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Laboratory and Field Evaluation of Local Bait Formulations of Certain Pesticides Against Mollusca Species

El-Sayed A. M. Abdallah; Fahmy A. Kassem and Ezzat A.Kadous
Plant Protection Department, Faculty of Agriculture, Alexandria University.

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ABSTRACT

The molluscicidal efficacy of certain pesticides and some of their mixtures were evaluated under both laboratory and field conditions.Tested compounds and mixtures have been locally formulated using wheat bran as carrier. All baits contained 2% blue dye. Toxicity obtained by methomyl 2% wheat bran bait was selected as reference terrestrial molluscicide. The data obtained under laboratory and field conditions against brown snail *Eubania vermeculata* and white snail *Theba sp* showed that:white snails were more sensitive against tested compounds especially after one day of treatments. Addition of water soluble toxicants to 1% methomyl bait was unable to enhance the molluscicidal activity. While selective herbicide (Atrazine) caused a moderate toxicity against both snails, the nonselective herbicide (paraquat) was non-toxic against used snails. The same trend was obtained with tomarin rodenticide and copper fungicide compounds such as copper oxychloride and cuprosan. There was a high degree of agreeability between the results obtained under both laboratory and field conditions. Finally methomyl locally formulated bran baits possess the same degree of toxicity against used snails as commercial recommended molluscicide (Limacir).

INTRODUCTION

The most effective chemical known used against terrestrial snails is the metaldehyde, polymerized form of acetaldehyde (Lange and Macleod 1941; Gragg and Vincent 1952; Pappas and Carman 1955; Getzin 1965; Crowell 1967; and Brar and Simwat 1973), however, due to not fully satisfactory control under field conditions many other compounds have been studied for their molluscicidal activity. Among these successfully effective compounds are: carbaryl (Getzin and Cole 1964 and Barry 1969); methiocarb (Daxi 1970), phorate (Barry 1969; Judge 1969; Singh and Agrawal 1978 and Mahendru and Agrawal 1982), aldicarb(Judge 1969; El-Okda et al. 1978 and Brar and Simwat 1973). Molluscicidal activity of other insecticides have also been studied by El-Okda 1978, 1982, and 1985; Singh and Agrawal 1979 and 1981; Mones and Gifot 1989; and Radwan and El-Wakil 1991. Bait formulation has been proved to be effective application against these terrestrial pests (Kassab and Daoud 1964, and EL-Okda 1983). In addition, more attractability has been achieved when baits formulated with wheat bran (El-Okda et. al.1983), or even with wheat bran extract(Stephenson 1972). In the present study several types of pesticides including insecticides,fungicides, herbicides, rodenticides and recommended molluscicides have been locally formulated as baits using wheat bran as carrier material and tested against two abundant species (*Theba sp.* and *Eubania vermeculata*) of terrestrial snails (El-Okda, 1983) that were collected from El-Tarh citrus orchard farm, Beheira governorate and tested in the laboratory and under field conditions in order to elucidate the difference of pesticides efficiency under different conditions and the potency of mixed pesticides as molluscicides .

MATERIAL AND METHODS

Local wheat bran baits were laboratory formulated for all tested candidates except metaldehyde 5% (Limacir) which supplied by EniChem Agricultural company. However, the technique based on mixing the carrier material with the calculated amount of the tested compounds after resolving it in ethanol. All laboratory formulated baits contained 2% blue dye. Baits were left for dryness in plastic basin before use. Tested compounds were: methomyl (Lannate) 2%, methomyl 1% plus copper sulphate 1%, Atrazine (Gesaprem) 2%, Copperoxychloride 2%, Cuprosan 2%(active ingredient is a mixture of zineb 15% and 65% Copperoxychloride), Gramaxone (paraquat) 2%, Tomarin (coumafuryl) 1%, ammonium sulphate with blue color 2%, methomyl 1% plus paraldehyde 1%, methomyl 1% plus pentachlorophenol 1%, Paraldehyde 1%, and Commercial metaldehyde 5% (Limacir)in addition to Tomarin ready made formulation. The tested herbicides and fungicides have been recommended by Ministry of Agriculture program against weeds and fungi respectively in citrus farms. They tested here in order to assesstheir toxicity against mollusca species.

A. Laboratory Experiments:-

1-Experimental Animals: Two economically important terrestrial snails *Theba sp.* and *Eubania sp.* were collected from El-Tarh citrus orchard farm,Beheira governorate. Snails were classified according to Janus (1965) and seperated in different enough glass jars and left at least 2 weeks under laboratory. condition before use.

2-Testing Procedure: Five gm bait of each candidate were available to snails in plastic pots according to Kassem and Abdallah (1992). Samples of 10 experimental animals were kept on plastic cover (15 cm.) containing 5 gm of each bait in glass petri-dish. Snails were placed aside from the bait. One liter plastic pot with

openings to allow respiration and good ventilation was placed up side down on the plastic plate to keep the snail and bait inside but without contact. Two ml of water were added daily on the top of the plastic plate to induce snail activity (Pappas and Carman, 1955). Three pots were set up for each treatment. Control animals were held in similar condition without toxic compounds. Mortality counts were made after 1,3 and 5 days of treatment. Abbott's formula (1925) was used in all tests to correct mortality counts.

B. Field Experiments:-

The study was carried out in an orchard of two feddans planted with citrus using randomized complete blocks design at El-Tarh Farm, Beheira governorate. Experimental area were 2 blocks separated by irrigation canal, each block was 3 raws of high productive orange trees. The distance between each tree is 5 meters. Each block is three trees width with forty trees long . Two trees were chosen as one replicate separated by one untreated tree. Four replicates were used for each treatment. Baits were distributed as a circle under the tree skirt. Heavy belt of poison bait surrounding all experimental field was applied to prevent any interaction of outsider snails from entering or escaping of experiment due to the heavy infestation of this area with most snail species known in the northern coast of Egypt (Kassab and Daoud, 1964). Snails, *Eubania vermeculata*; *Theba sp*; *Helicella vestalis* and *Cochlicella acuta* and slugs *Limax sp* were heavily observed in this area. Population counts of mollusca species were calculated using a wooden frame of one meter square and applied randomly all over the treated and untreated area. Population counts were taken after dawn and before sun - rise. Each treatment consumed 3 kg of the formulated baits prepared 24 hrs before use. Baits were applied before sun - set and after 2 days of slight irrigation. Mortality

counts were taken after 1,3 and 5 days according to Ballway (1972) and El-Okda (1981) as absence of movement and failure of the animal to withdraw inside its shell when prodding by thin stainless steel needle. Phytotoxicity observations were followed upon treated area compared to untreated ones along the experiment.

RESULTS AND DISCUSSION

1- Laboratory Studies:

Methomyl 2% was proven to possess a good potential as molluscicide candidate (El-Okda,1982 and El-Okda *et al.*1983). The results exhibited that adding water soluble compounds such as paraldehyde or pentachlorophenol to methomyl bait enhanced the toxicity with 20 and 10% respectively after 1 day of treatment than methomyl alone. However, the toxicity of methomyl alone was equal to the toxicity of methomyl in mixtures after 2 days and 5 days. Generally the toxic effect of the tested compounds was time dependent and the highest percentages of mortalities were obtained after 5 days of treatments. However, the differences in mortality between the 5 *th* and 2 *nd* days were nonsignificant in the most cases. In spite of both pentachlorophenol was the most efficient to be molluscicide of choice and copper compounds were systematically studied very early in 1920 against water snails (Shoeb,1975). These compounds when tested against white and brown terrestrial snails they caused very poor effect and the mortality percentage doesn·t exceed 10% in the case of white snail while with brown snail these percentages were 13.3 ,33.3 , 13.3 and 40 for copperoxychloride, cuprosan, NaPCP, and PCP-OH respectively (Tables 1 and 2). The same weak effect was observed against both kinds of snails using tomarin either using wheat bran as carrier or tomarin ready made baits which the mortality

Table(1): Effect of toxic baits after 1, 2 and 5 days against the white semis *Theba sp.*

Treatments	Mortality percentage		
	1 day Mean + SEM	2 days Mean + SEM	5 days Mean + SEM
ATRAZINE 2%	3.3 + 2.72	10.0 + 13.3	53.3 + 7.2
COP.OXYCHLORIDE 2:	0.0	0.0	6.7 + 2.72
CUPROBAN	0.0	10.0 + 0.0	10.0 + 0.0
LIMACIR	6.7 + 2.72	60.0 + 14.14	90.0 + 4.71
METHOMYL	20.0 + 4.71	70.0 + 4.71	93.3 + 5.44
NaPCP	0.0	0.0	3.3 + 2.72
PARALDEHYDE 1%	0.0	0.0	6.7 + 5.44
PARAQUAT	0.0	13.3 + 2.72	23.3 + 7.2
PCP-OH 0.5%	0.0	3.3 + 2.72	6.7 + 2.72
TOMARIN 1%	0.0	6.7 + 2.72	10.0 + 0.0
TOMARIN BAIT 1%	0.0	0.0	3.3 + 2.72
Mixtures :			
METH. + CuSO 1%	16.7 + 5.44	70.0 + 4.71	80.0 + 4.71
METH. 1% + PARALD.1%	40.0 + 4.71	80.0 + 4.71	90.0 + 4.71
METH. 1%+PCP 1%	30.0 + 8.17	73.3 + 7.2	83.3 + 9.81

Table(2): Effect of toxic baits after 1, 2 and 5 days against the brown garden snail *Eubania vermiculata.*

Treatments	Mortality percentage		
	1 day Mean + SEM	2 days Mean + SEM	5 days Mean + SEM
ATRAZINE 2%	6.7 + 5.44	60.0 + 9.43	66.7 + 5.44
COP.OXYCHLORIDE 2:	0.0	20.0 + 0.0	20.0 + 0.0
CUPROBAN	13.3 + 10.89	13.3 + 10.89	33.3 + 14.4
LIMACIR	13.3 + 10.89	93.3 + 5.44	100.0 + 0.0
METHOMYL	13.3 + 10.89	93.3 + 5.44	93.3 + 5.44
NaPCP	0.0	0.0	13.3 + 5.44
PARALDEHYDE 1%	0.0	0.0	0.0
PARAQUAT	0.0	13.3 + 5.44	20.0 + 9.43
PCP-OH 0.5%	0.0	13.3 +10.89	40.0 + 0.0
TOMARIN 1%	0.0	0.0	6.7 + 5.44
TOMARIN BAIT 1%	0.0	0.0	6.7 + 5.44
METH. 1%+$CuSO_4$ 1%	13.3 + 5.44	73.3 + 5.44	93.3 + 5.44
METH. 1%+PARALD 1%	6.7 + 5.44	53.3 + 5.44	86.7 + 5.44
METH. 1% + PCP 1%	20.0 + 9.43	73.3 + 10.89	100.0 + 0.0

was less than 10% even after 5 days of treatments. However, the baits were completely eaten by snails and the slime material produced by very active healthy snails were observed indicating that tomarin, anticoagulant compound, has no effect against both kinds of experimental snails. Methomyl acts mainly against acetylcholinesterase causing muscle spasm and snail gastrobodies retain outside the shell(El-Okda, 1981 and 1985). and metaldehyde affects feeding motoneurones and causing excessive releasing of slime material of the snail. However, exposing snails to poisoned bait containing mixture of both compounds did not increase the molluscicidal activity of the mixtures, as found when copper sulphate, or pentachlorophenol added to methomyl baits. White snails were more sensitive towards tested baits than the brown ones only after 1 day of treatments, however the highest mortality was obtained after 5 days of treatments. Atrazine is selective herbicide and is in great favor of killing weeds in corn and orchards, when formulated as wheat bran bait caused 66.7 and 53.3% mortality for brown and white snail respectively after 5 days of treatment. However brown snails were significantly more sensitive than white snails only after 3 days of treatments with mortality of 60.0 and 13.3% respectively. Paraquat is non- selective contact herbicide characterized by a rapid herbicidal effect and kills the green part of plants even in small doses and is also used as defoliant and desiccant (Mees, 1960). This compound caused unimpressive effect, mortality percentages were 20 and 23.3% against brown and white snails respectively after 5 days (tables 1 and 2). The limacir (5% metaldehyde) symptoms of poisoning include increased mucus secretion and uncoordinated muscular spasms followed by immobility and death, these symptoms agree with El- okda (1985). However,the molluscicidal effect was maximum

(100% mortality) after 5 days of treatments especially with brown snails. Mills *et al* (1990 and 1992) showed that acetaldehyde - one of metaldehyde metabolites - was found in the hemolymph of the snail after one meal of metaldehyde, and the effects produced by acetaldehyde on the behavior, feeding motoneurones and neural activity were similar. Paraldehyde was very poor as toxic candidate against both types of snails indicating that paraldehyde is not the right pathway of metaldehyde metabolism, or paraldehyde in not able to reach the site of action when added to diet and /or not able to release the acetaldehyde at the site of action.

2- Field Studies:

No phytotoxicity was observed due to used amounts of poisoned baits on tested citrus plants. Table 3 shows the degree of infestation before treatment. Infestation rates have reached 100% in tested area, weeded and neglected orchards were extensively plagued with terrestrial molluscs slugs and snails. In order to prevent any interaction from the surrounding area, a heavy belt of molluscicide was used around the whole experimental area and large number of dead slugs and snails accumulated inside the belt which prove the successful use of the belt. The most dominant snail was *Helicella vestalis* which contributes 27.5% of the total snail population. The least count was belong to *Theba sp* that constitute 5.4% of the population. Total number of slugs per feddan was estimated as more than 68000 / feddan. Fluctuation of mollusca counts were observed between the replicates as shown in Table 3, however this phenomenon is known when counting mollusca population under field condition (El- okda and Khalil,1981). Poisoned baits were applied 2 days after slight irrigation and it has been noticed a very highly degree of agreeability between the effect of

Table (3) : Land mollusca infestation before bait application*.

Animals	No. of animals in meter square						Total estimated No. in feddan	%
	R1	R2	R3	R4	R5	Mean.		
E. vermiculata	18	20	61	33	27	31.8	133560	10.7
H. vestalis	46	16	197	26	124	81.8	343560	27.5
Theba pisana	20	0	20	14	26	16.0	67200	5.4
C. acuta	5	4	70	4	103	53.2	223440	17.9
Youngsters	60	26	348	9	132	115.0	483000	38.6
Limax sp.	25	13	24	9	11	16.4	68880	

* Banila were collected randomly before sun- rise .

Table 4: Toxicity of the most active baits under field condition.

Type of snail	Methoa -yl 2%	Na_PCP 1%	Limacir 5%	Meth. 1% + CuSO4 1%	Meth. 1% + Parald 1%	Meth.1% + PCP 1%
Eubania :						
Live	17	4	15	0	2	0
Dead	32	56	54	122	21	43
Mortality %	65.3	93.3	78.4	100	91.3	100
Helicella:						
Live	51	0	25	0	3	0
Dead	237	24	111	77	44	66
Mortality %	83.3	100	81.6	100	93.6	100
Theba :						
Live	4	0	4	0	0	0
Dead	14	0	22	16	3	8
Mortality %	77.7	0	84.6	100	100	100
Cochlicella						
Live	4	0	7	0	0	0
Dead	79	33	38	36	6	61
Mortality %	95.2	100	84.4	100	100	100
Youngstere						
Live	33	11	43	0	4	0
Dead	298	76	245	115	58	58
Mortality %	87.8	87.4	85.1	100	93.5	100

Samples were collected randomly before sun rise.

tested pesticides under both field and laboratory conditions. Table 4 summarizes the data obtained under field condition after 5 days post-treatment against land snails. All noticed slugs under the trees were completely dead especially with methomyl and limacir, which the average number of three replicates were 49 and 33 respectively. However these numbers of dead slugs were even higher than the average of the untreated ones (16.4 , table 3). This could be explained that baits in treated areas attracted these animals more than the untreated ones. Although herbicides have been proven to possess molluscicidal properties (Barry,1969),atrazine and paraquat exhibited very weak toxicity against mollusca species. The copper fungicide tested compounds copperoxychloride and cuprosan and tomarin rodenticide were unimpressive as molluscicidal candidates. Only methomyl, methomyl mixtures with either copper sulphate , paraldehyde, or pentachlorophenol, and limacir (5% metaldehyde) were highly toxic compounds against land snails Table 4.

Generally youngsters were most abundant snails during the time of experiment, the highest mortality ratio obtained against this type of snails indicates the easy accessibility of wheat bran baits to young snails due to fine particles. however the lowest mortality was observed with the Limacir which was formulated in pellet form compared with locally formulated wheat bran baits.

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التقييم المعملى والحقلى لبعض الطعوم المحضرة محليا ضد انواع الرخويات

السيد احمد محمد عبدالله - فهمى احمد قاسم - عزت امين قادوس

تم اختبار الكفاءة الابادية لعدد من المبيدات الحشرية والنظرية والحائشية ومبيدات القوارض ومخاليطها تحت كلا من الظروف المعملية والحقلية ضد الرخويات. تم عمل التجهيزات معمليا باستخدام ردة القمح كمادة حاملة مع اضافة ٢٪ صبغة زرقاء. اظهرت الدراسة ان هناك توافق كبير بين سمية المبيدات المختبرة تحت كلا من الظروف المعملية والحقلية فى سميتها كمبيدات قواقع. وكان القوقع الابيض (التيبا) اكثر حساسية من القوقع البنى (ايوبانيا) وبصفة خاصة بعد يوم واحد من المعاملة. كما ان اضافة المواد السامة القابلة للذوبان فى الماء مثل كبريتات النحاس والبارالدهيد وخامس كلوريد الفينول لم يزد السمية لمبيد الميثوميل والذى استخدم كمرجع للسمية ضد هذه الرخويات. وبينما سبب مبيد الحشائش الاختيارى الاترازين سمية متوسطة ضد القواقع فان المبيد الغير اختيارى جرامكسون كان عديم الفاعلية تماما ويتساوى فى ذلك مع مبيد القوارض تومارين ومبيدات الفطريات الكوبروزان واوكسى كلورر النحاس. اخيرا فان سمية الميثوميل المحضر محليا معمليا باستخدام الردة كطعم كانت تتساوى مع المبيد التجارى المسجل ضد القواقع اليماصير (٥ ٪ ميتالدهيد).