MINIMAL BAITING AND CONTROL OF RATS IN STORAGES USING NEW GENERATION ANTICOAGULANT RODENTICIDES

M. BALASUBRAMANYAM, G.P. MADDAIAH and R. RAMAMURTHI

Center for Pesticides & Toxicology
Department of Zoology, Sri Venkateswara University
TIRUPATI - 517 502, Andhra Pradesh, INDIA

ABSTRACT

Rodents cause significant damage to stored products and the situation is more acute in developing countries like India. Anticoagulant rodenticides are considered as first-choice rodent control materials for most situations. Laboratory studies indicate that three anticoagulants in particular - bromadiolone, brodifacoum and flocoumafen - stand out as being more toxic than other compounds to commensal rodents. Preliminary field trials have been carried out in select areas using 0.005% bromadiolone (Moosh Moosh), 0.005% brodifacoum (Klerat) and 0.005% flocoumafen (Storm) against infestations of Rattus rattus. The methods for assessing rodent population levels indirectly involve monitoring of the relative activity before and after treatment. The efficacy of three anticoagulant rodenticides was evaluated using two census methods: Census feed consumption and tracking observation. Trial sites received "pulsed" treatment of anticoagulant rodenticide wax blocks at fixed intervals. The treatments resulted in reduction of R. rattus populations by 85-95% at different situations. Field trials indicated that commercial formulation of anticoagulant rodenticides could be more effective in controlling rodents with short feeding periods. This paper describes early results of appropriate baiting systems for use with the high potent, slow-acting poisions. Further experimental work on rodenticides on a larger scale is needed to develop effective strategies.

Introduction

Rodents are a big problem in fields, food stores, homes and public health situations. The damage caused due to the predominant commensal rat Rattus rattus in storages is increasingly realised recently by all sections of the society. Nearly all modern extermination procedures depend on chemical methods and poisioning of rats by means of rodenticides is mostly practiced since it achieve a relatively effective and rapid success. Anticoagulants are used for the overwhelming majority of rat control treatments in premises of all types and are considered first choice rodent control materials for most situations (Dubock, 1980). These anticoagulants in particular - bromadiolone, brodifacoum and flocoumafen - stand out as being more toxic than other compounds to commensal rodents (Balasubramanyam & Purushotham, 1988). These highly potent compounds, which are referred to as new-generation anticoagulants, were originally developed to combat warfarin resistance. The increased activity of these compounds permits new rodent control options as Dubock (1979) proposed the "pulsed baiting" technique as a means of exploiting the biological activity of potent anticoagulants in order to maximise treatment efficiency. In recent years, this technique is being used increasingly in field rodent control (Dubock, 1982; Buckle et al., 1984; Parshad et al., 1985; Balasubramanyam, 1986). This paper describes the impact of minimal baiting practices with particular emphasis on commensal infestations.

Materials and methods

The study area included three trial sites viz., co-operative store (site I), hostels godown (site II) and a poulty feed mill (site III). All the trial sites were moderately to heavily infested with R. rattus, the visual presence of which was confirmed by trapping. The premises were carefully observed for rodent signs and infested areas were pinpointed on a sketch lay out with baiting points and tracking tile locations.

Ready-to-use wax blocks (each weighing 20 g approx.) of anticoagulant rodenticides viz., flocoumafen (Storm 0.005%), bromodiolone (Moosh Moosh, 0.005%) and brodifacoum (Klerat 0.005%) were tried in trial sites I, II and III respectively. Cracked rice + bajra (Pennisetum typhoides), with Arachis (Arachis hypogea) oil as an adhesive, was used as census bait during the trials. A sufficient number of bait stations (made of card board) were placed at intervals of approximately 3-6 m in order to cover the entire trial area. Smoked tracking tiles were placed near the bait point along the walls, about 0.6 m away from the bait stations. About 25 to 40 bait points were monitored in the trial sites which ensure effective coverage with reference to rodent signs.

Methods for assessing efficacy

The methods for assessing population levels indirectly involve monitoring the relative activity before and after treatment. The percentage control success was measured by folloiwng the two methods of census feed consumption and tracking activity (Kaukeinen, 1979; Mathur and Prakash, 1983; Spaulding and Jackson, 1984; Balasubramanyam, 1986). The trials were conducted in three phases: Pre-treatment census, poison baiting and post-treatment census.

Census baiting and tracking were used simultaneously on the same sites to determine the relative efficacy of the candidate poison baits. Placebo food census was done for 3 days before and after treatment periods and the amount of bait consumed was measured to the nearest 0.1 g. Tracking tiles were rated according to the six classifications as specified by Kaukeinen (1979) and Spaulding and Jackson (1984) with relative numbers 0-5 indicating the activity signs. Individual rodenticides were applied in trial sites in three pulses on day 7, 14 and 21 in order to see the impact of minimal baiting practices. A lag phase of 3 days followed the pre-treatment census and poison baiting to reduce pre baiting effects. Similar lag phases were also observed between each pulse treatment and the start of post-treatment census. Daily search for carcasses were made after the treatments and dead animals were burried deep in the soil to minimize chances of secondary poisoning.

Regardless of the nature of the data, whether it be the grams of food consumption or the number of tracks, the percent reduction in activity and the related per cent control was calculated as follows:

$$100 - \frac{\text{Post-treatment census take/tracking index}}{\text{Pre-treatment census take/tracking index}} \times 100 = \%\ \text{reduction}$$

Results

The results revealed that the variation in the reduction of rodent numbers among the trial sites was not significant, indicating more or less uniform treatment in all areas (Table I, Fig.1). The effects of poison treatments on tracking activity seem to be consistent with the observed reductions in the consumption of placebo baits. The combined reduction of rodent activity, calculated from the census baiting and tracking indices in sites I, II and III are recorded as 92.95% (flocoumafen), 87.86% (bromadiolone) and 86.42% (brodifacoum) respectively.

Consumption of baits by rodents varied among the trial sites depending upon the infestation and baiting points. At all the bait points, a total of 964, 1420 and 778 g were consumed during the pre-treatment phases in sites I, II and III respectively. The total quantified value of tracks for the pre-treatment phase was 230, 278 and 182 respectively. The percentage reduction with regard to (a) total feed consumption/tracks throughout the census period, (b) average take per point, and (c) per cent active points, were pooled, and the mean percentages were calculated to minimise the errors in census assessments. Post-treatment consumption of placebo bait was 94.77, 88.25 and 86.30% lower than pre-treatment levels, whereas the percentage of tracked boards decreased by 91.14, 87.48 and 86.54 at the three trial sites, respectively, after flocoumafen, bromadiolone and brodifacoum treatment. In all the sites around 50 and 75% reduction in relative activity were computed after I and II pulse treatments respectively. Per cent active points after the treatment phase was minimum (4.33 and 4.44%) at site I and maximum (8.16 and 8.88%) at site III. Rat carcases were collected from all the sites following poison bait placement and were tested for anticoagulant poisoning.

Discussion and conclusions

It is suggested that higher toxicity of the second generation anticoagulants have the advantage of being more efficient for the control of most rodent pests under different situations (Greaves et al., 1988). The laboratory and field efficacy of bromadiolone, brodifacoum and flocoumafen in short feeding periods against commensal rodents has been reported from different regions (Dubock, 1980; Subiah and Mathur, 1985; Parshad and Chopra, 1986; Balasubramanyam and Purushotham, 1988). Short lethal feeding periods, however, do not translate into faster control in the field when the second generation anticoagulants are used with saturation baiting (Richards, 1983). Higher control success with flocoumafen (92.95%), bromadiolone (87.86%) and brodifacoum (86.42%) was obtained in trial sites I, II amd III respectively in the prsent study with pulsed application of ready-to-use wax blocks. Consistent

Table I: Results of Census bait consumption and tracking board activity on anticoagulant rodenticide trials against *R. rattus*

Anticoagulant	Census method	Pre-treatment	Reduction in relative activity – Post-treatment: Pulse I	Pulse II	Pulse III	Relative Per cent control
Flocoumafen (Site I)	a. Census consumption					
	Total consumption	964	436 (54.77)*	143 (85.17)	55 (94.30)	
	Average per point	10.71	4.84 (54.81)	2.38 (77.78)	0.50(95.33)	94.77
	% Active points	83.33	50.00(39.99)	21.67(73.99)	4.44(94.67)	
	b. Tracking data					
	Total minimum tracks	230	126 (45.22)	82 (64.35)	20 (91.30)	
	Average per point	2.55	1.40 (45.10)	1.03 (59.61)	0.33(87.06)	91.14
	% Active points	87.50	50.00(42.86)	23.33(73.34)	4.33(95.05)	
			Average (a + b)/2			92.95
Bromadiolone (Site II)	a. Census consumption					
	Total consumption	1420	750 (47.18)	356 (74.93)	122 (91.41)	
	Average per point	11.83	6.25 (47.16)	3.95 (66.61)	2.03(82.84)	88.25
	% Active points	85.00	51.66(39.22)	26.33(69.02)	8.00(90.50)	
	b. Tracking data					
	Total minimum tracks	278	176 (46.70)	92 (66.98)	30 (89.21)	
	Average per point	2.32	1.46 (37.00)	1.02 (56.04)	0.40(82.76)	87.48
	% Active points	87.50	54.00(38.28)	20.83(76.19)	8.33(90.48)	
			Average (a + b)/2			87.86
Brodifacoum (Site III)	a. Census consumption					
	Total consumption	778	362 (53.47)	145 (81.36)	75 (87.79)	
	Average per point	10.37	4.83 (53.42)	2.90 (72.04)	1.90(81.68)	86.30
	% Active points	84.00	53.33(36.51)	25.00(70.24)	8.88(89.43)	
	b. Tracking data					
	Total minimum tracks	182	100 (45.06)	70 (61:54)	26 (85.71)	
	Average per point	2.60	1.42 (45.38)	1.08 (58.46)	0.43(83.33)	86.54
	% Active points	86.66	49.33(43.08)	27.45(68.32)	8.16(90.58)	
			Average (a + b)/2			86.42

* Figures in parenthesis indicate per cent reduction in relative activity at each pulse treatment

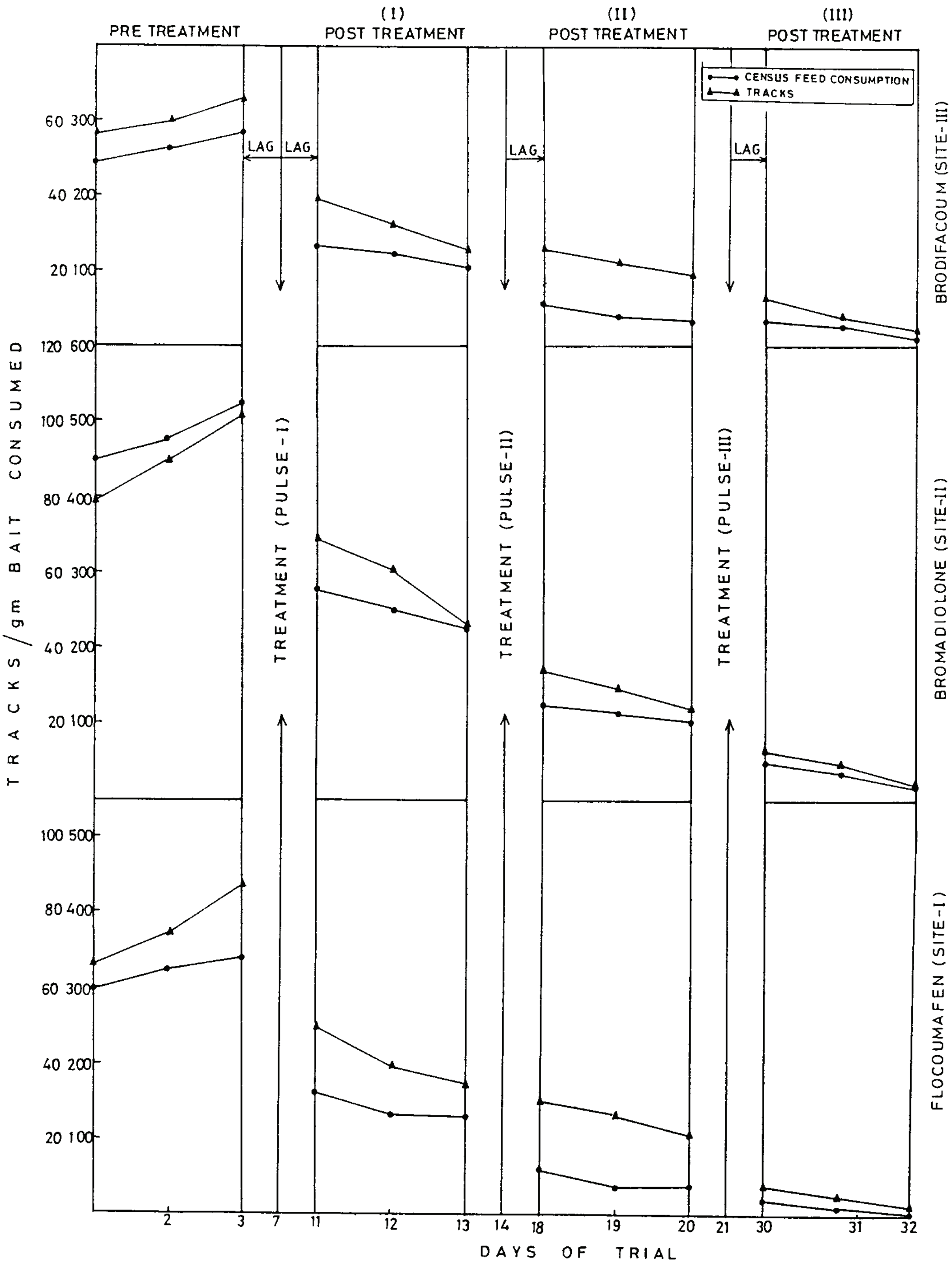

Fig.1. FIELD TRIALS SHOWING RESULTS OF PULSED BAITING AGAINST RAT INFESTATION INVOLVING 0.005% ANTICOAGULANT RODENTICIDES

field trials (representing 80-100% control success) have been reported elsewhere demonstrating the effectiveness of pulsed baiting with these anticoagulant rodenticides (Richards, 1983; Buckle et al., 1984; Richards and Huson, 1985; Johnson and Scott, 1986; Lund, 1988). In preliminary trials of pulsed baiting with 50 ppm brodifacoum, Dubock (1979) reported a savings of 75% bait and 50% labour than the surplus baiting. Results of the present study indicate that around 75% control is achieved after second pulse treatment and this minimizes the need for baiting the bait points by 50% for the next pulse. All the trial sites received only 15-20 gms of poisoned bait at each point and it was confirmed from the laboratory findings that these small bait points still contain a lethal dose for several rodents (Balasubramanyam and Purushotham, 1988). Thus the minimal baiting technique also seemed to offer significant safety advantages in reducing the amount of bait exposed thereby reducing the toxicant loading of the poisoned rodents. The paraffin block baits used in the present study have performed well in the field trials. Use of ready-to-use wax cakes are also easily adopted by the workers and minimised the risk involved in rodent control operations.

The data on field trials (Table I) reveal that a few active points are still available in the premises after treatment. This implies that, to maintain control, some type of ongoing baiting programme is always necessary. It is indicated from the study that 5-10% of bait points are active after the minimal baiting practices with the anticoagulant rodenticides. These points should be baited with permanent bait stations and be supervised at different intervals.

In view of the consistent values obtained in the present study with the census techniques (within 5 percent agreeement), one may be tempted to follow only one method in the field trials. It appears that food consumption as the most accurate method of population estimation, since very little interference is caused to the colony. However, it is important that the field evaluation as suggested by Kaukeinen (1979) should involve a minimum of two independent census methods to ensure that adequate data are generated. Simple vagaries in data can sharply affect the results obtained from a single method of assessment.

From the results it is evident that the efficacy of three anticoagulant rodenticides is in the order of flocoumafen > bromadiolone > brodifacoum. However our personal experience (Balasubramanyam, 1986) and reports from several parts of the world (Kaukeinen and Rampaud, 1986) claim that a wide range of rodent species including (Rattus sp.) are more susceptible to brodifacoum than bromadiolone. The results of the present study with brodifacoum may be attributed to several factors involved in site III which is a poultry feed mill.

To conclude, the second generation anticoagulants flocoumafen, brodifacoum and bromadiolone have more potential for the control of rodent infestations in storages with minimal baiting practices. The pulsed baiting method as presently verified, has great merit in agricultural and commensal situations wherein a mixed population of rodents exist. The method is especially suited for use with high potent, slow-acting second generation anti coagulants. However, pulsed baiting methodologies require extended study and refinement and further experimental work on rodenticides on a larger scale is needed to develop effective strategies.

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LUTTE CONTRE LES RATS DANS LES STOCKS DE DENREES AU MOYEN DE RODENTICIDES ANTICOAGULANTS DE SECONDE GENERATION EN APPATS ATTRACTIFS

M. BALASUBRAMANYAM et R. RAMAMURTHI

Center for Pesticide & Toxicology
Department of Zoology, Sri Venkateswara University
Tirupati – 517 502 Andhra Pradesh, India

Résumé

Les rongeurs causent des dégâts importants aux produits stockés et la situation est particulièrement aiguë dans les pays en voie de développement comme l'Inde. Les rodenticides anticoagulants sont considérés comme les substances les plus performantes dans la lutte contre les rongeurs. Les études de laboratoire indiquent que, particulièrement, trois d'entre eux, la bromadiolone, le brodifacoum et le flocoumafen, présentent une toxicité supérieure à celle de beaucoup d'autres molécules du même groupe pour les rongeurs commensaux. Des essais préliminaires en milieu agricole ont été entrepris dans des zones sélectionnées, en employant des appâts à 0,005 % de bromadiolone (Moosh), 0,005 % de brodifacoum (Klerat) et 0,005 % de flocoumafen (Storm) pour lutter contre *Rattus rattus*. Les méthodes servant à mesurer les niveaux des populations des rongeurs sont basées sur l'évaluation de l'activité de ces derniers ; la comparaison des niveaux, avant et après traitement, permet de mesurer l'efficacité de celui-ci. L'activité de trois rondenticides anticoagulants a été estimée en utilisant deux méthodes d'évaluation : mesure de la consommation alimentaire et observation visuelle des animaux. Des sites expérimentaux ont été régulièrement approvisionnés avec des blocs paraffinés contenant le rodenticide anticoagulant, disposés à des intervalles réguliers. Les résultats obtenus ont montré une diminution de 85 à 95 % des populations de *R. rattus* selon les sites. Les essais pratiques ont montré que les spécialités commerciales contenant les rodenticides anticoagulants les plus efficaces étaient celles qui ne nécessitaient qu'une ou deux ingestions d'appât par les rongeurs. L'exposé décrit les premiers résultats obtenus selon les divers modes d'appâtage au moyen de ce type de toxique. Afin de concevoir des stratégies de lutte efficaces, d'autres recherches expérimentales sont à poursuivre sur une plus grande échelle.