

## RODENT DAMAGE AND CONTROL IN WHEAT GROWING STAGES, SOHAG GOVERNORATE, EGYPT

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### Abstract

Rodent survey and damage of wheat tillers were done, at different growing stages, in three locations within Sohag Governorate, Egypt. The Norway rat, *Rattus norvegicus*, was the common species with 434 individuals, followed by *Rattus rattus*, with showing 348 individuals, while the *Arvicunthus niloticus* was 138 individuals. Maximum damage was recorded at wheat maturity stage. Three formulations of zinc phosphide 0.5% (A- zinc phosphide, B- zinc phosphide mixed with peanut butter and C- zinc phosphide mixed with egg) were applied simultaneously to three growth stages of wheat crop in order to break bait shyness to zinc phosphide and use it several times. The three formulas (A, B and C) caused average rodent population reduction of 73.6 %, 76.36 % and 86.21 %, respectively. Results concluded that zinc phosphide mixed with egg has more potential in enhancing bait acceptance, followed by zinc phosphide mixed with peanut butter. Both baits could be included in rodent control programs.

**Key words:** damage assessment, rodent control, Zinc Phosphide, wheat, bait acceptance, Sohag Governorate.

### INTRODUCTION

Rodents can cause serious damage to cereal crops of all kinds including wheat Sarwar (2015). Crop protection has been developed to prevent and control losses due to pests in the field (Oerke, 2005). Rodents can adjust to the cropping stages, from the initial period of the crop, capable of rapid population growth and emigration after crop harvest depending upon food availability (Sarwar *et al.*, 2011). Several rodent species were involved in damaging wheat. Many researchers in Upper Egypt (Beni-Suif, El Minia, Assiut, Sohag and Qena Governorates) found that the dominant rate species were, *R. norvegicus*, *R. rattus*, *A. cahirinus*, *A. niloticus*, *M. musculus*, *Geribilus spp.* and *Juculus spp.* The dominant species and rodent density are related to habitat preferences, crop type, abundance of shelter and other food available and the season (Hussein 1991); El Deeb and Lokma 1992); Emborak 1997); Abazaid 1990); Ahmed 2007 and Salit *et al.*, 1982). Many studies have been applied to overcome the problem of bait shyness, by using low concentration of zinc phosphide and enhance zinc phosphide baits with attractive additives (Gabr and Rizk 2010); Abdel-Azeem 2008) and Rizk *et.al.*, 2017). They decreased zinc phosphide concentration up to 0.25% and 0.125%, with the addition of different additives; to enhance bait intake and increase

mortality. Also, Pervez *et.al.*, (2005) studied bait formulations of egg mixed zinc phosphide (2%) tested against fields rats in wheat crop to evaluate the effectiveness at three growth stages of wheat i.e. tiller stage, grain hardening stage and mature grain stage. The present study aimed to record the damage by rodent to different wheat crop growth stages and using low concentration of three formulations of zinc phosphide bait, used simultaneously on different wheat stages, to reduce rodent populations in wheat fields at three location (El-maragha – Tahta – Gerga),Sohag Governorate.

## **MATERIALS AND METHODS**

### **Study area:**

The studies were conducted at the selected experimental area under wheat cultivation in three locations (El-maragha – Tahta – Gerga) at Sohag Governorate, Egypt (26°46'13"N, 31°30'10"E). In this work two Feddans were chosen, in each location, from September 2015 – to April 2016 at al-betakh village (El- Maragha), al-swalem village (Tahta) and al-khallafia village (Gerga), to estimate the damage of rodent in different growth stages at wheat crop.

### **Rodent's Damage to Wheat Fields:**

Pest damage studies were done during seedling, tillering, booting, dough, maturation and pre-harvesting growth stages. The data was recorded fortnightly from the wheat fields. To record the data in each replication within wheat fields, 10 spots were examined for rodent's damage. A wooden frame was used to delineate the quadrat into 1 × 1 m area. Then the percentage yield loss was computed as follows:

$$(\%) \text{ yield loss} = \frac{\text{Number of tillers cut}}{\text{Total number of tillers}} \times 100$$

### **Survey and population density of rodent species:**

To identify the pest species and their numbers, ten faddan of randomly selected wheat fields of the experimental area were used to trap rodents from e seedling to maturity stages from September 2015 to April 2017 at two successive seasons wheat crop. Fifty wire box traps, with spring door, were placed 10 meters apart for five successive nights. The traps in each location were baited with fresh falafel (minced horse bean fried in oil) and tomato slice. In all cases, the traps were baited daily and left from 6.0 P.M. to 7.0 A.M. every morning, traps were checked to collect the caught rats. The trapped rodents were identified according to Osborn and Helmy (1980). Number of the individuals of each rodent species was recorded for each tested location.

**Tested poison bait preparation:**

Zinc phosphide acute poison (94% active ingredient), obtained from Kafr El-Zayate for Pesticides & Chemicals, Egypt.

Prepared poison bait (each 100 gram) contain the following:

- A.** 65(g) broken wheat + 25 (g) ground wheat + 5 (g) sugars + 5 (g) corn oil + 0.5 (g) zinc phosphide.
- B.** 65(g) broken wheat + 25 (g) ground wheat + 5 (g) sugars + 5 (g) peanut butter + 0.5 (g) zinc phosphide.
- C.** 65(g) broken wheat + 25 (g) ground wheat + 5 (g) sugars + 5 (g) egg + 0.5 (g) zinc phosphide.

**Control bait:** 65(g) broken wheat + 25 (g) ground wheat + 5 (g) sugars + 5 (g) corn oil

**Rodent control:**

The 3 zinc phosphide formulation were tested simultaneously with three wheat crop growth stages: 1- tiller stage (7-8 weeks after sowing, WAS), 2- flower / grains hardening stage (10 WAS) and 3- maturity stage (12 WAS). Each experimental area comprising of eight faddan was divided into four blocks (three treatments and one control) using a randomized block design. In each block 50 bait stations (points) were installed at equal distance from each other with 100g bait/ station. At each bait station, bait was offered for 5 days and was replenished daily. The treatment blocks were comprised of zinc phosphide (0.5%), zinc phosphide (0.5%) mixed with peanut butter (0.5%) and zinc phosphide (0.5%) mixed with egg (0.5%). The consumed amount of each tested bait was determined. One day after the poison bait was removed, the population reduction of rodents was calculated using the following equation:

$$\text{Population reduction\%} = \frac{\text{Pre treatment consumption} - \text{Post treatment consumption}}{\text{Pre treatment consumption}} \times 100$$

**Statistical Analysis:**

The obtained results were statistically analyzed using COSTAT computer programs (2005).

**RESULTS AND DISCUSSION****1- Survey and rodent species composition in wheat crop fields:**

Survey of different rodent species, and number of each, were measured in the 3 locations (El-Maragha – Tahta – Gerga), during wheat growing stages, from September 2015 to 2017. Surveying rodent species in these locations showed that,

three species were found: the Nile grass rat, *Arvicanthis niloticus*; the Roof rat, *Rattus rattus* and the Norway rat, *Rattus norvegicus* recorded. All recorded species belonged to sub-order: Myomorpha, Family: Muridae. Rodents were identified according to **Osbron and Helmy (1980)**.

Data in Table (1) and Fig. (1) show average total number of three rodent species at two wheat crop seasons cleared that *R. norvegicus* is the dominant rat in the 3 locations (El-Maragha – Tahta – Gerga) with 156, 137 and 141 individuals, respectively, with total of 434 individuals (47.17%). Followed by *R. rattus* 127, 114 and 107 individuals in the 3 locations, respectively, with total of 348 individuals (37.83%) while *A. niloticus* was lowest 53, 46 and 39 individuals in the 3 locations, respectively, with total 138 individuals (15%). The total number of rats in El-Maragha location was 336 individuals with 36.52 percentage while in Tahta and Gerga locations were 297 and 287 individuals with 32.28% and 31.20%, respectively.

Table 1. Numbers of Rats and species composition in wheat crop fields at three locations.

Species \ Location	El-Maragha	Tahta	Gerga	Total	% of rats
<b><i>R. norvegicus</i></b>	156	137	141	434	47.17
<b><i>R. rattus</i></b>	127	114	107	348	37.83
<b><i>A. niloticus</i></b>	53	46	39	138	15
<b>Total</b>	336	297	287	920	
<b>% of rats</b>	36.52	32.28	31.20		

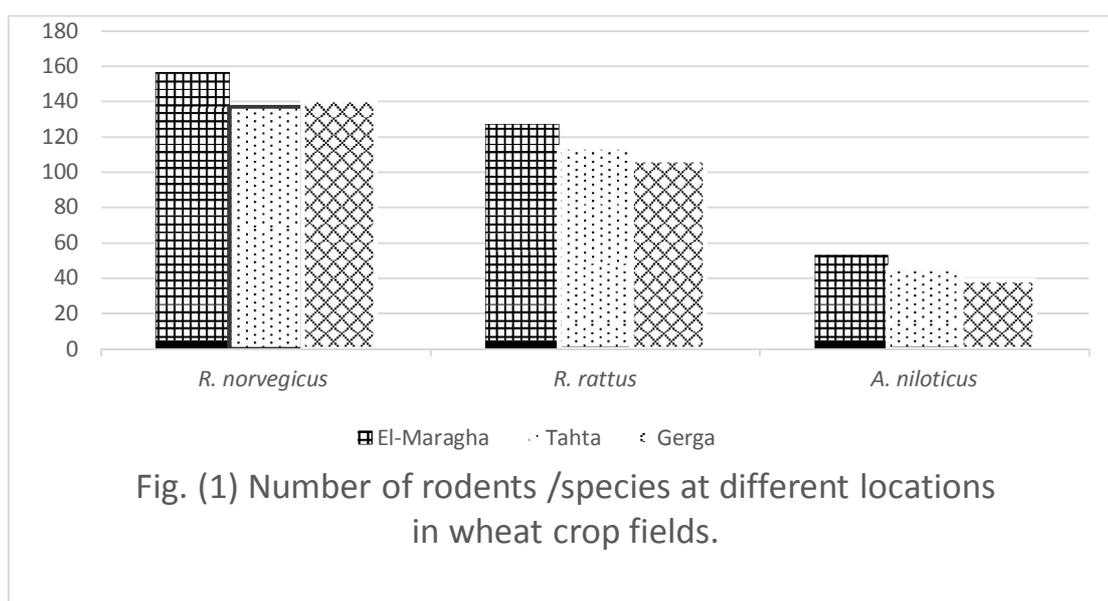


Fig. (1) Number of rodents /species at different locations in wheat crop fields.

## 2-Assessment of damage in wheat stages:

Table (2) showed trends of different levels of stem cutting at various growth stages occurred in wheat fields. There was less chance for Rodent to damage wheat in earlier stages, while damage increased in mature stage. At seedling stage the damage wasn't clear in fields because damaged is difficult to be observed. An analysis of the differences between damage levels at different locations showed minor differences during tillering, flowering and booting growth stages as the following.

Tillering stage:

The average ( $\pm$ S.E.) wheat tiller stage damage by rodents (per m<sup>2</sup>), at el-Maragha, Tahta and Gerga locations, were:  $3.50 \pm 2.92$ ,  $2.11 \pm 2.07\%$  and  $1.32 \pm 2.03$ , with percentage of yield loss of 0.39%, 0.23% and 0.15%, respectively, at Least Significant Difference (L.S.D. 0.05) of 0.36.

Flowering stage:

The average ( $\pm$ S.E.) wheat flower stage damage by rodents (per m<sup>2</sup>), at el-Maragha, Tahta and Gerga locations, were:  $5.85 \pm 3.50$ ,  $4.80 \pm 2.22$  and  $2.88 \pm 2.09$ , with percentage of yield loss 0.65%, 0.53% and 0.32% respectively, at Least Significant Difference (L.S.D. 0.05) 0.65.

Milk stage:

The average ( $\pm$ S.E.) wheat milk stage damage by rodents (per m<sup>2</sup>), at el-Maragha, Tahta and Gerga locations, were:  $12.00 \pm 4.14$ ,  $14.00 \pm 4.95$  and  $7.45 \pm 2.94$ , with percentage of yield loss 1.33%, 1.56% and 0.83% respectively, at Least Significant Difference (L.S.D. 0.05) 3.23.

dough stage:

At this stage the damage was duplicated at three locations the average ( $\pm$ S.E.) wheat dough stage damage by rodents (per m<sup>2</sup>), at el-Maragha, Tahta and Gerga locations, were:  $29.20 \pm 5.65$ ,  $23.70 \pm 4.70$  and  $19.00 \pm 4.47$ , with percentage of yield loss 3.24%, 2.63% and 2.11% respectively, at Least Significant Difference (L.S.D. 0.05) 6.36.

### Mature stage:

The highest Rodent damage at wheat crop recorded in this period the average ( $\pm$ S.E.) wheat mature stage damage by rodents (per m<sup>2</sup>), at el-Maragha, Tahta and Gerga locations, were:  $42.30 \pm 5.36$ ,  $37.85 \pm 4.41$  and  $32.4 \pm 4.21$ , with percentage of yield loss of 4.70%, 4.21% and 3.60% respectively, at Least Significant Difference (L.S.D. 0.05) of 5.06.

Mainly the percentage of yield loss in three locations was 10.32, 9.16 and 7.01 respectively.

Table 2. Assessment of rodent damage in different crop stages of wheat at 3 different locations

Location Crop stage	El-Maragha		Tahta		Gerga		L.S.D. 0.05
	No. of cut tillers/m <sup>2</sup> Mean ± S.E.	% yield loss	No. of cut tillers/m <sup>2</sup> Mean ± S.E.	% yield loss	No. of cut tillers/m <sup>2</sup> Mean ± S.E.	% yield loss	
Seedling	-	-	-	-	-	-	
Tillering	3.50 <sup>a</sup> ± 2.92	0.39	2.11 <sup>b</sup> ± 2.07	0.23	1.32 <sup>c</sup> ± 2.03	0.15	0.36
Flowering	5.85 <sup>a</sup> ± 3.50	0.65	4.80 <sup>b</sup> ± 2.22	0.53	2.88 <sup>c</sup> ± 2.09	0.32	0.65
Milk stage	12.00 <sup>a</sup> ± 4.14	1.33	14.00 <sup>a</sup> ± 4.95	1.56	7.45 <sup>b</sup> ± 2.94	0.83	3.23
dough stage	29.20 <sup>a</sup> ± 5.65	3.24	23.70 <sup>b</sup> ± 4.70	2.63	19.00 <sup>c</sup> ± 4.47	2.11	6.36
Mature stage	42.30 <sup>a</sup> ± 5.36	4.70	37.85 <sup>b</sup> ± 4.41	4.21	32.4 <sup>c</sup> ± 4.21	3.60	5.06
Total		10.32		9.16		7.01	

### 3-Efficiency of the 3 zinc phosphide formulations on rodent control:

#### 3-1-poison bait consumption:

Bait shyness consider major problem in zinc phosphide control because individual can avoid zinc phosphide baits after using bait once for a long period. So that we decrease the concentration of zinc phosphide in formula (A) to 0.5% in order to overcome bait shyness. In formula (B) we mixed zinc phosphide (0.5%) bait with peanut butter to increase acceptance. For formula (C) we added eggs, instead of peanut butter, to zinc phosphide (0.5%) and use the 3 formulas to control rodents in wheat fields. The obtained data are illustrated in tables (3 and 4). Mean daily consumption of each bait formulation was evaluated at three growth stages of wheat crop (Table 3). Mean bait intake of zinc phosphide (A) was measured  $5.95 \pm 1.31$  g/station/day. Bait intake at tillering stage of crop was  $8.43 \pm 0.50$  g, which almost decreased to half at flowering stage ( $4.00 \pm 0.29$ ) and at Mature stage to  $5.43 \pm 0.58$ . For Zinc phosphide mixed with peanut butter bait (B), intake at tillering stage of the crop was recorded  $28.33 \pm 2.03$  which decreased to  $10.67 \pm 0.88$  at flowering stage but the value increased to  $13.33 \pm 0.88$  at maturity stage. In case of bait Zinc phosphide mixed with egg (C) the intake remained higher at tillering stage  $31.67 \pm 1.86$  but bait intake was observed at flowering and maturity stage of the crop  $15.67 \pm 1.45$  and  $17.00 \pm 0.29$  g/bait station/day, respectively.

#### 3-2-population reduction:

The rodent population reductions, using different poison formulas in various growth stages of wheat crop, are shown in Table (4). Tracking consumption to assess rodent population reduction after baiting with the 3 formulations monitored by measuring pre-treatment and post-treatment intakes. The result of the field trials at

tiller, flower and mature stages of wheat crop showed mean population reduction of 73.60, 76.36 and 86.21 with the 3 zinc phosphide formulas A, B and C, respectively.

Table 3. Poison baits consumption at various growth stages in wheat crop

Treatment	Mean bait consumption (gm $\pm$ S.E.) / station / day			
	Tiller stage (7-8 WAS)	Flower stage (10 WAS)	Mature stage (12 WAS)	Average
Zinc phosphide	8.43 $\pm$ 0.50	4.00 $\pm$ 0.29	5.43 $\pm$ 0.58	5.95 $\pm$ 1.31
Zinc phosphide mixed with peanut butter	28.33 $\pm$ 2.03	10.67 $\pm$ 0.88	13.33 $\pm$ 0.88	17.44 $\pm$ 5.50
Zinc phosphide mixed with egg	31.67 $\pm$ 1.86	15.67 $\pm$ 1.45	17.00 $\pm$ 0.29	21.45 $\pm$ 7.23
Control	32.34 $\pm$ 3.45	37.62 $\pm$ 5.31	45.43 $\pm$ 6.58	38.46 $\pm$ 5.11

Table 4. Rodent population reduction by different poison baits in wheat crop at various growth stages

Treatment	Growth Stages	Treatment		population reduction%
		Pre	Post	
Zinc phosphide	Tillering	1115	274	75.43
	Flowering	578	156	73.01
	Maturity	394	121	69.29
	<b>Total</b>	<b>2087</b>	<b>551</b>	<b>73.60</b>
Zinc phosphide mixed with peanut butter	Tillering	978	265	72.9
	Flowering	765	145	81.05
	Maturity	465	112	75.91
	<b>Total</b>	<b>2208</b>	<b>522</b>	<b>76.36</b>
Zinc phosphide mixed with egg	Tillering	1023	125	87.78
	Flowering	345	56	83.77
	Maturity	431	67	84.45
	<b>Total</b>	<b>1799</b>	<b>248</b>	<b>86.21</b>

Surveys of rodent species in the study areas were conducted to record rodent species composition. *Rattus norvegicus*, was the dominant species. On the other hand, this may be due to the interspecific competition between this species and other species may be achieved. These results are agreed with Abd- El-Kawi (2005) who

found that Norway rat was the highest number in Assiut governorate. Ahmed (2007) surveyed of rodent species in three habitats at Menofia government, and the dominant species was Norway rat and roof rat.

Sarwar *et al.*, (2011) reporter that, the rat damage to field crops depends upon the cultivated crops, growth stage, the distance of the attacked plant from the border of the field and the rat density. Ahmed (2017) determined the damage due to rodents in some field crops i.e. wheat, corn and tomato as winter crops and, bean as summer crops during the mature stage of these crops. These results agree with El-Deeb *et al.* (2008) who recorded that the damage in some field crops i.e. maize, rice as summer crops and wheat, broad bean as winter crops due to rodent. The damage percentage was high in maize, rice as summer crops and wheat and broad bean as winter crops due to density of rats (Ahmed 2007).

The efficacy of the tested compounds differed from one to another according to the type of compound, its chemical structure and mixing additives. Reviewing the obtained results cleared that using zinc phosphide bait with low concentration break the bait shyness and can be used for several times in short periods, while the additives to zinc phosphide, like peanut butter and egg, increased rodent population reduction in different wheat stages. This data agrees with Leung *et al.* (2007); Rizk *et al.* (2017); Pervez *et al.* (2005); Sarwar (2015) and Oerke (2005)

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## الاضرار التي تسببها القوارض وطرق مكافحتها بمراحل النمو المختلفة لمحصول القمح بمحافظة سوهاج بمصر

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معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الدقي - حيزة - مصر.

تدمر القوارض من 7.01 الى 10.32 % بالمراحل المختلفة لنمو القمح بثلاث مناطق محل الدراسة (المراغة - طهطا - جرجا) بمحافظة سوهاج بمصر. أعلى نسبة إصابة سجلت عندما كان المحصول في طور النضج. كان الجرذ النرويجى الأكثر شيوعا ب434 فرد يليه الجرذ المتسلق ب348 فرد بينما الجرذ النيلى اقلهم عددا ب138 فرد. ثلاث تركيبات من فوسفيد الزنك بتركيز 0.5% و فوسفيد زنك مخلوطا بزبدة الفول السودانى وفوسفيد الزنك مخلوطا بالبييض تم استخدامها في ثلاث اطوار لمحصول القمح لكسر ظاهرة النفور من الطعم واستخدامه اكثر من مره خلال الموسم الواحد. تلك التراكيب خفضت تعداد القوارض ب73.6 % لفوسفيد الزنك و 76.36% لفوسفيد الزنك مخلوطا بزبدة الفول السودانى بينما كانت نسبة الخفض لفوسفيد الزنك المخلوط بالبييض 86.21%. أوضحت الدراسة الحاليه ان فوسفيد الزنك المخلوط بالبييض كان الأفضل لقبول الطعم يليه فوسفيد الزنك المخلوط بزبدة الفول السودانى يليه فوسفيد الزنك لتقليل تعداد الجرذان في الحقل بمراحل النمو المختلفة لمحصول القمح.