Field Performance of Selected Insecticides on Cotton Aphid, *Aphis gossypii* and Side Effects on Lady Beetle, *Coccinella septumpunctata*

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Abstract

Khalifa, M.H., A.R. Khirallah, F.I. El-Shahawi, N.A. Mansour and H.K. Abou-Taleb. 2024. Field Performance of Selected Insecticides on Cotton Aphid, *Aphis gossypii* and Side Effects on Lady Beetle, *Coccinella septumpunctata.* Arab Journal of Plant Protection, 42(2): 208-214. https://doi.org/10.22268/AJPP-001234

To evaluate some insecticide treatments against the adult stage of the cotton aphid, *Aphis gossypii* Glover (Hemiptera: Aphididae), two field trials were conducted during the cotton seasons of 2020 and 2021 in Abees, Alexandria, Egypt. The negative effects of insecticide treatments against the lady beetle, *Coccinella septumpunctata* L. larvae were also investigated. The study revealed that, in the 2020 cotton season, the neonictinoid insecticides thiamethoxam, acetamiprid, and imidacloprid, and the organophosphorus insecticide malathion significantly ($P < 0.05$) exhibited the greatest initial effectiveness against cotton aphid with initial population reduction of 76.8, 76.8, 74.8, and 73.7%, respectively. Thiamethoxam, acetamiprid, imidacloprid, pymetrozine, and malathion had the highest initial cotton aphid population reduction in 2021 of 75.7, 75.4, 75.2, 73.3, and 73.2%, respectively. Pymetrozin, thiamethoxam, malathion, and spiromesifen showed the least residual reduction rates of 81.2, 91.5, 81.6 and 82.5%, respectively. In both seasons, buprofezin significantly ($P < 0.05$) achieved the least initial toxicity as well as the highest residual toxicity against cotton aphid with reduction rates of 44.8 and 91.9% in 2020 and 52.4 and 87% in 2021, respectively. In addition, other tested insecticides had similar residual toxicity with buprofezin. Whereas, in 2020, imidacloprid and pymetrozin showed residual reduction rates of 89.1 and 91.9%, respectively, whereas in 2021, etophenprox and acetamiprid achieved residual reduction rates of 87.3 and 90.4%, respectively. On the other hand, in 2020, malathion and pymetrozine showed the highest initial toxicity on lady beetle with reduction rates of 27.7 and 25.3%, respectively. Buprofezin also showed in both seasons the least initial side effect against lady beetle and low residual toxicity with reduction rates of 12.1 and 12.2% in 2020 and 15.6 and 14.8% in 2021, respectively. Spiromesifen achieved the highest residual reduction rate (25.6%), significantly followed by malathion (19.2%). Thiamethoxam similar to buprofezin, also achieved the least residual reduction rate against lady beetle (11.4%). In 2021, malathion and spiromesifen showed the highest initial side effects against lady beetle with reduction rates of 26.8 and 26.6%, respectively. Spiromesifen, thiamethoxam, and malathion gave the highest residual toxicity with reduction rates of 22.8, 21.7 and 21.4%, respectively. According to the IOBC classification, all insecticide treatments were considered harmless against lady beetle, where the reduction rates were less than 50% in the field. The good selectivity feature of these insecticides makes them suitable components for IPM programs against cotton aphids.

Keywords: Cotton aphid, insecticides, IPM programs, lady beetle, natural enemies, selectivity.

Introduction

The cotton aphid, *Aphis gossypii* Glover (Hemiptera: Aphididae) is a polyphagous insect of cotton and many other ornamentals, crops and vegetables, which sucks plants sap. Cotton aphids cause crop losses by extracting phloem sap and contaminating cotton opened boll lint with honeydew (Sarwar *et al.*, 2014; Schepers, 1989). In Egypt, *A. gossypii* is one of the most serious insects which affects the cotton seed yield and the fiber quality, in addition to its ability to transmit viral diseases (Abou-Elhagag, 1998a; 1998b; El Kady, 2007). Effective aphid control which relies mainly on chemical insecticides application, is an important control component to minimize crop losses.

The rising use of chemical pesticides is linked to negative environmental effects, and unforeseen environmental implications are frequently difficult to forecast or anticipate (Petrelli & Mantovani, 2002). Furthermore, the intensive and unwise use of pesticides have led to resistance development in many targeted pest species (Tabacian *et al.*, 2011; Tabashnik *et al.*, 2009), which affects the pesticide use sustainability (Bass & Field, 2011). It is now essential to identify new and safer insecticides with enhanced efficacy and favorable toxicological profiles, to compliment other pest management components such as natural enemies. Lady beetles are voracious predators of many plant insect pests such as aphids. Aphidophagous lady beetles are thought to be highly polyphagous and they can feed on a wide variety of aphid species (Pedigo & Rice, 2006). Fortunately, larval and adult stages of lady beetles can provide sufficient control of aphid populations, and consequently can be an important component in IPM programs for cotton aphids control (Jiang *et al.*, 2018).

The use of non-selective insecticides is a significant factor in disrupting natural enemies in most cropping systems (Naranjo, 2001; Skouras *et al.*, 2017) causing negative impacts on natural enemies which leads to pest resurgence and secondary pest outbreaks (Fernandes *et al.*, 2010). Therefore, the conservation of natural enemies is very important for the IPM programs and is essential in any agro-ecosystem. The integration between pesticides with biological control agents including parasitoids and predators attracted the attention of those interested in plant protection as an important IPM component (Croft, 1990). Generally,

https://doi.org/10.22268/AJPP-001234

insecticides are considered appropriate to be used in the IPM if they combine insect pest control with minimal or no adverse effects on beneficial species (Singh & Varma, 1986). Consequently, the purpose of this study was to examine the field effectiveness of selected insecticides against the cotton aphid, *A. gossypii*, as well as their adverse effects that they may have on the lady beetle, *Coccinella septumpunctata* L.

Materials and Methods

Insecticides

Spiromesifen (Koffex 24% SC), used at 120 ml/100 L water, was produced by Turkey Agrimar Commercial Agencies. Imidacloprid (Potox 50%SC), used at 60 ml/100 L water, was produced by Jang Dong Lioy Chemical and Limited Company/ Sama company. Etophenprox (Primo10% SC), used at 100 ml/100 L water, and buprofezin (Ran Way 25% SC), used at 100 ml/100 L water, were produced by Starchem Industrial Chemicals-Egypt. Thiamethoxam (Actara 25%WG), used at 20 gm/100 L water, was produced by Syngenta. Acetamiprid (Altocor 20% SP), used at 25 gm/100 L water, was produced by Hefei Yifeng Chemical Industry CO LTD China/Green Land. Pymetrozine (Tedo 50% WDG), used at 50 gm/100 L water, was produced by Hailir pesticides & Chemicals-group Co LTD China/Starchem Industrial Chemicals– Egypt. Malathion (Malatox 57% EC), used at 250 ml/100 L water, was produced by Elhelb for Chemicals and Pesticides.

Field experiments

Two field experiments were carried out during 2020 and 2021 cotton seasons at Abees, Alexandria, Egypt. Cotton variety Giza 86 was sown following standard agronomic practices on the first of May in both seasons. Eight treatments in addition to control were arranged in a randomized complete block design (RCBD) with 4 replicates (175 m^2/each). Knapsack sprayer equipment (CP3) was used for treatments application at the rate of 200 L per feddan. Insecticides were applied on July 14 and July 27 in 2020 and 2021 seasons, respectively. Control was sprayed by water only. Ten plants per plot were selected randomly and inspected in the morning for the aphids and natural enemies' counts. The sampling was made just before spraying and 1, 3, 5, 7, 10 and 15 days after treatment. Aphids and predators reduction rate were calculated according to Henderson & Tilton (1955) equation. Insecticide treatments used in this study were categorized based on their effects on the natural enemies according to the International Organization of Biological Control (IOBC) classification to three categories as follows: N= harmless or slightly harmful (reduction field and semi-field 0-50%, laboratory <30%), M= moderately harmful (reduction field and semi-field 51-75%, laboratory 30-79%), and T= harmful (reduction field and semi-field >75%, laboratory ≥ 80%) (Boller *et al.,* 2005).

Statistical analysis

Initial reduction rate of cotton aphid and lady beetle were compared using one way analysis of variance (ANOVA). Residual reduction rates of cotton aphid and lady beetle were compared using a factorial split plot design, with insecticides treatments allocated to the main plots and time intervals as sub-plots. The general reduction rates of cotton aphid and lady beetle were compared using ANOVA following a factorial split-split plot design, with insecticides treatment allocated to the main plots, insects as subplots and time intervals as sub sub-plots. All data were presented as means and compared for significance by LSD test at the probability level of 0.05 using SAS software version 9.4 (SAS, 2017).

Results

Field efficiency of some insecticide treatments against cotton aphid on the cotton crop

Initial and residual reduction rates of cotton aphid caused by insecticides treatments during 2020 and 2021 cotton seasons are presented in Table 1. Thiamethoxam, acetamiprid, imidacloprid, and malathion significantly (P<0.05) achieved the highest initial effectiveness against cotton aphid followed by pymetrozine and etophenoprox with initial reduction 76.8, 76.8, 74.8, 73.7, 71.8 and 67.0%, respectively in 2020 cotton season. In 2021 cotton season, thiamethoxam, acetamiprid, imidacloprid, pymetrozine, and malathion achieved the highest cotton aphid initial reduction of 75.7, 75.4, 75.2, 73.3 and 73.2%, respectively.

In both seasons, buprofezin achieved the least cotton aphid initial reduction of 44.8 and 52.4%, in 2020 and 2021, respectively (Table 1).

According to the statistical analysis, pymetrozine, buprofezin, and imidacloprid significantly (P < 0.05) induced the highest residual reduction rate of cotton aphid. On the other hand, spiromesifen and thiamethoxam achieved the least residual reduction rate of 76.9 and 75.5, respectively (Table 1). In 2020 season, imidacloprid, buprofezin, pymetrozine, acetamiprid, etophenprox, and malathion achieved cotton aphid residual reduction rates of 89.1, 91.9, 91.9, 84.5, 82.4, and 80.4%, respectively. In 2021 season, acetamiprid, etophenprox, and buprofezin caused the highest residual activity with cotton aphid mean residual reduction rates of 90.4, 87.3, and 87.0%, respectively (Table 1). On the other hand, pymetrozine, malathion, and thiamethoxam showed the least residual activity with cotton aphid mean residual reduction rates of 81.2, 81.6, and 80.5%, respectively.

Side effects of some insecticide treatments on lady beetle on the cotton crop

Side effects of the tested insecticides against the predatory insect, lady beetle in 2020 and 2021 seasons are presented in Table 2. In 2020 season, malathion and pymetrozine recorded the highest initial toxicity on lady beetle with reduction rates of 27.7 and 25.3%. Buprofezin showed the least initial side effect against lady beetle with reduction rate of 12.1%. Concerning the residual toxicity, spiromesifen achieved the highest reduction rate (25.6%), followed by malathion (19.2%), acetamiprid (16.6%) and pymetrozine (14.4%). Thiamethoxam achieved the least side effect against lady beetle with residual reduction rate of 11.4% (Table 2). In 2021 season, malathion and spiromesifen showed the highest initial side effects against lady beetle with reduction rates of 26.8 and 26.6%, respectively.

Moreover, spiromesifen, thiamethoxam, and malathion gave the highest residual toxicity with reduction rates of 22.8, 21.7 and 21.4%, respectively (Table 2). According to the IOBC classification, all insecticide treatments were considered harmless against lady beetle, where the reduction rate was less than 50% in the field.

When the population reduction rates of cotton aphid and lady beetle caused by the insecticide treatments in 2020 and 2021 seasons were compared, all tested insecticides showed significant ($P < 0.05$) differential toxicity (Figure 1). In general, buprofezin showed the safest activity against lady beetle, with a good efficiency against cotton aphid in both seasons. In 2020 season, etophenprox and thiamethoxam recorded good field impact with low toxicity against lady beetle and high toxicity against cotton aphid (Figure 1-A). In 2021 season, imidacloprid, acetamiprid, and pymetrozine achieved good reduction rate against cotton aphid and low toxicity against lady beetle (Figure 1-B).

Table 1. Initial and residual reduction rate of cotton aphid population after treatment with selected insecticides during the 2020 and 2021 cotton growing seasons.

	Initial reduction rate (%) (24 h)		**Residual reduction rate (%) at different periods after treatment (days)**											
			3		**5**		**7**		**10**		**15**		**Mean**	
Treatment	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**
Spiromesifen	61.5 c	66.9 d	79.6 ± 1.9	81.5 ± 1.3	73.0 ± 0.4	91.7 ± 0.9	72.7 ± 1.8	98.0 ± 0.2	81.7 ± 1.0	75.8 ± 1.6	77.3 ± 1.2	65.6 ± 0.8	76.9 de	82.5 cd
Imidacloprid	74.8 a	75.2 a	89.7 ± 1.2	79.2 ± 0.3	84.9 ± 1.0	92.3 ± 0.9	85.4 ± 0.6	95.0 ± 0.5	98.1 ± 0.4	87.5 ± 0.4	87.6 ± 1.3	75.5 ± 0.6	89.1 a	85.9 bc
Etophenprox	67.0 b	65.7 d	73.9 ± 0.9	88.0 ± 0 .6	82.9 ± 0.8	81.1 ± 1.4	93.9 ± 0.8	90.1 ± 0.6	82.9 ± 0.9	90.6 ± 1.3	78.6 ± 0.3	86.9 ± 1.0	82.4 bc	87.3 ab
Buprofezin	44.8 d	52.4 e	83.4 ± 0.1	79.6 ± 2.5	95.4 ± 0.2	91.1 ± 0.5	97.2 ± 0.3	96.8 ± 0.7	94.8 ± 0.6	92.4 ± 0.7	89.1 ± 1.0	75.0 ± 1.5	91.9 a	87.0 ab
Thiamethoxam	76.8 a	75.7 a	72.6 ± 1.0	82.8 ± 1.5	76.3 ± 0.6	71.9 ± 0.7	69.7 ± 1.0	91.1 ± 0.1	81.1 ± 0.7	77.4 ± 0.7	77.9 ± 1.3	79.5 ± 1.2	75.5 e	80.5 d
Acetamiprid	76.8 a	75.4 a	76.9 ± 7.3	80.9 ± 0.8	83.7 ± 0.6	93.0 ± 0.5	85.6 ± 0.6	98.5 ± 0.3	90.5 ± 0.7	92.3 ± 0.6	85.6 ± 0.4	87.4 ± 0.6	84.5 b	90.4 a
Pymetrozin	71.8 b	73.3 ab	84.7 ± 0.2	66.7 ± 0.9	91.9 ± 0.4	70.9 ± 0.6	97.3 ± 0.2	98.8 ± 0.1	97.2 ± 0.7	89.3 ± 1.2	88.2 ± 0.9	80.6 ± 0.4	91.9 a	81.2 d
Malathion	73.7 ab	73.2 ab	76.7 ± 1.0	79.4 ± 0.6	97.6 ± 0.3	93.1 ± 0.5	86.3 ± 0.4	91.8 ± 0.2	71.5 ± 0.7	78.2 ± 1.4	69.9 ± 0.8	65.6 ± 0.5	80.4 cd	81.6 d

Each value is the mean of four replicates. Means followed with the same letters in the same column are not significantly different at P=0.05.

Table 2. Initial and residual reduction rates of lady beetle after treatment with selected insecticides during the 2020 and 2021 cotton growing seasons.

	Initial reduction rate (%) (24 h)		**Residual reduction rate (%) at different periods after treatment (days)**											
			3		**5**		**7**		**10**		**15**		**Mean**	
Treatment	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**
Spiromesifen	16.3 c	26.6 a	25.9 ± 0.7	28.4 ± 0.7	16.1 ± 0.9	10.4 ± 0.4	22.5 ± 0.8	19.6 ± 1.0	23.8 ± 0.9	20.9 ± 1.1	39.5 ± 0.4	34.4 ± 1.4	25.6 a	22.8 a
Imidacloprid	23.6 b	18.3 c	16.1 ± 0.9	15.9 ± 0.5	8.5 ± 0.6	7.0 ± 0.5	8.5 ± 1.0	20.0 ± 1.1	14.8 ± 0.5	9.0 ± 0.7	22.9 ± 1.9	21.4 ± 1.0	14.2 d	14.7 c
Etophenprox	14.7 d	18.8 c	22.2 ± 0.8	27.6 ± 0.7	7.3 ± 0.6	17.0 ± 0.6	4.3 ± 3.7	10.9 ± 0.4	9.7 ± 0.7	15.0 ± 0.9	17.6 ± 0.7	24.7 ± 0.9	12.2 de	19.1 b
Buprofezin	12.1 e	15.6 d	14.8 ± 1.3	18.6 ± 0.6	17.1 ± 0.1	11.4 ± 0.5	12.5 ± 1.3	15.5 ± 1.3	10.1 ± 1.6	16.9 ± 1.6	6.4 ± 1.1	11.4 ± 1.5	12.2 de	14.8 c
Thiamethoxam	23.5 b	23.9 b	13.2 ± 0.7	10.4 ±0.1	9.5 ± 0.3	5.9 ± 0.5	10.1 ± 0.7	16.9 ± 0.6	16.3 ± 1.2	36.7 ± 0.8	7.7 ± 0.5	38.5 ± 1.2	11.4 e	21.7 a
Acetamiprid	18.3 c	22.8 b	20.9 ± 1.3	17.4 ± 0.5	17.5 ± 1.1	18.5 ± 0.2	15.2 ± 1.0	15.9 ± 0.4	16.1 ± 1.2	10.6 ± 0.7	12.9 ± 0.7	13.6 ± 1.1	16.6 c	15.2 c
Pymetrozin	25.3 ab	19.8 c	18.2 ± 0.8	21.7 ± 1.0	11.9 ± 0.5	15.7 ± 0.5	10.7 ± 0.6	13.1 ± 1.3	15.0 ± 0.7	12.0 ± 1.1	16.2 ± 0.5	15.8 ± 0.6	14.4 cd	15.7 c
Malathion	27.7 a	26.8 a	30.8 ± 1.0	28.9 ± 1.0	12.1 ± 0.9	26.2 ± 1.0	8.9 ± 0.6	15.4 ± 0.8	20.8 ± 0.5	13.7 ± 0.8	23.3 ± 0.9	22.5 ± 1.2	19.2 b	21.4 a

Each value is the mean of four replicates. Means followed by the same letters in the same column are not significantly different at P=0.05.

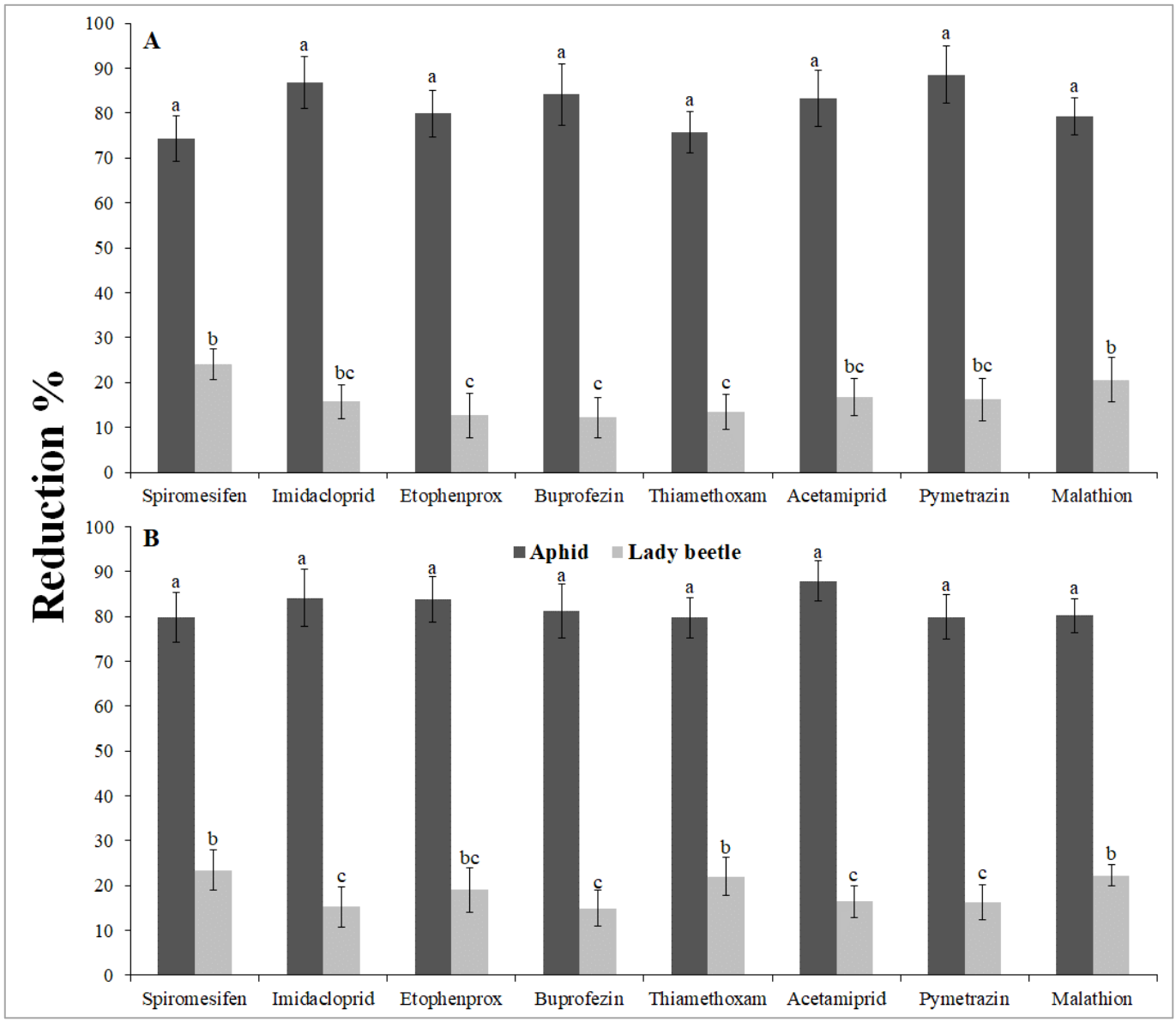

Figure 1. Split-split plot design analysis of residual reduction rates of cotton aphid and lady beetle populations after different insecticides treatments during 2020 (A) and 2021 (B) cotton seasons. Bars of the same color topped by the same letters are not significantly different at P=0.05.

Discussion

Cotton aphid is a sucking-piercing insect attacking a wide spectrum of economic plants, causing high crop losses. In addition, aphids can transmit a wide range of viruses damaging to the crop and secrete honeydew (Blackman & Eastop, 2000; Powell *et al.*, 2006). Lady beetles are highly polyphagous aphid predators, consuming most aphid species, and considered as a main component of any integrated aphid management program (Pedigo & Rice, 2014). Larval and adult stages of lady beetle provide effective control of aphid populations (Jiang *et al.*, 2018). The use of non-selective insecticides is a significant factor in disrupting natural enemies in most cropping systems (Naranjo, 2001; Skouras *et al.*, 2017) causing negative impact on natural enemies which leads to pest resurgence and secondary pest outbreaks (Fernandes *et al.*, 2010). The use of effective pesticides against the targeted insect pests with relatively fewer side effects to natural enemies is vital for any IPM program (Charleston *et al.*, 2005). In the present study, the efficiency of insecticides against cotton aphid and their impact on the lady beetle was carried out in 2020 and 2021 cotton seasons, to develop an effective IPM program for cotton aphid.

In this study, thiamethoxam, acetamiprid, imidacloprid, and malathion achieved the highest initial effectiveness against cotton aphid followed by pymetrozine and etophenoprox. Pymetrozine, buprofezin, and imidacloprid induced the highest residual reduction rates of cotton aphid population. Neonicotinoids are systemic insecticides with broad-spectrum that are frequently applied to control sucking insects on many ornamentals, field crops and vegetable plants through all the growing season (Nauen & Bretschneider, 2002; Nauen *et al.*, 2003). Gaber *et al.*

(2015) mentioned that the foliar application of neonicotinoid insecticides imidacloprid, thiamethoxam, and acetamiprid achieved high efficiency against cotton aphid in the cotton fields during 2013 and 2014 seasons. Similar findings demonstrated the superior effectiveness of neonicotinoid insecticides against cotton aphid in field settings (El-Naggar & Zidan, 2013; Shi *et al.,* 2011). According to Derbalah *et al.* (2013), malathion was the most effective against adults of cotton aphid when compared to mineral oil (CAPL-2) and two plant extracts (black cumin and wormseed). The results of the current investigation were consistent with those findings. Ullah *et al.* (2019) showed that buprofezin significantly decreased the fecundity and longevity of cotton aphid in two generations. In addition, Abou-Taleb & Barrania (2014) reported that highest reduction rate of *A. gossypii* population on eggplant was achieved by applying imidacloprid + buprofezin mixture.

The presence of natural enemies helps in pest control, reduces the insect pest populations, and prevents their outbreaks. Biological control is a natural phenomenon that plays a vital role in pest suppression (DeBach & Rosen, 1991). Wu *et al.* (2022) mentioned that lady beetles are effective predators for aphid control. Preservation of beneficial organisms, such as predators and parasites, is an essential element of any agro-ecosystem (Singh & Kaur, 2016). Even though insecticides can be effective against target insect pests, they can have harmful effects on natural enemies (Biondi *et al.,* 2012; 2013; Desneux *et al.,* 2007). The successful IPM program depends mainly on the integration between chemical and biological control components (Volkmar *et al.,* 2008). Therefore, an assessment of the toxicity of pesticides to natural enemies is a necessary information for developing integrated pest management strategies (Fontes *et al.,* 2018).

In the present study malathion and pymetrozine demonstrated the highest initial toxicity on lady beetle. According to the IOBC classification, all insecticide treatments in this study were considered as harmless against lady beetle, where the reduction rates were less than 50% in the field. It was reported that the systemic neonicotinoid insecticides such as thiamethoxam and imidacloprid are supposedly to have fewer side effects against natural enemies except if they feed on plant tissue or excretions or are exposed to these insecticides via food chain toxicity (Prabhaker *et al.,* 2011). On the other hand, Gaber *et al.* (2015) classified acetamiprid, imidacloprid, and malathion as harmful, whereas thiamethoxam as moderately harmful to the population of *C. undecimpunctata*. In the present study, buprofezin showed the least initial side effects against lady beetle. In previous studies, Lo (2004) showed that buprofezin was less harmful compared to many other groups of non-selective insecticides. In addition, Cabral *et al.* (2008) observed that buprofezin had no significant effects on adult survival or progeny production of *C. undecimpunctata*. Moreover, results of the present study were in accordance with Grafton-Cardwell & Gu (2003) who have studied the adverse effects of buprofezin on other coccinellids.

It can be concluded from this study that buprofezin was the safest insecticide against lady beetle, with a good efficiency against cotton aphid in both seasons. In 2020 season, etophenprox and imidacloprid demonstrated good field impact with low residual toxicity against lady beetle and high residual toxicity against cotton aphid. In 2021 season, imidacloprid and acetamiprid achieved good field residual reduction rate against cotton aphid and low residual toxicity against lady beetle. The positive features of these insecticides make them useful tools for conserving valuable natural enemies, and potential components for IPM programs against cotton aphids, particularly in the cotton crop.

الملخص

خليفة، محمد، عبدالناصر خيرالله، فكري الشهاوي، نبيل منصور، حمدي قطب. 2024. الكفاءة الحقلية لمبيدات حشرية مختارة على منّ القطن (*Aphis gossypii*) والآثار الجانبية على خنفساء أبي العيد (*Coccinella septumpunctata*). مجلة وقاية النبات العربية، 42(2): 208–214.

https://doi.org/10.22268/AJPP-001234

لتقييم بعض المعاملات بالمبيدات الحشرية ضدّ الطور البالغ لمنّ القطن (*Aphis gossypii* Glover)، أجريت تجربتان حقليتان خلال موسمي القطن لعامي 2020 و 2021 في أبيس، الإسكندرية، مصر. تمت دراسة التأثيرات السلبية للمبيدات الحشرية على يرقات خنفساء أبي العيد (*Coccinella septumpunctata* L.). كشفت الدراسة أنه في موسم القطن لعام 2020، أظهرت مبيدات النيونيكتينويد ثياميثوكسام، أسيتاميبريد، وإيميداكلوبريد، ومبيد الفوسفور العضوي ملاثيون أعلى فعالية أولية ضد منّ القطن بشكل معنوى مع نسب خفض أولية قدرها 76.8، 76.8، 74.8 و 73.7%، على التوالي. حقق الثياميثوكسام، الأسيتاميبريد، الإيميداكلوبريد، البيمتروزين، والملاثيون أعلى نسب خفض أولية لمنّ القطن في عام 2021 بنسبة 75.7، 75.4، 75.2، 73.3 و 73.2%، على التوالي. سجل البيمتروزين والثياميثوكسام والملاثيون والسبيروميسيفين أقل نسب خفض متبقية بلغت 81.2، 91.5، 81.6، و82.5%، على التوالي. في كلا الموسمين، حقق البيروفيزين أقلّ سمية أولية وكذلك أعلى سمية متبقية ضدّ منّ القطن بنسب خفض بلغت 44.8 و91.9% عام 2020 و 52.4 و87% عام 2021، على التوالي. إلى جانب ذلك، كان للمبيدات الحشرية الأخرى المختبرة سمية متبقية موازية مع البيروفيزين. حيث أظهر الإيميداكلوبريد والبيميتروزين في عام 2020 نسب خفض متبقية بلغت 89.1 و 91.9%، على التوالي، بينما في عام 2021 حقق الإيتوفينوبروكس والأسيتاميبريد نسب خفض متبقية بلغت 87.3 و 90.4%، على التوالي. من ناحية أخرى، في عام 2020، سجل الملاثيون والبيميتروزين أعلى سمية أولية على خنفساء أبي العيد بنسب خفض بلغت 27.7 و 25.3%، على التوالي. أظهر البيروفيزين أيضاً في كلا الموسمين أقل تأثير جانبي أولي ضد خنفساء أبو العيد وكانت السمية المتبقية قليلة بنسب خفض بلغت 12.1 و 12.2% في عام 2020 و 15.6 و 14.8% في عام 2021، على التوالي. حقق السبيروميسيفين أعلى نسبة خفض متبقي (25.6%) يليه الملاثيون (19.2%). الثياميثوكسام بالتوازي مع البيروفيزين الذي حقق أيضاً أقل خفض متبقي ضد خنفساء

أبو العيد (11.4%). في عام 2021، أظهر الملاثيون والسبيروميسيفين أعلى الآثار الجانبية الأولية ضد خنفساء أبو العيد بنسب خفض 26.8 و 26.6%، على التوالي. سجل السبيروميسيفين، الثياميثوكسام، الملاثيون أعلى سمية متبقية بنسب خفض بلغت 22.8، 21.7 و 21.4%، على التوالي. وفقًا لتصنيف IOBC، تم إعتبار جميع المبيدات المعاملة غير ضارة لخنفساء أبي العيد، حيث قلت نسب الخفض عن 50% في الحقل. إن ميزة الإختيارية الجيدة لهذه المبيدات الحشرية تجعلها عناصر مناسبة لبرامج المكافحة المتكاملة للآفات ضد حشرات من القطن.

كلمات مفتاحية: منّ القطن، المبيدات الحشرية، برامج المكافحة المتكاملة، خنفساء أبو العيد، الأعداء الطبيعية، الإختيارية.

عناوين الباحثين: محمد خليفة[1*]، عبد الناصر خيرالله[2]، فكري الشهاوي[1]، نبيل منصور[1] وحمدي قطب[2]. (1) قسم كيمياء وتقنية المبيدات، كلية الزراعة، جامعة الإسكندرية، الشاطبي، الإسكندرية 21545، مصر؛ (2) معهد بحوث وقاية النبات، مركز البحوث الزراعية، الصبحية، الإسكندرية، مصر. *البريد الإلكتروني للباحث المراسل: Mohamed.khalifa@alexu.edu.eg

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Received: March 7, 2023; Accepted: July 5, 2023

تاريخ الاستلام: 2023/3/7؛ تاريخ الموافقة على النشر: 2023/7/5