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# FIELD AND LABORATORY EVALUATION OF DIFFERENT RODENTICIDES FORMULATED BAITS

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## ABSTRACT

Evaluation of twelve of different rodenticides formulated baits were carried out with population infesting the field in addition to laboratory feeding free-choice test against albino norway rats (Rattus norvegicus var. albus). The results showed that the anticoagulants diphacinone (0.002% and 0.005%) and chlorophacinone (0.005% and 0.25%) when used with crushed maize , whole sorghum or wheat grains were very effective to reduce the rodent infestation in the field whereas coumatetralyl (0.037 % and 0.005%) with crushed maize or whole wheat grains were less effective. On the other hand, cholecalciferol (0.075%) as pellets proved to be very effective to reduce the population of rodents. Zinc phosphide (1.7%) with crushed maize or whole sorghum grains gave remarkable reduction of the rodents population in the field. All the tested rodenticides were found to be effective against albino norway rats at different cumulative dosages.

## INTRODUCTION

Egypt government has been exerted great efforts and money to get different rodenticides

which soon became more commonly used than the other ways for controlling rats and mice in Egypt. Therefore, evaluation has been conducted for providing the adequate effective rodenticides. The good use of anticoagulant rodenticides in rodent control proved to be more effective than Zinc phosphide(1)

The baiting with medium oatmeal or sooked wheat containing 0.002, 0.001 or 0.0005% brodifacoum completely controlled infestations of worfarin- resistant rats on.farm, whereas porson baits with 0.002% brodifacoum for only 1,4 and 7 days gave 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 and 5).

Warfarin, coumatetralyl, difenacoum, broadifacoum and bromodiolone were all toxic compounds against R. norvegicus. although several of these compounds were unpalatable (6). Calciferol at 0.1% plus warfarin at 0.025% is an effective combination against house mice when used with whole canaryseed (7)

The purpose of this research was for evaluate the different rodenticides formulated baits in the field and laboratory, to detect the activity of effective poisons for rodent control.

## MATERIALS AND METHODS

### I. Tested Rodenticides:

1- Racumin (0.037% coumatetralyl: 4-hydroxy -3-(1,2,3,4-tetrahydro -1- nephthyl)coumarin.)as whole wheat grains ready-made bait.

2- Racumin (0.005% coumatetralyl) as master-mix with crushed-maize ready made.

3- Ratkiller(a) (0.002% Diphacinone: 2-diphenylacetyl- 1,3-indendione.) as master-mix with crushed maize-ready made.

4- Ratkiller(b) (0.002% Diphacinone) as whole-sorghum grains ready-made bait.

5- Kaid(a) (0.005% chlorophacinone: 2-((p-chlorophenyl) phenylacetyl)-1,3-indandione) as master-mix with crushed maize-ready made.

6- Kaid(b) (0.005% chlorophacinone) as whole sorghum grains ready-made bait.

7- Quintox (0.075% Cholecalciferol) in a pelleted bait formulation.

8- Mard (0.005% Diphacinone) as master-mix with crushed maize. ready made.

9- Chlorocal(a) (0.25% Chlorophacinone) as whole wheat grains ready made bait.

10- Chlorocal(b) (0.25% Chlorophacinone) as whole sorghum grains ready made bait

11- Raad (1.7% Zinc phosphide) as crushed maize ready made bait.

12- Flash (1.7% Zinc phosphide) as whole sorghum grains ready made bait.

### II. Tested Animals:

White rats (Rattus norvegicus) used in this test were taken from a colony raised in the animal house of the Plant Protection Department, Faculty of Agriculture, Alexandria University.

## III. Methods of Testing:

A) Field Experiments (References 8 and 9).

The field experiments were at Faculty of agriculture research station, Alexandria University. The known weights of poisoned baits (200 gm.) were distributed at fixed distances (20 - 25 meters) around/or in the test area (2-3 feddans). Bait stations were used for baiting, to weight and check the bait consumption daily. In case of Zinc phosphide baitings, 25gm/station was applied at distance about 5 meters for three weeks. The poison baiting were continued until the consumption by rats were stopped Pre-and-Post-treatment with non-poison baits (crushed maize) were also conducted in the same manner to determine the percent control of the rodents. It was convenient to lay unpoisoned baits for 5 days before poison bait is begun and the results of the last two days were used. The results were recorded as mean weight of the baits consumed daily. Average amounts of non-poison and poison baits consumed per feddans were calculated as well as precent consumption.

The precent reduction in the activity of rodents and related percent control can be determined by the following equation (10)

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

B) Laboratory Experiment: (References 11 and 12)

This experiment was in the lab hause of the Plant Protection Department, Faculty of

Agriculture, Alexandria University.The white norway rats (Rattus norvegicus var albus) were caged individually with adequate water supply. Rats were preconditioned to the test diet which was crushed maize, until starting the test. Fresh bait and clean food pots were provided daily (13).

Two cups were placed inside the cage, one containing the non-poison bait (20 gm, crushed maize) and the other cup containing the poison bait (20 gm). Daily fresh baits were supplied and the position of the two bait cups were interchanged. Untreated rats were concurrently caged in separate cages with non-poison bait (crushed maize). Five to ten rats were used for each treatment. The results were recorded daily on bait consumption (poison and non-poison baits). The total consumption of non-poison and poison baits / rat and mean percentage of appetite were calculated by the following equation (14)

$$\% \text{ Appetite} = \frac{\text{Mean consumption of choice non-poison baits}}{\text{Mean consumption of non-poison baits for control}} \times 100$$

Mean percentage of palatability was determined by the following equation (14).

$$\% \text{ Palatability} = \frac{\text{Mean consumption of choice poison bait /24 hrs}}{\text{Mean consumption of choice non-poison bait/24 hrs}} \times 100$$

Mortality percentage and death time of each rat were reported. The average amount of consumed poison bait in gm/kg body weight as well as of active ingredient in mg/kg body weight were calculated.

## RESULTS AND DISCUSSION

### A) Field Results:

The results of the field experiments by different poison-baits are recorded in Table (1), from which it could be noticed that, the baiting of non-poison conducted before and after the poison treatments highly decreased the rodent infestations ; i.e., the amount consumed from non-poison bait (crushed maize) were found to be reduced in the post-treatments than pre-treatments.

Concerning the poison baitings, it was found that racumin with both concentrations (0.037% or 0.005% coumatetralyl, anticoaglaut) formulated with whole wheat grains or crushed-maize reduced moderately the rodent infestations, i.e., 3.5 and 2.81 kg/feddan caused 85.0% and 77.8% reduction of the infestation, respectively. Diphacinone as anticoagulant with 0.002(a) , 0.002% (b)as well as 0.005% in case of Ratkiller in crushed maize or whole sorghum ready made baits and Mard in crushed maize ready made bait, caused 90.6%, 90.0 and 95.2% reduction of rodent population by using 3.25, 3.5 and 2.83 kg poison bait/ feddan, respectively. So, the increase of diphacinone concentration increased the reduction percentage of rodent infestation by using the lowest amount per feddan. The different baiting (crushed maize or whole sorghum grains) with the same

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Table (1): Field evalution of different poison baits against rodent populations

| Rodenticides | Concentration % | Pre-treatment | | Treatment | | | Post Treatment | | Reduction % |
|---|---|---|---|---|---|---|---|---|---|
| | | Average Non-Poison bait consumed (Kg)//fed | Consumption % | Aveage poison bait consumed Kg/fed | Consumption % | Duration days | Non-poison bait consumed Kg/fed | Consumption % | |
| Racumin (Wheat bait) | 0.037 | 1.26 | 46.7 | 3.50 | 85.4 | 12.0 | 0.189 | 26.5 | 85.0 |
| Racumin (Crushed maize) | 0.005 | 1.11 | 69.4 | 2.81 | 75.3 | 16.0 | 0.247 | 29.7 | 77.8 |
| Rat killer(Crushed maize | 0.002 | 2.25 | 89.7 | 3.25 | 75.6 | 14.0 | 0.220 | 32.4 | 90.6 |
| Rat killer (Sorghum) | 0.002 | 2.3 | 85.0 | 3.50 | 77.8 | 14.0 | 0.230 | 22.1 | 90.0 |
| Kaid (Crushed maize) | 0.005 | 1.86 | 74.3 | 2.10 | 85.0 | 16.0 | 0.360 | 48.7 | 80.6 |
| Kaid (sorghum) | 0.005 | 1.63 | 88.1 | 2.20 | 77.2 | 15.0 | 0.160 | 17.2 | 90.2 |
| Quintox(pellets) | 0.075 | 3.35 | 100.0 | 0.57 | 31.8 | 13.0 | 0.310 | 36.0 | 90.8 |
| Nard(crushed maize) | 0.005 | 4.16 | 95.6 | 2.83 | 72.4 | 16.0 | 0.200 | 16.0 | 95.2 |
| Chlorocal(Wheat) | 0.25 | 4.38 | 97.3 | 1.50 | 46.9 | 16.0 | 0.160 | 12.8 | 96.4 |
| Chlorocal(Sorghum) | 0.25 | 4.3 | 93.9 | 1.90 | 43.2 | 13.0 | 0.100 | 4.8 | 97.7 |
| Read (Crushed maize) | 1.7 | 4.37 | 99.3 | 1.37 | 61.7 | 21.0 | 0.195 | 26.4 | 95.5 |
| Flash (Sorghum) | 1.7 | 6.56 | 100.0 | 1.56 | 62.7 | 21.0 | 0.415 | 39.9 | 93.7 |



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concentration of diphacinone nearly showed similar results. The anticoagulant chlorophacinone with concentrations of 0.005% and 0.25% in case of Kaid (as crushed-maize or whole sorghum grains ready made baits) and chlorocal (as whole wheat grains or whole sorghum grains ready made baits) showed 80.6% or 90.2% and 96.4 or 97.7% reduction of rodent population by using 2.1 or 2.2 and 1.5 or 1.9 kg poison baits per feddan, respectively. It could be noticed that, chlorophacinone at 0.005% formulated with whole sorghum grains proved to be highly effective to reduce the population of rodents in the tested area; since it exhibited 90.2% reduction with 2.2 kg bait per feddan. The increased concentration of chlorophacinone with 50 times to 0.25% did not show the corresponding suitable increase in the reduction percentage i.e. it caused 96.4% and 97.7% by using 1.5 and 1.9 kg/feddan from whole wheat and whole sorghum grains ready made baits, respectively.

Concerning Quintox (0.075% cholecalciferol as pellets bait) which is completely different from anticoagulants mode of action, once a rodent has eaten Quintox the cholecalciferol mobilies calcium ion from the bones into the blood stream. This causes a massive increase in blood calcium levels, leading to hardening of the tissues and death from heart attack in 3 to 6 days. (7,15). The results proved that activity of Quintox which gave 90.8% reduction of population by using the lowest amount per feddan equal to 0.57 kg/feddan.

On the other hand, Raad and Flash (1.7% Zinc phosphide) as crushed maize and whole sorghum grains ready-made baits, gave high

reduction in the rodent population by both baits; it caused 95.5% and 93.7% reduction by 1.37 and 1.56 kg/feddan, respectively

**B. Laboratory Results:**

Laboratory results of the evaluation of different poison baits against the white norway rats (Rattus norvegicus var albus) are shown in Table (2), from which, it could be observed that appetite of the free choice rats were found to be very low in relation to the untreated rats; the appetite percentages of these treated rats were ranged between 11.0 and 22.8% for all the tested poison baits. The palatability of the tested white rats to the anticoagulant baits were slightly low, whereas it was good to Quintox baits and not of such a degree as to prevent the consumption of lethal dose. The palatability of Zinc phosphide baits were found to be more palatable to consume large amounts.

Concerning the time to death and mortality percent, it was observed that, all the tested poison baits caused 100% death but at different time to death. Both baits of Zinc phosphide showed the shortest time to death as average 1.4 -1.5 days whereas the longest time to death was observed in case of Mard (0.005% diphacinone, crushed maize bait), Ratkiller (0.002% diphacinene, whole sorghum grains bait ); Kaid (0.005% Chlorophacione, whole sorghum grain bait) and chlorocal (0.25% chlorophacinone, whole wheat grains) which took 11.0, 9.3, 7.75 and 7.1 days, respectively for causing death. The other tested poison baits caused the death within 5-6.2 days.

Table (2): Laboratory evaluation of different poison baits against *Rattus norvegicus* (albino)

| Tested Rodenticides | Concentration % | Mean body weight (gm) | Mean Poison bait consumed per day gm | Mean Poison bait consumed per day % | Mean non-poison bait consumed / day gm | Mean non-poison bait consumed / day % | % Palatability | % Anorexia | % Mortality Range | % Mortality Final | Time to death days Range | Time to death days Mean | Average annual consumed / Kg body/day weight Bait gm/day | Average annual consumed / Kg body/day weight active ingredient mg/day | Average annual consumed / Kg body/day weight ingredient total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Untreated | ---- | 95 7 | ---- | ---- | 0 2 | 02 0 | ---- | ---- | ------ | ---- | --- | --- | --- | ----- | ----- |
| Racumin | 0.037 | 81 5 | 0 35 | 3 5 | 1 62 | 16 2 | 21 6 | 19 0 | 25-100 | 100 | 5-7 | 6 20 | 4 29 | 1 500 | 9 900 |
| Racumin | 0 005 | 71 5 | 1 09 | 10 9 | 1 07 | 10 7 | 50 3 | 22 0 | 25-100 | 100 | 3-7 | 5 20 | 15 25 | 8 760 | 3 950 |
| Rat killer(a) | 0 002 | 72 5 | 0 62 | 6 2 | 1 46 | 14 6 | 42 6 | 17 0 | 25-100 | 100 | 4-7 | 6 00 | 8 60 | 9 170 | 1 020 |
| Rat killer(b) | 0 002 | 80 5 | 0 25 | 2 5 | 1 43 | 14 3 | 17 5 | 17 4 | 30-100 | 100 | 8-10 | 9 30 | 3 10 | 0 060 | 0 560 |
| Kaid (a) | 0 005 | 65 0 | 0 71 | 7 1 | 1 35 | 13 5 | 52 6 | 16 5 | 25-100 | 100 | 3-7 | 5 30 | 10 98 | 0 550 | 7 920 |
| Kaid (b) | 0 005 | 67 0 | 0 20 | 2 0 | 1 75 | 17 5 | 11 4 | 21 3 | 25-100 | 100 | 3-10 | 7 75 | 3 00 | 0 150 | 1 170 |
| Quintox | 0 075 | 63 0 | 0 75 | 7 5 | 0 94 | 9 4 | 79 8 | 11 5 | 50-100 | 100 | 5-7 | 6 20 | 11 90 | 8 930 | 55 400 |
| Nord | 0 005 | 94 0 | 0 12 | 1 2 | 1 07 | 10 7 | 6 4 | 22 0 | 100 0 | 100 | 11.0 | 11 00 | 1 20 | 0 064 | 0 704 |
| Chlorocal | 0 25 | 75 0 | 0 47 | 4 7 | 0 9 | 9 0 | 52 2 | 11 0 | 50-100 | 100 | 5-8 | 7 10 | 6 30 | 15 700 | 111 500 |
| Chlorocal | 0 25 | 63 5 | 0 25 | 2 5 | 1 6 | 16 0 | 15 6 | 19 5 | 50-100 | 100 | 3-4 | 5 00 | 3 94 | 9 800 | 49 000 |
| Quad | 1 7 | 107 0 | 1 63 | 16 3 | 1 25 | 12 5 | 130 4 | 15 2 | 100 | 100 | 1-2 | 1 40 | 15 20 | 259 000 | 367 600 |
| Flash | 1 7 | 83 0 | 1 45 | 14 5 | 1 45 | 14 5 | 100 0 | 17 7 | 100 | 100 | 1-2 | 1 50 | 17 50 | 297 000 | 441 500 |



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On the other hand, Zinc phosphide with higher cumulative doses equal to 362.6 and 445.5 mg/kg body weight from Raad and Flash, caused 100% mortality at the shortest period of 1.4-1.5 days, respectively. Chlorocal (0.25% chlorophacinone) baited on whole wheat grains or whole sorghum grains accumulated relatively high doses equal to 111.5 and 49.0 mg/kg body weight which were required to obtain 100% mortality at 7.1 and 5.0 days respectively. Quintox (0.075% cholecalciferol) with 55.4 mg/kg cumulative dose caused 100.0% mortality during 6.2 days. However, the other anticoagulant tested baits caused 100% death at lower accumulated doses during different periods. Coumatetralyl (at 0.037/ and 0.005%) in case of Racumin caused 100% mortality with accumulation of 9.9 and 3.95 mg/kg body weight at 6.2 and 5.2 days, respectively. Diphacinone with 0.002% formulated with crushed maize or whole sorghum grains (Ratkiller a or b) and 0.005% with crushed maize (Mard) also caused 100% mortality with 1.02 or 0.56 and 0.704 mg/kg body weight accumulated within 6.0, 9.3 and 11.0 days respectively. Chlorophacinone (0.005%) formulated on crushed maize or whole sorghum grains accumulated active ingredient equal to 2.92 and 1.17 mg/kg body weight which caused 100% mortality during 5.3 and 7.75 days respectively.

It could be concluded that, the effects of anticoagulant derivatives (coumatetralyl , diphacinone and chlorophacinone) to reduce the rodent population were found different, depending on the used concentrations; the type of the formulated baits in addition to the derivative of anticoagulant compounds. The mode of action of Quintox (cholecalciferol) is

completely different from that of anticoagulant, it highly reduces the rodent infestation. So, it is very efficient, if it will alternatively use with anticoagulant in rodent control programe.

## REFERENCES


1- Desheesh, M.A.; M. A. Abdel latif and H. M. Youssef ( 1991) Comparative field studies of rodent control. J. Pest Control & Environ. Sci. 3 (1): 77-88.

2- Rennison, B. D. and A. C. Dubock (1978). Field trials of brodifacoum against warfarin-resistant infestations of Rattus norvegicus J.Hyg. Camb., 80:77-82.

3- Rowe, F.P., T. Swinney and C. Plant (1978). Field trials of brodifacoum against the house mouse (Mus musculus). J. Hyg. Camb., 80: 315-318.

4- Hadler, M.R. (1975). Laboratory evaluation of difenacoum as a rodenticide. J. Hyg. Camb. 74: 441-449.

5- Wang, P.O. (1981). Effectiveness of new anticoagulant rodenticides brodifacoum for control of wild rats in sugar cane fields.Rep.Tawron Sugar RGS. Inst.,94: 33-40.(c.f.B.A., 74 (12): 82229, 1982).

6- Gill, J.E. and R. Redfern (1979). Laboratory tests of seven rodenticides for the control of Mastomys natalensis. J. Hyg. Camb., 83: 345-352.

7- Rowe, F.P., F.J. Smith and T.Swinney (1974) Field trials of calciferol combined with warfarin against house-mice (Mus musculus L.).J. Hyg..Camb.:73: 353-360.

8- Rennison, B.D. (1977). Methods of testing rodenticides in the fields against rats. Pestic. Sci., 8: 405-413.

9- Desheesh, M.A.(1981) Rodent problems in Egypt: Field and laboratory evaluation of five anticoagulant rodenticides. Proc. 4th Pestic. Conf. Tanta Univ., September , vol.III: 65-75.

10- Kaukeinen, D.E. (1979). Field methods for census taking of commensal rodents in rodenticides evaluations. Vert. P. Cont. and Manay. Mate., 86-83.

11- Brooks, J. E.; P.T. Hutn; H. Naing; D.W. Walton and M.M. Tun (1979). Laboratory evaluations of rodenticides for use against south-cost asian commensal small mammals. WHO, VBC/79-720 (1-15).

12- Desheesh, M.A. and E.A. Kadous (1985). Comparative studies of different formulated baits for brodifacoum, difenacoum and coumatetralyl against albino rats (Rattus norvegicus)-Med.Fac. Landbouww, Rijksuniv, Gent, Belgium; 50/3a.

13- European and Mediterranean Plant Protection Organization (1975). Guide- lines for the development and biological evaluation of rodenticides. E.P.PO. Bulletin, 5(1): 49.

14- Mukatha, K.B; Krishanumari and S.K. Mojumder (1978). Toxicity of calciferol, worfarin and their combinations to Rattus norvegicus and Rattus rattus. Pestic Sci., 9: 44-50.

15- WelLcome Environmental Health (1991). Ouintox: The natural choice for rodent control. The wellcome foundation Ltd., Berk. Herts. HP4 - 2Dy, England.

الملخص العربي

# التقييم الحقلي والمعملي لطعوم مختلفة من مبيدات القوارض

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تم تقييم اثنى عشر من تجهيزات طعوم مبيدات القوارض المختلفة فى الحقل ضد الاصابة الحقلية بالفئران بالاضافة الى اختبار التغذية بالاختيار الحر باستخدام الفئران النرويجية البيضاء معمليا. اظهرت النتائج انه عند استخدام موانع التجلط ، دايفاسينون (٠٠٣ ر ٠ ٪ و ٠٠٥ ر ٠ ٪ ) و كلوروفاسينون (٠٠٥ ر ٠٪ و ٢٥ ر ٠ ٪ ) فى صورة ذرة مجروشة او حبوب السرجم والقمح الكاملة كانت لها فاعلية عالية فى خفض اعداد الفئران فى الحقل بينما كان صيمتاتترا ليل ( ٠٣٧ ر ٠ ٪ و ٠٠٥ ر ٠ ٪ ) فى صورة ذرة مجروش او حبوب القمح الكاملة اقل فاعلية . من ناحية اخرى اضهر الفوليبكالسيفيرول ( ٠٧٥ ر ٠٪ ) فى صورة حبيبات فاعلية عالية فى خفض اعداد الفئران بالاضافة الى ان فوسفيد الزنك ( ٧ر١ ٪) فى صورة ذرة مجروش او حبوب السرجم الكاملة اعطى ايضا انخفاض جيد فى اعداد الفئران فى الحقل . جميع مبيدات القوارض المختبرة وجد لها تاثير على الفئران النرويجية البيضاء وعلى الجرعات المختلفة المختبرة فى المعمل .