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COMPARATIVE FIELD STUDIES OF RODENTS CONTROL

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ABSTRACT

Comparative field experiments at Sabahia and Faculty of Agriculture Research Stations at Abbis, Alexandria, Egypt were conducted to evaluate the different methods of rodent control to select the effective one for using in rodent control programme. These experiments includes: anticoagulant rodenticides such as 0.005% brodifacoum ; 0.005 % difenacoum; 0.005 % flucoumafen; 0.005% chlorophacinone (each as whole wheat bait), 0 005 % diphacinone (as crushed wheat bait) and 0.012 % chlorophacinone + 0.019 % sulfachinoxaline as crushed maize bait; acute rodenticides such as zinc phosphide in two different baits and fumigant as potassium cyanide as well as trapping and weed burning. The results indicated that, most of the tested anticoagulants reduced the population of rodents during 7-days for more than 3-days applications For complete eradication, these anticoagulants should be applied for more than 7-days. On the other hand although baits of zinc phosphide were unpalatable, it highly reduced the rodent population in the field during 3-or 7-days of application These results may be due to the development of a poison bait shyness to the rats. The reduction in rodent population observed after 3- or 7-days was so low that potassium cyanide could not be used to control rodents in the field. The trapping and weed burning methods have weakly reduced the rodent population in the field. So, it could be concluded that good use of anticoagulants in rodent control proved to be the best method.

INTRODUCTION

Rodent exclusion involves the use of barriers, either chemical, mechanical, or other to prevent rodents from penetrating an area or causing hazards to several economic human life. Chemical poisons used in baits to control rodents are of several kinds such as anticoagulants with slow or cumulative action which are lethal only if two or more daily doses are consumed; single-dose acute rodenticides; fumigants and chemosterilants. Mechanical methods are being used such as trapping; weed burning and ultrasonic. The anticoagulants have been particularly successful in controlling Norway rats (Rattus norvegicus)(1). The baiting with medium oatmeal or soaked wheat containing 0.002, 0.001 or0.0005 % brodifacoum completely controlled infestations of warfarin-resistant rats on farm, whereas poison baits with 0.002% brodifacoum for only 1, 4 and 7 days achieved , respectively, only 41 , 51

and 68% control, respectively, of similar farm infestations, and so emphasized the need to continue baiting for longer periods (2). The bait of 0.005 % brodifacoum or difenacoum was found to be a near-optimal concentration for field use against different rodent species (3), (4), (5). Hand placement of commercially prepared baits of chlorophacinone and bromodiolone were very effective in controlling the pine vole (Microtus pinetorum) in a single 11.2 Kg/ha. application (6). Warfarin, coumetetralyl, difenacoum, brodifacoum bromodiolone and calçiferol were found to be toxic to the cotton rat (Sigmodon hispidus); ship rat (Rattus rattus) and Norway rat (Rattus norvagicus)(7), (8). Zinc phosphide, pyriminyl and kayanex showed good acute rodenticidal action against the rice field rat (Rattus argentiventer)(9). The treatments with zinc phosphide were significantly more successful against infestations of R. norvegicus on farms than those with norbormide which is used in situations where zinc phosphide can not be used efficiently without risk to livestock (10), but norbromide was failed to kill roof-rats in sewers (11). Pyriminyl showed marked degree of efficacy against different species of rodents (12) without any shyness effect in different baits (13). Gophacide rodenticide proved to be as effective as zinc phosphide for the control of wild house mice (14). Fumigants are used to kill rodents and their ectoparasites living in accessible area in buildings, ships or burrows in the soil. Fumigants are quite dangerous, both to the persons using them and the other humans or animals in the immediate area. Therefore, experience and skill is required in their application. However, carbon dioxide and sulphur dioxide are more rarely used with great caution to fumigate burrows (15) , whereas chloropicrin is used to drive house mice out of grain storage area, but calcium cyanide is used for out-door operations (16).

MATERALS AND METHODS

1. Tested Compounds:-

A. Anticoagulant Rodenticides:
   1. Kelerate (0.005% brodifacoum) as whole wheat grains.
   2. Ratak (0.005% difenacoum) as whole wheat grains.
   3. Storm (0.005% flocomafen) as whole wheat grains.
   4. Cereal-C (0.005% Chlorophacinone) as whole wheat grains.
   5. T.R.C. (0.005% diphacinone) as crushed wheat ready made bait.
   6. Lepit-E (0.012% chlorophacienone/0.019% sulfachinoxaline) as crushed maize mixed with husks of sun-flower seeds.

B. Acute and fumigant Rodenticides:
   1. Zinc phosphide (3%) as whole wheat or crushed maize baits.
   2. Potassium cyanide.

II. Traps:

Common wire spring traps were used in the trapping methods.

III. Methods of application:

a. Poison baits: (19), (20).

The known weights of 50 gm poisoned baits (anticoagulant or acute rodenticides) were distributed at fixed distances (3-4 meters) around/or in the test area. A cardboard dishes were used for baiting, to weigh and check the bait consumption easily.

In case of fumigants, the poisons were introduced into the treated burrows and then immediately closed with soil (21)

Pre-and post-treatments with non-poison baits (whole wheat grains) were also conducted in the same manner to determine the percent control of the rodents The experiments were conducted for 3 and 7 days. The results were recorded as mean weight of the poison baits consumed during the experiment/24 hrs as well as percent consumption of the poison baits. The palatability of the poison bait was also determined.

The precent reduction in the activity of rodents and related percent control can be expressed by the following equation (22).

$$\% \text{ Reduction} = 100 - \left(\frac{\text{Post - treatment data}}{\text{pre - treatment data}} \times 100\right)$$

b. Mechanical Control:

1. Trapping method:

The common wire spring traps were baited and distributed daily, and the positive traps were collected daily in the morning. The treatment success was assessed from the result of census baitings (wheat) conducted before and after treatment. Reduction percentage was calculated from the above equation.

2 Burning of weeds method:

This treatment was carried out to ditch the weeds which harbour the rodents and are often being burnt. the treatment success was assessed from the result of census baitings (wheat) conducted before and after treatment. Percent reduction (percent control) was calculated according to the former equation.

RESULTS AND DISCUSSIONS

A. Field Experiments for Anticoagulant:

The results of the field experiments by anticoagulant rodenticides for 3-days are recorded in Table 1 from which it could be mentioned that for non-poison baitings conducted before and after treatments, the application of anticoagulants slightly decreased the rodent infestations; i.e., the amounts consumed from non-poison bait (wheat) were found to be reduced after post-treatments than pre-treatments.

Concerning the amounts of consumed baits it was found that difenacoum exhibited the highest consumption by rodents whereas the lowest consumption was observed from diphacinone However, all the tested anticoagulants were palatable to the rodents in the field.

On the other hand, T.R.C. (0.005 % diphacinone crushed wheat ready-made bait), cereal-C (0.005% chlorophacinone; whole wheat ready-made bait) and Storm (0.005 % flocoumafen ; whole wheat ready-made bait) moderately succeeded in controlling the rodents by the application for three days. These three anticoagulants reduced the rodent population with 74.2 , 71.6 and 71.3 %, respectively. Kelerat slightly reduced the rodent population with 61.2%. The least reduction for rodent control population was observed in the case of Lepit-E and Ratak which caused 39.7 and 22.6 % reduction, respectively.

Thus, it could be mentioned that the application of anticoagulants for three days slightly controlled the rodents in the field because their mechanism depends upon the multiple dosages taken by rodents. Therefore, these tested anticoagulants were applied for longer periods than 3 days, e.g., 7 days.

The results of the field trials with anticoagulants for 7 days are recorded in table 2 from which the following points could be noted : Cereal-C (0.005 % chlorophasinone; whole wheat ready-made bait) and Lepit-E (0.012 % chlorophacinone, 0.019% sulfaquinoxaline; crushed maize mixed with husks of sun-flower seeds)were highly consumed; whereas, moderate consumption was observed in case of Kelerat (0.005% brodifacoum; whole wheat ready-made bait), Ratak (0.005% difenacoum; whole wheat ready-made bait), T.R.C. (0.005 % diphacinone; crushed wheat ready-made bait) and Storm (0.005 % flocoumafen; whole wheat ready-made bait).

Also, from the results of census baitings conducted before and after treatments (table 2), it was found that Cereal-C highly reduced the rodent infestation with 90.3 % reduction; i.e., the activity of the rodent population was decreased by 90.3% on applying Cereal-C for 7 days, Strom,

Table 1: Comparative results for field application of several anticoagulant rodenticides during 3 days.

Location	Poison bait	Concentration (%)	Pre-treatment: Consumed wheat (gm)	Pre-treatment: Consumption (%)	Treatment: Poison bait consumed (gm)	Treatment: Consumption (%)	Treatment: Palatability (%)	Treatment: Reduction (%)	Post-treatment: Consumed weight (gm)	Post-treatment: Consumption (%)
1	Brodifacoum	0.005	1009	67.3	1270	84.7	125.9	61.2	392	26.1
2	Difenacoum	0.005	1410	94.0	1485	99.0	105.3	22.6	1091	72.7
3	Flocoumafen	0.005	1250	83.3	1287	85.8	102.9	71.3	358	23.9
4	Chlorophacinone	0.005	1362	90.8	1373	91.5	100.8	71.6	387	25.8
5	Diphacinon	0.005	1014	67.6	972	64.8	95.9	74.2	262	17.5
6	Chlorophacinon Sulfaquinoxaline	0.012 0.019	1402	93.5	1399	93.2	99.8	34.7	846	56.4

Table 2: Comparative results for field application of several anticoagulant rodenticides during 7 days.

Location	Poison bait	Concentration (%)	Pre-treatment: Consumed wheat (gm)	Pre-treatment: Consumption (%)	Treatment: Poison bait consumed (gm)	Treatment: Consumption (%)	Treatment: Palatability (%)	Treatment: Reduction (%)	Post-treatment: Consumed weight (gm)	Post-treatment: Consumption (%)
1	Brodifacoum	0.005	1200	80.0	2416	86.5	86.3	86.5	162	10.8
2	Difenacoum	0.005	1225	81.7	2229	74.3	78.0	86.3	168	11.2
3	Flocoumafen	0.005	1235	82.3	2120	70.6	73.6	89.3	132	8.8
4	Chlorophacinone	0.005	1324	88.3	2865	95.5	92.7	90.3	128	8.5
5	Diphacinon	0.005	1455	97.0	2130	71.0	62.7	78.0	320	21.3
6	Chlorophacinon Sulfaquinoxaline	0.012 0.019	1150	82.3	2580	86.0	96.1	81.6	212	14.1

Kelerat and Ratak were also effective during 7-days application in reducing the population of the rodents with 89.3%, 86.5 and 86.3%, respectively. On the other hand, lepit-E and T.R.C. gave moderate reduction of rodent population with 81.6 and 78.0% ; respectively, during the application for 7 days.

It could be concluded that the application for 7 days are necessarily required for good rodent control.

B. Field Experiments for Acute and Fumigant Rodenticides:

The results of the field trials for 3 days by acute and fumigants rodenticides are illustrated in Table 3 from which several remarkable points were achieved:

Zinc phosphide (3%) in both baits (whole wheat or crushed maize baits) nearly prevented the consumption of the post treatment baits (non-poison whole wheat baits). this action may be due to either the ability of zinc phosphide to eradicate the rodents or the developing bait and/or poison shyness for rodents. On the other hand, Zinc phosphide gave high reduction in the rodent population by both baits, the percent reduction by zinc phosphide-wheat baits and zinc phosphide-crushed maize baits were 100.0 and 99.3 % respectively.

Although the reduction percentages caused by zinc phosphide were very high, the amounts consumed from its baits were very little. the consumption percentages were 16.7 and 9.9% from zinc phosphide-wheat and zinc phosphide-crushed maize baits, respectively. It was observed also that zinc phosphide poison baits were so unpalatable that they could not attract the rodents.

With respect to potassium cyanide as a fumigant, it was found that the reduction percentage in the rodent population after application in rates burrow was 25.6% only. This reduction was very low that potassium cyanide could not be used to control rodents in 3 days application (Table 3).

Concerning the application for 7 days , the results of the field control trials by acute and fumigant rodenticides are recorded in Table 4 which show that both baits of zinc phosphide (3% in either whole wheat or crushed maize) highly decreased the consumption of non-poison wheat baits in post-treatment. However, the reduction percentage in the rodent population by zinc phosphide wheat bait and crushed maize baits were 89.3 and 94.5%, respectively. these results of zinc phosphide treatment may be due to either the action of zinc phosphide to kill rodents or zinc phosphide bait shyness for rodents.

Table 3: Comparative results for field application of zinc phosphide (acute rodenticide) with two different baits and potassium cyanide (fumigant) during 3 days.

Poison bait	Pre-treatment		Treatment				Post-treatment	
	Consumed wheat (gm)	Consumption (%)	Poison bait consumed (gm)	Consumption (%)	Palatability (%)	Reduction (%)	Consumed weight (gm)	Consumption (%)
Location Zinc phosphide 3% (wheat bait)	1283	85.5	250	16.7	19.5	(100.0)	(0)	(0.0)
Location Zinc phosphide (Crushed maize bait)	1391	92.7	148	9.9	10.6	(99.3)	(10)	(0.7)
Location Potassium cyanide (Fumigant)	1179	78.6	1000	-	-	25.6	877	58.5

Table 4: Comparative results for field application of since phosphate (acute rodenticide) and two different baits and potssium cyanide (fumigant) during 7 days.

Poison bait	Pre-treatment		Treatment				Post-treatment	
	Consumed wheat (gm)	Consumption (%)	Poison bait consumed (gm)	Consumption- (gm)	Palatability (%)	Reduction (%)	Consumed weight (gm)	Consumption (%)
Location Zinc phosphide 3% (wheat bait)	1132	75.5	120	8.0	10.60	(89.3)	(120)	(8.0)
Location Zinc phosphide (Crushed maize bait)	1378	91.8	125	8.3	9.07	(94.5)	(76)	(5.1)
Location Potassium cyanide (Fumigant)	1150	76.7	1500	-	-	10.0	1035	69.0

The amounts consumed from both baits of zinc phosphide were very low. (for each bait). These results indicated that zinc phosphide in both baits (wheat and crushed maize) was not palatable to the rodents.

From the previously mentioned results, it could be concluded that the reduction in rodent populations are not attributed to acute toxicity of zinc phosphide.

On the other hand, concerning the application of potassium cyanide for 7 days in rats burrows, it was observed that the percent reduction in the rodent populations was 10.0 % only, which was lower than that after 3 days application (25.6%). This result may be due to either the hydrolysis of potassium cyanide inside the burrows and loss of its action in few hours or to the migration of the rodents from the treated area. However, the burrow system should be treated continuously.

C. Field Trials by Mechanical methods:

The results of the field rodent control by using traps and weed burning are recorded in Table (5). The application of trapping methods to rodent control reduced the rodent population with 16.2 % only. This result was assessed from the results of census baitings conducted before and after treatment.

With respect to the weed burning method, it was found from the results of census baitings conducted pre-and post-treatment that the activity of the rodent population was decreased by 39.8%.

Weed burning was more efficient than traps to reduce the rodent population.

It could be concluded that the rats are characterized by their neophobic reactions. Therefore, they tend to be away of the traps and are sometimes difficult to capture or control by this method. In addition, the use of the traps in rodent control is costy and needs an effort and maintence. On the other hand, weed burning is highly dangerous when used in areas of the field crops.

From the previously results, it could be stated that anticoagulant rodenticides are highly active in controlling rodents by adjusting their applications; formulations, and recommended concentrations.

Table 5: Results of mechanical methods for rodent control in the field.

Methods	Non-poison bait			
	Intial weight (wheat) (gm)	Pre-application consumed (gm)	Post-application consumed (gm)	Reduction (%)
Traps	1000	752	630	16.2
Weed burning	1500	1132	682	39.8

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الملخص العربى

دراسات حقلية مقارنة لمكافحة القوارض

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اجريت تجارب حقلية مقارنة فى محطتى البحوث لكلية الزراعة والصباحية بمنطقة ابيس بالاسكندرية لتقييم الطرق المختلفة لمكافحة القوارض وذلك لاختبار الوسيلة الفعالة لكى تستعمل فى برنامج مكافحة القوارض. وتشتمل هذه التجارب طعوم مختلفة من مانعات التجلط،طعوم من فوسفيد الزنك وكذلك سيانيد البوتاسيوم كماده مدخنة بالاضافة الى طريقة استعمال المصايد وحرق الحشائش ولقد اظهرت النتائج أن معظم مبيدات القوارض من مانعات التجلط قللت اعداد الفئران عند تطبيقها لمدة سبعة ايام بدرجة كبيرة عن ثلاثة ايام من التطبيق. ويمكن الحصول على مكافحة كلية بزيادة زمن التطبيق عن سبعة ايام من ناحية اخرى، على الرغم أن طعوم فوسفيد الزنك على القمح أو جرش الذرة كانت غير مقبولة للفئران فان عدد الفئران قد نقص وفى الحقل بدرجة كبيرة خلال ثلاثة أو سبعة أيام من التطبيق و بالتالى يمكن رجوع ذلك الى ظهور نفور لطعوم فوسفيد الزنك وليس لتاثير المركب وبالتالى فان النقص فى التعداد غير حقيقى. وكان النقص فى تعداد الفئران منخفضا جدا وفى حالة سيانيد البوتاسيوم لدرجة انه لا يمكن استعماله فى مكافحة جيدة للفئران فى الحقل وذلك ايضا بالنسبة للمصايد وحرق الحشائش. وعلى ذلك يمكن القول أن الاستعمال الجيد لمبيدات القوارض مانعات التجلط فى مكافحة القوارض يعتبر من افضل الطرق المستعمله.