Efficacy of certain insecticides and alternative agrochemicals in controlling aphids and their side effects on the predator *Coccinella undecimpunctata* in Eggplant fields.

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ABSTRACT

Five common insecticides (imidacloprid, emamectin benzoate, abamectin, thiamethoxam and Lambada-cyhalothrin), their mixtures with mancozeb and certain non- synthetic agrochemicals (Hydrogen Peroxide 35%, Calcium aluminum sulphate (Alum), Palm oil, lime sulphur and mixture from lime sulphur + Boric acid were evaluated to control Aphids in Egg plants under field conditions. Their selectivity against *Coccinella undeciumpunctata* were also studied during 2023 season. The results showed that insecticide and non- synthetic agrochemicals were highly effective in controlling *Aphis gossypii*, Also, the mancozeb gave an additive effect for all tested insecticide. Insecticide and non-synthetic agrochemicals were highly safe on *C. undeciumpunctata* except lambda-cyhalothrin. Average maximum reduction (%) of *A. gossypii* were achieved by imidacloprid (80.9%) followed by acetamiprid and lambada-cyhalothrin (73.7 and 73.7%) followed by abamectin (72.6%) and the last one was emamectin benzoate by (68.7%), respectively in 2023 seasons.

Keywords: non- synthetic agrochemicals; common pesticides; aphid; selectivity; Egg plants.

INTRODUCTION

Eggplant with great genetic diversity and morphological is present and famous as an economically main vegetable yield, particularly in the Mediterranean regions and Asia, (Chapman, 2020). Eggplant, *Solanum melongena* L. (Solanaceae), remains the third principal produce in the Solanaceae species after tomato and potato. (Chapman, 2019). Because of its great contented of biologically active compounds, minerals and vitamins, eggplant stays one of the valuable vegetables for human health in terms of foods importance (Docimo *et al.*, 2016). Aphids,*Aphis gossypii* Glover, is considered a key pest in eggplant field, (Yadav and Kumawat, 2013). The impacts of this pest include not only decreased productivity, but also actual harm to affected plants (Bosquee *et al.*, 2018), and the ability to transfer viruses. These insect pests harm an extensive variety of economic plants all over the world. Its feeding on the sap causes a dramatic decrease in the marketability of yields, honeydew production and necrosis spots and chlorosis, (Nampeera *et al.*, 2020), (Javed and Qiu, 2020). These characteristics make aphids a great dangerous pest on a broad kinds of orchards, greenhouses, and crops, (Blackman and Eastop, 2007). Although chemical treatment is the most common method for eliminating aphids, it has a number of problems, including harmful residues on foods, negative impacts on non-target species, insecticide resistance, and the spread of secondary pests. (Jordan *et al.*, 2020). As a result, the use of pesticide has to be altered using efficient and ecofriendly tactics., (Ghorbanian *et al.*, 2019). (Hamdy and Ahmed, 2014). Farmers' extensive and careless use of insecticides is having a negative impact on the bio ecosystem's natural and natural biological control methods. Therefore, it is necessary to conduct investigations on potential harmless insecticide alternatives. In order to reduce aphid pests, this study aims to evaluate the toxicity of five common insecticide, and four non- synthetic agrochemicals, and their selectivity against adult of *C. undeciumpunctata* on the eggplant crop. Also, the effect of combining with mancozeb on their toxicity against *Aphis gossypii* was examined.

MATERIALS AND METHODS

The trials were designed to examine several natural materials, insecticides, and their synergism as alternatives pesticides in controlling aphid pests in the field, as well as the selectivity against *C. undeciumpunctata*, on the aborigine crop. The studies were carried out in the experimental fields of the plant protection department, Faculty of Agriculture AL-AZhar University Assiut region through 2023 season.

The experimental plan

The trials were designed with Randomised Complete Block with three replicates and ten treatments. The pesticide dose as ministry of Agriculture recommendation.

The common insecticides were obtained from Shora chemical company, Cairo Egypt

The non- synthetic agrochemicals were supplied by El-Gomhoreia Co., Cairo, Egypt. All tested materials are shown in Table 1. All agriculture practices were done according to Ministry of agriculture recommendations and excepting treatments of non- synthetic agrochemicals different doses were used. Also, mancozeb was added (0.5ml per Litters water) to common pesticides and applied in other trails at the same time. Aphids numbers on eggplant were at determined on 0 randomly plants in each replicate pre and 1,3,7, and 10 days (day 24 Horus) post treatment. The population *C. undeciumpunctata* was determined also and recorded at the same intervals by counting adult and larvae on upper, middle and lower leaves of ten different plants, selected randomly in each replicate. The average no. of replicates was calculated and reduction percentage were calculated according to (Henderson and Tilton, 1955) equation .

Reduction %=(1-((Ta*Cb)/(Tb*Ca)X100

Where: Ta is % No. post- treatment; Tb is No. pre-treatment; Cb is Avg.No. pre-treatment for the control. Ca is Aveg No. post-treatment for the control.

Determination of selectivity degree

To determine the selectivity of different treatments against bee colony individuals, the mortality % in bee population were calculated and Metcalf Scheme (Metcalf, 1972) was adopted as follows.

Reduction % degree of selectivity Reduction % in Bees degree of selectivity

Less than 25% good selective 25-49% selective

49-79 % medium selective 79-89 % slab selective

RESULTS AND DISCUSSION

Reduction percentages in *A. gossypii* infestation after insecticides application in the eggplant field.

Data in table (2) Showed that average maximum reduction (%) of *A. gossypii* were achieved by imidacloprid (80.9%) followed by acetamiprid and lambada-cyhalothrin (73.7 and 73.7%) followed by abamectin (72.6%) and the last one was emamectin benzoate by (68.7%), respectively in 2023 seasons. These findings are consistent with those obtained by (Abd-Ella 2014), who reported that neonicotinoid, acetamiprid, and imidacloprid were particularly active on the Cowpea aphid under laboratory and field conditions. Emamectin benzoate was found to be efficient in suppressing *Aphis craccivora* on cabbage and beans by (Fening *et al.*, 2014). (Hossain *et al.*, 2012) showed that combining cotton seeds with imidacloprid reduced the pest population of aphids *A. gossypii* and *Bimisia tabaci* on the CB3 cotton cultivar

Field efficacy of tested agrochemicals against *A. gossypii* infestation in eggplants field.

Data in table (3) showed that the least average of reduction percentage was 62% in 2023 season after application of hydrogen peroxide 35% and there was no significant difference between Alum, Palm oil, and Lime sulfur. These results are in agreement with those gotten by (Caroline, 2004) reported that borates and boric acid controlled the populations of Thrips tabaci, fungi, algae, bugs and *A. gossypii*. (Gamal *et al.*, 2009) alum and citric acid were made as soluble powder preparations (90% Sp). Under filed conditions, the pesticidal activity of together preparations on the Ferrisia virgata on Sweet Acacia was calculated. After three days from treatment, the tested compounds indicated a little harmfulness at that point their activity improved regularly to allow the maximum efficiency after 18 days. The decrease in performing calculations after 18 days were 385.9 and 93. at 125 ppm in the case of alum and citric acid respectively (Abdel-Hafeez *et al.*, 2020) controlled Peach t Fly, *Bactrocera zonata* using Boric Acid as a safety insecticide. (Zamberlan and Froncheti, 1994) showed that Lime sulfur can be used within the whole vegetative various crops and is efficient in the winter treatment of fruit trees by its properties as an insecticide, miticide, bactericide, fungicide, and source of calcium and sulfur. Its activity against agents that cause fine mold, late bright, pink disease, brown decay, apple scab, and controlling vermin and bothers of two-spotted orange rust, leprose and coarse bugs legitimize its use.

(Franciele *et al.*, 2020) used lime sulfur and Bordeaux mixture as non-synthetic agrochemicals built on sulfur, copper, and calcium that are high safe substitutions to the unsafety practice of pesticides and used to control pests and treat diseases for example aphids and scale insects. The Bordeaux combination is valuable to different vegetable yields to dodge maladies contains lime and copper sulfate. These mixtures are applied in winter controlling on *Prunus* sp., *Malus* *domestica*, *Vitis* sp and has activity repellent, bactericidal and fungicidal activity against insects. Lime sulfur is active in managing scale insects and bugs, (Venzon *et al.*, 2016).

Impact of mancozeb to enhance the efficiency of tested insecticides against aphids in eggplant field.

Influence of tank mix of mancozeb on the efficiency of common insecticides against aphids at eggplant filed are shown in Table (4). The results showed that used mancozeb combination with insecticides gave an additive effect and increasing aphids controlling with percentages ranged from 0.27 to 5.15% and enhanced control over separate application of these compounds and they are compatible with each other for spray used to control the aphids. The highest reduction percentage was obtained by imidacloprid (83%) and the lowest was obtained by, emamectin benzoate (69.2%). These results are in agreement with the results of (Maniania and Sithanantham, 2003) who reported that thrips damage and density were significantly decreased in the chemical insecticide and fungal managements.

Selectivity degree of common insecticides against *C. undeciumpunctata* on the eggplant field.

According to data in Table (5), the studied chemicals were not harmful to *C. undeciumpunctata.* The percentages of reduction in *C. undeciumpunctata* population after insecticide application alone on eggplant field were 11.5, 13, 13.5, 23, and 31.2, for emamectin benzoate, imidacloprid, acetamiprid, abamectin, and lambada-cyhalothrin, respectively. The degree of selectivity for all insecticides was good, with the exception of lambada-cyhalothrin, which was selective.

(Sun *et al.*, 2007) evaluated the toxicity of chlorpyrifos 48%EC, omethoate 40%EC, cypermethrin 4.5%EC, imidacloprid 10%EC, and acetamiprid 3%EC on wheat aphids in the field. The reduction in wheat aphid numbers was greater than 90% after 7 days of management. All chemicals tested had a negative effect on coccinellidae (lady beetles) and aphidius three days after treatments with insecticides, and their populations declined significantly. However, the overall number of coccinellidae (lady beetles) and aphidius increased on the seventh day, and there were differences among those treated with abamectin, imidacloprid, and acetamiprid. According to (Bernard *et al.*, 2004), who suggested that any side adverse effects of insecticides on natural enemies might not be caused by the active ingredient, but rather by other factors.

Reduction percentage in the population of *C. undeciumpunctata* in eggplant field after application of agrochemicals.

Table (6) illustrates that the number of adults and larvae of *C. undeciumpunctata* in eggplant fields does not differ in all treatment's pre-spray the non-synthetic agrochemicals alone in the 2023 season. The tested non-synthetic agrochemicals were extremely safe for beneficial arthropods. The mean reduction percentages for all compounds tested on *C. undeciumpunctata* were 10.1, 16, 17.1, 8.3 and 12, respectively for (Alum, lime sulphur, limtop, Hydrogen Peroxide 35%, and palm oil). Each molecule had a high degree of selectivity, while Hydrogen Peroxide had the greatest one (35%). Non-systemic insecticides outperformed systemic insecticides in their selectivity to *C. undeciumpunctata* in the Eggplant field. This outcome is consistent with the findings of (IRAC, 2018), which found that lime sulfur was more harmless to *Chrysoperla externa* than *Coleomegilla quadrifasciata*. This item was rated as dangerous, with a class 1 (harmless) rating for coccinellid adults, a class 2 (somewhat harmful) rating for coccinellid larvae, and a class 4 (damaging) rating for both Chrysopidae stages. The tested non-synthetic agrochemicals were extremely safe for beneficial arthropods. This item was rated as dangerous, with a class 1 (harmless) rating for coccinellid adults, a class 2 (somewhat harmful) rating for coccinellid larvae, and a class 4 (damaging) rating for both chrysopid stages. Sulfur dioxide (SO_2) and sulfur gas (H_2S) produced by lime sulfur halt respiration. (Tuelher *et al.*, 2014) showed that the toxicity of calcium + sulfur on *Iphiseiodes zuluagai* is dosage dependent, with higher doses than the recommended range of 20 to 40 mL/Litter causing a significant decline in this insect population in coffee fields. When employed at low doses on *O. laevigatus*, these combinations may have a deleterious impact on generative ability and have sublethal effects. (*Biondi et al.*, 2012**)**

CONCLUSION

It was concluded that application of imidacloprid, hydrogen Peroxide 35% Alum, Palm oil, and Lime sulfur were highly effective in controlling *A. gossypii* and high safe on *C. undeciumpunctata*.

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Table 1: Insecticides and agrochemicals applied in this study.

Trade name	Common name	Recommended dose/ fed.
	Insecticides used	
Penzo 5.7%	emamectin benzoate	60 gm/ fed.
Lambagoc 5% EC	lambda-cyhalothrin	500 ml
Magnock 70% WG	imidacloprid	60 gm
Abamectin	abamectin 2%	60 ml
Aceta gold 20%SP	acetamiprid	50 gm
	Agrochemicals used	
Alum 17%	Alum (potassium aluminum sulfate), molecular weight (474.00)	200 gm
Lime sulphur 15%	Sulphur+Hydo	200 ml
Limtop	lime sulphur15% + Boric acid5%	200 ml
Hydrogen Peroxide 35%	H_2O_2	300 ml
Palm oil	Palm oil	
	Fungicide used as a synergist	
Dithane M-45 80 WP	mancozeb	750gm
	Check	

Table 2: Reduction percentages in *A. gossypii* infestation after insecticides application in the eggplant field.

Insecticides	Reduction percentage of aphid after applying common insecticides at different intervals					Percentage reduction
	Pre – applying county	1 day Initial kill	3-days post treatments	7- days	10 days	
emamectin benzoate	9	7.8	16	62	159	68.7
	*R%	56.5	77.1	79.6	61.5	
abamectin	9	8	9	73	117	72.6
	*R%	61.3	87.3	73.3	68.5	
acetamiprid	9	7	7	60	143	73.7
	*R%	66.2	88.9	78.1	61.5	
lambada-cyhalothrin	10	8	8	70	150	73.7
	*R%	65.2	88.6	77	63.9	
imidacloprid	10	5	5	55	120	80.9
	*R%	78.2	92.9	81.9	70.9	
Control	10	20	70	304	413	-

Table 3: Field efficacy of tested agrochemicals against *A. gossypii* infestation on eggplants.

Agrochemicals	Reduction percentage of aphid after applying material indicated Horus.					Percentage for the reduction mean
	Pre – applying county	24 hrs.	72 hrs	240 hrs	336 hrs	
Hydrogen Peroxide 35%	9	7	15	107	207	60
	*R%	61	76.2	60.1	44	
Alum	10	8	15	87	185	66.2
	*R%	60	78.6	71	55	
Palm oil	10	9	13	78	165	67.5
	*R%	55	81	74	60	
Lime Sulphur	9	8	12	65	143	68.4
	*R%	55.6	81	76	61	
Limtop	10	6	9	59	127	76.5
	*R%	70	87	80.1	69	
Control	10	20	70	304	413	-

Table 4: Impact of mancozeb to enhancement the efficiency of tested insecticides against aphids in eggplant field.

Insecticides	Percent reduction of infestation of after aphid indicated days					%Aveg. reduction	Aveg. % insectic-ide alone	% of additive mancozib to insecticide
	Pre-spray county	one day	3- days	5- days	10- days			
emactin benzoat + mancozeb	8	5	15	68	123	69.2	68.7	0.72
	*R%	68.8	73.2	72	62.8			
abamectin + mancozeb	9	9	6.5	76	117	72.8	72.6	0.27
	*R%	61	89.7	72	68.5			
acetamiprid + mancozeb	10	7	7	62	134	75.6	73.7	2.59
	*R%	65	90	79.7	67.6			
lambada-cyhalothrin + mancozeb	9	5	8	58	105	77.5	73.7	5.15
	*R%	72	87.3	78.8	71.8			
Imidacloprid + mancozeb	8	3	4	47	73	83	80.9	2.59
	*R%	81	92.9	80.7	77.9			
Control	10	20	70	304	413	-		

Table 5: The reduction in numbers of *C. undeciumpunctata* after application of insecticide alone on the eggplant field.

Insecticides	Reduction percentage at different% intervals post treatment				Avg, Reduction	Degree of selectivity acoording to Metclf scheme
	one day	3- days	7- days	10-days		
Emactin benzoate	23	11	9	3	11.5	Good selective
Imidacloprid	27	15	7	3	13	Good selective
acetamiprid	26	13	9	6	13.5	Good selective
abamectin	38	27	18	9	23	Good selective
lambada-cyhalothrin	47	38	23	17	31.2	Selective

Table 6: Reduction percentage in the population of *C. undeciumpunctata* in eggplant field after application of agrochemicals.

agrochemicals	%Reduction percentage at different intervals post treatment.				%Average reduction	Degree of selectivity acoording to Metclf scheme
	one day	3- days	7- days	10- days		
Alum	22	11	5.4	2	10.1	Good selective
Lime sulphur	28	15	21	-	16 .0	Good selective
Limtop	31.5	18	11.9	7	17.1	Good selective
Hydrogen Peroxide 35%	15	7	11.2	-	8.3	Good selective
Palm oil	25	12	8.00	3	12	Good selective

فاعلية المبيدات الحشرية الشائعة وبعض الكيماويات الزراعية غير المصنعة في مكافحة حشرة الم في محصول الباذنجان واختاريتها على *Coccinella undeciumpunctata*

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الملخص العربى

أجريت هذه التجربة في مزرعة كلية الزارعة جامعة الازهر بأسيوط لتقدير فاعلية خمسة من المبيدات الشائعة وهم الاباكتين والاسيتامبريد والايمامكتين بنزوات والاميداكلوبريد واللمباداسيهالوثرين وكذلك خمسة مواد غير مصنعة وهى سلفات الالمونيوم (الشبه),الكبريت الجيرى (ليم سلفر)، الكبريت الجيرى مضاف اليه حمض البوريك، ماء الاكسجين أوأخيرا زيت النخيل في خفض الاصابة بالمن على محصول الباذنجان. كما درس قابلية خلط المانكوزيب مع المبيدات المستخدمة وتأثيره علي كفاءة المبيدات في مكافحة المن. كما درس تأثير المبيدات السابقة والمواد غير المصنعة على أبو العيد فى الحقل. وكانت النتائج كالتالي أعطت جميع المركبات نسبة خفض للإصابة بالمن على محصول الباذنجان وكذلك أدت اضافة المانكوزيب الي زيادة غير معنوية في نسبة الخفض علي المن وكانت كل المواد المستخدمة آمنة على أبو العيد في الحقل حيث كانت جيدة الاختيارية ما عدا مركب اللمبادا سيهالوثرين كان بدرجة اختيارية اختياري فقط.

الكلمات الاسترشادية: الباذنجان, مبيدات الحشرات, المن, البدائل, المكافحة.