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EVALUATION OF SOME NON-TRADITIONAL PESTICIDES AGAINST THE TWO POD BORERS *Helicoverpa armigera* AND *Etiella zinckenella* POPULATION INFESTING COWPEA IN THE NEWLY RECLAIMED REGIONS

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ABSTRACT

The two pod borers *Helicoverpa armigera* Hubner and *Etiella zinckenella* Treitschke are the most destructive insect pests which infest several crops of leguminosae in Egypt. Field experiments were conducted to evaluate the efficacy of some relatively safe compounds beside the conventional pesticides for control of these pests on cowpea, *Vigna ungiculata* under the conditions of newly reclaimed regions.

The results revealed that most of the treatments were able to suppress the levels of infestation to different degrees according to the nature of the tested compounds and the number of sprays applied. Application of non-traditional compounds such as thiamethoxam (neonicotinoid group) or Indoxacarb (oxadiazine group) significantly reduced the larval populations of *H. armigera* by 76 and 70% and *E. zinkenella* by 58 and 55%, respectively. Plots sprayed with methoxyfenozide (non-steroid ecdysone agonist)provided satisfactory control (60% reduction) against *H. armigera* population while exerted weak activity(< 26%) against *E. zinkenella* population.

On the other hand, the potency of the common neurotoxic pesticides; chlorpyrifos (organophosphate) or cypermethrin (pyrethroid) were still the most effective pesticides against both species giving 76-81% reduction in infestation.

However, all the tested pesticides and the rates used had low residual effect against the two insects and thus, weekly applications to protect the plants of new insect attack were necessary. The treatments received six applications, throughout the entire season, effectively contained the damage caused by pest population more than those received four or two applications.

At harvest, high grain yield was obtained in the plots treated 6 times with the tested compounds. In general, Chlorpyrifos was the superior compound being registered (45.9%) increase in yield over the untreated control value, followed by Thiamethoxam (41.6%), Indoxacarb (39.0%), Cypermethrin (38.8%) then Methoxyfenozide (33.9%). Moreover, remarkable elevation in the percentages of damaged grains (~ 28.0%) was recorded in all treatments sprayed twice throughout the season, while the corresponding values in those received 6 applications were restricted within 13.6-16.4%.

The effectiveness and moderate persistence of such new compounds, beside their low mammalian toxicity make them promising agents when used alone or with other control measures on cowpea plantations.

INTRODUCTION

Cowpea *Vigna unguiculata* (L) plants are subjected to attack by several insect pests , the most serious of which is the bean pod borer *Etiella zinckenella* (Olandiran and Oso, 1985 and Abdallah *et al*, 1994). The other pod borer *Helicoverapa armigera* has been recently observed at increasing numbers, in cowpea cultivated in the newly reclaimed parts of the desert.

The damage of *H . armigera* usually occurs predominantly on young undeveloped pods whereas *E. zinckenella* fed on seeds only (Van Den Berg *et al,* 1998). Thus , the whole pods are destroyed during the crop's reproductive stage resulting considrable loss of yield at harvest (Sukul *et al,* 1989).

Field applications of several organophosphorous and pyrethroid pesticides had demonstrated their efficacy and residual activity for controlling the pod borers in cowpea cultivations (Abo El-Ghar *et al*, 1994 and Bachatly *et al*, 2002). However , the widespread use of the traditional insecticides, their toxic residues and hazard impacts on the environment encourage many researchers to explore new but effective compounds as safe alternatives for pest control (Dhadialla *et al.,* 1998 and Tomizawa and Casida, 2003).

The present study was conducted to evaluate the insecticidal efficiency of some relatively safe compounds beside the conventional pesticides for control of the two pod borers and their subsequent effects on grain yield obtained.

MATERIALS AND METHODS

Field experiments were laid out in an area of about $^1/_2$ feddan cultivated with cowpea plants var. Kafr El – sheeh at Nubaria region , Beheira Governorate; where sandy loam soil type was dominant. Seeds growing took place on May 13, 2005 ; drip irrigated and most cultural methods were followed as commonly practiced. Plants when fully established, where thinned down to 1 plant /stand. A randomized block design incorporated 3 replicates of each treatment including untreated control. Each replicate (plot) was 6 × 7 m ($^1/_{100}$ fed.) and about 1m planted area was left around each plot to avoid any insecticide drifts.

Pesticide treatments and yield assessments :

The tested pesticides and their recommended rates of application are shown in table (1).

Table (1): The tested pesticides and their rates of application :

Common name	Trade name	Chemical group	Rate of use/100L (recommended)	LD_{50} for rats (mg/kg)
Thiamethoxam	Actara 25% WG	Neonicotinoid	20 gm	1563
Indoxacarb	Avaunt 15% SC	Oxadiazine	26.3 gm	1732
Methoxyfenozide	Runner 24% SC	Diacylhydrazine*	37.5 ml	> 5000
Chlorpyrifos	Chlorzan 48% EC	Organophosphate	250 ml	149
Cypermethrin	Slabeed 30% EC	Pyrethroid	50 ml	250

*** Non-steroid ecdysone agonist**

Weekly samples (10 pods/plot) were randomly collected during the reproductive growth stage , examined in the laboratory and when the average

numbers of larvae of *H. armigra* and *E. zinckenella* considerably increased (3.0-4.6 larvae 10 pods), the pesticides were applied. For each compound, spraying was conducted 2, 4, or 6 times throughout the reproductive stage. The first spray started on July 26, 2005 and the other sprays were followed at weekly intervals. A knapsack sprayer 20L capacity was used in applying the tested compounds as foliar treatments , dilute with water at the rate of 400 L water/fed.

Regular samples were collected weekly just before the next spray, examined, recorded and the percent reduction in larval infestation of each species was calculated according to Henderson and Tilton formula (1955).

At harvest, five random plants were labelled in each plot, where the pods were picked twice at 10 days apart. The harvest pods air dried , the grains were separated and sorted (intact and damaged) and their weights per 5 plants were determined. The data were analyzed by the analysis of variance (A NOVA) and Duncan's multiple, range (Snedecor, 1970).

RESULTS AND DISCUSSION

A). Effect of the tested compounds on *H . armigera* infestation :

The average number of larvae/replicate and percent of reduction in infestation are presented in table(2).

The results showed that most of the chemical treatments were able to suppress the levels of infestation to different degrees in comparison to that of untreated control. The suppression, however , greatly varied according to the nature of the tested compound and the number of sprays applied .

In the 1st week after spraying, where all the plots were treated once, the non–traditional compounds; thiamethoxam and indoxacarb displayed over 70% reduction in infestation, meanwhile the non steroid ecdysone agonist, methxoyfenozide exhibited moderate control (61% reduction). In the meantime the common neurotoxic pesticides chlorpyrifos and cypermethrin significantly reduced the larval content much more the new compounds and can protect the pods, from new insect attack giving 79-83% reduction in infestation. The same trend of results was also observed in the 2nd inspection. Ahmad *et al*, (2003) evaluated the toxicity of new chemistries viz. fipronil, indoxacarb, and emamectin benzoate against field populations of *H. armigera*, which were highly resistant to conventional chemistries. They found that the majority of population exhibited susceptibility close to the baseline data. They concluded that such new compounds can restore the profitability of crop protection by countracting and preventing insecticide resistance in *H . armigera* , populations.

The present results also indicated that, the reduction in infestation obtained in the 3rd and 4th inspections varied according to number of sprays applied. The larval population of *H. armigera* depressed more when the tested compounds were applied 4 times (treatments B) than those applied twice (treatments A). The reduction in infestation amounted to be 53 and 55% when thiamethoxam was applied twice compared to 78 and 100% in those received 4 times application , at 3rd and 4th inspections, respectively (table2). A similar pattern of efficiency was manifested in most corresponding treatments. The effectiveness of thiamethoxam and imidacloprid against

several economic insects on a variety of crops including barley, cotton and corn as well as stored products are well documented (Lawson *et a* , 1999 and Yue *et al* , 2003).

Table (2): Efficacy of the tested pesticides against the pod borer *H. armigera* on cowpea plants, Nubaria region.

Treatment		Avg. no. Larvae/10 pods (Percent reduction in infestation) as indicated weeks after the first spray									
		Pre-count (just before spraying)	1		2		3		4		Overall mean	
Thiamethoxam	A	5.6	1.3	(76)	1.6	(71)	1.6	(53)	1.0	(55)	1.4	(64)
	B	4.6	1.3	(70)	1.3	(72)	0.6	(78)	0.0	(100)	0.8	(80)
Indoxacarb	A	4.6	1.3	(70)	1.6	(65)	1.6	(43)	1.6	(12)	1.5	(48)
	B	6.0	1.6	(72)	1.6	(73)	0.6	(84)	1.6	(32)	1.4	(65)
Methoxyfenozide	A	4.3	1.6	(61)	1.6	(63)	1.6	(39)	2.0	(0.0)	1.7	(41)
	B	3.6	1.3	(62)	1.3	(64)	1.0	(54)	1.3	(8.0)	1.2	(47)
Chloropyrifos	A	5.0	1.0	(79)	0.6	(88)	1.0	(67)	1.6	(19)	1.1	(63)
	B	3.6	0.6	(83)	0.6	(83)	0.3	(86)	0.6	(58)	0.5	(78)
Cypermethrin	A	3.3	0.6	(81)	0.6	(82)	1.0	(50)	0.0	(100)	0.7	(78)
	B	3.3	0.6	(81)	0.6	(82)	0.3	(85)	0.0	(100)	0.4	(87)
Untreated		6.6	6.3	-	6.6	-	4.0	-	2.6	-	4.9	-
LSD at 0.05		2.5	1.5		1.2		1.0		1.1		1.4	

A= Received two applications. **B= Received four applications.**

In the subsequent samples collected after the 4th spray, several green pods were infested with *E. zinckenella* larvae , but no actual numbers of *H. armigera* , larvae were found any more, even in untreated plots. Such decline of the natural population may be attributed to the maturation of some cowpea pods as well as the relatives care of young undeveloped pods (Van Den Berg *et al*, 2000). Probably, the adult migration towards more preferable hosts surrounding the experimental region can not also be neglected.

B). Effect of the tested compounds on *E. Zinckenella* infestation

The reduction percentages in larval infestation caused by different pesticide treatments are presented in Table (3).

The results showed gradual increase in the natural population (expressed as numbers of larvae/10 pods), throughout the whole experimental period (6 weeks).

In the meantime, most of the chemical treatments significantly reduced the incidence of the pod borer infestation shortly after spraying and thus different degrees of suppression were obtained. Thiamethoxam presented 58 and 63% reduction in infestation after one and two weeks of spraying while Indoxacarb displayed 55 and 67% reduction against *E. Zinckenella* population, repectively, table (3). However, the effects of the tested compounds (except methoxyfenozed), did not greatly differ of those obtained concerning the other lepidopterous insect *H . armigera* (Table 2).

The treatments were more recognized at 3rd inspection and forth where pesticides were applied 2, 4, or 6 times throughout the season. A progressive increase in the larval population was observed in the successive samples collected from treatments A (where the plotes were received only

twice sprays) table (3). This mean that the direct spray was able to affect the pod borer and protect cowpea plants for only two weeks after application and the insect population regained its vitality afterwards i.e. indicating short residual effects of the tested compounds.

Abo El-Ghar *et al* (1994): mentioned that the numbers of *E. Zinckenella* larvae found after 7 days of treatments of selected organophousphorous, carbamates and pyrethroids insecticides were significantly reduced by > 86% than those in the untreated plots. However , the IGRs applied alone , flufenoxuron , Dowco – 439 or in mixtures methomyl / flufenoxuron and chorpyrifos / Dowco – 439 exhibited moderate levels in controlling the larvae through 21 days after the treatments.

Table (3): Efficacy of the tested pesticides against the pod borer *E. zinckenella* on cowpea plants, Nubaria region

Treatment		Avg. no. Larvae/10 pods (percent reduction in infestation) as indicated weeks after the first spray							
		Pre-count (just before spraying)	1	2	3	4	5	6	Overall mean
Thiamethoxam	A	3.6	2.3 (58)	2.0 (63)	3.0 (53)	5.3 (27)	7.6 (17)	10.0 (15)	5.0 (38.8)
	B	4.0	3.6 (41)	2.3 (61)	2.6 (64)	3.0 (63)	3.6 (65)	6.0 (54)	3.5 (58.0)
	C	5.6	4.3 (50)	3.0 (64)	2.6 (74)	2.6 (77)	3.6 (75)	5.3 (71)	3.6 (68.5)
Indoxacarb	A	3.3	2.3 (55)	1.6 (67)	2.6 (59)	4.6 (31)	7.0 (17)	8.6 (20)	4.5 (41.5)
	B	4.6	3.6 (49)	2.6 (62)	3.0 (63)	2.6 (72)	5.3 (55)	8.0 (47)	4.2 (58.0)
	C	5.3	3.6 (55)	2.6 (67)	3.3 (65)	3.6 (72)	4.0 (70)	6.3 (64)	3.8 (65.5)
Methoxyfenoz-	A	3.6	5.6 (0.0)	3.6 (33)	5.3 (18)	6.0 (18)	7.6 (17)	9.6 (18)	6.3 (17.3)
ide	B	4.3	6.3 (5..0)	4.0 (37)	6.0 (22)	6.0 (31)	9.0 (18)	11.3 (20)	7.1 (22.2)
	C	3.3	4.6 (9.0)	3.6 (26)	3.6 (39)	4.0 (40)	7.0 (17)	7.3 (32)	5.0 (27.2)
Chloropyrifos	A	4.6	1.6 (77)	1.6 (77)	3.3 (60)	6.0 (35)	8.3 (29)	10.3 (31)	5.2 (51.5)
	B	3.3	1.6 (68)	1.3 (73)	1.6 (73)	1.6 (76)	3.0 (64)	7.0 (35)	2.7 (64.8)
	C	4.6	2.3 (67)	1.0 (85)	2.3 (72)	2.0 (78)	2.6 (78)	3.0 (80)	2.2 (76.7)
Cypermethrin	A	4.3	1.6 (76)	1.6 (75)	2.6 (66)	6.0 (31)	7.6 (31)	11.0 (22)	5.1 (50.2)
	B	3.6	2.3 (58)	1.3 (76)	1.6 (65)	1.6 (78)	3.0 (67)	7.0 (41)	2.8 (65.8)
	C	4.6	2.3 (67)	1.3 (81)	1.6 (81)	1.6 (83)	2.3 (80)	3.3 (78)	2.1 (78.3)
Untreated		5.6	8.6 -	8.3 -	10.0 -	11.3 -	14.3 -	18.3 -	11.8 -
L.S.D at 0.05		1.4	0.9	1.1	1.2	1.5	1.8	1.6	2.0

A= Received two applications. B= Received four applications. C= Received six applications.

Similarly , the insect population of treatments B raised with the time elapsed after spraying compared to those treated six times (treatments C). This confirm the previous results of short residual effects of the tested compounds. Such decline (short persistence) of the activity was manifested even in the conventional pesticides . The prevailing weather conditions of Nubaria region during July and August which exceeds 38 °C during the daytime 16 hrs. may play an important role in enhancing the compounds degradation.

In controlling the major insect pests (including *H. amigera* and *E. zinkenella*) of soybean in Thailand, Abdullah *et al*, (2001) concluded that better control and highest yield were achieved when applied cypermethrin at 0.0007% , Azadirachtin at 0.1% or Delfin at 53.000 unit / mg at 10 days

interval until harvest.

C). Effect of the tested compounds on grain yield :

The data of grain yield /5 plants obtained after different insecticidal treatments are presented in table (4).

As mentioned before , most of the treatments suppressed the pest populations and thus , positive effects on the yield were gained compared to the unsprayed control. However the grain yield tended to be higher in plots sprayed 6 times than those received four or only two applications. In term of figures, 138.6, 155.5 or 173.5 gm grain/5 plants were obtained where the insecticide thiamethoxam was sprayed 2, 4 or 6 times, respectively. Similar results were recorded with the other tested pesticides. Chlorpyrifos was the superior compound in this respect being registered 45.9% increase in the yield over the control value followed by thiamethoxam. (41.6 %) , and indoxacarb (39%), cypermethrin (38.8%) then methoxyfenozide (33.9%). Owatsakul (1998) reported that cyhalothrin L 2.5 % EC at 20 m/20 L and alphacypermathrin 10% EC at 15ml/20 L provided effective control of the limabean pod borer, the infested pods were about 14.5% and 25.8% respectively, compared to 77.4% in the untreated plots.

Since majority of the Egyptians often consume cowpea as dry grains after cooking , the incidence of the grain damage was considered in present study. The results in table (4), indicate remarkable elevation in the percentages of damaged grain in all treatments sprayed twice throughout the season.

Table (4): Effect of various insecticidal treatments on grain yield of cowpea plants.

Treatment		Avg. grain yield (gm/5 plants)			% increase over control	% damaged grains
		Intact	Damaged	Total		
Thiamethoxam	A	103.6	35.0	138.6	13.1	25.3
	B	134.5	21.0	155.5	26.9	13.5
	C	148.5	25.0	173.5	41.6	14.4
Indoxacarb	A	98.8	46.2	145.0	18.4	31.9
	B	116.0	28.5	144.5	17.9	19.7
	C	142.3	28.0	170.3	39.0	16.4
Methoxyfenozide	A	96.4	35.6	132.0	7.8	27.0
	B	108.5	33.5	142.0	15.9	23.6
	C	126.5	37.5	164.0	33.9	22.9
Chloropyrifos	A	94.6	42.0	136.6	11.5	30.7
	B	115.8	29.6	145.4	18.7	20.4
	C	150.2	28.6	178.8	45.9	16.0
Cypermethrin	A	99.1	37.5	136.6	11.5	27.5
	B	124.2	21.0	145.2	18.5	14.5
	C	146.8	23.2	170.0	38.8	13.6
Control		88.2	34.3	122.5	-	28.0
LSD at 0.05		19.5	5.2	20.4		3.4

A= Received two applications. B= Received four applications.
C= Received six applications.

Such effects , which related to high pest infestation, sometimes exceed the control value (28.0%). On the other hand, in most treatments received 6 sprays, beside the high productivity gained, the reduction in the damaged grains was restricted within 13.6 – 16.4 %.

In fact, the tested pyrethroid and organophosphate pesticides are prominent tools for control both insect species. However, the effectiveness and moderate persistence of such new compounds, beside their low mammalian toxicity make them promising pest control agents (Smagghe *et al* 1999 and Abdalla *et al*, 2005) .

It could be concluded that weekly applications of the promising compounds during podding and maturation stage of cowpea plants are necessary in controlling both *H. armigera* and *E. Zinckenella* populations. They also should be used in rotation with each other to reduce the possibility of resistance development.

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تقييم فاعلية بعض المبيدات الغير تقليدية على المجموع الحشري لكل من دودة اللوز الأمريكية ودودة قرون اللوبياء التى تصيب اللوبياء فى الأراضي حديثة الاستصلاح.

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قسم آفات ووقاية النبات، المركز القومي للبحوث.

تعد حشرتا دودة اللوز الأمريكية *Helicoverpa armigera Hubner* ودودة قرون اللوبياء *Etiella zinckenella Treitschke* من أكثر الآفات ضررا للعديد من المحاصيل البقولية فى مصر. أجريت تجارب حقلية لتقييم كفاءة بعض المركبات الآمنة نسبيا وبعض المبيدات التقليدية فى مكافحة الآفتين على اللوبياء تحت ظروف المناطق المستصلحة حديثا.

بينت النتائج قدرة معظم المعاملات الكيميائية فى خفض مستويات الإصابة بدرجات مختلفة تبعا لطبيعة المركب المختبر وعدد مرات استخدامه. فالمعاملة بالمركبات غير التقليدية مثل thiamethoxam أو indoxacarb أحدثا خفضا معنوياً في التعداد اليرقي بنسبة ٧٦ ، ٧٠% لدودة اللوز الأمريكية وبنسبة٥٨ ، ٥٥% لدودة قرون اللوبياء لكلا المركبين، على التوالي. أما المعاملة بالمبيد methoxyfenozide، فقد أظهرت أيضا نتائج مرضية ضد يرقات دودة اللوز الأمريكية (حوالي ٦٠% خفضا فى الإصابة) بينما نشاط ضعيف (لم يتعدى ٢٠%) ضد يرقات دودة قرون اللوبياء. ومن ناحية أخرى هناك مبيدات أكثر تأثيرا على كلتا الحشرتين فاستخدام chlorpyrifos أو cypermethrin عملا على خفض الإصابة بنسبة ٧٦-٨١% وتشير النتائج أيضا أن جميع المبيدات المختبرة لها تأثير باق ذو فعالية محدودة، ولذا فتكرار الرش أسبوعيا يعد ضروريا لحماية النباتات من أية إصابات حشرية جديدة. كما أن المعاملة ٦ مرات طوال موسم النمو أدى إلى خفض الضرر الناتج عن الإصابة الحشرية بصورة أفضل مقارنة بالمعاملات الأخرى التى تم رشها مرتين أو أربعة مرات. وعند الحصاد إنعكس تأثير هذه المعاملات على الانتاجية وكان المحصول الناتج من ٦ معاملات يفوق المحصول الناتج من المعاملات الأقل تكرارا، وقد إزداد المحصول بنسبة ٤٥,٩% مقارنة بالشاهد عند المعاملة بالمبيد chlorpyrifos يليه thiamexthoxam (٤١,٦%)، indoxacarb (٣٩%) وcypermethrin (٣٨,٨%) لكلاً منهم وأخيرا methoxyfenozide (٣٣,٩%) وقد صاحب ذلك ارتفاع ملحوظ فى نسبة الحبوب التالفة ، بلغت ٢٨% فى المعاملات التى أجريت مرتين فقط طوال الموسم، بينما كان مستوى الضرر فى الحبوب محصوراً بين ١٣,٦% ، ١٦,٤% فى حالة المعاملات التى طبقت ست رشات طوال الموسم،ويمكن القول أن كفاءة هذه المركبات الحديثة ومدى ثباتها المناسب على النباتات المعاملة، بالإضافة إلى قلة سميتها على الثدييات تجعل منها مبيدات واعدة فى المكافحة عند استخدامها منفردة أو مع طرق المكافحة الأخرى على نباتات اللوبياء.