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TOXICITY EFFECT OF CERTAIN ZINC PHOSPHIDE CONCENTRATIONS ON SOME RODENT SPECIES UNDER LABORATORY CONDITIONS

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ABSTRACT

These experiments were carried out under laboratory conditions at Agriculture Zoology and Nematology department, Faculty of Agriculture Al-Azhar University, to study effect of certain concentration of zinc phosphide on some rodent species (wild house mouse, *Mus musculus* L., albino house and the Nile rat *Arvicanthis niloticus* Desm.,) by using choice and non choice feeding tests.

The obtained data indicated that all tested concentrations of zinc phosphide using choice feeding system gave completely kill for both sex *M.musculus* and *A.niloticus* .

The time for death was varied according the tested species incase of *M.musculus* L., time to death of males was shorter than females, while in *A.niloticus* time to death for females was shorter than males.

The palatability of *M.musculus* female was more than male while the palatability of *A.niloticus* male was more than female.

INTRODUCTION

Rodent pests are a major constraint an agricultural production in Egypt as well as in many countries of the world. They damage vegetables and stand crops from the time of planting through harvesting and cause additional damage and waste by contamination. The chemical control of rodents has been practiced for more than 200 years.

On the other hand, toxicity of zinc phosphide was studied by Gaber(1991); El-Mahrouky (1992); Asran(1994); Keshta (1996) and wahab *et al.*(1997) on the wild and albino house mice, *M.musculus* L., under both choice and non-choice test, the data proved that there is a positive link between time to death and the consumed quantity of the zinc phosphide bait by the wild and albino mice at the used experimental conditions.

The present work aimed to study the effect of certain concentrations of zinc phosphide on the wild house mouse (Albino house mouse) *M.musculus* L., and the Nile rat *Arvicanthis niloticus* by using choice and non-choice feeding tests under laboratory conditions.

MATERIALS AND METHODS

Toxicological experiments were carried out under laboratory conditions of Agriculture Zoology and Nematology department, Faculty of Agriculture,Al-Azhar University, Nasr City, Cairo and Shandweel Agriculture

Research Station, Sugar Crops Research Institute, Agricultural Research Center, Shandweel village, Sohag Governorate.

-Tested compound
- Zinc phosphide:

Technical grade zinc phosphide (94 % active ingredient) was provided by Abou Zaapal Company.

Chemical structure:

Chemical Name: Zn_3P_2
Trade Name : Zinc phosphide
Tested concentration: 0.5, 0.75, 1.00, 1.25 and 1.50 % the compound was mixed thoroughly with molasses (1.00 %) at concentrations 0.5, 0.75, 1.00, 1.25 and 1.50 % .

Tested method:

The wild house mice *Mus musculus* and Nile rat, *Arvicanthis niloticus*, were collected from Gazert Shandweel village. The albino ones brought from National Research Center, Dokki, Giza Governorate. For each experiment, healthy mature mice (5 males and 5 females) for every strain were weighted to the nearest gram and sex was determined. Animals were retained in individual cages, 42 × 24 × 17 cm. For a maximum of two weeks before initiating tests. Abnormally large or small animals or obviously pregnant individuals were omitted from the experiment. Zinc phosphide was mixed thoroughly with fresh crushed maize and molasses (1.00 %) at concentrations of 0.5, 0.75, 1.00, 1.25 and 1.50 %. Food was removed from the animal cages a minimum of 4 hours before administering the chemical. Choice and non-choice feeding experiments were conducted using zinc phosphide and prain baits. In the choice test described by Htun and Brooks (1979). The palatability was calculated according to the next equation:

$$\text{Palatability} = \frac{\text{Av. of poison bait cons.}}{\text{Av. of poison bait cons. + Av. of plain bait cons.}} \times 100$$

Water was available to animals through the experiments. Mortality was observed daily and recorded for a week after poisoning. Average of death length was calculated in hours. In the non-choice test zinc phosphide treated crushed maize was offered at concentrations of 0.5, 0.75, 1.00, 1.25 and 1.50 %. Bait consumption was recorded daily and the reduction in weight and its percentage for both males and females were calculated.

RESULTS AND DISCUSSION

I-Effect of certain concentrations of zinc phosphide on the wild House mouse *Mus musculus* by using choice and non-choice feeding tests under laboratory conditions:

1- For choice test, the average of poison bait consumption for males and females were (0.6 and 0.8g), (0.7 and 1.8g),(0.7 and 1.2g), (0.8 and 1.0g) and (0.5 and 0.6g); 0.5, 0.75, 1.00, 1.25 and 1.50 % tested zinc phosphide concentration, respectively. The tested females consumed more quantity of the poisonous bait than males for the whole investigated concentrations of zinc phosphide. The palatability of males were more than females, Fig.(1).

Other investigator studied the mortality of *M.musculus*, such as Asran (1994), who found that, zinc phosphide bait of 1 % gave 90 % mortality for *M.musculus* under choice test under laboratory conditions and Keshta (1996), found that males and females of wild house mouse *Mus musculus* L. mortalities for the different concentrations (0.5, 1.00, 1.5 and 2.00 %) were (4/5 and 5/5), (3/5 and 5/5), (4/5 and 5/5) and (4/5 and 4/5) respectively under choice feeding test condition.

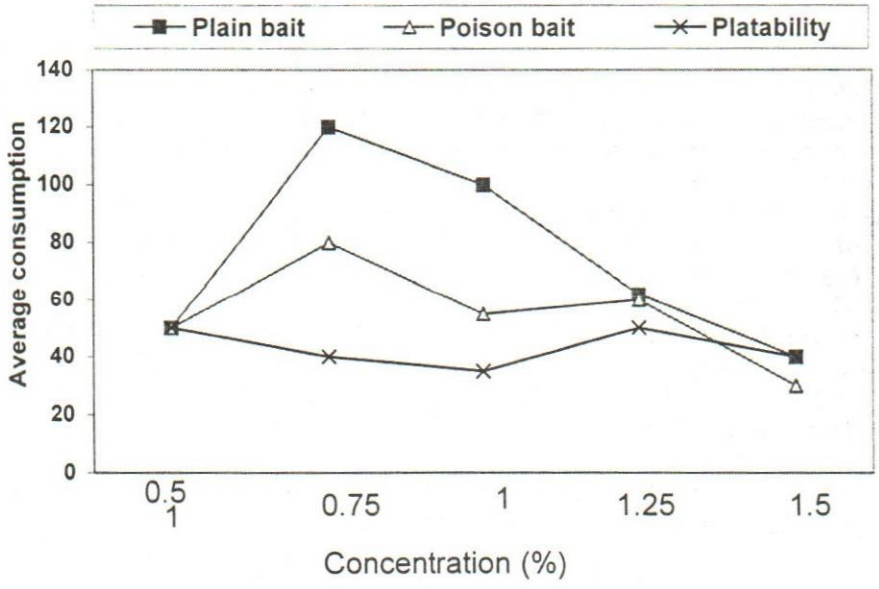

Fig. (1): Effect of certain concentrations of zinc phosphide on the average consumption and palatability of wild house mouse, *Mus musculus* Linn. under choice feeding test.

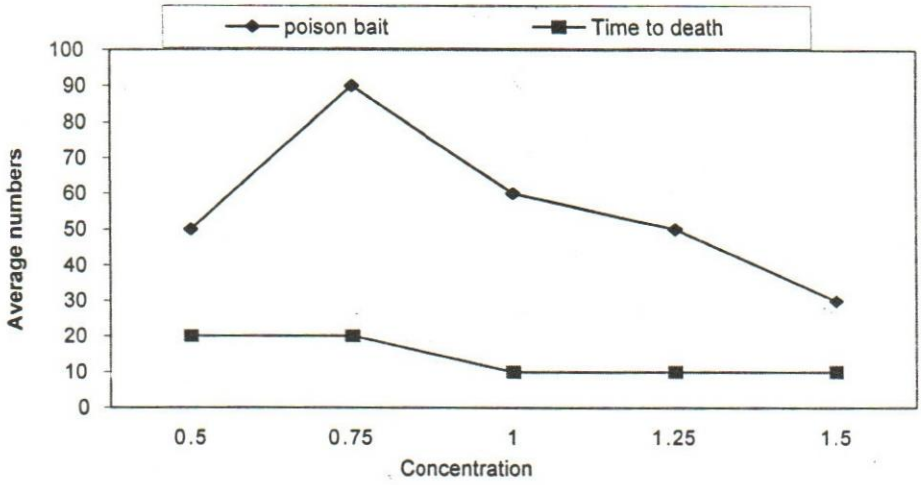

Fig.(2): The average hours to death of the wild house mouse, *Mus musculus* Linn. under choice feeding test.

2- All concentrations of zinc phosphide against *M.musculus* under choice feeding system gave completely kill for both sex. The results proved that there is a positive correlation between the kill percentage and each of the consumed amount of the poisonous bait and the animal acceptance to the introduced bait.

3- The average of time to death of males and females of wild house mouse for (0.50, 0.75, 1.00, 1.25 and 1.50 %) of zinc phosphide concentrations were (13 and 19 hr.), (23 and 15 hr.), (11 and 16hr.), (11and 14hr.) and (11 and 11hr.), respectively, Fig.(2). Asran (1994) found that the mean of death length in choice test for *M.musculus* (38 hr.) at 1 % concentration of zinc phosphide.

4- For non- choice feeding test the average of the bait consumption for male and female were (0.2 and 1.0g), (0.3 and 0.4g), (0.7 and 0.39g) and (0.5 and 0.6g), respectively. The all used concentrations of zinc phosphide gave entirely kill when they were introduced to the wild house mouse *M.musculus*. Time to death of females was shorter than males for all concentrations except for 1.25 % zinc phosphide concentrations. The highest weight reduction was 1.4g at 0.75 % concentration and the lowest weight reduction was 0.3g at 1.00 % concentration for male and female.

II- Effect of certain concentrations of zinc phosphide on the albino house mouse, *Mus musculus* L.,by using choice and non-choice feeding tests under laboratory conditions:

1- For choice tests average of the poison bait consumption for five males and five females for the applied concentrations of zinc phosphide bait, 0.50, 0.75, 1.00, 1.25 and 1.50 % were (0.5 and 0.8 gm), (0.6 and 1.5 gm), (0.7 and 1.2 gm), (0.8 and 1.0 gm) and (0.5 and 0.6 gm), respectively. Palatability of the

female of the albino house mouse was more than male. The all used concentrations of zinc phosphide gave kill 5/5 for males and females. Time to death of males is shorter than that of females, Fig.(3).

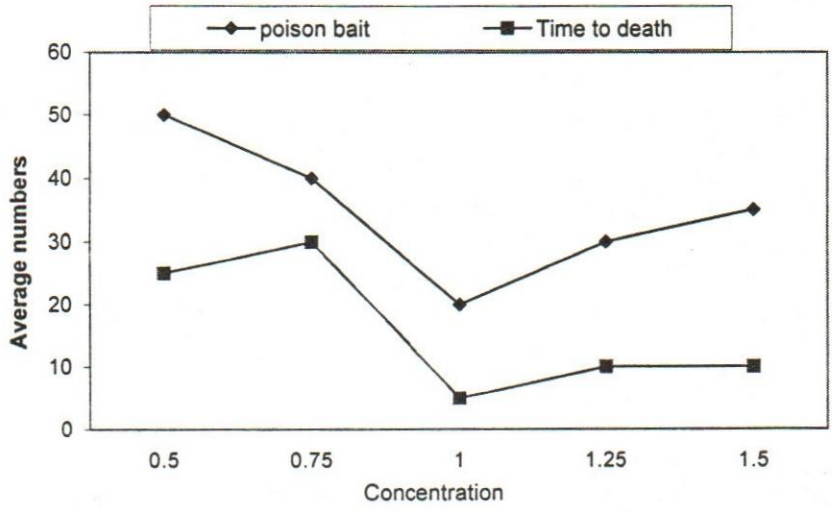

Fig.(3): The average hours to death of the wild house mouse, *Mus musculus* Linn. under non-choice feeding test.

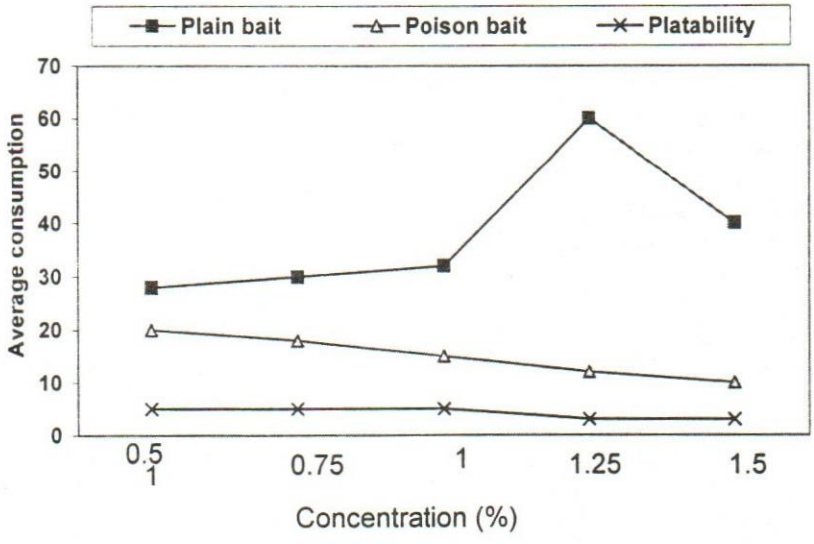

Fig. (4): Effect of certain concentrations of zinc phosphide on the average consumption and palatability of Nile rat, Arvicanthis *niloticus* Desm. under choice feeding test.

Our results agree with that obtained by Bradfield and Gill (1984); Asran (1994) and Keshta (1996).

2- For non-choice test all used concentrations of zinc phosphide gave kill 5/5 for the males and females of albino house mouse. There is a negative link between each of the used concentrations and the consumed amount of the bait to cause death. There is no remarked relation between the consumed amount of the applied bait and mortality percentage.

III- Effect of certain concentration of zinc phosphide on the Nile rat, *Arvicanthis niloticus* by using choice and non-choice feeding test under laboratory condition:

1-For choice test the average of the bait consumption for five males and five females treated with 0.50, 0.75, 1.00, 1.25 and 1.50 % zinc phosphide concentrations using choice feeding test were (1.0 and0.8 gm), (0.9 and 0.8 gm), (1.0 and 0.8gm), (0.7 and 0.7 gm) and (0.8 and 0.7gm), respectively. Males were consumed poison bait higher than females for most zinc phosphide concentrations. The palatability of male Nile rat was more than female. Time to death for females shorter than males, Fig. (4).

El-Nashar (1998) and Al-Gendy (1999) found that the palatability of individuals of the albino Norway rat increased significantly at lower concentrations than the highest one. Also, the palatability of the female of the albino Norway rat was more than male in case of garlic oil, but for cotton seeds oil was opposite.

2- For non-choice test the average of the bait consumption for males and females for the applied concentrations of zinc phosphide bait, (0.50, 0.75, 1.00, 1.25 and 1.50 %) under non-choice feeding test were (9.0 and 4.9 g), (1.7 and 1.3 g), (1.3 and 1.9 g), (1.8 and 1.3 g) and (1.1 and 0.8 g) respectively. All used zinc phosphide concentrations gave kill 100 % for the males and females of Nile rat. Time to death of females was shorter than males at all zinc phosphide concentrations, Fig. (5).

Abd-Allah *et al.*, (1991) ; El-Nashar (1998) found that average of day to death of albino Norway rat, *Rattus norvegicus* Berken, because of in taking zinc phosphide bait mixed with either olive oil or conditions was longer than no-choice test for the all applied storage periods.

3- **Effect of certain concentratios of zinc phosphide on the Nile rat, *Arvicanthis niloticus* by using choice and non-choice feeding test under laboratory conditions:**

Trails of rodenticide baits containing 0.50, 0.75, 1.00, 1.25 and 1.50 % zinc phosphide (mixed with 1 % molasses) were carried out under laboratory conditions for choice and non choice feeding test against each of males and females of the Nile rat, *Arvicanthis niloticus*, to study the following points:

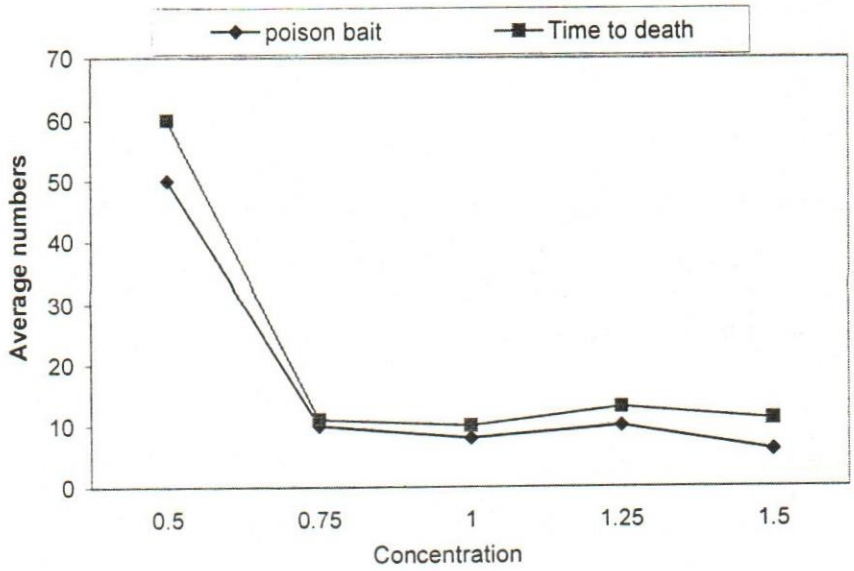

Fig.(5): The average hours to death of the Nile rat, *Arvicanthis niloticus* Desm under non-choice feeding test.

A- Choice feeding test:

I- The results cleared that the average of the bait consumption for five males and five females for the applied concentrations of zinc phosphide bait, 0.50, 0.75, 1.00, 1.25 and 1.50 % under choice feeding test were (1.0 and 0.8 gm), (0.9 and 0.8gm), (1.0 and 0.8 gm), (0.7 and 0.7gm) and (0.8 and 0.7 gm), respectively.

The obtained data agree with those of El-Nashar (1998) who found that there were no any noticeable differences between the two applied feeding systems and each of the consumed quantity from zinc phosphide bait and number of feeding days. Also, average of bait consumption by female was nearly equal to male for the most cases.

II- Plain bait consumption

The results cleared that the average of plain bait consumption by females were less than male for (0.50, 0.75, 1.00, 1.25 and 1.50 %) concentrations of zinc phosphide Fig.(4).

El-Nashar (1998) cleared that average of the plain bait consumption by albino Norway rat, *Rattus norvegicus* was nearly the same for both of male and female. The results showed that the all used concentrations of zinc phosphide gave kill 5/5 for the Nile rat.

The results showed that the all used concentrations of zinc phosphide gave kill 5/5 for the Nile rat. Some investigators supported those results such as Abdallah *et al.*, (1991) and Al-Gendy (1999) who conciliated that zinc phosphide gave complete mortality to *A.niloticus* and *R.norvegicus* .

B- Non-choice feeding test:

Poisonous bait consumption:

The results cleared that the average of total bait consumption for five males and five females for the applied concentrations of zinc phosphide bait, (0.50, 0.75, 1.00, 1.25 and 1.50 %) under non-choice feeding test were (9.0 and 4.9 gm), (1.7 and 1.3 gm), (1.3 and 1.9 gm), (1.8 and 1.3 gm) and (1.1 and 0.8 gm) respectively Fig. (5). The results showed that all used zinc phosphide concentrations gave kill 100 % for the males and females of Nile rat.

El-Deeb *et al.,* (1991) stated that complete mortality was recorded rapidly for *Mus musculus* and *Rattus rattus*, while *Arvicanthis niloticus* and *Rattus norvegicus* took longer period.

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تأثير سمية بعض التركيزات من فوسفيد الزنك على بعض أنواع القوارض فى المعمل.

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أ-تأثير بعض التركيزات من فوسفيد الزنك على فؤيرة المنازل البرية wild house mouse باستخدام التغذية الاختيارية والإجبارية تحت الظروف المعملية:

١- أوضحت النتائج أن الإناث المختبرة استهلكت كميات من الطعم المسمم أكثر من الذكور لجميع التركيزات المستخدمة ، وأن استساغة الذكور كانت أعلى من استساغة الإناث .

٢- أوضحت النتائج أن جميع التركيزات المستخدمة لفوسفيد الزنك على فؤيرة المنازل ***M.musculus*** تحت نظام التغذية الاختيارية أعطى نسبة موت كامل ١٠٠ % لكل من الذكور والإناث وأن هناك علاقة موجبة بين نسبة الموت وكمية المستهلك من الطعم المسمم ، واستساغة الحيوان للطعم المستخدم

٣- متوسط الزمن اللازم لموت ذكور وإناث فؤيرة المنازل للتركيزات المستخدمة لمبيد فوسفيد الزنك (٠,٥ ، ٠,٧٥ ، ١,٠ ، ١,٢٥ ، ١,٥ %) كان (١٣ ، ١٩ ساعة) ، (٢٣ ، ١٥ ساعة) ، (١١ ، ١٦ ساعة) ، (١١ ، ١١ ساعة) على التوالى .

٤- أوضحت النتائج أن جميع التركيزات لفوسفيد الزنك تحت ظروف التغذية الإجبارية أعطى نسبة موت ١٠٠ % وأن الزمن اللازم لموت إناث فؤيرة المنازل أقل من الزمن اللازم لموت الذكور عند جميع التركيزات المستخدمة ماعدا ١,٢٥ % .

ب- تأثير بعض التركيزات من فوسفيد الزنك على فؤيرة المنازل البيضاء Albino house mouse باستخدام التغذية الاختيارية والإجبارية تحت الظروف المعملية:

١- أوضحت النتائج أن فى الاختبار الاختياري كان متوسط الاستهلاك لطعم فوسفيد الزنك عند التركيزات المطبقة (٠,٥ جم ، ٠,٨ جم) ، (٠,٦ جم ، ١,٥ جم) ، (٠,٧ جم ، ١,٢ جم)، (٠,٨ جم ، ١,٥ جم)، (٠,٥ جم ، ٠,٦ جم) على التوالى . استساغة إناث فؤيرة المنازل البيضاء كانت أعلى من استساغة الذكور وأن جميع التركيزات المستخدمة أعطت نسبة موت ٥/٥ للذكور والإناث . زمن الموت للذكور أقصر من زمن الموت للإناث.

٢- أوضحت النتائج أن فى الاختبار الإجباري كان متوسط الاستهلاك لجميع التركيزات المستخدمة أعطت نسبة موت ٥/٥ للذكور والإناث . وان هناك علاقة سالبة بين التركيزات المستخدمة وكمية الطعم المسببة للموت . وهناك علاقة غير واضحة بين الكمية المستخدمة من الطعم ونسبة الموت.

(ج) تأثير بعض التركيزات من فوسفيد الزنك على جرذ الحقل النيلى باستخدام التغذية الاختيارية والإجبارية تحت الظروف المعملية.

١- للاختبار الاختياري كان متوسط المستهلك للذكور والإناث للتركيزات المستخدمة من طعم فوسفيد الزنك (١جم ، ٠,٨ جم) ، (٠,٩ جم ، ٠,٨ جم) ، (١ جم ، ٠,٨ جم)، (٠,٧ جم ، ٠,٧ جم)، (٠,٨ جم ، ٠,٧ جم) على التوالى. الذكور كانت تستهلك كمية الطعم المسمم أكثر من الإناث لمعظم تركيزات فوسفيد الزنك . استساغة ذكور جرذ الحقل النيلى أعلى من استساغة الإناث . جميع التركيزات المستخدمة أعطت نسبة موت ٥ /٥ . زمن الموت للإناث أقصر من زمن الموت للذكور.

٢- للاختبار الإجباري كان متوسط الاستهلاك من الطعم المسمم للذكور والإناث للتركيزات المستخدمة من طعم فوسفيد الزنك (٩,٠ جم ، ٤,٩ جم) ، (١,٧ جم ، ١,٣ جم) ، (١,٣ جم، ٠,٩ جم) ، (١,٨ جم ، ١,٣ جم) ، (١,١ جم ، ٠,٨ جم) جميع التركيزات من فوسفيد الزنك أعطت نسبة موت ١٠٠% للذكور و إناث جرذ الحقل النيلى. زمن موت الإناث أقل من زمن الذكور عند جميع التركيزات لفوسفيد الزنك المستخدمة .