Influence of some Insecticides on the Biological Attributes of *Orius albidipennis* (Reuter) (Hemiptera: Anthocoridae)

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Abstract: Effect of direct application of five bio- and conventional insecticides Dipel2x, Radiant, Proclaim, Aphox and Coragen) at three different concentrations on the biological attributes of immature (1st, 3rd and 5th nymphal instars) and adult stages of *Orius albidipennis* (Reuter) (Hemiptera: Anthocoridae) were evaluated. Procalim, Aphox and Coragen had harmful effect and caused significant reduction in the tested stages of *O. albidipennis*as compared to Dipel 2x and Radiant insecticides, irrespective of tested concentrations. Also, the direct impact of those insecticides on immature stages was higher than that recorded for adult stage. Insecticide-treated immature stages of *O. albidipennis* had negative impact on developmental periods. However, the longevity, fecundity rates and hatchability percentages of obtained adults from insecticide-treated immature and insecticide- treated adult stages were differed from those of untreated (control).

Keywords: Insecticides, *Orius albidipennis*, toxicity, development, longevity, fecundity, hatchability

INTRODUCTION

Successful integrated pest management (IPM) is strongly relied upon understanding the effect of the biotic and abiotic factors affecting the population of pests (Gullan and Cranston, 1994). Chemical and biological control methods represent the main components in any IPM program. One of these biological control methods is the use of natural enemies such as the anthocorid predator *Orius albidipennis* (Reuter) (Hemiptera: Anthocoridae) that is known as an important biological control agent for several pests (Sobhy *et al.*, 2010). On the other hand, the hazards of insecticides on the surrounding environment and non-target organisms including natural enemies vary in several ways; depending upon the behavior and the intrinsic toxicity of the chemical, exposure of the non-target organisms and application coverage. The impact of insecticides may range from lethal (complete mortality) to sub-lethal effects such as decreasing the efficacy, longevity and fecundity of females, development rates as well as the alteration of searching behavior (John *et al.,* 2007).

Bearing all these views in mind, the main objective of the current study is to study the direct effect of five bio- and conventional insecticides at different rates on the mortality percentages and the biological attributes of *O. albidipennis* under laboratory conditions.

MATERIALS AND METHODS

Insecticides

The commercial products of the selected insecticides with their field rates, active ingredients, PHI (pre-harvest interval) and the target pests are listed in Table (1). These insecticides included, two bioinsecticides (Dipel 2x, Radiant) and three conventional insecticides (proclaim, Aphox and Coragen) the three tested concentrations of the selected compounds in the present study were prepared one hour prior to experiments.

Adults of *O. albidipennis* (Reuter) were provided by the *Chrysoperla* Mass Production Unit, Faculty of Agriculture, Cairo University. The predators were kept in cylindrical plastic jars (10 cm diameter x 20 cm height), covered with perforated stretched plastic sheets held in place using rubber bands. Each jar was provided with two small balls of white foam to reduce cannibalism (Sobhy, 2004). Frozen eggs of *Ephestia kuehniella* (Zeller, 1879) (Lepidoptera: Pyralidae) were supplied as food source (Ito, 2007). Jars were also provided daily with pieces of Egyptian lettuce (*Lettuce sativa*) leaf veins as an ovipositional substrate during the ovipositional period. Rearing of *O. albidipennis* was performed under laboratory conditions of 26±1°C, 60±10%RH and 16L: 8D photoperiod. Female of *O. albidipennis* inserts its eggs into lettuce leaf veins. Lettuce veins harboring eggs of *O. albidipennis* were placed in plastic jars until hatching. Newly-hatched predatory nymphs were continuously provided with frozen eggs of *E. kuehniella* with a moistened cotton wool (Puysseleyr *et al.,* 2014). This procedure of *O. albidipennis* rearing was repeated for several successive generations before using the predator in the planned experiments. Males and females of *O. albidipennis* can be easily distinguished from each other by observing the end of the abdomen under a stereomicroscope.

Experiments

Effect of insecticides on the biological attributes of *O. albidipennis*

This experiment was performed to evaluate the direct effect of the five selected bio- and conventional insecticides (Dipel 2x, Radiant, Proclaim, Aphox and Coragen) at three different concentrations on the mortality percentages of newly molted first, third and fifth nymphal instars, as well as the adult stages of *O. albidipennis* Fig (1). These insecticides were tested under laboratory conditions of 26±1°C, 60±10% RH

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and 16:8 L/D photoperiod. The direct effects of each insecticide on the mortality percentages of *O. albidipennis* were replicated 4 times (R = 40 individuals). In addition, the effects of tested insecticides on the developmental period and longevity of treated individuals of *O. albidipennis* were replicated 40 times (R = 1 individual).Also, each treatment was replicated 4 times, with ten young adults (R = 5 males and 5 females) to evaluate the fecundity and hatchability of insecticide-treated immature and adult stages of *O. albidipennis*

Statistical analysis

All obtained data were analyzed using SAS package 11.0 v (SAS Institute Inc, 2005). When F values were significant, means were separated using Fisher's least significant differences (FLSD) at a 0.05 level of significance (SAS Institute Inc, 2005). Proportional data were transformed by arcsine square root (ARC sine) before analysis. Ldp line Software used to calculate probit analyses according to Finney (1971), which calculate LC_{50} to each tested insecticide.

Table (1): List of tested bio- and conventional insecticides including their active ingredients, recommended field rates (FR) and target pests

Tested Insecticides	Active ingredients	FR	Target pest	PHI* (day)
Dipel 2x 6.4% DF	*Bacillus thuringiensis* var. *kurstaki*	200 gm/fed 150 gm/ton	PTM in field PTM in storage	N/A**
Radiant 12% SC	Spinetoram	120 cm^3/fed 100 cm^3/fed	Aphids PTM	1
Proclaim oupty 5% WG	Emamectin benzoate	60 gm/fed	PTM in field	3
Aphox 50% SC	Primicarb	50 gm/100L	Aphids	15
Coragen 20% SC	Chlorantraniliprole	60 cm^3/fed	PTM in field	7

* **PHI** = (pre-harvest interval) the period in days after pesticide treatment until harvest, while the residue levels of the pesticide allowed in the harvested crop that degrade to a level that is acceptable by crop's growth, environmental conditions (such as rain or UV radiation) and by the microorganisms on the plants or in the soil (https://WWW.APC.gov.eg).
****N/A** = Not available.

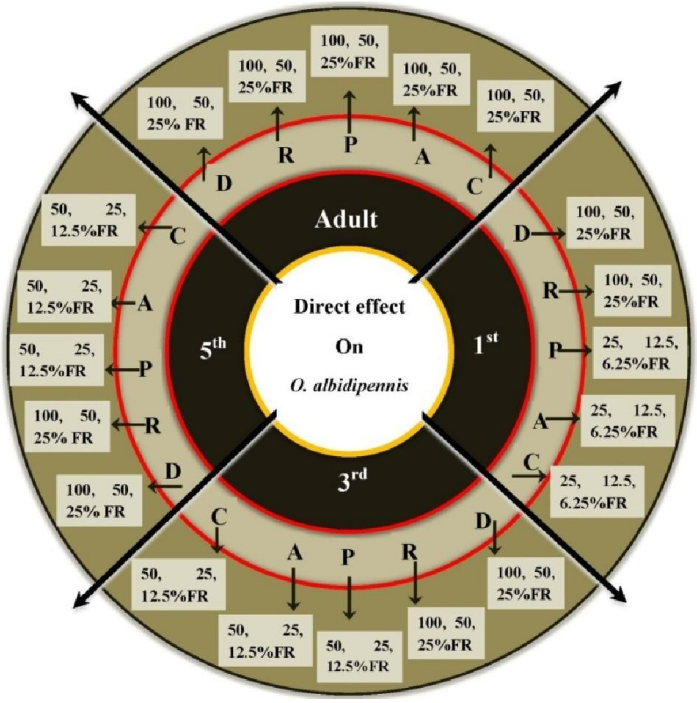

Fig (1): Schematic diagram of tested insecticides at different concentrations against nymphal instars and adult stages of *O. albidipennis*.
D= Dipel 2x, **R=** Radiant, **P=** Proclaim, **A=** Aphox and **C=** Coragen.
1^{st}, 3^{rd}, 5^{th} = first, third and fifth nymphal instars.
FR= field rate

RESULTS

Mortality percentages of insecticide-treated *O. albidipennis*

First nymphal instar

As shown in Fig (2a), Dipel 2x and Radiant treatments were excluded during statistical analysis at 12.5% FR and 6.25% FR. Proclaim, Aphox and Coragen treatments were also excluded at 100% FR and 50% FR. Statistical analysis proved that there were significant differences in the mortality percentages of untreated and treated *O. albidipennis* 1st nymphal instars among tested insecticide treatments at 100% FR (F= 623.31; P<0.0001), 50% FR (F= 256.54; P<0.0001), 25% FR (F= 13.93; P<0.0001), 12.5% FR (F= 15.98; P=0.0002) and 6.25% FR (F= 19.44; P<0.0001, Fig 2a).

Third nymphal instar

The obtained results in Fig (2b) indicated that Proclaim, Aphox and Coragen caused 100% mortality in third nymphal instar at 100% FR. Statistical analysis further proved that there were significant differences in the mortality percentages at 100% FR (F= 403.81; P<0.0001), 50% FR (F= 19.24; P<0.0001), 25% FR (F= 9.43; P=0.0002) and 12.5% FR (F= 6.86; P =0.0061, Fig 2b).

Fifth nymphal instar

Untreated (control) *O. albidipennis* 5th nymphal instar recorded the lowest mortality percentages at 2.50% Fig (2c). At 100% FR, there were significant differences between the tested insecticides in terms of percentages of mortality (F= 264.43; P<0.0001). The same trend of insecticides toxicity to 5th nymphal instar of *O. albidipennis* was also observed in 50% FR (F= 19.24; P<0.0001) and 25% FR (F= 21.55; P<0.0001, Fig 2c).

The adult stage

Generally, results in Fig (2d) indicated that *O. albidipennis* adults were the most tolerant stages to the toxicity of tested insecticides irrespective of studied concentrations. Obviously, the percentage of mortality in *O. albidipennis* adults treated with the tested bio- and conventional insecticides differed significantly at 100% FR (F= 11.70; P<.0001), 50% FR (F= 13.03; P<.0001) and 25% FR (F= 4.35; P=0.0090, Fig 2d).

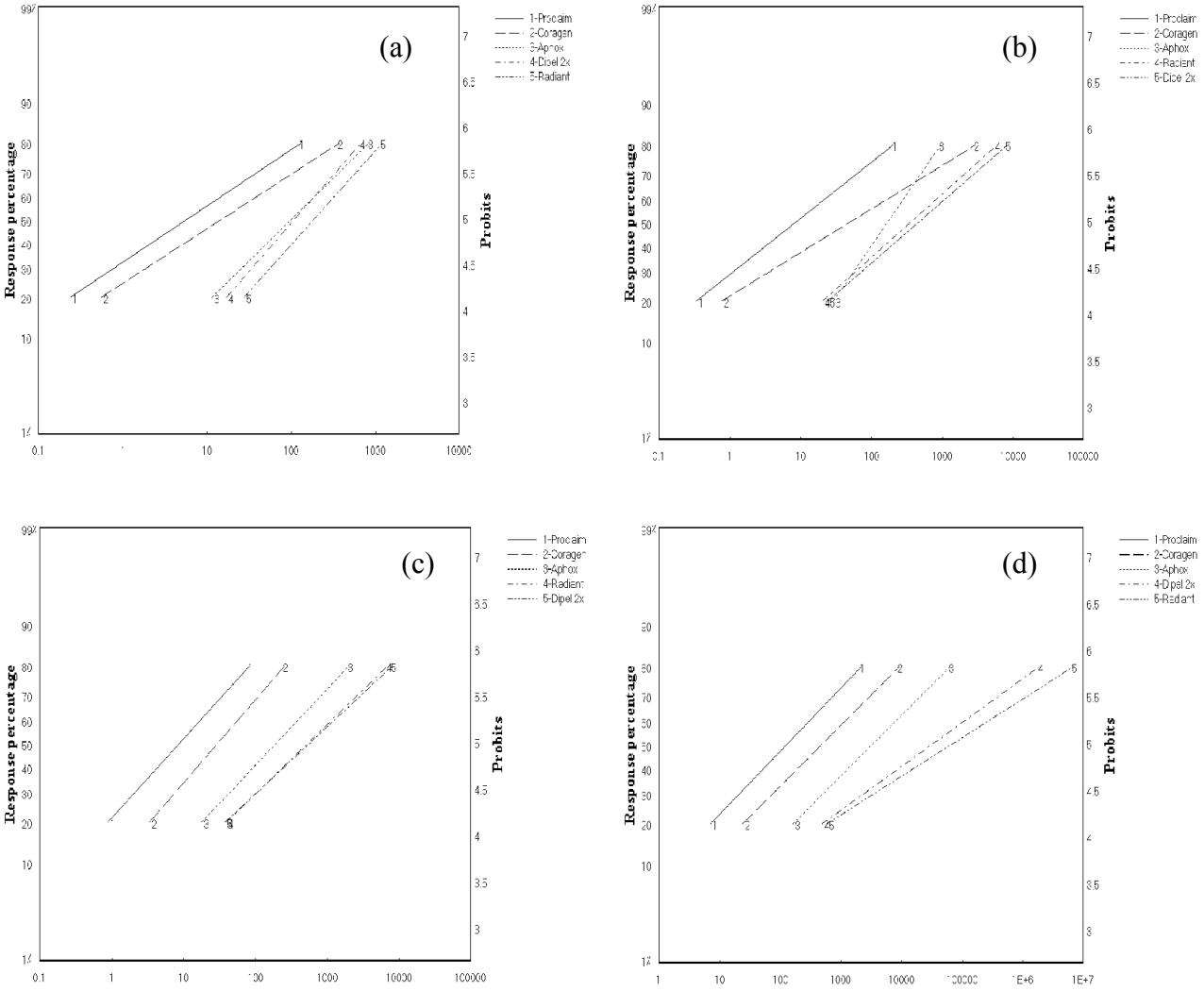

Fig (2): The toxic effects of tested bio- and conventional insecticides to first (a), third (b), fifth (c) nymphal instars and adult stage (d) of *O. albidipennis* in direct effect bioassay under laboratory conditions.

Developmental periods of insecticide-treated *O. albidipennis*

First nymphal instar

Clearly, untreated (control) individuals of *O. albidipennis* lasted the shortest developmental period of 11.28 days (Table 2). Treating first instar with the tested insecticides had a significant effect on the developmental time (from first nymphal instar to adult stage) at 100% FR (F= 4.36; P= 0.0149); 50% FR (F= 4.36; P= 0.0149) and 25% FR (F= 21.63; P<0.0001), 12.5% FR (F= 17.89; P<0.0001) and 6.25% FR (F= 12.34; P<0.0001, Table 2).

Third nymphal instar

Obviously, untreated (control) individuals of *O. albidipennis* showed the shortest developmental period at 8.43 days (Table 2). The developmental time differed significantly among tested insecticides at 50% FR (F= 50.86; P<0.0001), 25% FR (F= 42.02; P <0.0001) and 12.5% FR (F= 39.81; P<0.0001, Table 2).

Fifth nymphal instar

Untreated (control) individuals of *O. albidipennis* showed the shortest developmental period at 2.10 days. Significant differences were existed between the tested insecticides in terms of developmental time of 5thnymphal instar of *O. albidipennis* at 50% FR (F= 10.94; P<0.0001), and 25% FR (F= 10.12; P<0.0001) and 12.5% FR (F= 7.87; P<0.0001, Table 2).

Table (2): Mean developmental periods (±SE) of insecticide-treated first, third and fifth nymphal instars of *O. albidipennis* obtained from direct treatment

Treatment	100%FR	50%FR	25%FR	12.5%FR	6.25%FR
	1st Developmental period, days (±SE)				
Control	11.28±0.47b	11.28±0.47b	11.28±0.47c	11.28±0.47b	11.28±0.47b
Dipel 2x	12.5±0.26a	12.35±0.22a	12.10±0.16b	−	−
Radiant	12.45±0.20a	12.50±0.19a	12.30±0.13b	−	−
Proclaim	−	−	14.00±0.18a	13.65±0.15a	13.30±0.22a
Aphox	−	−	13.80±0.15a	13.45±0.15a	13.20±0.18a
Coragen	−	−	14.05±0.23a	13.70±0.19a	13.35±0.16a
	3rd Developmental period, days (±SE)				
Control	8.43±0.35b	8.43±0.35c	8.43±0.35c	8.43±0.358b	
Dipel 2x	9.75±0.16a	9.60±0.16b	9.50±0.16b	−	
Radiant	9.70±0.17a	9.60±0.21b	9.60±0.17b	−	
Proclaim	−	11.80±0.17a	11.30±0.13a	11.10±0.17a	
Aphox	−	11.80±0.14a	11.25±0.17a	11.15±0.15a	
Coragen	−	11.95±0.19a	11.60±0.14a	11.40±0.16a	
	5th Developmental period, days (±SE)				
Control	2.10±0.12a	2.10±0.12b	2.10±0.12b	2.10±0.12b	
Dipel 2x	2.35±0.10a	2.35±0.10b	2.25±0.11b	−	
Radiant	2.38±0.11a	2.33±0.10b	2.30±0.13b	−	
Proclaim	−	3.35±0.22a	3.20±0.22a	3.13±0.18a	
Aphox	−	3.33±0.23a	3.20±0.22a	3.05±0.19a	
Coragen	−	3.38±0.23a	3.25±0.20a	3.15±0.12a	

Means followed with the same letters (column wise) are not significantly different (LSD at P ≤ 0.05).
1st= first nymphal instar, 3rd = third nymphal instar and 5th = fifth nymphal instar
Number of replicates for each treatment (40).
− Treatments were excluded during statistical analysis.
FR= field rates.

The longevity of insecticide-treated *O. albidipennis*

The obtained adults from treated first nymphal instar

The obtained data in Tables (3 and 4) showed that the longevity of untreated (control) individuals of *O. albidipennis* lasted 23.00 and 4.90 days in females and males, respectively.

There was significant difference among tested insecticides at 100% FR in terms of female (F= 10.32; P<0.0001, Table 3) and male longevity (F= 10.30; P<0.0001, Table 4). Pertaining to *O. albidipennis* female and male at 50% FR, significant difference existed in female (F= 9.77; P= 0.0001) and in male longevity (F= 9.77; P= 0.0001). Statistically, there were significant differences at 25% FR in female (F= 53.82; P<0.0001, Table 3) and male longevity (F= 34.68; P<0.0001, Table 4). Obviously, the significant differences existed at 12.5% FR in female (F= 109.47; P<0.0001) and in male longevity (F= 31.27; P<0.0001). The same trend of significance was also recorded at 6.25% FR among female (F= 77.47; P<0.0001, Table 3) and male longevity (F= 36.03; P<0.0001, Table 4).

The obtained adults from treated third nymphal instar

Obviously, untreated (control) individuals of *O. albidipennis* showed the longest longevity at 23.00 and 4.95 days in females and male, respectively (Table 3 and 4). No significant differences were detected between longevities of *O. albidipennis* adults obtained from the 3rdnymphal instar treated by Dipel 2x and Radiant treatments or between those treated by Proclaim, Aphox and Coragen treatments at all tested rates (Tables 3 and 4).

The obtained adults from treated fifth nymphal instar

Clearly, data obtained in Tables (3 and 4) indicated that the adult stages of *O. albidipennis* (females and males) obtained from untreated (control) 5th nymphal instar lived longer as compared to other treatments. There was significant difference among tested insecticides at 100% FR in terms of female (F= 111.73; P<0.0001, Table 3) and male longevity (F= 14.25; P<0.0001, Table 4). The same trend was also recorded at 50% FR in female (F= 51.47; P<0.0001) and in male longevity (F= 14.41; P<0.0001) and at 25% FR, in female (F= 50.98; P<0.0001) and male longevity (F=9.82; P<0.0001). Moreover, the significant differences between untreated (control) and such insecticide treatments were existed at 12.5% FR in female (F= 30.51; P<0.0001, Table 3) and in male longevity (F= 19.38; P<0.0001 Table 4).

The adult stage

As shown in Tables (3 and 4) the direct effect of tested insecticides on the adult stage longevity (females and males) was less than that observed when *O. albidipennis* nymphal instars (1st, 3rd and 5th instars) were treated with the tested insecticides. Moreover, the significant differences between longevity of females existed at 100% FR (F= 36.42; P<0.0001), 50% FR (F= 36.20; P<0.0001) and 25% FR (F= 34.43; P<0.0001, Table 3). Similarly, male longevity differed significantly among tested insecticides at 100% FR (F= 8.82; P<0.0001), 50% FR (F= 8.84; P<0.0001) and 25% FR (F= 5.36; P=0.0001, Table 4).

Fecundity rates of Insecticide-treated *O. albidipennis*

The obtained adults from treated first nymphal instar

Apparently, untreated (control) individuals of the *O. albidipennis* females from treated 1st nymphal instar recorded the highest fecundity rate at 170.99 eggs. The fecundity rates showed significant differences at 100% FR (F=3.98; P=0.0577), 50% FR (F=3.47; P=0.0763), 25% FR (F=24.38; P<0.0001), 12.5% FR (F=23.88; P<0.0001) and 6.25% FR (F=23.67; P<0.0001, Fig 3).

The obtained adults from treated third nymphal instar

Untreated (control) of *O. albidipennis* females observed from 3rdnymphal instar showed the highest fecundity rate at 140.21 eggs. The significant differences between the tested insecticide of 3rdnymphal instar of *O. albidipennis* at 100% FR (F= 4.14; P= 0.0531), 50% FR (F= 116.97; P<0.0001), 25% FR (F= 68.31; P<0.0001) and 12.5% FR (F= 176.50; P<0.0001, Fig 3).

The obtained adults from treated fifth nymphal instar

The tested insecticides had a profound negative effect on the fecundity rates of eggs laid by Orius females previously treated as 5thnymphal instar with the studied insecticides. There were significant differences among tested insecticides at 100% FR (F= 11.25; P= 0.0036), 50% FR (F= 97.96; P<0.0001), 25% FR (F= 65.49; P<0.0001) and 12.5% FR (F= 97.50; P<0.0001, Fig 3c).

The adult stage

Generally, the fecundity rates was in the order of Dipel 2x> Radiant>Aphox> Proclaim> Coragen at 100 and 50% FR. Statistical analysis showed that the rates of fecundity rates in *O. albidipennis* females treated with certain bio and conventional insecticides differed significantly at 100% FR (F= 76.49; P<0.0001), 50% FR (F= 87.67; P<0.0001) and 25% FR (F= 96.55; P<0.0001, Fig 3d).

Hatchability percentages of insecticide-treated *O. albidipennis*

The obtained adults from treated first nymphal instar

The tested insecticides at their tested rates (100, 50 and 25% FR) demonstrated various hatchability percentages of the eggs laid by *Orius* females obtained from insecticide-treated 1stnymphal instar. Statistically, there were significant differences in the percentages of hatchability among tested insecticides treatments at 25% FR (F= 5.96; P= 0.0020), 12.5% FR (F= 4.84; P= 0.0197) and 6.25% FR (F= 0.79; P= 0.5246, Fig 4).

The obtained adults from treated third nymphal instar

The obtained data in Fig (4) showed that the hatchability percentages were significantly affected by different rates of the tested insecticides. Statistical analysis proved that there were significant differences among tested insecticides treatments at 50% FR (F= 8.47; P= 0.0003), 25% FR (F= 7.81; P= 0.0005) and 12.5% FR (F= 1.19; P= 0.3547, Fig 4).

The obtained adults from treated fifth nymphal instar

Clearly, the highest percentage of hatchability was recorded in untreated (control) individuals at 97.95%. Significant differences existed between the tested insecticide treatments of 5thnymphal instars of *O. albidipennis* at 50% FR (F= 6.08; P= 0.0018), 25% FR (F= 2.66; P= 0.0571) and 12.5% FR (F= 77.58; P<0.0001, Fig 4).

The adult stage

Untreated (control) of *O. albidipennis* females recorded 97.99% (Fig 4). Significant differences were observed among the studied insecticides in the hatchability percentages at 100% FR (F= 8.84; P= 0.0002), 50% FR (F= 11.39; P<0.0001) and 25% FR (F= 2.41; P= 0.0768, Fig 4).

Table (3): Female longevity (±SE) of *O. albidipennis* treated as first, third, fifth nympal instars or as adult stage with certain insecticides

Treatment	100%FR	50%FR	25%FR	12.5%FR	6.25%FR
	Female longevity obtained from treated 1ST, days (±SE)				
Control	23.00±0.40a	23.00±0.40a	23.00±0.40a	23.00±0.40a	23.00±0.40a
Dipel 2x	17.75±1.06b	18.10±1.14b	18.48±1.09b	–	–
Radiant	17.95±1.14b	18.20±0.97b	18.60±1.08b	–	–
Proclaim	–	–	8.73±0.82c	9.25±0.73b	9.60±0.79b
Aphox	–	–	9.10±0.84c	9.63±0.81b	9.88±0.90b
Coragen	–	–	8.40±0.81c	9.05±0.60b	9.35±0.86b
	Female longevity obtained from treated 3rd, days (±SE)				
Control	23.00±0.35a	23.00±0.35a	23.00±0.35a	23.00±0.35a	
Dipel 2x	18.13±1.07b	18.80±1.07b	19.05±0.87b	–	–
Radiant	18.20±0.92b	18.80±1.01b	19.03±1.16b	–	–
Proclaim	–	9.85±1.21c	10.55±0.99c	10.98±1.08b	–
Aphox	–	10.63±1.18c	10.05±0.97c	11.15±1.04b	–
Coragen	–	9.30±1.02c	10.03±1.12c	10.45±1.11b	–
	Female longevity obtained from treated 5th, days (±SE)				
Control	24.00±0.39a	24.00±0.39a	24.00±0.39a	24.00±0.39a	
Dipel 2x	18.88±0.20b	19.18±0.24b	19.83±0.21b	–	–
Radiant	18.75±0.22b	19.20±0.30b	19.73±0.28b	–	–
Proclaim	–	11.78±1.01c	12.80±0.91c	13.13±1.23b	–
Aphox	–	12.95±0.98c	13.80±0.94c	13.38±1.04b	–
Coragen	–	11.43±0.88c	12.00±0.88c	13.20±1.03b	–
	Female longevity obtained from treated adults, days (±SE)				
Control	24.00±0.30a	24.00±0.30a	24.00±0.30a		
Dipel 2x	20.83±0.26b	21.13±0.31b	21.85±0.25b	–	–
Radiant	20.75±0.19b	21.00±0.15b	21.88±0.27b	–	–
Proclaim	14.05±1.02c	14.50±1.00c	14.35±1.15c	–	–
Aphox	14.60±1.05c	14.90±0.77c	14.95±0.98c	–	–
Coragen	13.70±0.93c	14.03±1.12c	14.43±0.97c	–	–

Means followed with the same letters (column wise) are not significantly different (LSD at P ≤ 0.05).
1st = first nymphal instar, 3rd = third nymphal instar and 5th = fifth nymphal instar
Number of replicates for each treatment (40).
– Treatments were excluded during statistical analysis.
FR= field rates.

Table (4): Male longevity (±SE) of *O. albidipennis* treated as first, third, fifth nympal instars or as adult stage with certain insecticides

Treatment	100%FR	50%FR	25%FR	12.5%FR	6.25%FR
	Male longevity obtained from treated 1ST, days (±SE)				
Control	4.90±0.13a	4.90±0.13a	4.90±0.13a	4.90±0.13a	4.90±0.13a
Dipel 2x	3.85±0.23b	4.00±0.22b	4.00±0.24b	–	–
Radiant	3.95±0.16b	3.95±0.23b	4.08±0.22b	–	–
Proclaim	–	–	2.43±0.82c	2.55±0.25b	2.70±0.19b
Aphox	–	–	2.58±0.19c	2.73±0.20b	2.98±0.21b
Coragen	–	–	2.40±0.14c	2.53±0.23b	2.70±0.17b
	Male longevity obtained from treated 3rd, days (±SE)				
Control	4.95±0.11a	4.95±0.11a	4.95±0.11a	4.95±0.11a	–
Dipel 2x	3.98±0.21b	4.00±0.17b	4.05±0.18b	–	–
Radiant	3.95±0.14b	4.00±0.17b	4.00±0.16b	–	–
Proclaim	–	3.05±0.16c	3.18±0.14c	3.40±0.15b	–
Aphox	–	3.18±0.20c	3.40±0.19c	3.53±0.16b	–
Coragen	–	3.00±0.15c	3.20±0.16c	3.35±0.13b	–
	Male longevity obtained from treated 5th, days (±SE)				
Control	4.95±0.09a	4.95±0.09a	4.95±0.09a	4.95±0.09a	–
Dipel 2x	4.10±0.16b	4.15±0.19b	4.15±0.19b	–	–
Radiant	4.00±0.15b	4.05±0.13b	4.10±0.21bc	–	–
Proclaim	–	3.43±0.18c	3.65±0.18cd	3.65±0.15b	–
Aphox	–	3.50±0.19c	3.68±0.13cd	3.70±0.14b	–
Coragen	–	3.38±0.16c	3.63±0.14d	3.50±0.20b	–
	Male longevity obtained from treated adults, days (±SE)				
Control	5.05±0.10a	5.05±0.10a	5.05±0.10a	–	–
Dipel 2x	4.35±0.17b	4.35±0.19b	4.40±0.21b	–	–
Radiant	4.30±0.13b	4.30±0.16b	4.38±0.17b	–	–
Proclaim	3.80±0.17c	3.88±0.12c	4.15±0.15b	–	–
Aphox	4.00±0.19bc	4.18±0.11bc	4.20±0.11b	–	–
Coragen	3.80±0.18c	3.85±0.17c	4.10±0.14b	–	–

Means followed with the same letters (column wise) are not significantly different (LSD at $P \leq 0.05$).
1st = first nymphal instar, 3rd = third nymphal instar and 5th = fifth nymphal instar
Number of replicates for each treatment (40).
– Treatments were excluded during statistical analysis.
FR= field rates

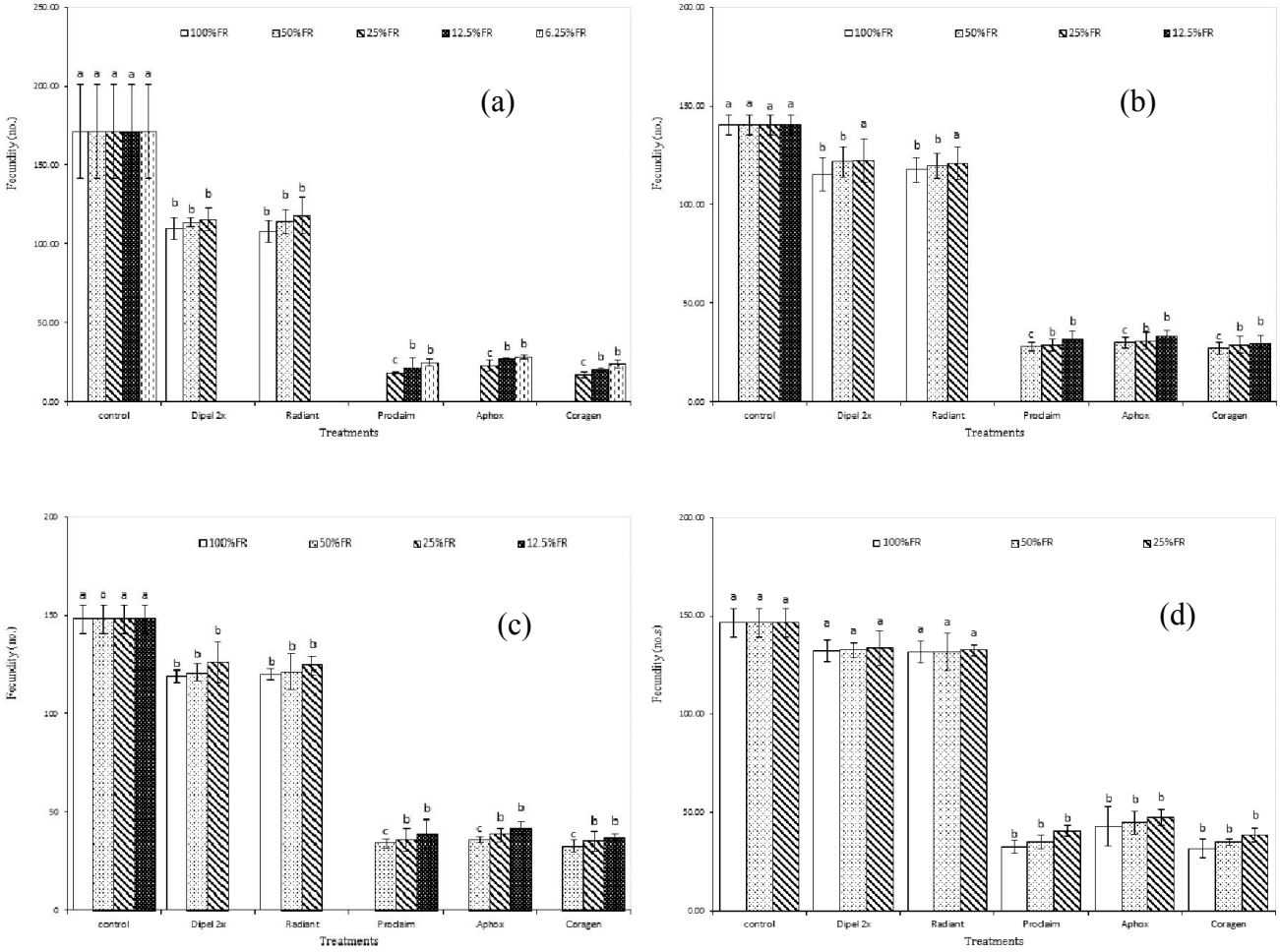

Fig (3): Fecundity rates (±SE) of the eggs laid by *O. albidipennis* females obtained from insecticide-treated first (a), third (b), fifth (c) nymphal instars and adult stage (d) after direct treatment- Bars with different letters indicated significant difference

DISCUSSION

The obtained results in this study confirmed the importance of the selection of suitable insecticide concentrations and the method of application to minimize the toxicity on *Orius* sp. (Angeli *et al.,* 1998). Results indicated that the selected insecticides significantly reduced the fecundity and fertility of *O. albidipennis* females at 100% FR as compared to untreated females. This finding is consistent with that of Felip *et al*. (1987). On the same trend, the survival rate of tested nymphs and adult stages of *O. albidipennis* was highly correlated to the studied insecticide concentrations (Munyuli *et al.,* 2007). In this study, Dipel 2x® was the least toxic insecticide to *Orius* sp. population; this is supported by findings of Mohamed (1993). The integration of Dipel 2x® or Radiant® bioinsecticides with *O. albidipennis* were slightly harmful to the predator after being exposed to recommended, half and quarter field rates (Mahmoud and Osman, 2007), and these results are in harmony with those of Sarhan (2004). As for Radiant® insecticide, it could be considered as a good candidate to be a part of integrated pest management program within potato crop where *Orius* spp. would be deployed (Al-Antary *et al.,* 2010).

According to the selectivity of the Emamectin benzoate (Proclaim®), Biondi *et al.* (2012) found that the insecticide exhibited high toxicity to *Orius* sp. and affected the reproductive performance at the same conditions. Primicarb (Aphox®) could be considered a moderate harmful insecticide on the adult stage (Lee *et al.,* 1997). Based on IOBC standards about Primicarb toxicity; Jansen (2001) indicated that this insecticide had harmful impacts to natural enemies when applied to control the insect pests in the field at zero days. Also, Symington (2003) confirmed that Aphox® had unfavorable effect on the fecundity of *O. albidipennis*. The ability of Primicarb to be implemented in IPM strategy is depended on the frequency distribution of that insecticide at a low concentration under semi-field and field conditions Veire *et al.* (2002). Regarding the toxicity of Chlorantraniliprole (Coragen® insecticide), the present findings were inconsistent with those of Broughton *et al.* (2014), who stated that Chlorantraniliprole had less negative effect on *Orius* sp.

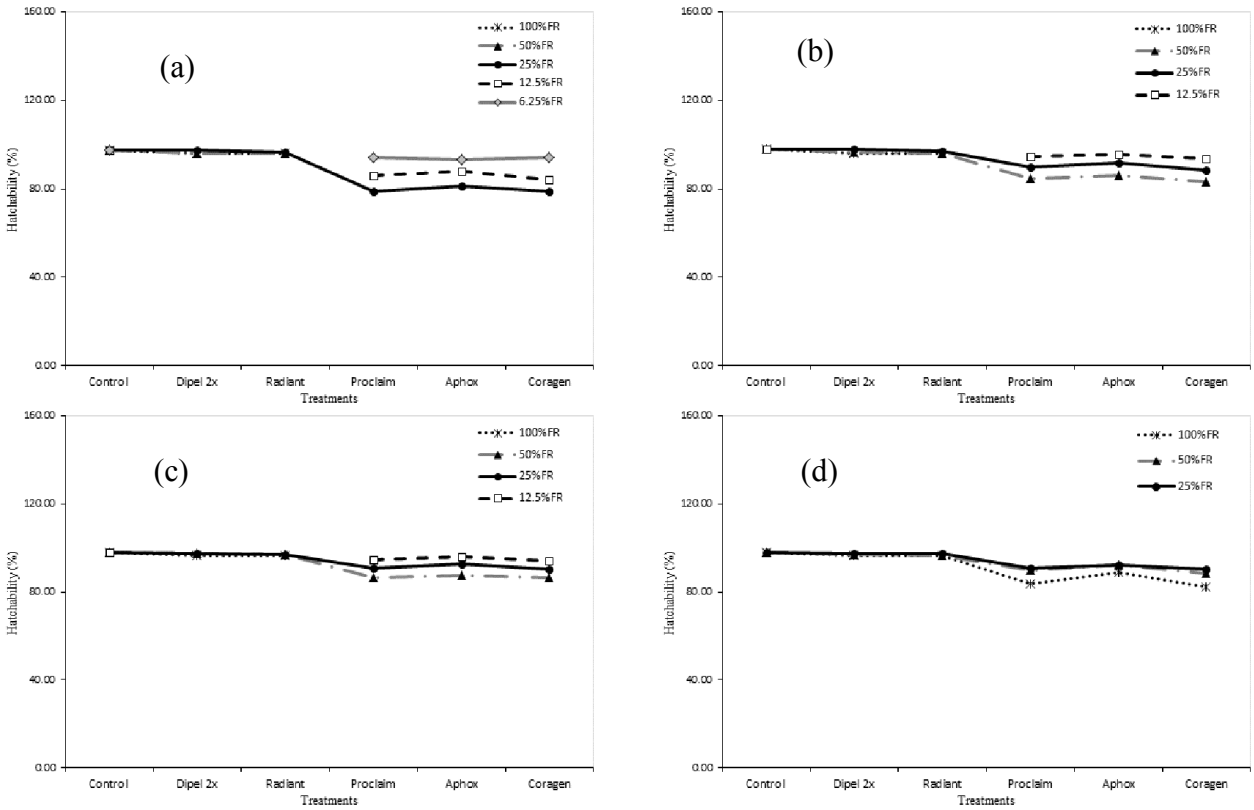

Fig (4): Hatchability percentages of the eggs laid by *O. albidipennis* females obtained from insecticide-treated first (a), third (b), fifth (c) nymphal instars and adult stage (d) after direct treatment.

CONCLUSION

Proclaim, Aphox and Coragen insecticides had a profound and significant influence on the mortality percentages, developmental periods, longevity, fecundity rates and hatchability percentages toward on the newly molted young nymphal instars and adult stages of *O. albidipennis*. However, the influence of different insecticides on the tested stages of *O. albidipennis* increased with increasing the concentrations. Overall, tested insecticides were more toxic and had negative impacts on the first and third nymphal instars more than fifth nymphal instar and adult stage of *O. albidipennis*.

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تأثير بعض المبيدات على الأطوار غير الكاملة و الكاملة لمفترس *Orius albidipennis* (Reuter) (Hemiptera: Anthocoridae)

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تم تقييم خمسة أنواع من المبيدات الحيوية والتقليدية (Dipel 2x و Radiant و Proclaim و Aphox وCoragen) على الصفات البيولوجية لمفترس *O. albidipennis*، حيث سجل العمر الحورى الأول أعلى نسب موت بعد المعالة بالجرعات الموصى بها أو نصفها، ووصلت نسبة موت العمر الحورى الأول إلى ١٠٠% بعد المعاملة بكلاً من Proclaim و Aphox و Coragen. وعلى نفس النمط وصلت نسب موت العمر الحورى الثالث والخامس للمفترس إلى ١٠٠% عند الجرعة الموصى بها بعد المعاملة بنفس المبيدات، أما بالنسبة لأفراد الطور الكامل للمفترس والمعاملة بالجرعة الموصى بها، فقد كانت أكثر تحملاً للتأثير المباشر للمبيدات.سجلت الأفراد المعاملة بمبيد الـ Coragen أعلى نسبة موت. وعلى هذا أثبتت الدراسة أن التعرض المباشر للمبيدات المختبرة كان ذو تأثير كبير ومعنوي أيضاً على طول فترة نمو الأعمار غير الكاملة للمفترس *O. albidipennis* التي تم معاملتها بالمبيدات المختبرة، وسجلت الأعمار الحورية المعاملة بكلاً من Dipel2x و Radiant أقصر فترة نمو، بينما سجلت أطول فترة نمو عند المعاملة بالـ Coragen. كما لوحظ أيضاً أن تأثير التركيزات المختلفة لكلاً من Proclaim و Aphox و Coragen كان متقارباً بالنسبة لفترة حياة الطور الكامل الناتج (الذكور أو الإناث) كان متقارباً جداً. أيضاً كان لتركيز المبيد أثراً معنوياً على خصوبة الإناث ونسبة فقس البيض.