FIELD EFFICACY OF A NOVEL BAIT FORMULATION, COUMATETRALYL PASTE, AGAINST RICEFIELD RATS

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ABSTRACT

The efficacy of a novel bait formulation of coumatetralyl paste (Racumin Paste®) for the control of ricefield rats was evaluated in two farms in Laguna. Different treatment methods were evaluated by census of rat activity and tiller damage near harvest. Results indicate that the test formulation can be used either for surplus or unrestricted baiting or pulse or restricted baiting. It was found that coumatetralyl paste is palatable to rats and effective in reducing rat infestations in treated plots. The surplus baited plot exhibited the lowest mean percent damage (1.82%) compared to other treated plots and the control. The pulse baited plot also exhibited significant reduction of rat damage (3.7%), but was comparable to damage observed among the positive check plots. The positive check plots were treated by surplus baiting using coumatetralyl rice bait. The mean percent damage observed in the untreated plot (6.75%) was found significantly higher to those observed among the treated plots. Monitoring for non-target species risk was carried out on all test plots. No dead non-target animals were found. Coumatetralyl paste was proved to be an efficient bait formulation in the control of ricefield rats, even when used in pulse baiting.

Key Words: rodenticide, rodent control, Racumin Paste®, R*attus tanezumi* Temminck

INTRODUCTION

Rat infestation of ricefields has been a persistent problem in rice agriculture. Previous estimates indicated that up to 90% of ricefields suffered measurable damage from rats with an average percent tiller cut of 40%. Serious damage also occurs in other crops including corn, sugarcane, coconut and other important cereals and vegetables (Benigno and Sanchez, 1984).

Current control strategies to reduce damage due to rats rely heavily on the use of commercially available anticoagulant rodenticides (Ocampo, 1994). These compounds have been effectively used to control rats not only in rice agriculture and other crops but also in structures and households. The advantages of anticoagulant materials over that of other control agents have been well recognized (Bently and Larthe, 1959; Greaves and Ayres, 1969; and Greaves and Rehman, 1977). However, there is a continuing need to develop more effective and safe formulation to minimize the adverse effects of toxicants to human and the general environment. The test formulation, therefore, must be packaged with safety features and sufficiently attractive for the target species to consume a reasonable quantity even in the presence of palatable food alternatives.

This study was conducted to evaluate the efficacy of the new rodenticide formulation of coumatetralyl paste (0.0375%) against the common ricefield rats, *Rattus tanezumi* Temminck. Coumatetralyl is an effective rodent toxicant and one of the recommended anticoagulants for the control of ricefield rats (Fall, 1977). It is currently available locally as dispersible powder, and the powder is mixed with cereals (e.g., polished rice) for use in baiting. Nevertheless, the present coumatetralyl paste has been claimed to be an improvement of the commercially available formulation. The present test material is a pre-solution coumatetralyl mixed with cereals, vegetable oils, sugar dyestuff, and a taste deterrent, Bitrex. The manufacturer claims that because of the improved formulation properties, it may be consumed by rats at the maximum amount possible, making coumatetralyl as potential "single feed" rodenticide.

MATERIALS AND METHODS

Test Site

The experiment was conducted in two separate farms along the boundaries of Calauan and Victoria, Laguna, Philippines from September to December 1998. One of the farms is a 6-hectare ricefield along a feeder road leading to a village, while the other one is an adjacent 26-hectare ricefield of single ownership. An irrigation canal separates the two farms. According to the farm cooperators, both farms had histories of heavy rodent infestations. This may be largely due to the adjacent main irrigation canal with uncultivated and weedy dikes. Rodent reinvasion routes are numerous, such as hedgerows of coconut grooves, watercourses, and weedy dikes.

The trial site is a typical irrigated ricefield area planted with rice at least twice a year. The irrigation canal supplies water during the wet season, while ground water extracted by a pump is the main source of irrigation during dry season. Mixed farming is not a usual practice. Within the community, livestock was minimal consisting of domestic fowls (chicken and ducks), hogs, cattle, and carabao. Other animals include dogs, cats, and a number of species of wild birds.

Pre- and Post-treatment Census

Four experiment plots (approximately 2 hectares/plot) of contiguous ricefields were chosen for the study. All plots were within the 32-hectare experimental site described above. Indirect pre-treatment and post-treatment censuses of rat infestation were separately conducted using both bait consumption and tracking indices.

The census using tracking index utilized the ordinary vinyl tile (32cm^2), half of which was coated with black duplicating ink. The coated tiles were laid around each experimental plot in 20 places for 3 consecutive days. On each of the 3-day observation periods tracks made by rat were noted and visually scored. Recording was made in the following manner:

0 = no track
1 = 1 to 5 footprints
2 = approximately 50% of the uncoated side of the tile was covered by foot prints
3 = more than 50% of the uncoated side of the tile was covered by foot prints

The tiles were inspected early morning, gathered, and cleaned by using cotton balls soaked with acetone. The freshly coated tiles were then re-distributed in all plots.

Census feeding was conducted simultaneously with the tracking census. Pre-constructed bait containers made of empty oil can were laid around each experimental plot in approximately the same manner as the tracking tiles. Each container was filled with 100 grams untreated plain polished rice baits. On each day of the 3-day observation period, the residual baits were inspected and visually scored in the following manner:

0 = no consumption
1 = about 75% remained uneaten
2 = 50% remained uneaten
3 = about 25% remained uneaten to fully consumed

Upon inspection, the uneaten baits were removed and fully replenished. On the third day, all baits and bait containers were retrieved.

The pretreatment census commenced about 2 weeks after transplanting of rice while the post-treatment census was conducted about a week after harvest. The relative pattern of activity, whether from bait consumption index or the number of tracks, was expressed as % reduction and computed according to the following formula:

100- [(Post treatment census data/Pre-treatment census data)X 100] = % reduction

The census parameters measured were the total score for 3 days, percent active tiles and active points.

Treatments

All the treatments commenced about two weeks after transplanting. The established test plots were randomly assigned to the following treatments:

Treatment A - Surplus baiting (unrestricted) with coumatetralyl paste formulation
Treatment B - Pulse baiting (restricted) with coumatetralyl paste formulation
Treatment C - Surplus baiting (unrestricted) with coumatetralyl dispersible powder (0.75% coumatetralyl) mixed with polished rice, positive check plot
Treatment D - Untreated, negative check plot

The positive control plots were treated with coumatetralyl rice bait, which was produced by mixing the commercially available dispersible coumatetralyl (0.75%) powder and rice at 1:20 ratio. The resulting bait material contained 0.0375% coumatetralyl. The bait was packaged in small plastic bags (100g each) ready for use. For the test material, the prepared baits of the same weights were also similarly packaged.

In surplus or unrestricted plots (Treatment A and C) the standard technique of sustained baiting (Anon. 1976) was followed. The technique entailed the following:

1. **Selection of baiting location.** In each plot (composed of at least 8 regular size paddies), 8 baiting locations were selected with the distance at each site of about 50 meters from the center location. Initially, 2 bait containers placed along paddy dikes were provided in each location. One hundred grams of prepared baits were provided per bait container.

2. **Treatment of plots.** Both Treatments A and C plots were visited twice a week except during the period of stormy weather. In some locations, where rats continued to consume most of the baits, additional baited containers were provided. Among locations with consumption, the initial 2 baited containers were maintained. Spoiled baits were removed and properly disposed.

3. **Duration of baiting.** Baiting started 2 weeks after transplanting and was terminated 2 weeks before harvest. In some areas, where bait consumption declined, containers were removed.

To test the manufacturer's claim thant coumatetralyl paste formulation exhibit characteristics to kill rats following single feeding, pulse baiting method (Treatment B above) using the test formulation was also conducted. The test plot was provided with the same number of containers per baiting location. Establishment of baiting locations, however, followed a different pattern, i.e., baited containers were distributed in areas where greater rat activities are expected to occur. The bait containers were inspected and refilled only once per week.

During the regular inspection of the test plots, the relative number, location and behavior of potential non-target (both wild and domestic) animals present around baited areas were noted. General searches within and around baited areas for rodents and non-target carcasses were conducted. The general pattern of bait consumption and the fate of uneaten baits were also noted. Bait takes in each container was visually estimated and recorded in four ways: slightly taken, ¼ consumed, ½ consumed, ¾ consumed, and fully consumed. The values obtained through this scheme were the basis in estimating percent bait consumption per observation period for each test plot.

Two weeks prior to harvest, damage appraisal was conducted. In each plot, 5 representative paddies were randomly selected. A wholly randomized sampling procedure was used to determine the cut tillers. The procedure required a random selection of 10 sample rows and 10 sample hills per row. The extent of rat damage was expressed in percent tillers cut based on the counts of damaged and undamaged tillers from 100 hills per paddy. Rat damage was estimated using the following formula:

% Damage= [(Number of damaged tillers X Number of damaged hills) /Total tillers in damaged hills] X 100

RESULTS AND DISCUSSION

The study was conducted during the rainy season. The increment weather greatly affected activities of the pre-treatment tracking census and the whole 3-month baiting operation. A number of tracking tiles and some bait stations placed in low-lying areas were washed out due to floods, consequently rendering the census tools ineffective in these locations.

During the pre-treatment period, rat activity based on tracking data was generally lower than expected. Tracking scores obtained from all treatment plots during the pre-treatment census and those scores obtained from bait consumption index indicated that all experimental plots were infested with rats prior to treatment.

The amount of census bait consumed varied among treatment plots. During the pre-treatment census, consumption was highest in the untreated plot (Treatment D) and lowest in the coumatetralyl paste surplus baited plot (Treatment A). During the post-treatment census, the highest baiting index score was recorded on the untreated plot, while the lowest was on the positive control plot (Treatment C). Declines in census bait index were recorded on the untreated plot (Table 1). The highest reduction during the post treatment census was recorded in the positive control plot followed by both the coumatetralyl paste treated plots. The whole set of census data prove that rodenticide-baiting treatments caused significant reduction of infestation in the study area. The slight reduction of rodent activity in the control plot may have been due to the general change in the surrounding caused by the harvesting of the crop.

Table 1. Percent reduction in bait census index in all test plots after 8 to 10 weeks of baiting in a field trial of coumatetralyl paste in rice, September- December, 1998 Victoria, Laguna

Test Plot	Total score for 3 days	Percent Reduction		
		Average score per container	%active containers	Ave. score per baiting point
Treatment A (Surplus baiting with coumatetralyl paste)	21.4	2.1	46.2	31.5
Treatment B (Pulse baiting with coumatetralyl paste)	37.0	36.7	4.2	NR*
Treatment C (Surplus baiting with coumatetralyl powder, positive check)	60.0	62.5	62.9	7.5
Treatment D (Untreated plot)	18.3	19.7	18.2	0.46

* NR= no reduction

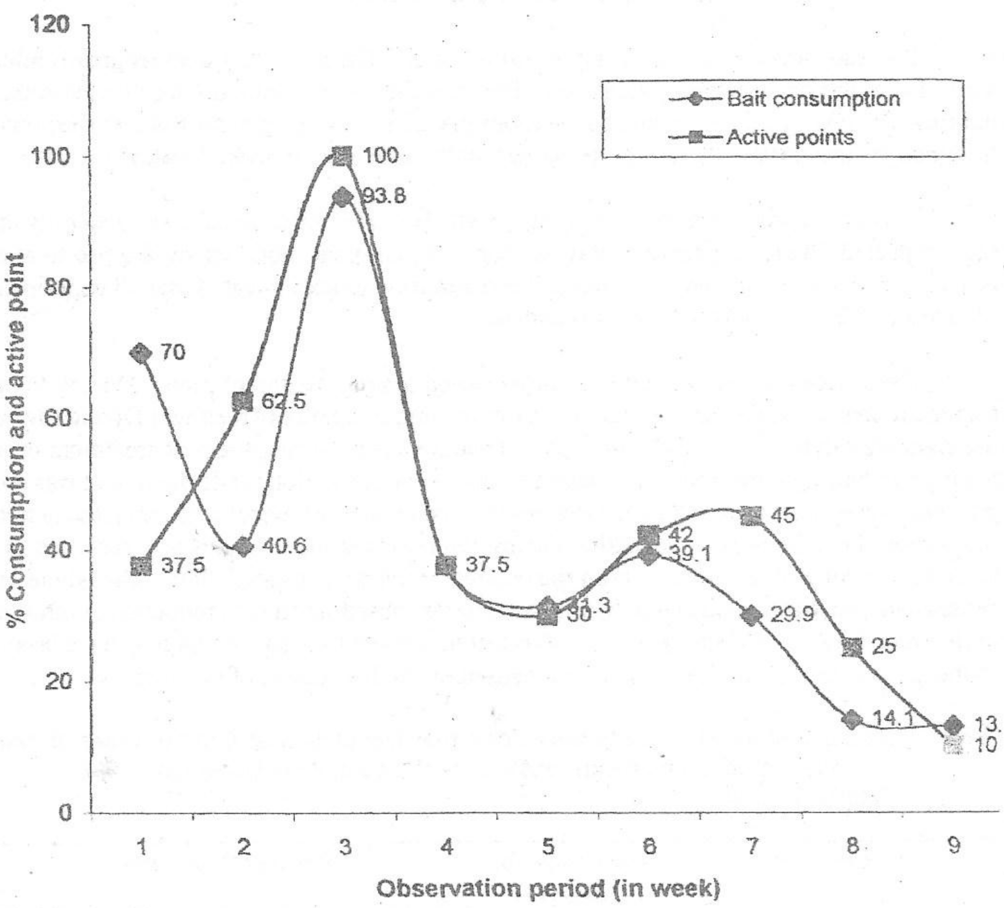

Figure 1. Bait consumption pattern in rice paddies with surplus baiting method using the test formulation, coumatetralyl paste, during a wet season trial (Sept.- Dec., 1998) Victoria, Laguna (Observation period: 1-3= pre-booting stage; 4-6= booting stage; 6-9= maturing to pre-harvest period)

The pattern of bait consumption among plots baited with coumatetralyl paste shows that the test bait was well accepted by the rats (Figure 1 and 2). Among paddies surplus baited with the test formulation, consumption was low during the first week of treatment and peaked during the third week at about 90% (Figure 1). During this period, all of the bait containers were active. This peak of consumption coincided with the pre-booting stage of rice development. During the succeeding weeks, consumption was sustained at significantly lower level, reaching only 13% consumption level during the 9th week of treatment. In the pulse-baited area (Figure 2) initial bait consumption was low at only 18% during the first week. The level of consumption increased until the 4th week of treatment. During the 4th week, all baits were consumed. The growth stage of rice development then was pre-booting booting stage. Immediately after the peak, low consumption was recorded, and from the 6th week to the 9th week of treatment, no consumption was recorded at all.

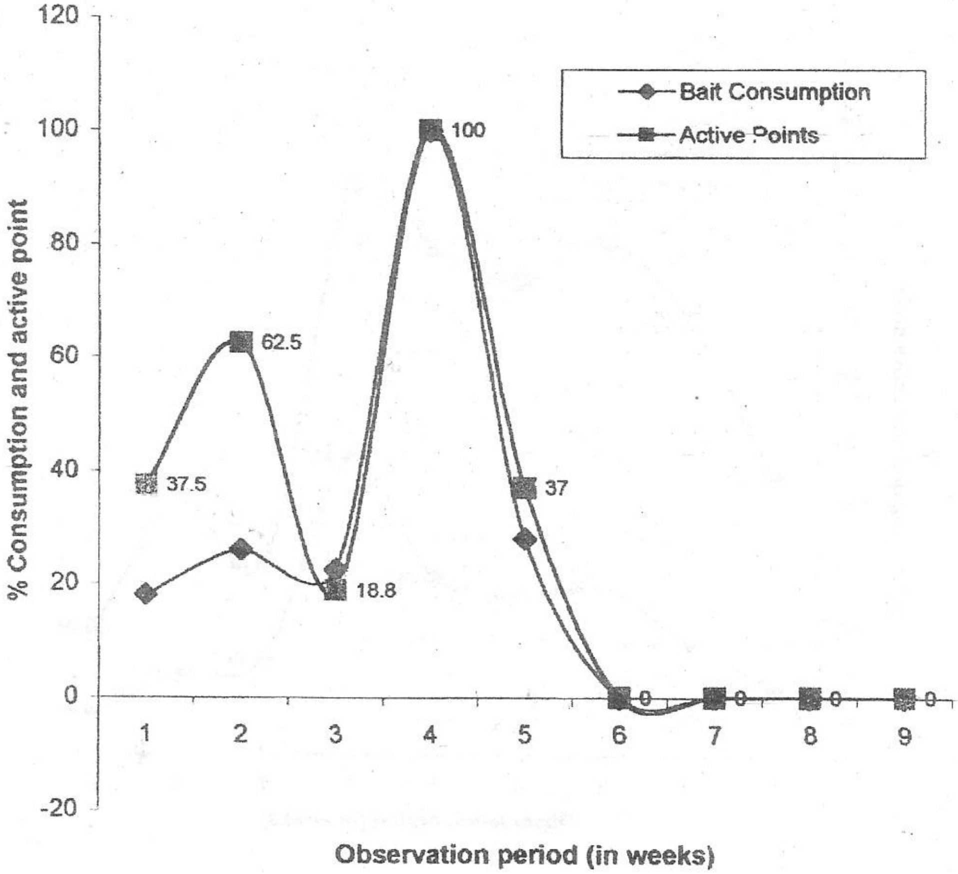

Figure 2. Bait consumption pattern in rice paddies with pulse baiting method using the test formulation , coumatetralyl paste, during wet season trial (Sept. Dec., 1998) Victoria, Laguna (Observation period: 1-3= pre-booting; 4-6= booting stage; 7-9= maturing to pre-harvest).

Bait consumption in the positive check plot was found to be generally low and had peaked much later compared with the other treated plots. Bait consumption level in this plot had peaked during the 6th week of treatment period and coincided with the flowering and panicle formation stages of rice. During the 7th week, there was only about 15% bait consumption; and at 2 weeks prior to harvest, bait consumption remained at about 6% (Figure 3).

Result of damage assessment confirmed the level of control achieved with the coumatetralyl paste treatments (Table 2). Data analysis indicated significant differences in the mean percent damage of the treatment plots (F value= 13.42, P< 0.01). The untreated plot exhibited the highest level of rat damage at 6.57%. Levels of rat damage were significantly lower

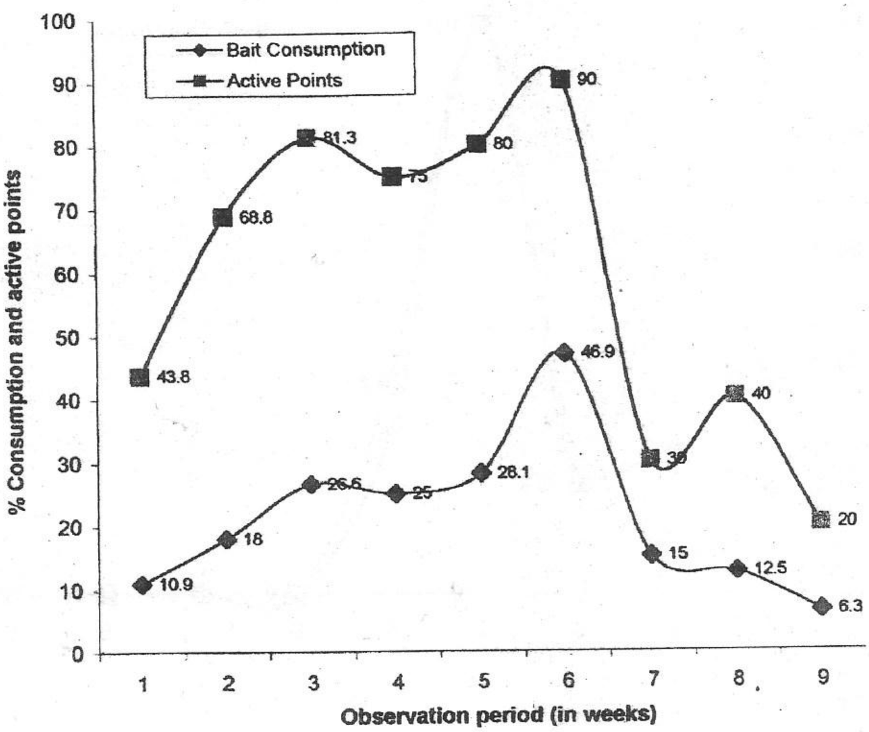

Figure 3. Bait consumption pattern in rice paddies with surplus baiting (unrestricted) using coumatetralyl dispersible powder during a wet season trial (Sept.- Dec., 1998) Victoria, Laguna Observation period: 1-3= pre-booting stage; 4-6= booting stage; 7-9= maturing to pre-harvest period)

in all coumatetralyl treated plots than the negative control plot. The level of damage estimated from the pulse-baited plot using coumatetralyl paste (3.75%) is comparable to that of the positive check plot (3.49%) as indicated by the absence of significant difference in mean damage between these two treatment plots. The surplus baited plot using the test formulation exhibited the lowest level of rat damage at mean value of 1.82%. This value is significantly different compared to values obtained in the other 2 treated plots, and the control plots. The present results suggest that coumatetralyl paste can either be used as material for surplus baiting or pulse baiting. If used in pulse baiting, its effect may be comparable, if not better, to the protection being provided by the conventional rat control method, i.e., surplus anticoagulant baiting. If used in surplus baiting, the optimum level of control may also be attained.

Table 2. Percent rat damage, based on tillers cut index, observed among treatment plots during the wet season field trial of coumatetralyl paste, September- December 1998, Victoria, Laguna

Treatment Plot	Paddy Number					
	1	2	3	4	5	Mean + SE*
Treatment A (Surplus baiting with coumatetralyl paste)	0.95	1.35	2.93	1.61	2.26	1.82 + 0.61a
Treatment B (Pulse baiting with coumatetralyl paste)	2.06	3.27	3.10	4.71	5.62	3.75 + 1.98b
Treatment C (Positive check- surplus baiting with coumatetralyl dispersible powder)	2.01	2.42	5.32	3.25	4.43	3.49 + 1.91b
Treatment D (Untreated plot)	7.27	5.40	8.15	6.34	5.70	6.57 + 1.29c

*Mean values designated with the same letter are not significantly different from each other at $P > 0.05$ using LSD

There were very few rodent carcasses recovered along the treated plots. A total of 17 dead rats were counted within the plot surplus baited with the test formulation, and 3 dead rats were recovered along the pulse-baited area. Dead rats were only observed during the pre-booting and booting stages of rice and corresponded with the peak of bait consumption. No rat carcasses were observed along the positive check plot but foul smell due to rats was generally present. Despite comprehensive searching neither bird carcasses nor those of other non-target organisms were found.

CONCLUSION

Surplus baiting with coumatetralyl paste provided good rodent control. The novel formulation has also potential to be used for pulse or restricted baiting. A more restricted bait application regimen however, needs further evaluation to generally assess safety and economy of baiting.

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