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Performance of Two Spinosyn Products to Combat the Grasshopper, *Catantops axillaris* Thunburg, (Orthoptera: Acrididae) in Comparison to a Conventional Insecticide in Baharia Oasis of Egypt

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ABSTRACT

Field trials to evaluate the performance of two spinosyn products namely spinosad (spintor 24SC) and spinetoram (radiant 12 SC) in comparison with chloropyrifos (dursban 45% ULV) to combat the nymph instars of the predominant grasshopper, *Catantops axillaris* (Orthoptera: Acrididae) were conducted in Baharia Oasis, in Egypt during the summer season of 2007. After 24 hours post spray, initial kill of spinosad at 24, 30 and 36 g.a.i. showed reduction % as 74.04, 73.40 and 74.04%, respectively .Initial kill of spinetoram at 6, 9 and 12 G.A.I. /fed., indicated reduction % as 78.34, 77.11 and 80.21%, respectively. The conventional insecticide chlorpyrifos 45% at 94.5 g.a.i/ fed resulted in 88.64 % as reduction. The residual effect of the three products continued to show very good performance up to 10 days after application with more than 87% kill. Spinotoram 12 SC was very close to Chlorpyrifos performance. Spinotoram was 12 SC 3-4 times stronger than spinosad based on g.a.i /fed. The two spinosyn products proved to be good alternative to the conventional insecticide. Radiant represented the lowest g.a.i used to kill grasshoppers (6-12 g.a.i /fed). Results of these trials are the 1st report about these new safe bio-insecticides to combat the grasshoppers in Egypt.

Key Words: Efficacy, Spinosad, Spinetoram, Grasshoppers.

INTRODUCTION

Along the last three decades, several laboratory and field trials were carried out to combat the desert locust and grasshoppers in Egypt by using alternative different classes of safe and environmentally acceptable chemicals; El-gammal (1983); El-Gammal *et al.* (1988, 2001, 2004a & b); El-Gammal (1983, 1992, 1994, 2003) and El-Gawhary *et al.* (2006). These trials were conducted to control of the desert locust, *Schistocerca gregaria* F. and the grasshoppers, *Euprepocnemis plorans plorans* and *Catantops axillaris* using insect growth regulators, plant extracts, spores of *Metahrizium flavoviride*, anti-molting agents and desert locust egg pod extracts.

The 1st generation of spinosyn family is Spinosad. It has a favorable mammalian toxicity and environmental profile (Sparks *et al.* 1995).The availability of a novel chemical group, with a new mode of action that differs from conventional insecticides in current use, is an asset to insecticide resistance management programs (Horowitz and Ishaaya 1994). Furthermore, Temerak (2003) stated that Spinosad is not easily affected by the existing resistance mechanisms for conventional insecticides in Egypt. Peterson *et al.* 1997 indicated that application of Spinosad in conjunction with naturally occurring beneficial arthropods is an excellent example of a functional integrated pest management (IPM) program. The 2nd generation of the same family is Spinotoram. Temerak (2007) reported that radiant 12SC was 5 times stronger than Spintor 24SC for the control of cotton leaf worm in the field.

The naturally produced bio-insecticides by plants or by micro-organisms could prove effective substitute for insecticides because they are feasible, economical, biodegradable, slow to select of resistance, and carefully targeted durable due to their unique characteristics (Zain-Ul-Abdin, 2002).

Therefore, the present study is an attempt to test two spinosyns with novel mode of action for the control of the grasshopper, *Catantops axillaris* (Thumberg) (Orthoptera: Acrididae) under field trial conditions in Baharia Oasis, Egypt.

MATERIALS AND METHODS

1-Target pest

C. axillaries is the most predominant acridid insect in Baharia Oasis, especially on alfalfa. The chemical insecticides are still the most effective controlling tool against this pest.

The population density of the nymphal instars of *C. axillaris* in the summer season of 2007 ranged from

20 to 25 nymph /m^2, especially during July and August. Therefore, these insects as well as the location were chosen to investigate the performance of two new bio-insecticides with novel mode of action in the fields of alfalfa of Baharia Oasis during August, 2007.

2. Insecticides used

2.1. Spinosad (spintor 24 SC)

Spinosad is the first active ingredient derived from the metabolites of the naturally occurring Actinomycete-bacteria, *Saccharopolyspora spinosa* Martz & Yao by Dow AgroSciences Co.. It's formulation is a mixture of two of active metabolites of this bacteria, spinosyn. **A**, ($C_{41}H_{65}NO_{10}$) and spinosyn **D**, ($C_{42}H_{67}NO_{10}$). Spinosad represents the 1st generation in the family of spinosyns

2.2. Spinotoram (radiant 12 SC %)

Spinotoram is the 2nd generation in the spionsyn family. It is a new member of spinosyn metabolites developed by Dow Agrosciences. It was derived by fermentation of *S. spinosa* followed by chemical modification to create the unique active ingredient of Radiant (Spinetoram), which consists of a mixture of, major component (3-ethoxy-5,6-dihydro, spinosyn J) and the minor one (3-ethoxy, spinosyn L).

Both chemicals were received from DOW Agrosciences to evaluate them for the control of the nymphal instars of the predominant grasshopper, *Catantops axillaries* in Baharia Oasis, in comparison to the recommended dose of the organophoshorous insecticide, chloropyrifos-45 ULV formulation, (Cressman and Dobson, 2001).

3. Experimentation

Trials were conducted in an area of about 2000 m^2 of alfalfa. An area of 500 m^2 was served for each Spinosad, Spinotoram, Chlorpyrifos and the untreated with inter space of 50 meter to avoid the migration between these large plots. The areas were heavily infested with the late stage of the grasshopper.

The ground application of the suspension concentrate (SC) of Spinosad 24% and Radiant 12% was carried out by knapsack Mistblower motor sprayer fitted with a 35cc engine fload carbarter system (Clavio). A calibration program for ground spraying machines (Hindy, 1989) was applied as follows:

Q = (T.Rw.Vo)/ 252, where:
Q = Flowrate (L./min.).
T = Spraying volume (L./Feddan).
Rw = Effective run width (m.).
Vo = Working speed (Km/hr.).

The flow rate of the knapsack ground sprayer was measured as the discharge water flow from one atomizer per min. for three replications. The swath width of this sprayer was estimated by target spraying technique using water sensitive papers (Novartis cards) with minimum spot diameter of 50 micrometers. Six wiere holders were put vertically at 30 cm higher at diagonal line in each plot.

In the case of spraying with the ultra low volume (ULV) formulation of chloropyrifos 45%, the calibration of the UL VA-plus hand held sprayer was carried out also, according to Hindy (1989).

The treated and untreated insects of *C. axillaris* were sampled before and after application in the treated 3 sites plus the untreated plots by using sweep-net. Counts of alive insects were only measured. This procedure was repeated 10 times inside each plot along 10 days after treatment. The reduction percentages in the daily numbers of the treated grasshoppers were calculated by Henderson and Tilton equation (1955).

4- Statistical analysis

Data were subjected to analysis of variance (ANOVA) and means were separated by Duncan multiple range tests (Duncan, 1955).

RESULTS AND DISCUSSION

1. Specifications of spraying technique

The spectrum of the application rates of Spinosad -24 SC and Spinotoram 12 SC was received on water sensitive paper to evaluate the number of producing droplets in each cm^2 and the volume mean diameters of these droplets ml (V.M.D.).

Table 1 reveals that, the rates of application were 100, 125 and 150 mL/fed. from Spinosad 24SC. Whereas

they were 50, 75 and 100 ml/fed from Spinotoram 12 SC . The numbers of the produced droplets after spraying with the illustrated three doses of Spinosad 24SC, droplets number/cm^2 were 122, 116 and 120 droplets/cm^2 and their volume mean diameters :V.M.D. were 100, 128 and 138 micron for each dose. In the case of spraying with the tested three doses of Spinotoram 12 SC were 95, 131 and 130 droplet/cm^2 and their volume mean diameters (V.M.D.) were 114, 130 and 134 micron for each dose, respectively. It is clear that, the used knapsack sprayer in the present study induced sufficient number and V.M.D of biopesticides droplets for killing the treated grasshoppers' *C. axillaris* by the used three rates of application from both Radiant and Spinosad. These results coincide with those of Himel (1969) who stated that, the optimum size for insecticide droplets is that size which gives high control of the insect with the lowest amount of toxic chemical and minimum ecosystem contamination. He added that, the optimum diameter of spray droplets for agriculture applications should be up to 140 micrometers.

2. Efficacy of tested bioinsecticides

Table 2 indicates that the three rates of ground application, 24, 30 and 36 g.a.i./fed. from Spinosad 24SC, induced high percentages of reduction one day after treatment. These percentages were, 74.04, 73.40 and 74.04 % in the nymph population of the grasshopper, *C. axillaris* on alfalfa for each rate, respectively. The maximum reduction percentages in the population of *C. axillaries* were obtained after 10 days of treatment with the tested three rates of application, these percentages were, 91.03, 93.86 and 95.28%, respectively.

Table 3 shows that the three rates of ground application, 6,9 and 12 g.a.i./fed. from Spinotoram 12SC resulted in high percentages of reduction in the nymphal population of the treated grasshopper, *C.axillaris* one day after application on alfalfa,. These percentages were 78.34, 77.11 and 80.21, respectively. These

Table (1): Specifications of spraying with the bioinsecticides, Radiant 12% and Spinosade 24% against the grasshopper *Catantops axillaris* (Thumberg) in Baharia Oasis.

Specifications.	Spinosad 24 SC				Spinotoram 12 SC			
	1st	2nd	3rd	Average	1st	2nd	3rd	Average
Rotes of application (ml/fed.)	100	125	150	--	50	75	100	--
Rotes of application (ml/plot.)*	12	15	18	--	6	9	12	--
No. droplets/cm^2	122.0	116.0	120.0	119.3	95	131	130	118.7
Volume mean diameter of droplets (V.M.D.) :	100	128	138	122.0	114	130	134	126.0

* The experimental plot was 500 m^2 in size, equal to 0.12 feddan.

Table (2): Field performance of the bio-insecticide, Spinosad 24SC to combat the grasshopper, *Catantops exillaris* (Thumberg) in Baharia Oasis (August, 2007).

Days	24 GAI/Feddan		30 GAI/Feddan		36 GAI/Feddan		No. alive insects in the untreated plot/m^2
	No. insects/ m^2	% Reduction	No. insects/ m^2	% Reduction	No. insects/ m^2	% Reduction	
O*	25.0	--	25.0	--	25.0	--	22.0
1	6.3	74.04	6.7	73.40	6.3	74.04	21.3
2	5.3	77.74	5.3	77.74	5.7	76.06	21.0
3	3.3	86.14	4.3	81.94	4.7	80.26	21.0
4	3.3	86.14	3.3	86.14	3.3	86.14	21.0
5	2.3	90.34	2.3	90.34	2.3	90.34	21.0
6	2.1	91.18	2.0	91.60	2.0	91.60	21.0
7	2.0	91.60	2.0	91.60	1.8	92.44	21.0
8	1.7	91.98	1.3	93.86	1.1	94.81	18.7
9	1.8	91.50	1.3	93.86	1.1	94.81	18.7
10	1.9	91.03	1.3	93.86	1.0	95.28	18.7
L.S.D.= 1.37		87.69		87.43		87.63	

*O-day is the day before treatment.

Table (3): Field performance of the bio-insecticide, Spinotoram 12 SC to combat the grasshopper, *Catantops exillaris* in Baharia Oasis (August, 2007).

Days	6 GAI/.Feddan		9 GAI/.Feddan		12 GAI/.Feddan		No.alive insects in the untreated plot/m^2
	No.alive insects/ m^2	% Reduction	No.alive insects/ m^2	% Reduction	No.alive insects/ m^2	% Reduction	
O*	25.0	--	22.0	--	24.0	--	20.0
1	5.7	78.34	5.3	77.11	5.0	80.21	21.0
2	5.3	80.71	4.3	82.21	3.7	85.97	23.0
3	4.3	82.80	4.3	85.04	3.3	88.04	23.0
4	2.3	91.35	2.3	90.17	2.0	92.17	21.3
5	2.3	91.62	2.3	95.14	1.7	93.55	22.0
6	2.0	93.04	2.0	92.09	1.7	93.84	23.0
7	1.7	93.54	1.7	95.66	1.3	94.54	21.7
8	1.7	93.54	1.3	94.86	1.3	95.29	23.0
9	1.7	93.54	1.3	94.86	1.0	96.38	23.0
10	1.7	93.54	1.3	94.86	1.0	96.38	23.0
L.S.D.= 1.11		89.02		90.20		91.64	

*O-day is the day before treatment.

Table (4): Performance field comparison among the most effective doses of Spinosad 24SC, spinotoram 12SC at the 10 day in comparison to chloropyrifos 45ULV to combat *Catantops exillaris* in Baharia Oasis (August, 2007).

Days	Spinosad at 24 GAI/fed		Spinotoram at 12 GAI/fed		Chlorpyrifos at 94 5 GAI/fed	
	No. alive insects/ m^2	% Reduction	No. alive insects/ m^2	% Reduction	No. alive insects/ m^2	% Reduction
0*	25.0	--	24.0	--	22.0	--
1	6.3	74.04	5.0	80.21	2.5	88.64
2	5.3	77.74	3.7	85.97	2.2	89.60
3	3.3	86.14	3.3	88.04	2.1	90.45
4	3.3	86.14	2.0	92.17	2.0	90.91
5	2.3	90.34	1.7	93.55	1.5	93.18
6	2.1	91.18	1.7	93.84	1.5	93.18
7	2.0	91.60	1.3	94.54	1.5	92.91
8	1.7	91.98	1.3	95.29	1.0	95.45
9	1.8	91.50	1.0	96.38	1.0	95.45
10	1.9	91.03	1.0	96.38	1.0	95.45
.S.D.=2.19		87.69		91.64		92.52

- The recommended dose of chloropyrifos-45% (u.l.v) is 225 gm.a.i./ha., (94.5 gm.a.i/feddan) (Cressman and Dobson 2001).

percentages started to increase from the second day of application up to the maximum percentages in the last day of observation (day-10). They were 93.5, 94.9 and 96 % reduction, for each rate, respectively. No clear difference among the toxic effects of the three rates of application except the high rate of application (100 ml/fed.) which exhibited a slight difference than the others.

In a comparison of Table 2 and 3, Spinosad showed reduction % of 87-87.7. However, Spinotoram even at lower rate g. a. i. indicated 89-92% reduction. In case of assuming that the reduction from all doses was equal, Spinotoram was 3-4 times stronger than Spinosad based on g .a. i /fed.

The above data were in line with those of Temerak (2007), who indicated that radiant 12SC (Spinotoram) was 5 times stronger than Spintor 24 SC (Spinosad) for the control of cotton leaf worm in the field.

3. Comparison of the toxic effects of the bioinsecticides and chloropyrifos

A comparative study between the effects of the bioinsecticides, Spinosad 24SC, Spinotoram 12 SC and the organophosphorous insecticide, chloropyrifos 45% on the nymphal instars of *C. axillaris* was conducted using 100ml/fed. each. The initial kill of Radiant-12% (80.21%) was more than that of Spinosad-24% (74.04%), but they were less than the initial kill of the recommended dose of chloropyrifose-45% (88.64) (Table 4).

Also, Table 4 reveals that, the residual effects of the three chemicals were increased, but the latent toxicity of Radiant 12% (96.38%) was more than that of Spinosad-24% (91.03%) 10 days after application against the nymphal instars of *C. axillaris*. Zain-Ul-Abdin (2002) stated that, the bio-insecticides should be used against the pest insects. They are biodegradable and slow to select of resistance because of their unique characteristics. A field study was carried out by Mansoor *et al.* (2001) to compare efficacy of conventional insecticides *i.e.* curacron, larvin and tracer (Spinosad) against *Helicoverpa armigra* on cotton. They stated that, tracer showed significantly better control of this insect as compared to conventional insecticides.

On the basis of the previous results, it may be concluded that bio-insecticides i.e. Spinotoram and Spinosad could prove effective substitute for the conventional insecticides.

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الملخص العربى

تقييم حقلى لمبيدات حيوية جديدة ضد نطاط *Catantops axillaris* Thunburg فى الواحات البحرية المصرية (Acrididae: Orthoptera))

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أجريت تجربة حقلية بالواحات البحرية المصرية خلال صيف عام ٢٠٠٧ لتقييم فعالية المبيدات الحيوية سبينوساد -٢٤%" و"راديانت -١٢% مقارنة بفعالية "الكلوروبيريفوس – ٤٥% ضد حوريات النطاط *Catantops axillaris* Thunburg المنتشرة على الزراعات هناك، وخلال هذه التجربة تم رش المستحضرات المائية لهذين المركبين بطريقة الرش بالأحجام الكبيرة فى الماء والتى أنتجت أعدادا مناسبة من القطيرات ومتوسط حجم مثالى مناسب لمكافحة هذه الآفة، وبرش الراديانت ١٢% بمستويات رش ثلاثة وهى ٥٠، ٧٥، ١٠٠ مليلتر/ فدان نتج عن ذلك نسب عالية لخفض تعداد هذه الحشرة بعد يوم واحد من المعاملة، وهذه النسب هى ٧٨,٣٤ ، ٧٧,١١ ، ٨٠,٢١% لكل مستوى من مستويات التطبيق السابق، وعند رش مستويات ثلاثة أخرى من مركب "الإسبينوساد ٢٤% وهى ١٠٠ ، ١٢٥ ، ١٥٠ مليلتر/ فدان كانت النتائج أقل منها فى حالة رش "الراديانت ١٢%" حيث كانت نسب خفض تعداد هذه الحشرة هى ٧٤,٠٤ ، ٧٣,٤٠ ، ٧٤,٠٤% لكل مستوى على حده بعد يوم واحد من الرش. وبمقارنة فعالية "الراديانت -١٢%" والإسبينوساد -٢٤%" بفعالية المبيد الكيميائى "الكلوروبيروفوس ٤٥%" ضد هذه الآفة باستخدام حجم رش واحد من كلا المركبين وهو ١٠٠ مليلتر/فدان لوحظ أنه بالرغم من أن تركيز "الإسبينوساد" ضعف تركيز "الراديانت" فإن نسبة القتل الفوري "للراديانت" (٨٠,٢١%) كانت ٣-٤ مرات أكبر منها فى حالة رش "الإسبينوساد" (٧٤,٠٤%) بناء علي نسبة المادة الفعالة، وكذلك فإن التأثير الباقى للمركبات الثلاثة استمر طوال العشرة أيام التالية للرش، وعلى أساس هذه النتائج يمكن القول بأن هذه النوعية من المبيدات الحيوية قد تكون بديلا فعالا في برامج السيطرة على مقاومة الآفات لفعل المبيدات التقليدية ضد آفات عائلة الجراديات، ولكن ذلك يحتاج إلى مزيد من الدراسات ضد الآفات الأخرى من هذه العائلة فى المستقبل القريب.