EFFECT OF CERTAIN PLANT EXTRACTS AGAINST *SESAMIA CRETICA* LED. IN MAIZE FIELDS

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Abstract

Jojoba oil preparations (Nat 1 and Natcom 40) and bestachia leaves extracts (in water, methanol and acetone) in addition to Diazinox were assayed for effectiveness against *Sesamia cretica* Led. in 2002 & 2003 early summer maize plantations. Data revealed that methanol-bestachia extract caused severe reduction in egg-mass counts (86.5% than control). Nat 1 caused the highest reduction in larval counts (81.4%). The highest reduction in number of plants containing perforated leaves and dead hearts (81.2 and 86.5% than control, respectively) were due to Nat 1 treatment. increasing the resultant dry ears yield (24.9 ardab / feddan), reflects 86.7% increase in corn yield than control. In addition, these materials manifested prolonged effects when caused a longer pupal period than control (9 days), 49% reduction in pupal weight. Also, these materials had a delayed effect on deposited eggs 61 and 69.6% reductions, respectively, in hatching larvae were recorded than control. Data from the lab. were, almost, in the same trend as those from the field in which the shortest LT_{50} values (4.24, 3.01 and 2.53 days) for the 1^{st}, 3^{rd} and 5^{th} instars larvae treated with Nat 1 at 1% concentration. Also, the lowest LC_{50} values were occurred for the three respective instars in the treatments of acetone-bestachia extract (0.079 – 0.098%) and Nat 1 (0.087 – 0.121%).

Jojoba oil (Nat 1) and bestachia leaves extracts could be considered as successful natural agents as used in an integrated pest control program of *S. cretica* in maize plantations.

INTRODUCTION

Maize is one of the most important grain crops in Egypt, as it conforms to wheat in its economic importance. The pink stem borer, *Sesamia cretica* Led. is one of the main corn stem borers in Egypt. The female moths prefer laying most of eggs on plants about 20 to 30 days after plantation. As the infested seedlings are dead heart and rotten in the same stage, consequently causing a great reduction in the yield, Abul-Nasr *et al.*, (1968) and Awadallah, (1974). In order to avoid the hazards caused to the environment, due to the repeated use of convential chemical insecticides that are commonly used for corn borers control, the use of normal products are mainly plant extracts which proof to have deleterious effects on target insects El-Sayed (1982 a & b) and Awadallah *et al.*, (1984). Many crude plant extracts and derivatives of

several plant species have been reported by Jacobson (1989) as possibly used against lepidopterous larvae.

The present study aimed to assay the efficacy of some jojoba oil preparations and bestachia leaves extracts, applied in maize fields, against *S. cretica* infestation, and their effect on the subsequent yield. In the same time, laboratory studies were also conducted to find out the toxicity effect of the assayed materials on 1^{st}, 3^{rd} and 5^{th} instars of *S. cretica* larvae.

MATERIALS AND METHODS

I. Preparation of the materials:

Two plant species belonging to different families were chosen in the present experiments, bestachia leaves (*Adhatoda vasica)* were extracted in the laboratory, while jojoba oil extract was used as formulations in commercial names [Nat 1 (96% jojoba oil + 4% mineral oils) and Natcom 40 (40% jojoba oil + 59% mineral oils + 1% garlic oils)]. Also, Diazinox 5% granules was used as a chemical pesticide.

Extractions were prepared as described by Afifi *et al.* (1988). Bestachia fresh leaves were washed by water and then air dried in shade. The dried powder leaves were mixed with different polaritic organic solvents (methanol or acetone) at ratio of 1 (gm powder) : 2 (cm^3 solvent) And blended in high speed electric blender for 15 minutes then filtered on anhydrous sodium sulphate. The obtained solution was, thourghly, freezed at – 4 °C until used. The solvent was evaporated by electric fan. A volume of 500 ml water was mixed with the residue of the dried extract after adding 3 – 4 droplets (3 cm^3 approximately) of Sisi emulsifier to obtain an emulsion of the desired extract 10% W / V. The treatment of water bestachia extract was done received in boiling water as described by Emare *et al.* (1994) prepared by adding 500 ml of boiling water to 50 gm of ground parts of some leaf plants and stirring for 15 minutes after stoppering the container tightly. Nat 1 and Natcom 40 formulations were prepared by adding 5 cm^3 / 500 ml water making 1% V / V concentration. Preparations of extracts were kept in the refrigerator at 4 °C until used in the following experiments:

a-Field experiments:

In 2002 & 2003 early summer seasons of corn, an area of about half feddan was chosen and divided into plots of 3.5 X 3 meters each, containing 5 rows / plot at distance of 70 cm between rows. Seeds of Giza 2 were sown at 3 – 4 seeds / hill, on April, 19^{th} 2002 and 17^{th} 2003 for the highest premium infestation by *S. cretica* El-Saadany (1965) and Awadallah *et al.* (1993). Plantations were arranged in complete randomized block design. The normal agriculture practices as land preparations,

irrigation, mechanical weed control and fertilization were followed. A hand sprayer (one liter) was used for applying the liquid material at a rate of 2 cm^3 and approximately 2 gm in case of Diazinox in the whorl of each plant. Spraying of each material was applied three times. The first started 17 days after sowing, while the second was 8 days later. Data concerning the infestation by *S. cretica* egg-masses / 30 plant / plot and larval / 20 plants / plot were recorded after 24 hours of spraying. The perforated leaves and dead hearts were estimated per 50 plants / plot, after 38 days from sowing. At harvest all maize ears of each plot were separately and adjusted to find out the dry ears (ardab / feddan). *S. cretica* pupae were collected from different of 2002 & 2003 seasons. A number of 16 pupae / treatment were weighed while larvae of the last instar were kept in a plastic box until pupation and moths emergence. Mean pupal period was estimated for each treatment. Every couple of healthy moths was confined in glass chimney cage placed on a Petri – dish and covered with muslin cloth (4 replicates). Inside cage, a piece of cotton / wet by a 30% sucrose solution (as a source of food) and a rolled piece of wax paper (as a side for laying eggs) were placed. The total number of eggs / female and egg hatching were recorded and compared to that of control.

b- Bioassay studies:

Laboratory experiments were conducted to clarify the toxic effects of the prepared bestachia extracts, jojoba formulations and the chemical pesticide (Diazinox) on the 1^{st}, 3^{rd} and 5^{th} instars of *S. cretica* larvae. The total number of treated larvae were divided in 4 replicates of 20 larvae each. Five concentrations (1%, 0.5%, 0.25%, 0.125% and 0.0625%) were assayed from each materials. LT_{50} and LC_{50} values at 5% confidence limits and slope regression lines were represented and interpreted, using probit analysis statistical method of Litchfield and Willcoxon (1949)

Effects of the tested materials on *S. cretica* either in the field or in the laboratory are illustrated in Tables (1 – 3) and Figs (1 & 2) as follows:

RESULTS AND DISCUSSION

I. Field results:

I.1. Deposited egg-masses:

As shown in Table (1), average counts of the two seasons of study, all treatments caused, significant, reductions in the number of *S. cretica* egg-masses. The highest efficacy was due to methanol-bestachia extract which caused 1 egg-mass / 30 plants represented 86.5% reduction than control counts, followed with acetone bestachia extract, Nat 1 and Natcom 40 had intermediate efficacy, 2.3, 2.4 and 2.5 egg-masses as 68.9, 67.6 and 66.2% reduction than control, respectively. Diazinox

and water-bestachia extract were the least effective materials (3.9 and 4.2 egg-masses as 47.3 and 43.2% reduction than control, respectively).

I. 2. Larval counts:

The untreated maize plants harboured significantly, the highest *S. cretica* larval counts (29.5 larvae). The severest reduction occurred with Nat 1 treatment (5.5 larvae as 81.2% reduction). Bestchia extract in methanol and the chemical pesticide Diazinox followed by Nat 1 in effectiveness (73.6 and 64.7% reductions, respectively than control). On the contrary, Natcom 40, bestachia extracts in acetone or in water were the least effective against *S. cretica* infestation, 13.7, 15.2 and 17.7 larvae / 20 plants as represented 53.6, 48.4 and 40% reduction respectively, Table, 1).

I.3. Perforated leaf plants:

The highest average count of plants contained perforated leaves was in untreated plots (15.4 ± 1 plants). While, Nat 1 caused the highest efficacy, 2.9 perforated leaf plants only / 50 plants as 81.2% reduction than control, bestachia extracts in methanol and acetone had an intermediate efficacy (72.7 and 67.5% reduction, respectively). The least effective materials were water-bestachia extract, the chemical insecticide Diazinox and jojoba oil Natcom 40 caused 57.8, 56.5 and 55.8% reductions than control, respectively. Table (1).

I.4. Dead heat plants:

The results achieved from the other infestation symptoms (plants containing perforated leaves) were similar with which caused from dead hearts. The highest efficacy of Nat 1 and methanol-bestachia extract treatments caused recognized reductions as 86.5 and 81.2% than control, respectively. The remaining treatments could be classified in a descendingly order as the chemical insecticide Diazinox, water-bestachia extract, Natcom 40 and acetone-bestachia extract. 4.4, 4.8, 5.0 and 6.0 dead hearts / 50 plants, respectively 66.9, 63.9, 62.4 and 54.9 reductions, respectively, Table (1). Former results revealed that, Nat 1 and methanol-bestachia extract showed the highest efficacy treatments against *S. cretica*, reduced the counts of egg-masses, larvae (plants containing perforated leaves and those of dead hearts).

I.5. Dry ears yield:

All treatments caused an increasing in maize ears yield especially, that of Nat 1 gave the highest yield (24.9 ardab / fed., *i.e.* 86.7% higher than control yield 13.3 ardab / fed.). The remaining 5 preparations took a different position between the mentioned groups of high and low effect. Those could be fairly arranged in descendingly order according to obtained yield as methanol-bestachia extract and in acetone that resulted two seasons averages of 22.6 and 22.0 ardab / fed. (69.3 and

65.3% increase than control), respectively. On the contrary, water-bestachia extract gave the lowest efficacy, 17.8 ardab, only (29.3% increase) (Table, 1).

I.6. Latent effect:

I.6.a. Pupal period:

As shown in Table (2), all preparations prolonged the pupal period (9.7 – 12.4 days) when compared with that in the control (9.0 day). The longest pupal period (12.4 days) resulted from the treatment of water-bestachia extract indicating the severest effect, followed, insignificantly, by Nat 1 (11.5 days). Natcom 40 and bestachia in methanol led to a similar pupal period 11.2 and 11.1 days, respectively. On the contrary, bestachia in acetone led to an insignificant pupal period 9.7 days than that in case of control (9.7 days). The chemical insecticide, Diazinox had an intermediate effect on the pupal duration (10.4 days), Table (2).

I.6.b. Pupal weight:

All field treatments caused significant reductions in the pupal weight when averaged 110 to 125 mg only / pupa opposed to 216 mg in the control. The severest effect was that of Nat 1 led to the highest pupae 110 mg / pupa. That was followed, insignificantly, by methanol-bestachia extract (119 mg / pupa). On the contrary, the lowest effect on the weight was from Natcom 40 152 mg / pupa) and Diazinox 151 mg / pupa), Table (2).

I.6.c. Egg hatching:

Latent effect of the different used materials on egg hatching is shown in Table (2). Normal *S. cretica* adults that developed from egg-mass collected from different maize plant treatments were allowed to lay eggs in which they were counted per female. The percentage of hatching eggs / female in the control was 81.9% as an average of the two seasons, on the other hand the lowest hatching, 24.9 and 32.1% were recorded from Nat 1 and bestachia in methanol treatments, respectively, indicating the highest efficacy. On the contrary, the chemical insecticide Diazinox had the least effect on eggs hatching (63.7% hatching indicating 22.2% decrease than control), followed, insignificantly, by Natcom 40 (58.4% hatching).

These results agree with the finding of Antonious *et al.*(1992) recorded the longest pupal duration of *Spodoptera littoralis* by feeding 4th instar larvae on leaves of castor bean treated with methanol-bestachia extract. The same authors attributed the primary effects of bestachia extracts seem due to antifeedant nature of this extract, the growth depression was mainly caused due to feeding depression or may be by the interaction of this extract in some way with the insect enzymatic or hormonal systems. Also, Abd-El Rahman (2003) mentioned that the jojoba oil at low rates, (1 and 0.5%)

decrease the infestation rates by *Liriomyza trifolii* in Faba bean field, about 83.84 and 90.82% reductions than control, respectively.

II. Laboratory results:

Responses of 1st, 3rd and 5th *S. cretica* larval instars to the different tested materials are shown in Table (3) and illustrated in Figs. (1 & 2).

Data found in Table (3) and Fig. (1) showed that, bestachia in acetone and Nat 1 were the most toxic materials against the three tested larval instars, had the lowest LC_{50} values, 0.079, 0.079 and 0.098% for the first material and 0.087, 0.057 and 0.121% for the second one against the three respective instars . In this respect, bestachia in methanol and Natcom 40 occupied the second rank, had LC_{50} values ranged between 0.159 – 0.183 and 0.122 – 0.151%, respectively. Diazinox caused the weakest effect against *S. cretica* larvae, ranged between 0.237 - 0.325% as LC_{50} values.

Also, the same table and Fig (2) revealed that LT_{50} values decreased as larval age increased and, in the same time, the natural materials needed shorter periods (2.71 – 6.96 days) than that needed for Diazinox to kill 50% of larval population.

The previous results are considered in harmony with those obtained by Hegazy *et al.* (1992) & Sadek (2003) when stated that phytochemical constituents extracted from bestachia extract in ethanol and methanol showed feeding deterrent effects against 2nd and 4th instars larvae of *S. littoralis* leading to insect mortality.

A general glance to all previous results illustrated in Table (1, 2 and 3) and Figs (1 & 2) pointed that, Nat 1 product is considered the most harmful against *S. cretica*. In addition to its clear toxicity (LC_{50} = 0.087 – 0.121%), it caused a recognized decrease in no. of egg-masses (about 68%) and larvae (about 81%) and egg hatching (70%) comparing with the control results. Also, it reduced the pupal weight (about 49%), shortened the pupal duration (about 28%) and finally increased clearly the yield about 87% than that in the control. Remain materials also increased the yield but relatively in lower ratios, 69.3, 56.3, 56.0, 50.7 and 29.3% for bestachia in methanol, bestachia in acetone, Natcom 40, Diazinox and bestachia in water, respectively.

Table 1. Average counts of egg-masses, larvae, infestation symptoms and dry maize yield after treatment by different plant extracts combined of two years 2002 & 2003.

Treatments	Average counts of two years				
	Egg-masses / 30 plants	No. of larvae / 20 plants	No. of (50 plants)		Yield (Ardab /fed.)
			Perforated leaf	Dead hearts	
Bw	4.2 ± 0.4	17.7 ± 2.18	6.5 ± 0.6	4.8 ± 1.4	17.8
	(3 – 6)	(10 – 26)	(4.4 – 9.2)	(1.5 – 12)	
% reduction or increase	43.2	40	57.8	63.9	+ 29.3
Bm	1 ± 0	7.8 ± 1.2	4.2 ± 0.7	2.5 ± 0.4	22.6
		(4.2 – 14)	(1.5 – 7.6)	(1.1 – 3.8)	
% reduction or increase	86.5	73.6	72.7	81.2	+ 69.3
Ba	2.3 ± 0.3	15.2 ± 2	5 ± 0.5	6 ± 1	22
	(0 – 4.5)	(9.2 – 24)	(3.6 – 8.3)	(2.4 – 9.5)	
% reduction or increase	68.9	48.4	67.5	54.9	+ 56.3
Nat 1	2.4 ± 0.3	5.5 ± 0.5	2.9 ± 0.5	1.8 ± 0.4	24.9
	(1 – 4)	(4 – 8)	(1.3-5.3)	(0.8 – 4.3)	
% reduction or increase	67.6	81.4	81.2	86.5	+ 86.7
Natcom 40	2.5 ± 0.4	13.7 ± 1.3	6.8 ± 0.9	5 ± 0.8	20.8
	(1 – 4)	(8.3 – 20)	(2.4 – 11.1)	(1.2 – 8)	
% reduction or increase	66.2	53.6	55.8	62.4	+ 56
Diazinox	3.9 ± 0.5	10.4 ± 1.1	6.7 ± 0.5	4.4 ± 0.9	20.1
	(2 – 6)	(4 – 14)	(5 – 9.6)	(0.9 – 7.2)	
% reduction or increase	47.3	64.7	56.5	66.9	+ 50.7
Control	7.4 ± 0.4	29.5 ± 3.1	15.4 ± 1	13.3 ± 2.61	13.3
	(6 – 9)	(12 – 40)	(11.8 – 19.4)	(4.3 –21.6)	
	–	–	–	–	
F value	8	11.4	11.7	28.2	7.4
L.S.D.	1.1	3.9	1.9	1.5	1.2

Bw: bestachia – water extract
Bm: bestachia – methanol extract
Ba: bestachia –acetone extract
An Aradab = 140 Kg

Table 2. Average counts of pupal period and weight and percent of eggs hatching / female as latent effects of plant extracts after field treatment.

Treatments	Average counts of two years for		
	Pupal period (days)	Weight of pupa (gm)	Egg hatching (%)
Bw	12.4 ± 0.4 (10.5 – 15.5)	0.139	53.1
Reduction %	37.8	35.4	35.1
Bm	11.1 ± 0.4 (10 – 25)	0.119	32.1
Reduction %	23.3	44.9	60.8
Ba	9.7 ± 0.4 (8.5 – 11)	0.132	49.6
Reduction %	7.8	38.7	39.4
Nat 1	11.5 ± 0.3 (10 – 12.5)	0.110	24.9
Reduction %	27.8	49	69.6
Natcom 40	11.2 ± 1.6 (10 – 13.5)	0.152	58.4
Reduction %	24.4	29.7	28.7
Diazinox	10.4 ± 0.5 (9 – 13)	0.151	63.7
Reduction %	15.6	29.9	22.2
Control	9 ± 0.3 (8 – 10.5)	0.216	81.9
		–	–
F value	3.7	17.2	
L.S.D.	1.1	0.028	

Bw: bestachia – water extract
Bm: bestachia – methanol extract
Ba: bestachia – acetone extract
An Aradab = 140 Kg

Table 3. LT_{50} & LC_{50} values calculated for *S. cretica* 1st, 3rd and 5th instar larval feeding on maize stems after different times and by 1% concentration of different materials.

Treatments	LT_{50} 'days' with concentration 1%			LC_{50} % after 14 days		
	1st instar	3rd instar	5th instar	1st instar	3rd instar	5th instar
Bw	6.96	3.19	2.94	0.141	0.408	0.159
Bm	5.13	4.31	3.04	0.159	0.174	0.183
Ba	6.12	3.20	2.71	0.079	0.079	0.098
Nat 1	4.25	3.01	2.53	0.087	0.057	0.121
Natcom 40	5.15	4.51	6.26	0.141	0.122	0.151
Diazinox	11.3	4.99	3.50	0.274	0.325	0.237

Bw: bestachia – water extract
Bm: bestachia – methanol extract
Ba: bestachia – acetone extract
An Aradab = 140 Kg

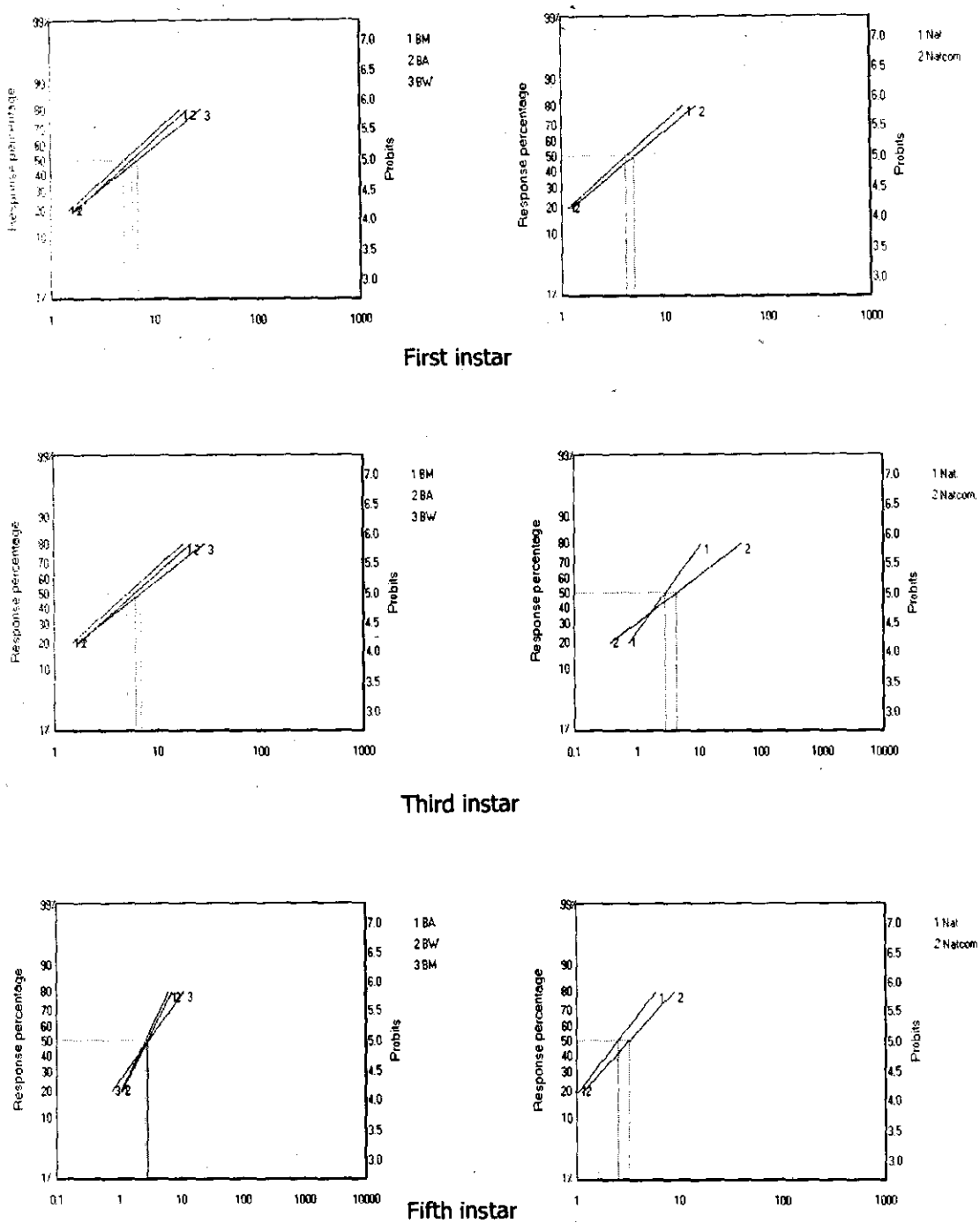
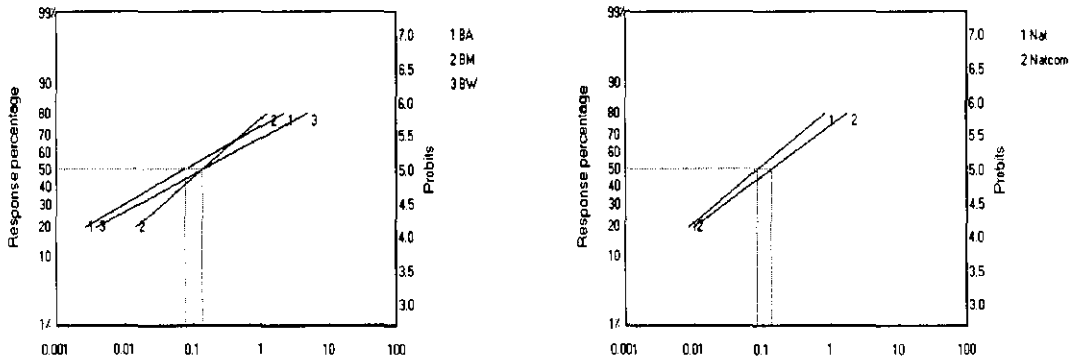
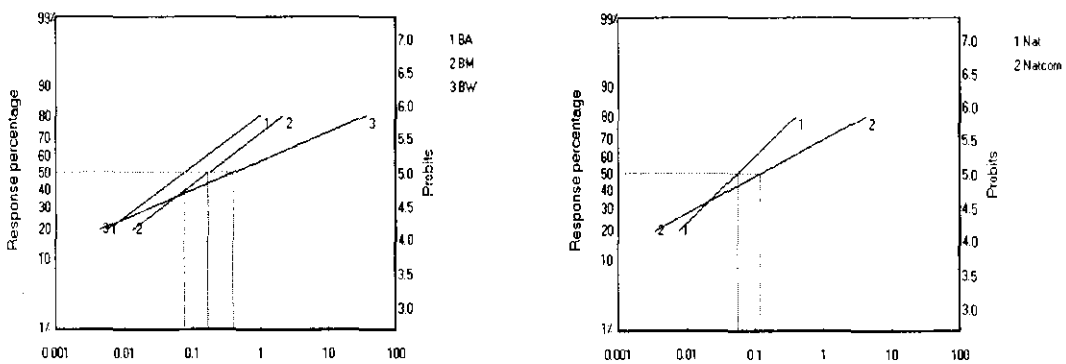


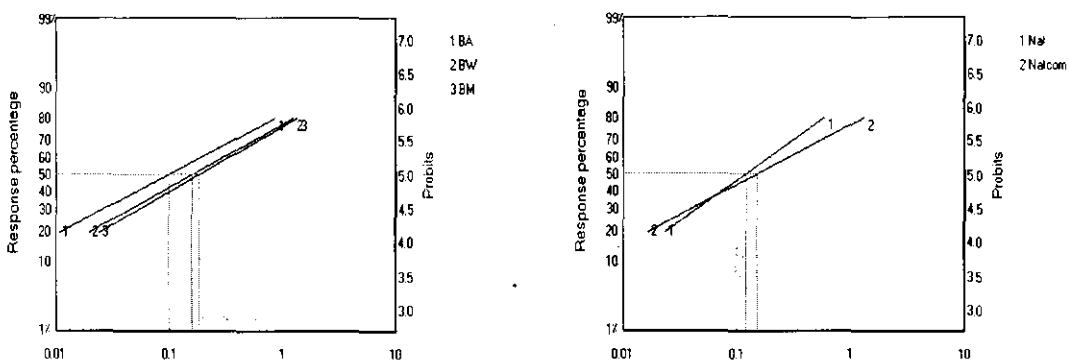
Fig 1. Probit-regression-time showing response of 1st, 3rd and 5th instar larvae fed on tender pieces of maize stems treated with different assayed materials.



First instar



Third instar



Fifth instar

Fig 2. Log concentration lines showing response of 1st, 3rd and 5th instars *S. cretica* larvae, 14, 9 and 6 days after feeding on tender pieces of maize stems treated with the assayed materials.

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تأثير بعض المستخلصات النباتية ضد دودة القصب الكبيرة فى حقول الذرة

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١. *قسم وقاية النباتات – كلية الزراعة – جامعة بنها*

٢. *معهد بحوث وقاية النباتات – وزارة الزراعة – الدقى – جيزة*

تعتبر مستحضرات زيوت الهوهوبا (نات ١، ناتكوم ٤٠) ومستخلصات أوراق البستاشيا فى كل من الماء والميثانول والأسيتون من المواد ذات الكفاءة فى مكافحة دودة القصب الكبيرة على نباتات الذرة. وخلال العروة الصيفية المبكرة لموسمي ٢٠٠٢، ٢٠٠٣ أثبتت النتائج أن مستخلص البستاشيا فى الميثانول حقق أفضل نسبة نقص فى تعداد لطع البيض (٨٦,٥% كمتوسط عامى الدراسة عن المقارنة). مستحضر نات ١ حقق أعلى نقص فى تعداد اليرقات (٨١,٤% كمتوسط عامي الدراسة عن المقارنة) وأعلى نقص فى تعداد النباتات المحتوية على أوراق مثقبة وحالات القلب الميت (٨١,٢، ٨٦,٥ عن المقارنة على الترتيب) كما أعطى هذا المستحضر محصول بمتوسط ٢٤,٩ أردب / فدان بزيادة ٨٦,٧% عن المقارنة. وبالنسبة للتأثير المتأخر أحدثت هذه المواد زيادة فى عمر العذارء عن المقارنة (٩ يوم)، ٤٩% نقص فى أوزان العذارى كما امتد التأثير لوضع البيض حيث انخفضت اعدادها كذلك نسبة الفقس بحوالى ٦١% الى ٦٩,٦% عن المقارنة توافقت نتائج الحقل مع نتائج الاختبارات الحيوية حيث كانت أقل قيمة LT50 (٤,٢٤، ٣,٠١، ٢,٥٣ يوم) بالنسبة للأعمار اليرقية الأول والثالث والخامس على الترتيب نتيجة المعاملة بمستحضر نات ١ بتركيز ١% وكذلك قيمة أقل LC50 تحقق للأعمار الثلاثة نتيجة المعاملة بمستخلص البستاشيا فى الأسيتون (٠,٠٧٩-٠,٠٩٨%) ونات ١ (٠,٠٨٧-٠,٠١٢١%) مما يشير الى أن زيت الهوهوبا (نات ١) ومستخلص البستاشيا فى الميثانول من الممكن استخدامهما فى برنامج عمل للمكافحة المتكاملة لدودة القصب الكبيرة فى زراعات الذرة.