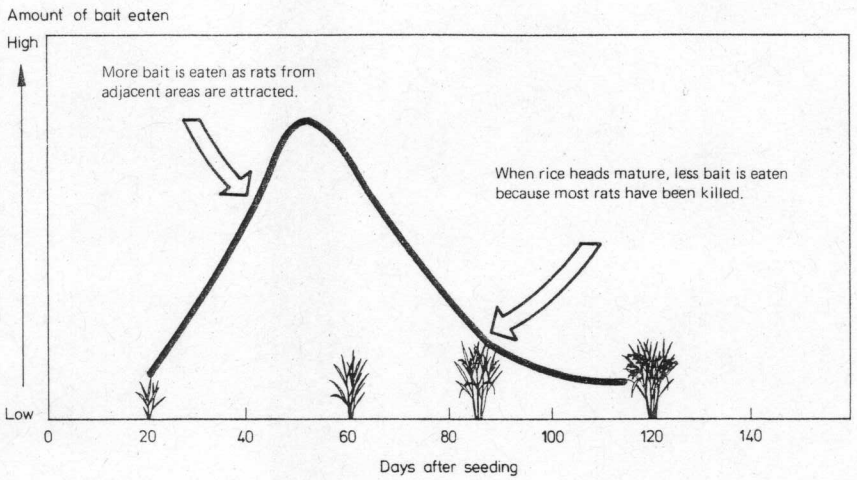


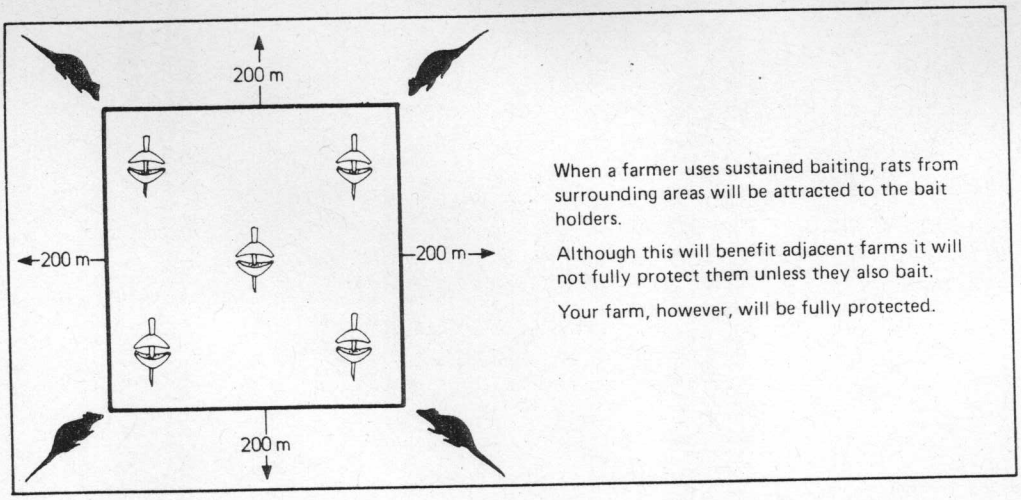
- Remove and replace wet or moldy bait.
- If rats do not eat any bait at any point, reduce the number of holders.
- Always leave at least one bait holder at each of the 5 original baiting points to monitor rat activity.

Pattern of bait consumption during the crop season

More bait is eaten as rats move into the field and consume bait from the added holders.

When rice heads mature, less bait is eaten because most rats have already been killed, bait holders have been reduced, and any remaining rats would prefer to feed on the rice rather than the poisoned bait.





When a farmer uses sustained baiting, rats from surrounding areas will be attracted to the bait holders.

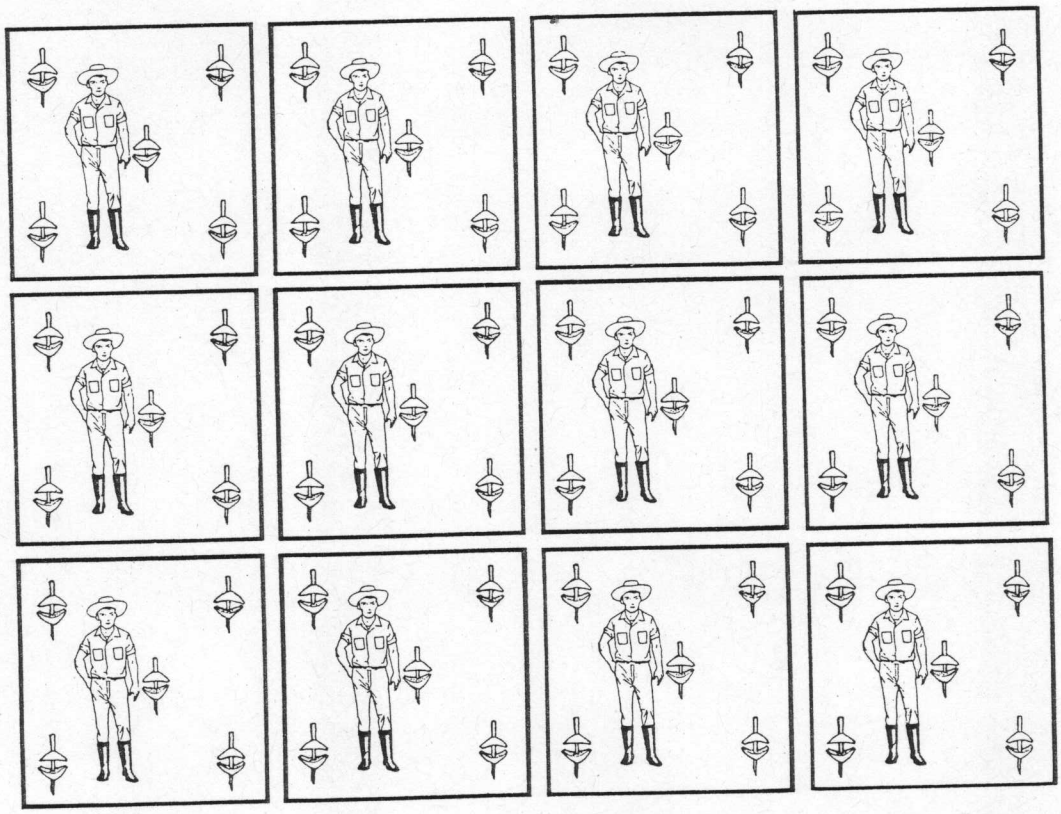
Although this will benefit adjacent farms it will not fully protect them unless they also bait.

Your farm, however, will be fully protected.

Advantages of cooperative rat control

When one farmer uses sustained baiting, the protective benefits may extend outside his farm for 200 m in all directions.

Rat control is more effective if a farmer and all of his neighbors in an area use sustained baiting and cultural control practices.



SUMMARY

These recommendations have been developed, tested, and shown to be effective in the Philippines. They were designed for the individual small farmer, with the assumption that adjacent farms may not control rats. These recommendations may be modified to account for local conditions in other countries.

When these recommendations are followed and rat damage still occurs, the reason can usually be traced to a failure to follow all the steps. For example,

1. Weeds were allowed to grow tall on dikes and adjacent areas.
2. Planting time was too early or too late, not in synchrony with most of the other fields in the area.
3. Bait holders were not checked twice a week.
4. Bait holders were not increased when consumption of bait increased.
5. Rodenticide was not mixed according to label directions.
6. Bait material used was not accepted by rats.
7. Traditional acute rodenticide was used and bait shyness developed.