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MOLLUSCICIDAL EFFICICIENCY OF SOME PESTICIDES AGAINST *Helix aspersa* LAND SNAILS UNDER LABORATORY CONDITIONS

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ABSTRACT

The relative toxicity of three pesticides namely, indoxacarb, lufenuron and *Bacillus thuringiensis* were determined in the laboratory against the brown garden snails *(Helix aspersa)*. Methomyl involved as a common standard is being used recommended molluscicide against such pest. The toxicity index of the tested compounds was 100, 92.18, 88.05, 84.28 and 40.86 for methomyl, lufenuron, indoxacarb SC, *Bacillus thuringiensis* and indoxacarb EC, respectively. Also, data indicated that the percentages of mortality were increased by increasing the concentration of the tested pesticides. Lufenuron was the highest effect (63.33%) after 2 days while the lowest effect was indoxacarb EC (18.33 %) whereas indoxacarb SC and *B. thuringiences* were intermediate. After seven days the results revealed that lufenuron and indoxacarb SC were the most effective against land snails (85.12%) and (78.44%) respectively, compared with methomyl (96.19%), while *B. thuringiences* has a moderate effect (47.85%). Indoxacarb EC has a slight effect (32.14%); hence, most of the tested compounds used in the present study can be recommended for field – trials against *H. aspersa* in terms of efficacy.

INTRODUCTION

Snails and slugs are among the most bothersome pests in many garden and landscape situations. The brown garden snail *(Helix aspersa)*, is the common snail causing problems in California gardens; it was introduced from France during the 1850s for use as food. Terrestrial gastropods (mollouscus: snails and slugs) are being abundantly distributed in north coast, new reclaimed lands and addition to delta region of Egypt Kassab and Daoud,(1964); El- Okda and Khalil,(1981) and Abo- Bakr(1997). Several species of slugs are frequently damaging, including the gray garden slug *(Deroceras reticulatum)*, the banded slug *(Limax poirieri)*, and the greenhouse slug *(Milax gagates)*. Both snails and slugs are members of the mollusk phylum and are similar in structure and biology, except slugs lack the snail's external spiral shell, (Flint, 1998).. Snails and slugs feed on a variety of living plants as well as on decaying plant matter. On plants they chew irregular holes with smooth edges in leaves and can clip succulent plant parts. They can also chew fruit and young plant bark (Flint, 1998). Indoxacarb is the common name proposed for the S. isomer of oxadiazine derivative, which is the more insecticidally active isomer. This compound represents a new class of compounds has broad-spectrum insecticidally activity and yet be environmentally soft (Salagado, 1990).Lufenoron is a new insecticide effective on pyrethriod and organophosphates- resistant pests. It was soft on adult beneficial and predatory mites, safe on a wide range of crops and

suitable for integrated pest management (Harder *et al.*1995).One of the most promising biocontrol approach that has received attention of many scientists is the development of *Bacillus thuringiensis* toxins as insecticides (Belfiore *et* al., 1994). *B. thurringiensis* is one of the biological insecticide containing proteins that are highly toxic to insects. More than 182 species of insects have been found to be susceptible to *B. thurringiensis* based bioinsecticides (Dean, 1984).

Therefore, the present study was conducted in the laboratory to evaluate the relative toxicity of these new safe pesticides as molluscicides for use against land snails.

MATERIALS AND METHODS

Tested Pesticides:-

Suspension concentrate and emulsifiable concentrate formation of indoxacarb (Avanut® 15%): methyl (s)-N-[7.chloro -2,3,4,a,5-tetrahydro-4a (methoxy carbonyl) indeno [1,2-e] [1,3,4] oxadiazin – 2- yl carbonyl] – 4? (trifloro methoxy) carbonilate; lufenuron (Match® 5 %) : N-[[[2,5-dichloro-4-(1,1,2,3,3,3-hexafluoro-propoxy)-(phenyl]amino]carbonyl]-2,6-difluorobenzamide (CA); (Xen- Tari® 10.3%) *Bacillus thurringiensis*, aizawai and methomyl (Lannate® 90 %): S: Methyl-N-(methyl carbamoyl) oxyl - thioacetimidate .

Tested pests:-

The brown garden snails *Helix aspersa* O.F. Müler were collected from vegetable fields in spring season 2004 from Koom - Hamada district El – Behera governorate. They were acclimatized for a week under laboratory conditions and fed on lettuce
(*Lactuca sativa*) ad. lib.

Laboratory experiments:-

I – Toxicity studies

Serial concentrations (2 , 4 , 6 , 8 , 1 , 12 and 15 $X10^4$ ppm) for each tested pesticide were prepared in aqueous solution, each concentration was replicated 3 times and the lettuce leaves were dipped in the aqueous pesticide preparation for 5 seconds then allowed to dry. Leaf discs were cut (2.5cm in diameter) and patches of 15 healthy animals were placed in it for seven days. Results were obtained after 48 hrs of treatment and the percentages of mortality were calculated and compared with the control group according to Abbott's formula (1925). Percentage of snails' mortality was plotted on log arithmetic – probability graph paper and LC_{50} and LC_{95} values could be estimated. The toxicity index was determined according to Sun (1950) as (A/B) X 100, where A and B are the LC_{50} values of both the most toxic compound and the other tested compounds respectively. The obtained data were analyzed according to Litchfield and Wilcoxn method (1949).

II –Biological effects:

In this method, toxic wheat bran baits were prepared containing each LC_{50} and 0.5 LC_{50} values for each pesticides (w / w), the bait consisted of (wheat bran : molasses : blue dye) with the ratio 8:1:1 respectively (WHO, 1961). Bait were distributed in three replicates for each treatment, each replicate contain 10 snails and 10 grams of bait. Control was made using fresh water with the bait. Replicates were kept under laboratory conditions and suitable humidity required for snail activity.

Daily dead snails were counted and removed from each replicate. Mortality percentage was calculated and the molluscicidal potency was measured for all tested compounds after 7 days.

RESULTS AND DISCUSSIONS

Relative toxicity data of the four tested pesticides against the adult snails *Helix aspersa* are presented in table (1). Results indicated that methomyl was the most toxic compound against the adult land snail *Helix aspersa*. Whereas, indoxacarb EC was the lowest one. The tested compounds can be arranged in a descending order according to its LC_{50} as follows: methomyl > lufenuron > indoxacarb SC > *B. thurringiensis* > indoxacarb EC. The difference between the LC_{50} values of methomyl and that other tested pesticides was significant ($p < 0.05$) as indicated by none overlapping of the respective 95% fiducial limits. The toxicity index showed that methomyl was about 1.084, 1.14, 1.18, and 2.45 times as toxic as lufenuron, indoxacarb SC, *B. thurringiensis* and indoxacarb EC, respectively.

Table (1):- Toxicity of certain pesticides against land snails *Helix aspersa* following feeding on treated lettuce leaves for seven days.

Compounds	LC_{50} X 10^4 ppm	95% fiducial limit x 10^4 ppm		Slope ± S.E.	X^2	Toxicity index
		upper	lower			
Indoxacarb EC	14.5	19.4	9.6	2.18±0.14	5.90	40.68**
B. thurringiensis	7	9.6	4.3	1.12±0.96	3.90	84.28**
Indoxacarb SC	6.7	7.5	4.5	1.42±0.23	2.03	88.05*
lufenuron	6.4	6.7	5.3	1.16±0.15	2.92	92.18*
Methomyl	5.9	6.1	5.4	2.34±0.33	3.8	100

* Significant difference at 0.05 ** Significant difference at 0.01

The data in table (2) indicate the toxic effect of the pesticides used on *Helix aspersa* after different time intervals. After 2 days, the lowest concentration (0.5 LC_{50} values) of lufenuron, methmoyl, indoxacarb SC, *B. thurringiensis*, and indoxacarb EC caused 46.67, 32.50, 13.8, 10 and 3.67 mortality respectively. While the highest concentration (LC_{50} values) showed that lufenuron had the highest effect (63.33%) followed by indoxacarb SC (62.67%), methmoyl was (53.33%), *B. thurringiensis* (20%) and the lowest effect was indoxacarb EC (18.33%) mortality. After 5 days, the mortality percent was increased with 0.5 or LC_{50} respectively. After 7 days, lufenuron showed the highest effect (85.12%), while the lowest one was indoxacarb EC (32.14%).

Table (2): Efficacy of sub lethal concentration of the tested pesticides against land snails *Helix aspersa* using toxic bait at different time intervals.

No. of days	Con.	Indoxacarb EC		Indoxacarb SC		lufenuron		*B. thurringiensis*		Methomoyl	
		% Mortality	Lethal dose of active Ingredient mg	% Mortality	Lethal dose of active ingredient mg	% Mortality	Lethal dose of active Ingredient mg	% Mortality	Lethal dose of active Ingredient mg	% Mortality	Lethal dose of active Ingredient mg
1	A	9.33±1.5	11.4±0.14	51.00±2.14	35.5±0.12	56.67±1.12	3.7±0.20	10.00±1.11	7.21±0.01	53.33±2.13	22.0±0.11
	B	3.67±1.2	5.8±0.21	16.67±2.30	13.3±020	36.67±1.20	1.6±0.10	9.00±1.2	1.25±0.02	23.33±1.20	9.50±0.12
2	A	18.33±1.23	11.7±0.32	62.67±2.36	36.5±0.13	63.33±1.23	3.8±0.12	20.00±2.18	8.1±0.02	66.67±1.13	22.0±0.12
	B	3.67±1.23	6.1±0.22	16.67±2.30	13.8±0.15	46.67±1.50	1.7±0.22	10.00±1.20	1.35±0.01	32.50±1.15	10.6±0.15
3	A	20.00±2.12	14.0±0.32	66.33±3.14	37.3±0.33	76.33±2.13	3.8±0.11	31.10±2.39	8.1±0.10	76.3±2.17	22.1±0.12
	B	10.00±1.40	6.4±0.25	17.40±1.40	18.2±022	54.80±1.80	2.0±0.20	16.68±1.25	1.42±0.10	35.05±1.20	11.0±0.16
4	A	28.07±2.17	14.5±0.12	76.00±3.11	38.3±0.23	78.89±2.14	3.8±0.13	44.43±2.14	8.8±0.12	76.3±2.17	23.2±0.11
	B	24.07±1.6	6.5±0.20	34.43±1.60	18.5±0.25	65.67±1.60	2.1±0.15	24.43±1.50	2.35±0.12	38.40±2.40	11.2±0.60
5	A	30.18±1.13	15.5±0.25	76.00±2.22	39.4±0.25	83.03±3.12	3.9±0.20	44.86±2.01	9.1±0.20	80.65±1.18	24.4±0.14
	B	24.07±1.13	7.1±0.32	41.20±2.11	18.6±0.35	68.20±2.10	2.2±0.50	26.50±2.10	3.42±0.02	39.60±1.25	11.6±0.23
6	A	31.12±2.14	16.8±0.24	78.44±1.13	39.8±0.12	85.12±2.22	3.9±0.14	46.45±1.05	9.3±0.11	96.15±1.22	24.8±0.12
	B	25.50±1.24	7.4±0.33	45.3±2.20	19.0±0.18	68.50±1.20	2.3±0.17	26.5±1.05	4.2±0.12	42.50±2.30	12.2±0.24
7	A	32.14±2.13	17.3±0.26	79.13±1.36	41.9±0.14	85.12±1.56	4.1±0.11	47.85±3.00	9.3±0.03	96.19±2.17	24.8±0.12
	B	25 5±2.13	8.1±0.36	46.5±1.45	20.4±0.23	68.50±1.70	2.4±0.12	28.40±1.6	4.5±0.04	45.25±2.34	12.5±0.28
mean	A	24.16 ±2.33**	14.5±0.25	69.93±2.13*	38.4±0.18**	75.49±2.15	3.84±0.13	34.94±2.61**	8.55±0.11	77.93±2.13	23.33±0.12
	B	16.67±2.30**	6.77±0.24	31.16±1.25**	17.4±0.22	58.43±1.80**	2.04±0.11	20.21±1.8**	2.64±0.16	36.66±2.14	11.23±0.18

Mean % of mortality is the average of five replicates each one contain ten animals.

* **Significant difference at 0.05** ** **Significant difference at 0.01**

A = LC_{50} B = 0.5 LC_{50}

Comparing the toxic effects of the pesticides with 0.5 or LC_{50} concentrations, it was found the highest effects were obtained by methmoyl followed by lufenuron then indoxacarb (SC), *B. thurringiensis* and finally indoxacarb EC with significant differences among treatments as indicated in table (2).

Generally, lufenuron, indoxacarb SC and *B. thurringiensis* showed high molluscicidal effect against land snails, an important pest on most field crops, under laboratory conditions compared with methomyl itself. In addition, other positive properties of these compounds low toxicity to non- target organisms and short persistence in the environment. Salagado, (1990); Harder *et al*, (1996); and Pluschkell *et al.*, (1998).

These results agree with the findings by Hussien (2003) who indicated that methomyl was more effective as molluscicide compound using application and poisoned food techniques than indoxacarb. Kishore (1987) illustrated that the chemical control is the most powerful tool available for controlling snails. Zedan *et al* (1999) found that bacterial formulation was the most effective against land snails compared with Lannate.

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دراسات معملية لتقدير كفاءة بعض المبيدات على القواقع الأرضية

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استهدفت هذه الدراسة معرفة كفاءة أربع مركبات حديثةآمنة على البيئة من مجاميع مختلفة هى مركب الماتش (لوفينيرون٥١%) والأفانت (إندوكساكارب٥%) فى صورتين مركز قابل للإستحلاب (EC) ومركز معلق قابل للانسياب (SC) و المبيد البكتيرى الزينتارى (*Bacillus thurringiensis* ١٠,٣ %) و مقارنتها بمركب اللانيت (ميثوميل ٩٠ %) الموصى به فى مكافحة القواقع الأرضية. تم أستخدام قوقع الحدائق البنى *Helix aspersa* المنتشر بصورة وبائية فى محافظات الوجه البحرى وذلك تحت الظروف المعملية. تم تقدير التركيز القاتل لنسبة ال٥٠ % من الأفراد لكل المبيدات المستخدمة فى التجربة . وأظهرت النتائج أن قيمة LC_{50} لهذه المركبات كانت ٥,٤ و ٦,٤ و ٦,٧ و ٧ و ١٤,٥ X ١٠ $^{-٤}$ جزء فى المليون لمركب اللانيت ثم الماتش ثم الأفانت فى صورة المعلق قابل للانسياب ثم المركب البكتيرى الزنتارى ثم مركب الأفانت فى صورة مركز قابل للاستحلاب على التوالى. كما أوضحت النتائج أن مركب الماتش أعطى نتائج ممتازة فى إبادة القواقع الأرضية تحت ظروف المعمل وصلت إلى نسبة إبادة ٧٥,٤٩ % مقارنة بمركب اللانيت ٧٧,٩٣ % يليه مركب الأفانت فى صورة SC بنسبة ٧٢,٧٩ % ثم المركب البكتيرى زنتارى بنسبة ٣٤,٩٤ % كما أظهرت النتائج أن أعلى كفاءة لهذه المركبات كانت بعد سبعة أيام من المعاملة .