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ROLE OF INSECT GROWTH REGULATORS (IGR_S) FOR COTTON LEAFWORM; *Spodoptera Littoralis* BOISD. AND CONSERVING TO SOME PREDATORS IN SUGAR BEET FIELDS

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ABSTRACT

The cotton leafworm, *Spodoptera littoralis* Boisd. is considered the most dangerous insect pest which threat the early sugar beet plantations. Because the conventional insecticides lead to much hazards to natural enemies, it has been important to find out other alternative safe technique. The current investigation was conducted at sugar beet fields in 2013 and 2014 seasons at Shenno village (Kafr El-Sheikh Governorate) for evaluating the effect of one conventional compared to insect growth regulators (anti-moulting) on larval mortality of *S. littoralis* and their side effects on certain predators mainly (*Chrysoperla carnea* Setphens and true spiders). Field tests proved that the insect growth regulators caused high reductions in larvae populations, ranging between 93.39 and 94.98% where are almost the same with conventional one (94.88%) . The insect growth regulators caused a low reduction in *Chrysoperla carnea* and true spiders populations (35.54 – 40.51%), while the conventional insecticide caused a high reduction in these predators by 93.39%. This investigation show that the insect growth regulators were efficient in reducing the larvae populations of *S. littoralis*, and in the same time caused a low reduction on predators in comparison with the conventional one.

INTRODUCTION

Sugar beet, *Beta vulgaris* L. is the second largest crop after sugarcane for sugar production in the world and about 28% of sugar is produced from sugar beet. Sugar beet contains 3 to 4% more sucrose than sugarcane (Baloach *et al*., 2002). In Egypt, total planted area of this crop is about 433 thousand feddans (Anonymous, 2014).

The cotton leafworm, *Spodoptera littoralis* Boisd. is a destructive insect pest of sugar beet plantations, particularly to the early plantations as the larvae seriously attack the younger plants causing significant defoliation (Guirguis, 1985; Youssef, 1986 and Shalaby *et al*., 2011).

The excessive use of conventional insecticides, particularly those with long residual effect, has caused severe harm to the natural balance between pests and their enemies. Insect growth regulators (IGRs) offer alternatives to conventional chemical larvicides that pose problem of resistance and environmental safety (El-Khayat *et al*., 2012 and Sadanandane *et. al*., 2012).

Recently, the insect growth regulators have been developed as insecticides with high activity against lepidopterous and coleopterous insect pests. Their effects on growth and development of various larval stages of *S. littoralis* and they had no effect against egg and pupal stages (Gujar and Mehrotra, 1986). Toxicity and biochemistry study of some insect growth

regulators were carried out on the cotton leafworm, *Spodoptera littoralis* larvae at different application rates . Larval weight gain was considerably decreased as concentration increased. Pyriproxyfen showed high antifeedant activity in a concentration-dependent manner, and larvae stopped to eat from the third day with high dose. (Nasr and Badawy, 2010).

The present study was carried out to investigate the effect of some insect growth regulators (IGRs) and conventional insecticides, against larvae of *Spodoptera littoralis* feeding upon the sugar beet plants sown early, during August plantations, and their side effects on some predators, mainly *Chrysoperla carnea* Stephens and true spiders (Araneae).

MATERIALS AND METHODS

This experiment was conducted at a sugar beet field planted with Demapoly cultivar on 2nd of August at Shenno village, Kafr El-sheikh Governorate for two successive seasons; 2012/2013 and 2013/2014.The experimental field was divided into 20 plots (each measured 42m²). The plots were laid out as five treatments and four replicates. The treatments were as follows:

a) Tac 50% EC (Chlorpyrifos), conventional insecticide
b) Diname 5%SG(Emamactin benzoate), anti growth regulatore(AGR).
c) Nomolt 15% EC(Teflubenzuron), AGR.
d) Echio 10% EC(Novaluron), AGR.

Numbers of *S. littoralis* larvae, *Chrysoperla carnea* eggs and larvae and true spiders(adult and juvenile) were counted per 40 sugar beet plots just before spraying. The using knapsack sprayer (20 L volume) was used for spraying when infestation by *Spodoptera littoralis* reached 10 egg- masses/ 100 sugar beet plants. Doses of treatments are presented in Table(1).

Numbers of *S. littoralis* larvae and true predators were counted one, 7, and 10 days after spraying for Tac insecticide and 3, 7 and 10 days after spraying for the other insecticides because of no response (mortality and/or abnormal molting with impaired ability to feed) was observed with one-day-old larvae until 48 h after treatment (Fisk and Denis, 1992). Reductions were calculated by Henderson and Tilton (1955) formula

Reduction % =

$$1-\frac{\text{No in treated plots after spray}}{\text{No. in treated plots before spray}}\times\frac{\text{No in check plots before spray}}{\text{No. in check plots after spray}}x100$$

RESULTS AND DISCUSSION

1.Effect of treatments on mortality of *Spodoptera littoralis* larvae:

Data presented in Tables (1 and 2)show the effect of treatments on *S. littoralis* population. In the first season(2012/2013), the conventional insecticide(Tac 50% EC) induced a population reduction of 92.05% one day after treatment, with any effect to antimoulting compounds as they still not working against the larvae moulting. Three days after treatment, the insect growth regulators (IGR) resulted in mortality values ranging between 91.01 and 94.02% and the values of mortality were particularly higher seven days after treatments; 95.81- 97.30%. However, the average mortality over the experimental period due to IGR ranged between 93.53 and 94.58%, which is almost the same effect of the conventional insecticide(94.06% mortality). Statistical analysis revealed no significant differences among the four treatments.

Results of the second season 2013/2014 (Table 2) took a trend similar to that of the first season. The conventional insecticide(Tac 50% EC) killed 94.53% of *S. littoralis* larvae one day after treatment. The average insect reductions over all the experimental period were 95.28, 95.57, 93.25 and 95.69% for Dinamo, Nomolt, Echio(IGR) and Tac(coventional insecticide), respectively. The results in Fig.(1) showed that each treatment contributed by a quarter. So, the insect growth regulators had an effect similar to a chemical insecticide.

2. Effect of insecticides on mortality of *Chrysoperla carnea* and true spiders:

In 2012/2013 season (Table 3) one day after treatment, the conventional insecticide (Tac 50% EC) killed 93.77% out of *C. carnea* and true spiders, with an over all average throughout the four examinations of 92.54% . By contrast, the three IGRs proved to be much safer to the considered predators with reduction values of 40.93, 35.17 and 40.07% for Dinamo, Nomolt and Echio, respectively.

Data of the second season (Table 4) were very similar to those of the first one. One day after treatment with the conventional insecticide(Tac 50% EC), 95.11% of the predators were killed, at mortality reached 94.22% seven days after treatment. Also, the IGRs were less affecting on both natural enemies, resulting in only reductions of 40.08, 35.91 and 38.32% for Dinamo, Nomolt and Echio, respectively. Therefore, the mean reductions were 40.51, 35.54 and 39.20% for Dinamo, Nomolt, Echio respectively . While the highly mean reduction (93.38%) recorded when using Tac.(Fig. 2). Data analysis indicated significant differences between in predators' reductions between the four insecticides.

Many authors reported that insect growth regulators conserve natural enemies compared to conventional insecticides ones, e.g. Valentine *et al*. (1996) mentioned that numbers of spiders were lower in conventional pesticides treatments compared with insect growth regulators for lepidopteran pest control in apples. Also, Naranjo *et al*. (1998) investigated that use of insect growth regulators (IGRs) help to conserve populations of *Bemisia*

tabaci natural enemies. In Pakistan**,** Gogi *et al*. (2006) reported that buprofezin and lufenuron for control of *Bemisia tabaci* and *Helicoverpa armigera* achieved significant reductions in cotton crop damage and appeared safe to predator populations; chrysopids, coccinellids, formicids and arachnids . This finding agree with Ferreira *et al*. (2006) who found that emamectin benzoate was harmless and chlorpyrifos was harmful to populations of *Chrysoperla externa* Hagen. El-Khouly (2002) showed that insect growth regulators (e.g. teflubrenzuron) caused a high reduction against *Cassida vittata* Vill. numbers with lower toxicity against predators in sugar beet fields.

Generally, chitin synthesis inhibitors (CSIs) are One of the biggest groups of the growth regulators against Lepidopteran larvae among others, developing molt disruption by inhibiting membrane transport of UDP-N-acetylglucosamine. However, CSIs may adversely affect non-target organisms including benificial insect species and crustaceans with chitin as a component of exoskeleton (Miyamoto *et al*. 1993).

Table (1): Reductions in *Spodoptera littoralis* larvae due to IGRs and insecticides applications in August plantation, 2012/2013 season.

Treatments	1st day	3rd day	7th day	10th day	Mean
Dinamo 5% SG 20 gm/100 L water	-	91.01	97.30	95.43	94.58 a
Nomolt 15% SC, 50 cm/100 L water	-	94.00	95.90	93.25	94.38 a
Echio 10% EC, 60 cm/100 L water	-	94.02	95.81	90.75	93.53 a
Tac 50% EC, 1 liter/feddan	92.05	-	96.89	93.23	94.06 a

The values were an average of four determinations. Values followed by the same letter in column are not significantly different at p < 0.01 .

Table (2): Reductions in *Spodoptera littoralis* larvae due to IGRs and insecticides applications in August plantation, 2013/2014 season.

Treatments	1st day	3rd day	7th day	10th day	Mean
Dinamo 5% SG 20 gm/100 L water	-	93.47	96.28	96.11	95.28 a
Nomolt 15% SC, 50 cm/100 L water	-	94.80	97.84	94.07	95.57 a
Echio 10% EC, 60 cm/100 L water	-	93.79	97.84	88.14	93.25 a
Tac 50% EC, 1 liter/feddan	94.53	-	97.22	95.32	95.69 a

The values were an average of four determinations. Values followed by the same letter in column are not significantly different at p < 0.01 .

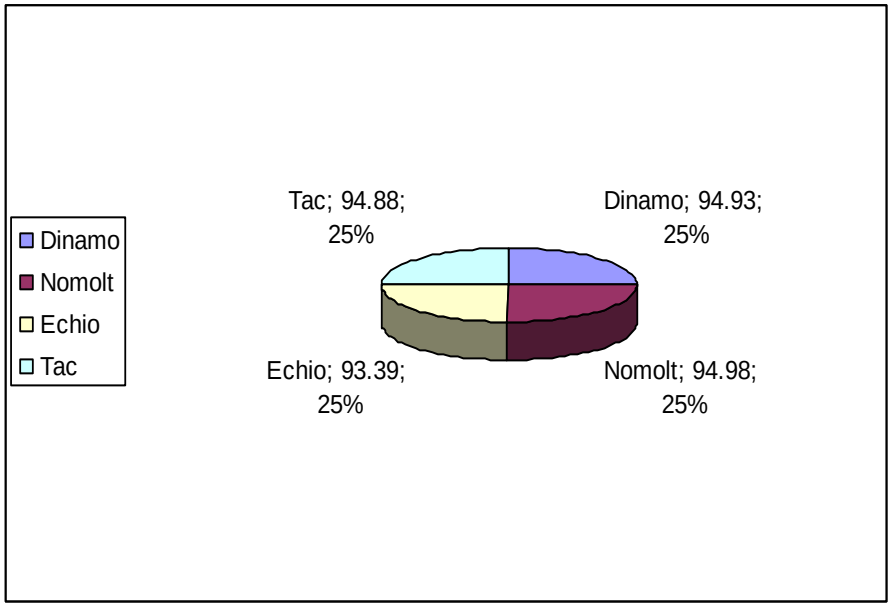

Fig.(1): Maen reductions in the larvae of S. Littoralis during seasons, 2012/2013 and 2013/2014.

Table (3): Reduction percentages in *Chrysoperla carnea* and true spiders (Araneae) due to IGRs and insecticides applications in August plantation, 2012/2013 season.

Treatments	*Chrysoperla carnea*					True spiders					Overall mean
	1st day	3rd day	7th day	10th day	Mean	1st day	3rd day	7th day	10th day	Mean	
Dinamo 5% SG 20gm/100 L water	-	46.37	43.11	42.48	43.99	-	41.28	38.17	34.16	37.87	40.93b
Nomolt 15% SC, 50 cm/100 L water	-	40.21	37.70	36.00	37.97	-	35.94	30.65	30.52	32.37	35.17b
Echio 10% EC, 60cm/100 L water	-	44.10	41.87	41.03	41.62	-	42.00	39.47	34.09	38.52	40.07b
Tac 50% EC, 1liter/feddan	95.94	-	93.34	91.22	93.50	92.53	-	92.09	90.12	91.58	92.54a

The values were an average of four determinations. Values followed by the same letter in column are not significantly different at p < 0.01 .

Table (4): Reduction percentages in *Chrysoperla carnea* and true spiders (Araneae) due to IGRs and insecticides applications in August plantation, 2013/2014 season.

Treatments	*Chrysoperla carnea*					True spiders					Overall mean
	1st day	3rd day	7th day	10th day	Mean	1st day	3rd day	7th day	10th day	Mean	
Dinamo 5% SG 20gm/100 L water	-	42.81	41.92	40.00	41.58	-	41.44	38.58	35.73	38.58	40.08b
Nomolt 15% SC, 50 cm/100 L water	-	37.72	37.54	35.40	36.89	-	38.09	35.52	31.18	34.93	53.91b
Echio 10% EC, 60cm/100 L water	-	41.63	39.16	37.02	39.27	-	41.28	38.31	32.52	37.37	38.32b
Tac 50% EC, 1liter/feddan	94.67	-	92.51	92.07	93.08	96.70	-	95.42	93.96	95.36	94.22a

The values were an average of four determinations. Values followed by the same letter in column are not significantly different at p < 0.01 .

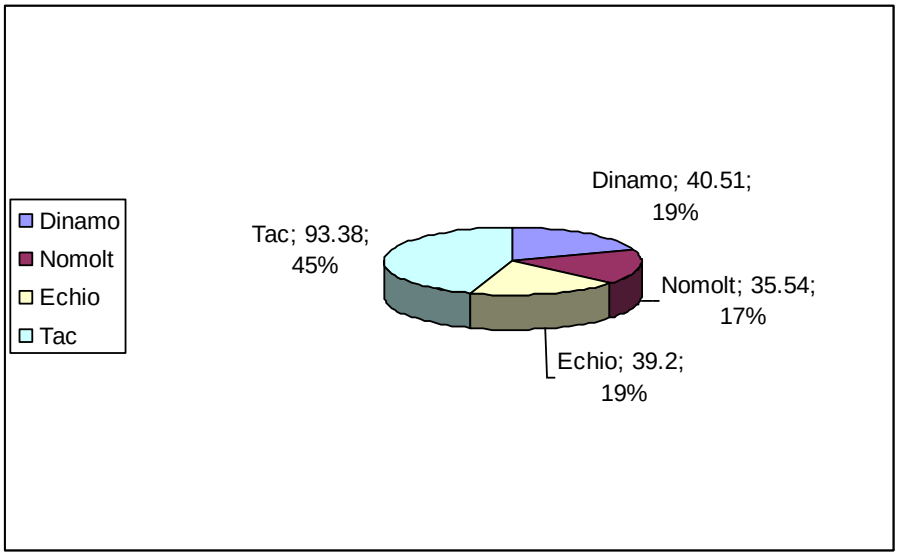

Fig. (2):Mean reductions in the tested predators during seasons, 2012/2013 and 2013/2014.

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دور منظمات النمو الحشرية في مكافحة دودة ورق القطن و الحفاظ على بعض المفترسات في حقول بنجر السكر

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تعتبر دودة ورق القطن *Spodoptera littoralis* Boisd من أخطر الآفات الحشرية التي تهدد زراعات بنجر السكر المنزرعة خلال العروات المبكرة ، ونظرا لأن استخدام المبيدات الحشرية التقليدية يؤدى لأضرار خطيرة للأعداء الحيوية ، أجرى هذا البحث في حقول بنجر السكر بقرية شنو ، محافظة كفر الشيخ موسمى 2012/ 2013و 2013/2014م ، لتقييم تأثير مانعات الانسلاخ على يرقات دودة ورق القطن مقارنة باحدى المبيدات التقليدية وكذلك الآثار الجانبية لهذه المبيدات على بعض المفترسات (أسد المن والعناكب الحقيقية).

أثبتت التجارب الحقلية أن المركبات المانعة للانسلاخ أحدثت انخفاضا في تعداد اليرقات بقيم عالية تراوحت بين 93,25% , 95,57% حيث تشابهت مع المبيد التقليدي الذي سجل انخفاضا تراوح بين 95,69،94.06 %. بينما سببت المركبات المانعة للانسلاخ انخفاضا في تعداد أسد المن والعناكب بقيم تراوحت بين 35,17 ، 40,93% ، أما المبيد التقليدي أحدث انخفاض كبير في تعداد هذه المفترسات مقداره 17.92 .

توضح نتائج هذا البحث أن المركبات المانعة للانسلاخ كانت فعالة في خفض تعداد يرقات دودة ورق القطن وفى نفس الوقت كانت آمنة نسبيا على كل من أسد المن والعناكب الحقيقية بالمقارنة بالمبيد الحشرى التقليدى .