Annals of Agric. Sci., Moshtohor **ISSN 1110-0419**
Vol. 51(4) (2013), 421– 426 **http://annagricmoshj.com**

Effect of two insecticides on eggs and larvae of pink bollworm, *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae)

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Abstract

Under the laboratory conditions, toxicological evaluation of two compounds, Radiant 12% and Profenofos 72% against one day old eggs and newly hatched larvae of *Pectinophora gossypiella* (Saund.) and biological effect of these compounds on larvae, pupae and adult emergence resulted from treated eggs and larvae were studied. The results revealed that LC_{25} were 1.528 and 0.011 ppm., when one day old eggs were treated with Radiant and Profenofos respectively, while these values were 0.944 and 0.009 ppm for newly hatched larvae treated with the previous compounds, respectively. Also, no difference was recorded for the hatchability % between eggs treated with LC_{25} of Radiant and Profenofos. Profenofos caused high increase in pupal malformation than Radiant and showed significant reduction in the moth emergence percentage compared with control.

Key words: Radiant 12%, Profenofos 72 %, *Pectinophora gossypiella* and biological study.

Introduction

Cotton is one of the major economic crops in Egypt. Throughout the cotton growth season, it is attacked by many pests, from the seedling stage to harvest causing different degrees and types of damage. Among these pests, the pink bollworm (*Pectinophora gossypiella*) is considered the most destructive pest infesting cotton bolls causing severe damage and high loss in both quality and quantity of cotton yield **(Lohag and Nahyoon, 1995)**.

Radiant 12% is the second generation of Spinosad. Spinosad is a mixture of Spinosyns A and D, which are fermentation products of the soil actinomycete *Saccharopolyspora spinosa* **(Mertz and Yae, 1990 and Thompson *et al.*, 1997).** Spinosad is a natural bio-insecticide offered a new mode of action and relatively safe on natural enemies and no significant difference was recorded for the hatchability between 1&3 day old eggs of pink bollworm **(Temerak 2003 and 2007)**. They indicated the effect of Spinosad on the reduction in number of *Spodoptera littoralis* eggs and larvae. **Al-Shannaf** and **Kandil, (2005**) recorded that spinosad has highly effect on eggs of *Helicoverpa armigera* (Hub).

The objective of the present study was to investigate the effect of Radiant 12% and Profenofos 72% on pink bollworm (eggs and newly hatched larvae) as well as their latent effect on the first generation.

Materials and Methods

Insecticides used:-

1)Radiant SC12% :-

Common name: - Radiant SC12% (Spinetoram). It is a new product from spinosyns group with the same mode of action. It is a trademark of Dow Agro Science Co.

2) Profenofos 72%

O-(4-Brom-2-chlorphenyl)-O-ethyl-S-propylthiophosphat; Profenofos

Introduced by Ciba-Geigy AG (now Syngenta AG).

Insect used:

Pink bollworm, *P. gossypiella* larvae laboratory strain was reared for several generations under conditions of 26±1^{0}C and 75±5 RH at laboratory of Bollworms Research Department, Plant Protection Research Institute, Agriculture Research Center as described by **Rashad and Ammar (1985).**

-Eggs and larvae used:

Four groups of freshly emerged moths of *P. gossypiella* were used. Each group contained 10 pairs (♂X♀) were confined in a glass chimney cage (17 cm height and 7.12 cm in diameter), inside which a piece of cotton wool previously soaked in 20% sugar solution was suspended for moths' nutrition and renewed each 48 hr. The top and bottom of each cage were covered with screening mesh kept in position by rubber bands for stimulating egglaying response in the females. Eggs were deposited through the screening mesh, one piece of paper placed at upper and lower parts of the cages in open Petri-dish that served as an ovipostion site, eggs were collected daily and kept in glass jars (1/2 kg). These eggs were maintained at 26±1^{0}C and 75±5 RH. One day old eggs and newly hatching larvae were used in the experiments.

Procedure:

To study the ovicidal and larvicidal activity of Radiant 12% and Profenofos 72% against *P. gossypiella* eggs and/or newly hatched larvae, serial concentrations in water were prepared. Six concentrations (0.351, 0.175, 0.087, 0.043, 0.021 and 0.0107 ppm) for Profenofos and five concentrations (12.5, 6.25, 3.125, 1.562nd 0.781ppm) for Radiant were freshly prepared form the stock solution of each compound (one ml/ liter water).

Treatment

Treatment of eggs was done by dipping a piece of paper containing eggs in the different tested concentrations of the two compounds. Three replicates, each contained 200 to 300 eggs were dipped in each concentration of each compound. The eggs were left until dried. Other three replicates of similar eggs were dipped in water and left as control. Eggs were kept in an incubator under constant conditions 26±1°C and 75±5% RH. The hatchability percentages were estimated after three to nine days. Data were corrected and LC_{25} for each compound was calculated by using proban software.

For the biological aspects studies, three replicates each of 50 tubes, each tube (2 X 7.5 cm) containing 3 gm of diet were used. Newly hatched larvae resulted from treated eggs with $LC_{25}$of two compounds were transferred individually to the diet tubes by camel hair brush. The same was done with the newly hatched larvae resulted from untreated eggs. For larvae, 300 tubes divided to two groups each of 50 tubes, each tube (2 X 7.5 cm) containing 3 gm of diet treated by LC_{25} of Radiant and Profenofos were used. The tubes were capped with cotton and kept in laboratory under the previous conditions in an incubator and inspected daily until pupation. Pupae resulted from each treatment were removed and placed in clean tubes until adults' emergence. Percentage of larval mortality, larval malformation, larval duration, pupal duration, percentage of adults' emergence, malformation and sex ratio, fecundity and fertility were recorded.

Newly emerged moths resulted from treated eggs or newly hatched larvae by LC_{25} Radiant and Profenofos were sexed and transferred to chimney glass cages (five pairs /cage). Each treatment was replicated three times. The moths were fed on 20% sucrose solution. Cages were examined daily to record pre ovipostion, ovipostion and post ovipostion periods and the numbers of deposited eggs, percentage of hatchability and estimated females and males longevity.

The recorded data were statistically analyzed with one-way analysis of variance (ANOVA) ($P< 0.05$) **(Snedecor, 1952)** and Duncan's multiple range test means was used **(Duncan, 1955).**

Results and Discussion

Toxicological effect of Radiant 12% and Profenofos **72%:**

The susceptibility of one day old eggs and newly hatched larvae of *P. gossypiella* to Radiant and Profenofos was showed in Table (1).

Table 1. Toxicological evaluation of Radiant 12% and Profenofos 72% against eggs and newly hatched larvae of pink bollworm.

Stage	Treatment	Toxicity		
		LC_{50}(ppm)	LC_{25} (ppm)	Slope
One day old eggs	Radiant 12%	3.94	1.528	1.6377
	Profenofos 72%	0.031	0.011	1.2805
newly hatched larvae	Radiant 12%	3.099	0.944	1.3067
	Profenofos 72%	0.022	0.009	1.0187

The LC_{25} and LC_{50} values for one day old eggs and newly hatched larvae varied between the two compounds. The LC_{50} and LC_{25} values of Radiant were 3.94and 1.528 ppm for one day old eggs and 3.099 and 0.944 ppm for newly hatched larvae while these values were 0.031and 0.011 ppm for one day old eggs and 0.022 and 0.009 ppm for newly hatched larvae in Profenofos treatment.

These data revealed that one day old of eggs were less susceptible to Radiant and Profenofos than newly hatched larvae. These results agree with **Al-Shannaf and Kandil (2005)** who recorded that the LC_{50} of spinosad for one and two days old eggs of *Helicoverpa armigera* were 2.56 and 1.31 ppm, respectively. **Ascher *et al.*, (1983)** treated 0-3 day old eggs of *Lobesia botrana* with diflubenzuron and found that LC_{50} value was 70 ppm at 27°C.

Effect on hatchability and incubation period of eggs:

Date in Table (2) showed the effect of Radiant and Profenofos on hatchability and incubation period of pink bollworm eggs. It is obvious that the Radiant and Profenofos at the treatment of LC_{25} value reduced the percentage of hatchability reaching to 72 and 73 % for one day old eggs, respectively, than 2 % in the control. Both compounds had the same effect on eggs hatching.

The present results are agree with those of **Ioriatti *et al.*, (1992)** who treated 0-3 day old eggs of *Lobesia botrana* with different Benzoylphenylureas and found 60% eggs mortality for lufenuron and 20-30% for both flufenoxuron and hexaflumuron. **Cabezon *et al.*, (2006)** found that lufenuron,

significantly, reduced hatchability on all eggs age of *L. botrana*.

The incubation period of pink bollworm eggs was highly significantly affected by LC_{25} treatment of Radiant 12% and Profenofos 72% (Table 2). This incubation period prolonged to 4.9 and 5.7 days when 1 day old eggs were treated with Radiant and Profenofos, respectively, compared with 2.8 days for control.

Table 2. Latent effect of two insecticides, Radiant 12% and Profenofos 72% on larval, pupal and adult stages when treated as one day old eggs or as newly hatched larvae.

treatments		eggs		Larval stages			Pupal stage					
		% hatchability	Incubation of 1 day old of eggs ± SE	Duration/days ± SE	weight	malformed	% pupation	Duration/days ± SE	weight	malformed	Total immature stages	% adult emergence
Eggs	Radiant	73	4.9±0.01	18.86 ±0.11	0.0237± 0.001	8.66± 0.68	91.33± 0.68	11.16 ±0.15	0.0179± 0.0001	4.3±0.23	34..92 ±0.56	73.66 ±1.9
	Profenofos	72	5.7±0.3	17.03 ±0.11	0.077±0.004	7.56± 0.56	78.66± 1.69	9.2±0.29	0.0221± 0.0001	9.3±0.68	31.93± 1.95	81.0± 2.37
Larvae	Radiant		-	23.46 ±1.29	0.023±0.004	11.87 ±0.4	59.7±19.0	11.26 ±6.5	0.019	6.67± 1.36	34.72± 3.4	69.0± 3.9
	Profenofos		-	20.1± 0.32	0.02±0.001	9.6±0.7	67±0.03	12.8± 0.45	0.016±0.008	8.67± 0.23	32.9±0.5	77.0± 2.48
control			28	15.0± 0.20	0.0327± 0.001	1.0±0.4	94.3±1.1	7.9±0.2	0.033±0.001	-	22.9±1.3	97.0± 0.4
LSD				1.359	0.0080	3.674	11.798	1.01	0.0001	0.651	1.311	5.361
				**	**	**	***	*	**	***	***	***

These results are in agreement with **Sammour *et al.*, (2008)**. They found a reduction in eggs' hatchability of cotton leafworm after treating larval instar with Chlorfluazuron and Leufenuron. This preventation of eggs' hatching may be due to the penetration of these compounds into the eggs and prevents hatching by interfering with embryonic cuticle synthesis.

Effect of Radiant and Profenofos on some biological parameters of Pink Bollworm:

Larval stage:

It was clear that the two tested compounds, significantly, prolonged the duration of the larval stage resulted from treated eggs or newly hatched larvae than that of the untreated one (check). Table (2) revealed that larval duration resulted from treated eggs were 18.86 and 17.03 days, respectively and 23.46 and 20.1 days after treatment of newly hatched larvae by Radiant and Profenofos, respectively, compared with 15.0days in the control.

Malformation of larvae:

As shown in Table 2, the high percentage of malformed larvae resulted from treated neonate larvae with Radiant and Profenofos being 11.87 and 9.6 %, respectively. These percentages were less among eggs treated with the two respective compounds (8.66 and 7.56 %, respectively).

Pupal stage:

The data illustrated significant increase in pupal duration of *P. gossypiella* resulted from the treated one day old eggs and newly hatched larvae with Radiant or Profenofos treatments. These durations were 11.16 and 9.2 days resulted from treated eggs, respectively and 11.26 and 12.8 days for pupae resulted from newly hatched treated larvae, respectively, compared with 7.9 days in control (Table 2).

Pupal malformation:

In Table 2, the treatment of Profenofos caused high number of malformed pupae than Radiant. These malformations were 9.3 and 8.67 % for pupae resulted from treated eggs and larvae, respectively. On the other hand, this percentage in Radiant treatment decreased to 4.3 and 6.67 %, respectively.

Total duration of immature stages:

Data in Table 2 showed that the two tested compounds significantly prolonged the total duration of immature stages than that of control as data recorded 34.92 and 31.93 days, when resulted from treated eggs and 34.7 and 32.9 days when resulted from treated larvae with Radiant and Profenofos, respectively compared with 22.9 days in control.

Radiant and Profenofos compounds used in this study were significantly affected on some biological parameters compared with control. They caused an increase in larval and pupal durations and decrease in the percentages of pupation and adults' emergence. These data are similar to the data obtained by many authors who used different IGRs against many lepidopterous insects, e.g., *P. gossypiella* **(Flint *et al.*, 2001)** and, *Spodoptera littoralis* (**Ismail, 1980;**

El-Deeb *et al*., 1991; Shaurub *et al*., 1999 and **Abdel-Aal, 2003)**. **Yin *et al*., 2008**, reported that prolongation in the immature stages durations and the decrease in survival rate of *Plutella xylostella* after treatment by the LC_{25} and LC_{50} of spinosad compound.

Adult stage:

Adults' emergence:

Data given in Table 2 showed significant reduction in the moth emergence percentage compared with control. The percentages of adult emergence were 73.66 and 81.0 % resulted from treated eggs and 69.0 and 77.0 resulted from treated larvae for both Radiant and Profenofos compounds, respectively compared with 97.0 % in control.

Pre-ovipostion period:

The pre-ovipostion period was highly significantly influenced by both tested compounds (Table 3). The Radiant compound caused considerable shortage in female pre-ovipostion period. This period reached 2.43 & 2.5 days, respectively when females resulted from treated eggs. This period increased to 4.33 and 3.86 days when resulted from treated larvae compared to 2.77 days in control.

Ovipostion period:

The two tested compounds caused highly significant shortage of the ovipostion period (Table 3), being 11.23 and 9.93 days resulted from treated eggs with Radiant and Profenofos, respectively. On the other hand, these periods were 10.2 and 8.46 days when resulted from treated larvae with Radiant and Profenofos compared to 13.7 days in control. These data indicated that Radiant and Profenofos had high effect on females resulted from treated one day old eggs and larvae.

Adult longevity:

Female's longevity was highly significantly affected by Radiant and Profenofos. The longevities were 16.3 and 13.8 days/♀ resulted from treated eggs, respectively, compared to 18.67 days/ female in control. Female longevity prolonged when 1st instar larvae were treated with Radiant. On contrary, the male longevity resulted from treated eggs and larvae was shortened than that of the control. The recorded means were 11.67 &12.37 days resulted from treated eggs and 15.3 &13.4 days/♂ resulted from treated larvae with Radiant and Profenofos compounds, respectively compared with 17.7 days/ ♂ in control (Table, 3).

Reproductive potential:

High reduction in numbers of eggs laid by female resulted from treated eggs and larvae were found. The mean numbers of laid eggs were 192.67 and 186.0 eggs/ female resulted from treated eggs and 197.0 and 169.67 eggs/female resulted from treated larvae with Radiant and Profenofos, respectively, compared with 253.6 eggs/ female in control (Table 3). In Table (3) the percentage of eggs hatchability was 74.33 and 86.33 % in the treatment of eggs and 65.33 and 65.33 % in treatment of larvae for Radiant and Profenofos, respectively, compared with 95 % in control.

Radwan (2002) found that treatment of neonate spiny bollworm larvae with LC_{50} of spinosad reduced fecundity of resulted adults and hatchability of deposited eggs and shortened the adult life span, while the larval and pupal duration were prolonged. Amer (2004) determined the biological effects of spintor (spinosod) against newly hatched larvae of pink and spiny boll worms. Spinosad caused significant reduction in fecundity, hatchability of deposited eggs and pupation percent and shortened adult life span and male longevity.

Liu and Trumble (2005) and **Zalizniak and Nugegod (2006)** reported that spinosad had high effect on fertility and fecundity of *Bactericerca cockerelli*.

Table 3. Effects of two insecticides, Radiant 12% and Profenofos 72% on some biological aspects of pink bollworm.

Treatments		Period (days) of			Fecundity		Longevity/days SE±	
		Preovipostition	Oviposition	Postoviposition	Total eggs/♀	% hatchability	♀	♂
treated eggs	Radiant	2.43 ± 0.23	11.23±0.24	3.53±0.01	192.67±3.49	74.33±2.11	16.3±1.6	11.67±0.56
	Profenofos	2.5±0.1	9 93±0.32	1.6±0.13	186±4.41	86.33±1.86	13.8±0.43	12.37±0.39
treated larvae	Radiant	4.33±0.1	10.2±0.5	4.5±0.24	197.0±1.78	65.33±4.4	19.06±1.1	15.3±1.3
	Profenofos	3.86±0.35	8.46±0.33	2.97±0.23	169.67±8.29	65.33±4.4	19.06±1.1	13.4±0.9
Control		2.77±0.14	13.7±0.07	2.3±0.1	253.6±7.3	95.0±0.89	18.67±1.3	17.7±0.9
LSD		0.20	1.066	0.113	6.735	3.914	1.120	1.026
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دراسه التأثير البيولوجي لمركبى رادينت وبروفينوفوس على بيض و يرقات دوده اللوز القرنفليه (رتبة حرشفية الاجنحة- عائلة جليشيدى)

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تم دراسه التأثير الأبادي لمركبي الراديانت (الجيل الثاني للسبينوساد) و البروفينوفوس على بيض عمر يوم ويرقات حديثة الفقس لدوده اللوز القرنفليه وقد تم متابعه التأثير علي النواحي البيولوجيه لليرقات و العذاري و الحشرات الكاملة الناتجه من كل طور. و قد أظهرت النتائج أن بيض عمر يوم كان أقل حساسيه للمركبيين عن يرقات الفقس الحديث. واظهرت النتائج ايضا عدم وجود تاثير لكلا المركبين على نسبة الفقس على البيض المعامل لكل من المبيدين ، بينما نتج من المعاملة بالمبيد رادينت يرقات صغيرة الحجم جدا وكذلك اعطى مبيد البروفينوفوس زيادة عالية فى درجة تشوه العذارى اكثر من الرادينت ولكن في الأطوار الكاملة أظهرت النتائج حدوث نقص شديد في عمر الفراشات التي نتجت من معاملات البيض بالبروفينوس بالاضافة الى نقص شديد في عدد البيض الموضوع.