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RODENTICIDE EFFICACY AGAINST RODENT POPULATIONS IN GROUNDNUT FIELDS DISTRICT UPPER DIR PAKISTAN

By

[*1]Fawad Khan, [2] Farhanda Manzoor,[3] Kehkashan ,[4]Akhtar Badshah Khan, [3]Inam Ullah, [3]Sumbal Bibi

[1*]Medical Entomologist, Health Department, Khyber Pakhtunkhwa, Pakistan

[2]Menhaj university Lahore

[3-]Entomology department Abdul Wali Khan University Mardan Khyber-Pakhtunkhwa

[4]Zoology department University of malakand Chackdara Dir lower

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Abstract

This study evaluated the efficacy of four different rodenticide treatments—Aluminum. Phosphide (fumigant), Racumin 0.75% grain bait, Zinc Phosphide 2% cake bait, and Zinc Phosphide 2% grain bait—in controlling rodent burrow activity in groundnut fields. The results demonstrated that Aluminum Phosphide was the most effective, showing rapid and significant reductions in active burrows, achieving a 94.80% reduction by Day 4. Racumin showed a more gradual effect, with a 72% reduction by Day 4, while Zinc Phosphide 2% cake and grain baits exhibited slower, less effective results, reaching reductions of 62% and 60%, respectively. The study highlights the advantages of Aluminum Phosphide for rapid eradication in large-scale infestations, while Racumin is suitable for long-term rodent management with less immediate risk to non-target species. Zinc Phosphide baits, although effective, require multiple applications and are best suited for areas with lower rodent populations. Based on these findings, it is recommended that farmers use Aluminum Phosphide for quick rodent control in ground nut fields, while considering the efficacy variation based on location and crop type.

Keywords: *Rodent, Groundnut Upper Dir*

INTRODUCTION

Groundnut (Arachis hypogaea L.) is one of the most important summer oils in the world. Groundnut seeds contain high oil (45%), 26-28 % protein, 20% carbohydrates and 5 % fiber. The seeds have high nutritive value for human consumption and for animal feed, as well as the green leaf is also used as hay for livestock (Abdalla et al. 2009). The cultivated area of groundnut in Egypt during the 2013-2014 seasons was about 56,866 hectares. Recently groundnut in Egypt has been given great attention due to its suitability for growing in the newly reclaimed sandy areas (FAO, 2014). Groundnut is called the king of oilseeds due to the 43-55% oil content in its seeds (Shad et al., 2009, Naeem-Ud-Din et al. 2009). The pods are formed beneath the soil, so this crop is called 'groundnut'. Its oil is good for edible oil production as it contains 22 % linoleic acid and 61 % oleic acid (PARC). It is grown in a large area of the world as an oilseed crop. Its cultivation is preferred in rain-fed areas in the world as well as in Pakistan. Resistance to water stress has been reported in groundnut but the prolonged drought has worse effects on the pods and seeds (Stansell et al., 1976; Rao et al., 1989). Groundnut (Arachishypogaea L.), also known as peanut, is an important food and cash crop across West Africa. The crop is cultivated mainly by small households and resource-poor farmers. Cultivated groundnut (Arachishypogaea L.) belongs to the genus Arachis in the subtribe Stylosanthinae of the tribe Aeschynomenea of the family. Leguminosae (Ntareet al. (2008)). It is a legume that ranks 4th among the oilseed crops and 13th among the food crops of the world. It provides high-quality edible oil (48–50%), easily digestible protein (26–28%), and about half of the 13 essential vitamins and more than a third of the 20 essential minerals necessary for human growth and maintenance. In addition, it produces high-quality fodder for livestock. (Taru et al. 2008; Multipurpose Groundnut Feb 2009). Among the oilseeds, the groundnut crop is important for its oil production (Naeem-UdDin et al. 2009). Ground nuts are among traditional oilseed crops. Groundnut is grown as an oilseed crop in Pakistan, but its production is very low to meet the requirements of edible oil production (Liaqat Ali Shahid et al. 2010). Ahmad 1990 stated that ground nuts were first cultivated commercially on an area of 400 hectares in 1949. In Pakistan, groundnut was not being grown as an oilseed crop earlier, but now major

*Corresponding Author: **Fawad Khan** .

concerns are being shown to the use of groundnut crops for edible oil rather than using only as a nut crop. (Ahmad et al.1990). The physical properties of Bambara ground nut and other grains and seeds are necessary for the design of equipment to handle, transport, process, and store the crop. The physical properties of Bambara groundnut have been evaluated as a function of grain moisture content varying from 5% to 35% (wb). In this moisture range, grain length, width, thickness, and geometric diameter increased from 10.5 to 14.65 mm, 9.48 to 11.65 mm, 8.50 to 10.90 mm and 9.65 to 12.55 mm respectively; the grain surface area and volume increased from 304 to 495 mm^2 and from 425 to 900 mm^3, respectively; the sphericity decreased from 0.90 to 0.87; the 1000-seed mass increased from 500.2 to 800.6 g; true and bulk densities decreased from 1.285 to 1.160 g/cm^3 and from 0.795 to 0.696 g/cm^3, respectively; the porosity and angle of repose increased with increase in moisture content up to 43.8% and 23.5°, respectively, at 20% moisture content; the sphericity decreased from 0.895 at 5% moisture content to 0.820 at 35% moisture content. The coefficient of static friction increased from 0.39 to 0.66, 0.29 to 0.58, and 0.25 to 0.49 for plywood, galvanized iron, and aluminum, respectively (Baryeh E. D., 2010). There are many rodenticides available for rodent management in a market, but few provide immediate control on a large scale while also offering a high level of safety to non-target predators and scavengers in the food chain. These are minimum requirements for the control of rodents in broad-acre crops and in certain other agricultural situations. It is environmentally safe. Zinc phosphide is not readily absorbed directly into plants via the root system or direct exposure to foliage. Zinc phosphide residues do not accumulate in soil (Staples et al., 2003). Racumin Anticoagulant is the most important rodenticide worldwide. Racumin has been known since 1957 as a multiple-dose anticoagulant and has been used successfully over many decades (Pospischil & Schnorbach, 1994). It can't produce bait shyness in rodents and through accidentally eating recovery is also through Vitamin K dose. Aluminum phosphide is used in Morocco as a fumigant to control rodents and stored grain pests. The trade name is Phostaxin. It comes in dark grey tablets of 3 grams each Consisting Of. Aluminum phosphide 56% and Aluminium carbamate 44%. Aluminum phosphide is highly toxic, low cost, and easily accessible (Hajouji et al. 2006).

MATERIALS AND METHODS

The experiment was conducted in the Upper Dir region of Khyber Pakhtunkhwa (KP), Pakistan, over four weeks during the 2024 groundnut growing season, to evaluate the efficacy of different rodenticides in controlling the rodent infestations that negatively affect groundnut yields. The study area, spanning 13 acres, was divided into four sections: 6 acres treated with Aluminum Phosphide fumigation, 3 acres with Racumin grain bait, and 2 acres each with Zinc Phosphide cake and grain baits. The region's moderate to high temperatures, ranging from 15°C at night to 35°C during the day, and its loamy, flat soil, were favorable conditions for rodent activity. Four rodenticides were prepared using established formulations: Zinc Phosphide 2% cake bait, Zinc Phosphide 2% grain bait, and Racumin 0.75% grain bait, all prepared with precise ingredient proportions and careful handling to ensure safety and effectiveness. Zinc Phosphide cake bait was made using broken rice, wheat flour, ground maize, ground millet, edible oil, and Zinc Phosphide, while the grain baits followed similar preparation protocols with different ingredient ratios. Racumin bait, consisting of broken rice, ground maize, millet, edible oil, and Racumin, was also prepared following specific safety precautions. All rodenticides were applied in a manner that minimizes exposure to non-target species, and burrows were monitored for activity reduction after the treatments. The application methods varied: Aluminum Phosphide fumigation involved placing tablets inside 89 active burrows, which, upon exposure to moisture, released lethal phosphine gas; Racumin grain bait was broadcast evenly across 3 acres with 45 burrows specifically targeted; Zinc Phosphide cake bait was placed inside burrows and along rodent pathways on 2 acres; and Zinc Phosphide grain bait was scattered and replenished daily across another 2-acre section. Data collection included daily monitoring of burrow activity, with burrow activity rated based on visible signs such as droppings and tracks, and activity reduction was calculated. Statistical analysis using ANOVA and Tukey's test helped determine the significance of rodenticide effectiveness, with a p-value threshold set at 0.05. The results were carefully recorded, and GPS coordinates were used to geo-tag each treatment area for accurate data tracking. This study provided valuable insights into the comparative effectiveness of these rodenticides and will help inform future pest management strategies.

Table: Rodenticides Efficacy in Reducing Rodent-Burrows Upper Dir

Treatment Type	Pre-Treatment Active Burrows (No.)	Day 1 - % Reduction	Day 2 - % Reduction	Day 3 - % Reduction	Day 4 - % Reduction

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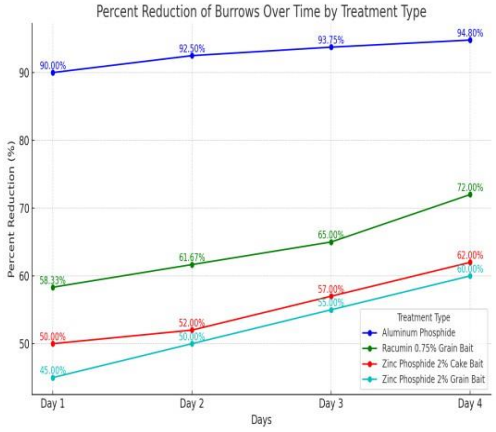
Aluminum Phosphide (Fumigant)	120	90.00 % (108 burrows)	92.50 % (111 burrows)	93.75 % (112 burrows)	**94.80 % (113 burrows)**
Racumin 0.75% Grain Bait	60	58.33 % (35 burrows)	61.67 % (37 burrows)	65.00 % (39 burrows)	**72.00 % (42 burrows)**
Zinc Phosphide 2% Cake Bait	35	50.00 % (17 burrows)	52.00 % (18 burrows)	57.00 % (20 burrows)	**62.00 % (22 burrows)**
Zinc Phosphide 2% Grain Bait	**25**	**45.00 % (14 burrows)**	**50.00 % (15 burrows)**	**55.00 % (16 burrows)**	**60.00 % (17 burrows)**



Results:

In an advanced evaluation of rodenticide efficacy within groundnut fields, four distinct treatments were administered over 4 days to assess their impact on rodent burrow reduction. The first treatment, **Aluminum Phosphide (Fumigant)**, applied to 6 acres with an initial count of 120 active burrows, exhibited superior performance, with a remarkable reduction starting at 90.00% on Day 1 (leaving 108 burrows), which gradually increased to 94.80% by Day 4 (113 burrows), demonstrating near-total eradication of rodent activity. In comparison, **Racumin 0.75% Grain Bait**, used on 3 acres with 60 initial burrows, showed a more gradual reduction, beginning at 58.33% (35 burrows) on Day 1 and increasing progressively to 72.00% (42 burrows) by Day 4. This indicates a less aggressive but steadily improving control of the rodent population. Similarly, **Zinc Phosphide 2% Cake Bait**, applied to 2 acres with 35 initial burrows, demonstrated consistent effectiveness, reducing burrows by 50.00% (17 burrows) on Day 1, and steadily progressing to a 62.00% reduction by Day 4 (22 burrows). Lastly, **Zinc Phosphide 2% Grain Bait**, tested on 2 acres with an initial 25 burrows, exhibited the lowest efficacy, starting with a 45.00% reduction (14 burrows) on Day 1 and reaching 60.00% by Day 4 (17 burrows). The comparative data indicate that while all treatments resulted in varying degrees of rodent burrow reduction, Aluminum Phosphide (Fumigant) was the most efficient, achieving the highest level of control, whereas Zinc Phosphide treatments, while effective, demonstrated a more gradual and less robust impact on rodent populations.

DISCUSSION

Among all the four treatments, Aluminium Phosphide (Fumigant) showed much better results than acute poisons and chronic poison. Each of the four days of treatments, Aluminium Phosphide showed better results than each day of other poisons. However, Racumin came second in the list showing weaker results in the first two days while promising results in the next two days. Similarly, the Zinc Phosphides (Cake and Grain) came third and fourth respectively. The cake and grain both showed weaker results on Day 1 and Day 2 and much improved results on Day 4. Singla and Babbar (2015) showed a higher reduction in rodent activity with two rodenticide treatments using 2% zinc phosphide and 0.005% bromadiolone baits and a 79.98-92.18% reduction was observed in rodent activity which supports the results of our study as a minimum 61% and maximum 77% using zinc phosphide 2% as grain bait. Similarly, the results of Khan et al. (2012) follow our findings who reported a 62.7% reduction in the burrow activities using zinc phosphide (2% wax cake and broken rice) as bait control of rodents in groundnut crops. The observations made by Yangxin et al. (2005) are parallel to our finding which evaluated the efficacy of 56% aluminum phosphide tablet against Meriones unguiculatus and provided

*Corresponding Author: **Fawad Khan** .

scientific evidence for controlling rodents. The rate of eliminating mouse holes was 94.93% in the rainy season and 94.00% in the dry season. The total average rate of eliminating mouse holes was 94.37%. So, the 56% aluminum phosphide tablet had a good effect on killing rodents in fields.

CONCLUSIONS AND RECOMMENDATIONS

The current study it is concluded that among all the treatments, Aluminum Phosphide showed significantly better results followed by Racumin and zinc Phosphide cake, and the least control of rodents was found in Zinc Phosphide grain bait. It is therefore recommended from the current study that Aluminum Phosphide should be used by farmers in ground nuts. However, the efficacy of Aluminum Phosphide may vary from location to location and crop to crop.

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*Corresponding Author: **Fawad Khan** .