EFFECT OF SOME ORGANIC AND BIOINSECTICIDES ON ADULT OF *CULEX PIPIENS* MOSQUITOES IN CAIRO GOVERNORATE, EGYPT.

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ABSTRACT

The domestic mosquito *Culex pipiens (Diptera: Culicidae)* is one of the most important public health pests spread in Egypt. So the aim of this research was to study toxicological effect of some organic and bio-pesticides on adult instar of the domestic mosquito that collected from different location of Cairo Governorate in Egypt, during the period of 2020-2022 in Toxicology Enviromental Research Unit, Faculty of Agriculture, Ain Shams University. We use three organic Insecticides (Chlorpyrifos, Lambda-cyhalothrin , Imidaclopride) and two bio-Insecticide (Emamectin benzoate, Spinosad) at different concentrations (0.01, 0.1 and 1ppm) were applied on mosquito adult. It was recorded the value of $LC_{50,}$ toxicity and the resistance rate to different pesticides on the field and Susceptible strains after 24 hours of treatment. The result showed the highest effect on the East strain then the North strain to Chlorpyrifos. In the case of the Lambda - cyhalothrin had the highest resistance in the South strain. In Imidacloprid was the resistance rate high in the South strain, and Emanating benzoate has higher in the resistance in the East strain, while, Spinosad recorded higher resistance in the South strain compared to The Susceptible strain. The relative Potency of Spinosad was higher in all strains on adult of *culex pipiens*. Spinosad was higher in toxicity index to the adult mosquitoes compared to other pesticides.

Keywords: Culex *pipiens,* Chlorpyrifos, Lambda-cyhalothrin, Imidacloprid, Emamactin benzoate and Spinosad.

INTRODUCTION

Mosquitoes (Diptera: Culicidae) spread in different climatic environments to reach every area where humans live and transmit to them many diseases. Mosquitoes are the essential vector of many pathogens and parasites such as viruses, protozoans, bacteria, and nematodes, which cause dangerous diseases, as malaria, yellow fever, dengue, chikungunya fever, Zika fever, and filariasis. Culex, Aedes, and Anopheles mosquitoes are considered the responsible vectors of these diseases **(Barbosa *et al*., 2011).**

Few chemical insecticides are safe enough for use in water that is used for drinking and bathing. The most commonly used is the organophosphorus insecticide temephose, which is effective and safe in drinking water at a concentration of 1 part per million **(WHO 2005 & 2006).** In Egypt, current programmes are largely dependent on organophosphorus insecticides.

In Egypt, the common mosquito species is *Culex pipiens,* which causes infections and disability in persons **(Kady *et al*., 2008**)

Spinosad is one of these inert biopesticides. It is an active ingredient of the plant-protection product which has an insecticidal effect. Is a fermented product secreted by a bacterium living in the soil, *Saccharopolyspora spinosa.* Spinosad causes in a short time in the insect nervous system excitation leading to involuntary muscle contractions, prostration with tremors and paralysis. The insect stops feeding and paralysis can occur within minutes after ingestion, death.

Vol. (52); Iss. (5); No. (7); May, 2023
ISSN 1110-0826
ONLINE ISSN 2636 - 3178

However, long term and intensive use of insecticides often lead to emergence of resistance**. (Kirst, 2010)**

Spinosad as a larviciding tool will be effective in Egypt. Spinosad has number of advantages over OP insecticides. Beside its higher insecticidal action against mosquito larvae, it is biodegradable with no significant effect on non- target creatures and minimal risk to human health **(Garza- Robledo *et al.*, 2011; Kemabonta and Nwankwo, 2013).**

Culesx. pipiens populations due to significant geographic heterogeneity of the resistance It should be noted that bottle bioassays show resistance trends of mosquito populations regardless of resistance mechanism which can be managed (e.g., insecticide rotation) **(Scott *et al.* 2015)**

Recommended that wide rotational insecticide application in Egyptian *Culex. pipiens* mosquito control programs, also, cooperation between health and agriculture ministries in one plan is suggested to avoid control agent complications. On the other hand, more molecular and biochemical studies on insecticide resistance in Egyptian *Culex. pipiens* are needed. **(Aly *et al.* 2016)**
The objective of this study was to determine the resistance/ susceptibility status of the tested.

Five commercial pesticides that are recommended by WHO Three organic Insecticide (Chlorpyrifos, lambada cyhalothrin, imidaclopride) and two bio-Insecticide (emamectin benzoate, spinosad) on adult mosquito from Cairo Governorate.

MATERIALS AND METHODS

All experiments were conducted during the period of 2020-2022 in Toxicology Enviromental Research Unit,Faculty of Agriculture , Ain Shams University

Strains of *Culex Pipiens:* The field strains were collected from Cairo Governorate from different locations (Hadayek El-Kobba) named North strain, (Helwan) named South strain, (Al-Marj) named - East strain and (Azbakeya) named West strain. the susceptible strains of *Culex. pipiens* was obtained from the Research Institute of Medical Entomology, Ministry of Health, Dokki, Giza, Egypt.

Insecticides: Five commercial pesticides that are recommended by WHO, were selected, represent four groups, organophosphorous (Chlorpyrifos), synthetic pyrethroide (lambada-cyhalothrin), organic neonicotinoid (Imidacloprid) and bio-insecticides (Spinosad and Emamactin benzoat) commonly applied to control adult Culex.pipiens.

Organic Pesticides

-Organophosphorous (Chlorpyrifos ethyl) EC**:**Emulsifiable Concentrate

Trade name, Newturbofos (Kafr EL-Zayat chemicals Co)

-Pyrethroids (Lambda-cyhalothrin) EC**:**Emulsifiable concentrate

Trade name Kordon (Egyptian Chemicals Chema-Al Esraa.)

-Organic Neonicotinoid (Imidacloprid) **WP**:Wettable Powder

Trade name Merk Super (Egyptian Chemicals El Kadaya Atfeeh Center Giza

ISSN 1110-0826
ONLINE ISSN 2636 - 3178

Bioinsecticides

- (Emamectin benzoate) WDG (WG) : Water dispersible granules

Trade name Andraws (Chemical Limited China Kam Agrochemicals.)

- (Spinosad) SC: Suspension Concentrate

Trade name Conserve (The Egyption Company for Seeds and Agrochemicals – Tanta (imported))

The experiments:

Experiments on adult *Culex. pipiens* (CDC bottle bioassay): The experiments were determined according to Centers for Disease Control and Prevention (CDC) bottle bioassay guidelines (**Brogdon and Chan, 2010)**

In this method we used, 250 ml bottles with screw lids and coated from inside by 1 ml from serial of concentrations (0.01, 0.1 and 1ppm) for prepared concentration 0.01ppm was from 0.01 mg pesticide in 1 liter water, 0.1ppm was from 0.1 mg pesticide in 1 liter water and 1ppm was from 1 mg pesticide in 1 liter water while experiment control (control bottle) in 1L of water only. All bottles were leave uncapped for drying prior to bioassay. Number of adult female mosquito (20) from field strains and susceptible strain were introduced into each bottle by aspirator apparatus. For each insecticide concentration, one control bottle. The number of dead or alive mosquitoes were recorded after 24 hours. Mosquitoes were considered dead when they were incapable of flying or maintaining an upright posture on the bottle surface. Each assay was three replicated. Mortality rate were corrected for natural mortality in control according

Vol. (52); Iss. (5); No. (7); May, 2023
ISSN 1110-0826
ONLINE ISSN 2636 - 3178

to **Abbott's formula (Abbott, 1925)**. Probit regression lines were estimated to the LC_{50} and slope values by probit analysis program according to **(Finney, 1971)**. The LC_{50} values were expressed as ppm. The same procedures were applied with both susceptible and field strains. This ratio was gradually increased due to the selection pressure by tested insecticides. Lethal concentrations for 50% and 90% mortality levels, with 95% confidence limit (CL) and line parameters of log dose-probit response lines (Ld-p Lines) were determined using a probit analysis computer program **(Karaagac, 2012)**. The rates of development of resistance were studied through the slope of the mortality lines.

The resistance ratio was estimated as follows:

$$\text{Resistance Ratio (RR)} = \frac{LC_{50} \text{ of the selected field strain}}{LC_{50} \text{ of the susceptible strain}}$$

The following criteria proposed by **(Mazzarri and Georghiou, 1995)** were adopted to classify the resistance level of populations: low (RR<5), moderate (5<RR<10), and high (RR>10). Toxicity Index recorded to accroding **Sun (1950)**

$$^{*}\text{Toxicity Index} = \frac{\text{The value of } Lc_{50} \text{ for the most efficient pesticides}}{\text{The value of } Lc_{50} \text{ for the other pesticide}} \times 100$$

$$\text{Relative Potency}^{**} = \frac{\text{The value of } Lc_{50} \text{for the less efficient pesticides}}{\text{The value of } Lc_{50} \text{ for the other pesticide}}$$

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ISSN 1110-0826
ONLINE ISSN 2636 - 3178

In all cases, the resistance/susceptibility status of mosquito populations collected from the four locations and susceptible strains were evaluated according to WHO criteria **(WHO, 2014).**

RESULTS AND DISCUSSION

The toxicity to different pesticides on the field and Susceptible strains after 24 hrs.of treatment of Adult of *Culex pipiens* were higher in the eastern strain and then the north strain to different pesticides while Lambda-cyhalothrin was higher in the South strain, the resistance rate was higher in the South strain of all pesticides, and Emamactin benzoate was higher in the East strain, while Spinosad was higher in the South strain compared to The Susceptible strain after 24 hrs.of treatment. The relative efficacy of Spinosad was higher in all strains, on the adult insect of the house mosquito.

The data in **Table (1)** and **Fig. (1)** showed that after 24 hours of treatment, Chlorpyrifos had the highest effect on The West strain following with The South strain, The North strain and The East. LC_{50} values of these strains were 0.075,0.108, 0.175 and 0.239 ppm respectively. The LC_{90} values sighted highest in The North strain and the lowest value in The West strain compared to The Susceptible strain. The data in the same **Fig..** showeds that the slope of the line was higher in The South strain and lower in the north strain. The Susceptible strain was (1.09 ± 0.221) . By calculating the resistance rate, the highest resistance was in the East strain with a rate of (8.852) compared to the

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ISSN 1110-0826
ONLINE ISSN 2636 - 3178

Susceptible strain. The East strain recorded highest resistance and the West strain recorded the smallest resistance to Chlorpyrifos.

The data in **Table (1)** and **Fig. (2)** showed that after 24 hours of treatment,the tested pesticides lambda-cyhalothrin had the highest effect on The East strain, following with The West strain, The North strain and The South strain. The LC_{50} values of these strains were 0.012,0.037, 0.048 and 0.059 ppm respectively. The LC_{90} values sighted highest value in The South strain and the lowest value in The North strain comparing with the Susceptible strain. The data in the same **Fig.** showeds that the slope of the line was higher in the north strain and lower in The South strain. .By calculating the resistance rate, the highest rate were in The South strain resultiny (5.36) according to the Susceptible strain. The south strain recorded highest resistance strain and the east strain recorded the smallest resistance to Lambda-cyhalothrin compaving with susceptibl strain.

The data are showedn in **Table (1)** and **Fig. (3)** conclude that after 24 hours of treatment, imidacloprid had the highest effect on The East strain following with, The North strain, The West strain and The South strain. The LC_{50} values were 0.0036, 0.0054, 0.0063 and 0.128 ppm were respectively, The LC_{90} values were the highest value in The South strain and the lowest value in The North strain compared to The Susceptible strain. The data in the same **Fig..** showed that the slope of the line, a higher in The North strain and lower in The West strain. The Susceptible strain was (0.37 ± 0.115) . By calculating the resistance rate, the highest rate was in The South strain with a rate of (142) comparing with the

Susceptible strain. The south strain was record a highest resistant strain and The East strain recorded the smallest resistance to Imidacloprid.

The data are showedn in **Table (1)** and **Fig. (4)** showed that after 24 hours of treatment**.** Emamactin benzoat had the highest effect on The West strain, following with, The South strain, The North strain and The East strain. The LC_{50} values were 0.07, 0.265, 0.458 and 0.475 ppm were respectively, The LC_{90} values were the highest value in The South strain and the lowest value in The West strain comparing with the Susceptible strain. The data in the same **Fig..** showeded that the slope of the line was higher in The West strain and lower in The South strain. The Susceptible strain was (0.714 ± 0.189).By calculating the resistance rate, the highest effect was in the east strain with a rate of (13.19) comparing to the Susceptible strain. The east strain was recorded a highest resistance and The West strain recorded the smallest resistant to Emamactin benzoat.

The data are showedn in **Table (1)** and **Fig. (5)** showed that after 24 hours of treatment. Spinosad had the highest effect on The East strain following with,The West strain, The North strain and The South strain. The LC_{50} values were 0.0009, 0.0041, 0.0048 and 0.05 ppm were respectively. The LC_{90} values were the highest value in The South strain and the lowest value in The East strain compared to The Susceptible strain. The data in the same **Fig..** showed that the slope of the line was higher in The East strain and lower in The South strain. The Susceptible strain was (0.717 ± 0.14) . By calculating the resistance rate, The highest effect was in The South strain with a rate of (250) comparing to The Susceptible strain. The

South strain recorded a highest resistant strain and The East strain recorded the smallest resistant to spinosad.

The data in **Table (1)** and **Fig. (6)** showed the effect of the tested pesticides on The North strain of adult mosquitoes after 24 hours. of treatment with different concentrations. The biocidal Spinosad was more efficient with a value of LC_{50} 0.0048 ppm, imidacloprid with a value of 0.0054, and the least efficient was Emamactin benzoate.The value of LC_{90} was sighted that the highest value in Emamactin benzoat, following with Chlorpyrifos, Lambda-cyhalothrin , Imidaclopride and spinosad, and the value were 8.644, 2.763, 0.426 and 0.14 pmm respectively. The data in the same **Table** showed, the toxicity index of the Spinosad had the highest toxicity index of 100% in The North strain, while the toxicity of Emamactin benzoate was the least, and the relative efficiency of Spinosad was 95.42 fold, Imidaclopride 84.81fold, and the relative efficiency of Emamactin benzoate was lower. On domestic adult mosquitoes 24 hours. of treatment.

The data in **Table (1)** and **Fig. (7)** recorded the effect of the tested pesticides on The South strain of adult mosquitoes after 24 hours. of treatment with different concentrations. The biocidal Spinosad was more efficient with a value of LC_{50} 0.050 ppm, Lambda-cyhalothrin with a value of 0.059 ppm, and the least efficient was Emamactin benzoate. The value of Spinosad recorde the highest value of LC_{90} following by Emamactin benzoate, imidaclopride, Lambda-cyhalothrin and Chlorpyrifos, the value were 70.601, 37.852, 5.87, 4.61 and 0.734

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ISSN 1110-0826
ONLINE ISSN 2636 - 3178

respectively. The data in the same **Table** showed, the biocide Spinosad had the highest toxicity index of 100% in the South strain, Emamactin benzoate resulted the least, and the relative efficiency of Spinosad was (5.30) fold, Lambda-cyhalothrin (4.49) fold, and the relative efficiency of Emamactin benzoate was lower. on the tested insects after 24 hours. of treatment.

The data in **Table (1)** and **Fig. (8)** recorded the effect of the tested pesticides on The East strain of adult mosquitoes after 24 hours.of treatment with different concentrations. The biocidal Spinosad was more efficient with a value of LC_{50} 0.0009 ppm, Imidaclopride with a value of 0.0036 ppm, and the least efficient was Emamactin benzoate.The value of Emamactin benzoate recorded the highest value of LC_{90} following by Chlorpyrifos, Imidaclopride, Lambda-cyhalothrin and spinosad, and the value were 17.046, 2.369, 0.87, 0.731 and 0.044 respectively.The data in the same **Table** showed the biocide Spinosad had the highest toxicity index of 100% in The East strain, Emamactin benzoate resulted the least, and the relative efficiency of Spinosad was (527.78) fold, Imidaclopride (131.94)fold, and the relative efficiency of Emamactin benzoate was lower on tested insects after 24 hours. treatment.

The data in **Table (1)** and **Fig. (9)** showed the effect of the tested pesticides on The West strain of adult mosquitoes after 24 hours. of treatment with different concentrations. The biocidal Spinosad was more efficient with a value of LC_{50} (0.0041) ppm, Imidaclopride with a value of (0.0063) ppm, and the least efficient was Chlorpyrifos.The highest value of LC_{90} with Imidaclopride following by lambda cyhalothrin, Emamactin benzoate, Chlorpyrifos and Spinosad resulting 2.11, 1.575,0.828, 0.511 and 0.097 ppm respectively. The data in the same **Table** showed, the biocide Spinosad had the highest toxicity index of 100% in The West strain, while Chlorpyrifos was the least, and the relative efficiency of Spinosad was (18.29)fold, Imidaclopride (11.90)fold, and the relative efficiency of Chlorpyrifos was lower on the tested insects after 24 hours of treatment.

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ISSN 1110-0826
ONLINE ISSN 2636 - 3178

Table (1) : Toxicity index, relative potency and resistance ratio (R.R) of insecticides on Adult of *Culex pipiens* collected from different sites of Cairo Governorate comparison with Susceptible strains**.**

Strain	Insecticides	LC_{50} (ppm)	LC_{90} (ppm)	Slope ± S.E.	Toxicity Index*%	Relative Potency**	R.R
North	Chloropyrifos	0.175	2.763	1.07 ± 0.181	2.7	2.62	6.481
	Lambda-cyhalothrin	0.048	0.426	1.35 ± 0.132	10	9.54	4.36
	Imidacloprid	0.0054	0.14	0.906 ± 0.14	88	84.81	6
	Emamactin benzoat	0.458	8.644	1.005 ± 0.183	1	1	12.72
	Spinosad	0.0048	1	0.554 ± 0.108	100	95.42	24
South	Chloropyrifos	0.108	0.734	1.54 ± 0.199	46.30	2.45	4
	Lambda-cyhalothrin	0.059	4.61	0.676 ± 0.11	84.75	4.49	5.36
	Imidacloprid	0.128	5.87	0.772 ± 0.114	39.06	2.07	142
	Emamactin benzoat	0.265	37.852	0.595 ± 0.175	18.87	1	7.36
	Spinosad	0.050	70.601	0.407 ± 0.109	100	5.30	250
East	Chloropyrifos	0.239	2.369	1.288 ± 0.186	0.38	1.99	8.852
	Lambda-cyhalothrin	0.012	0.731	0.72 ± 0.117	7.5	39.58	1.09
	Imidacloprid	0.0036	0.87	0.539 ± 0.117	25	131.94	4
	Emamactin benzoat	0.475	17.046	0.824± 0.18	0.19	1	13.19
	Spinosad	0.0009	0.044	0.762 ± 0.121	100	527.78	4.5
West	Chloropyrifos	0.075	0.511	1.537 ± 0.211	5.47	1	2.778
	lambda-cyhalothrin	0.037	1.575	0.788± 0.113	11.08	2.03	3.36
	Imidacloprid	0.0063	2.11	0.508 ± 0.112	65.08	11.90	7
	Emamactin benzoat	0.070	0.828	1.196 ± 0.201	5.86	1.07	1.94
	Spinosad	0.0041	0.097	0.934 ± 0.117	100	18.29	20.5
Susceptible	Chloropyrifos	0.027	0.403	1.09 ± 0.221	0.74	1.33	1
	Lambda-cyhalothrin	0.011	1.184	0.632 ± 0.114	1.82	3.27	1
	Imidacloprid	0.0009	2.71	0.37 ± 0.115	22.22	40	1
	Emamactin benzoat	0.036	2.241	0.714 ± 0.189	0.56	1	1
	Spinosad	0.0002	0.012	0.717 ± 0.14	100	180	1

LC_{50} : Lethal Concentration 50% **SE** : Standard Error
LC_{90}: Lethal Concentration 90% **R.R.:** Resistance Ratio
ppm: Part per million

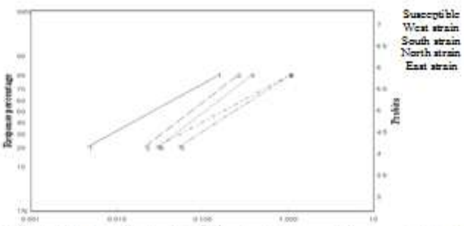


Fig (1): Toxicity lines of chlorpyrifos on field strains and susceptible strain

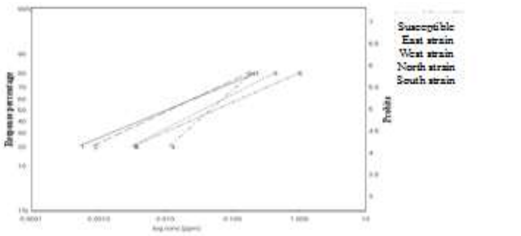


Fig. (2):Toxicity lines of -lmbada cyhalothrin on field strains and susceptible strain

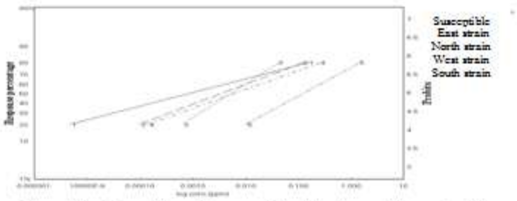


Fig. (3): Toxicity lines of imidacloprid on field strains and susceptible strain

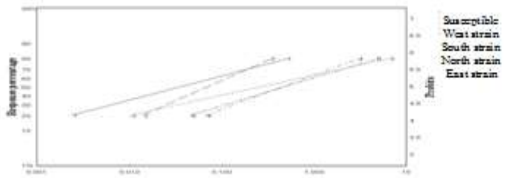


Fig. (4): Toxicity lines of emamactin benzoat on field strains and susceptible strain

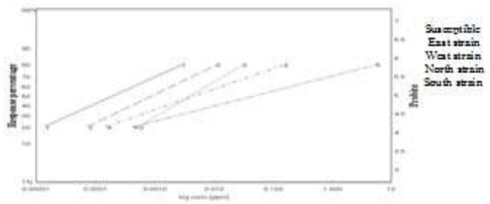


Fig. (5): Toxicity lines of Spinosad on field strains and susceptible strain

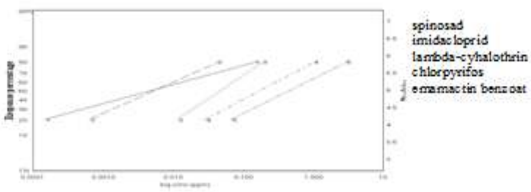


Fig. (6) Toxicity lines of chlorpyrifos , lambda-cyhalothrin,imidacloprid,emamactin benzoat and spinosad on North strain

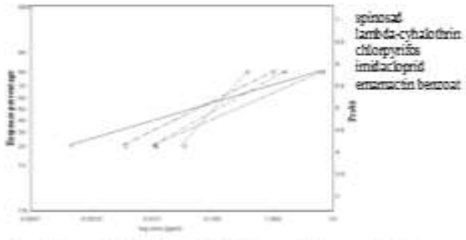


Fig. (7) Toxicity lines of Chlorpyrifos, Lambda-cyhalothrin, Imidacloprid,Emamactin benzoat and Spinosad on south strain

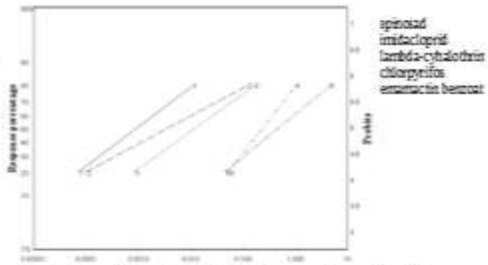
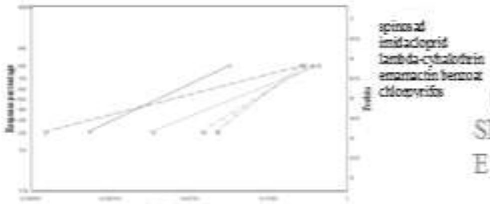


Fig. (8) Toxicity lines of chlorpyrifos , lambda-cyhalothrin, imidacloprid,emamactin benzoat and spinosad on East strain



(10); No. (5); Jule 2022
SN 1110-0826
E ISSN 2636 - 3178

Fig. (9) Toxicity lines of Chlorpyrifos , lambda-cyhalothrin, Imidacloprid, Emamactin benzoat and Spinosad on West strain

The obtained results were in harmony with These obtained results are in harmony with **Thompson *et al.*, (2000)** Spinosad was a new insecticide that shows promise as a mosquito control agent. **Watson (2000)** suggested that Spinosad is a neurotoxin with a novel mode of action involving the nicotinic acetylcholine receptors and GABA receptors. It kills the target insects through activation of the acetylcholine nervous system by nicotinic receptors which results in continuous activation of motor neurons and leads to insect death due to exhaustion **(Salgad, 1998 and Thompson *et al.*, 2000). Liu *et al.* (2004)** reported that susceptible strains were as susceptible to imidacloprid as to permethrin in larval assays. **Paul *et al.* (2006)** reported low mortality to imidicloprid treatments of *Ae. aegypti* in treated bottle assays**. Harrington & Poulson (2008)** which conclude that to fully understand the respective roles of *Culex species* in the epidemiology of WNV and other pathogens, more attention should be paid to these considerations for accurate species identifcation. **Pridgeon *et al.* (2008)** reported that imidacloprid applied topically was moderately toxic and lower in toxicity than permethrin for the three mosquito species tested. **Liu *et al.*, (2009).** Aprevious study on pests, i.e., *Anopheles albimanus, Culex quinquefasciatus, Mosquitoes and Culex pipiens pipiens* has suggested that alteration of target genes might lead to the reduction of binding affinity with insecticides, thereby overwhelming the effect of insecticides. **Al-Sarar (2010)** showed field population from AL-Wadi district (AL-W) low resistance to lambda-cyhalothrin (3.8-folds) **Muller *et al. (*2010)** fermented fruit juice combined with sugar and an, oral insecticide Spinosad applied to nonflowering vegetation practically eliminated the local adult *Cx. pipiens* population, Mosquitoes in the experimental sites decreased from 125 to approximately eight per trap. After baitIinsecticide application, only 3% of the females were multiparous in the treatment area. **Andreadis *et al*. (2010)** provide further evidence for local overwintering of WNV in diapausing *Culex pipiens,* albeit at very low rates, consistent with the paucity of WNV-positive mosquitoes detected in June and early July despite the emergence of females from hibernacula in early May in this region**. Bass., *et al*. (2011).** During target-site resistance the binding site of an insecticide is modified (mutated) or lost and catalyzing the target-site is incompatible for activation. **David *et al.* (2011)** said that the excessive use of insecticides creates insecticide resistance in pests and is considered the greatest example of micro-evolution. Previous studies have shown more than 500 different types of pest species that have evolved insecticide resistance. **Marina *et al*. (2012)** said that Spinosad was the first to report as an effective larvicide against Cx. coronator, which is currently invading the southern United States. These results substantiate the use of Spinosad as a highly effective mosquito larvicide, even in habitats such as unused car tires that can represent prolific sources of adult mosquitoes**. Zahran (2014)** The highest level of resistance against the tested insecticides was found in Abouhomoss strain (27.3, 22.2 and 24.8- fold) and the lowest level of resistance was recorded in Montaza strain (12.75, 15.17 and 8.17-fold) towards cypermethrin, deltamethrin and temephos,respectively. On the other hand, all strains recorded no resistance against Spinosad. **Moselhy *et al.* (2015)** recorded that the highest larvicidal effect in Spinosad treatment followed by temephos, fenitrothion then malathion. **Isaacs *et al.* (2017)** concluded that pyrethroid efficacy should not discount mosquitoes that survive insecticide exposure with fewer than six legs, as they may still be capable of biting humans, reproducing, and contributing to malaria transmission. **Bhubaneshwari** and **Dhananjoy (2018)** reported that the occurrence of *Culex pipiens Linn*. in Manipur. *Culex quinquefasciatus* which is a symapatric to pipiens had been reported but not the pipiens. In future the procurement of the two species and differentiation through cytotaxonomy, molecular and whole life cycle studies would be a decisive one for ascertaining the true identities and existence of the species *Culex pipiens*. **Abdel baset *et al.* (2019)** conducted that adult mosquito surveys were in Monufia as a representative of the Egyptian governorates in NileDelta.*Culex pipiens* was the predominant species in all study regions. **Liu *et al*. (2019)** reported that long-term dataset from Shandong demonstrates major increases in pyrethroid resistance over a 20-year period. The L1014F kdr mutation may be considered a viable molecular marker for monitoring pyrethroid resistance in Cx. p. pallens. **Moreno-Gómez *et al.*, (2021)** showed that sublethal doses reduced mosquito survival, influencing population size in the next generation. They also provided 100% protection to human hosts and presented relatively low risks to human and environmental health. Emphasised These findings the need for additional studies that assess the benefits of using sublethal doses as part of mosquito management strategies**. Ramzi *et al*., (2022)** found of their research could help with the development of botanical insecticides that might contribute to management programs for controlling vectors of important diseases. **Field *et al*. (2022)** definesd window for diapause induction across the United States, shaped by temperature, latitude, elevation, and mosquito population genetics. Coinciding with the cessation of WNV activity, these data can have important implications for mosquito control, where targeted efforts prior to diapause induction can decrease mosquito populations and WNV overwintering to reduce mosquito-borne disease incidence the following season. **Nagaa *et al.* (2022)** indicated that LC_{50} of MSA 102 a significant prolongation in the development time and less adult emergence compared with the control. Moreover, adult females surviving the treatment of MSA 102 as larvae, laid no eggs. **Yuki** and **Lindy (2022)** reviewed the recent and historical literature on the origin and ecology of this important mosquito and its enigmatic forms. human-biting and other adaptations to human environments may have evolved on the timescale of millennia rather than centuries.

CONCLUSION

The Spinosad was more toxic to the adult mosquitoes in the four strains compared to the other pesticides. Spinosad was higher in toxicity index and more potent relative to the adult mosquitoes compared to other pesticides.

REFERENCES

Abbott, W. S. (1925). A method for computing the effectiveness of an insecticide. Journal of Economic Entomology, 18: 256-267.

Abdelbaset, B. Z.; Moselhy, W. A. and Eltaly, R. I. (2019). Ecological and Behavioral Studies of Mosquito Vectors in Monufia, Nile Delta, Egypt. Journal Biological Sciences, 12(1):131–144.

Al-Sarar, A. S. (2010). Insecticide resistance of *Culex pipiens* (L.) populations *(Diptera: Culicidae)* from Riyadh city, Saudi Arabia: Status and overcome. Journal of Biological Sciences, 17: 95–100.

Aly, M. Z. Y.; Soliman, B. A.; Osman, K. S. M. and Alhousini, E. M. E. (2016). Molecular and Biochemical Studies on Insecticide Resistance in Egyptian Culex pipiens Mosquitoes. M. Sc. Thesis, Zoology Department, Faculty of Science, South Valley University.

Andreadis, T. G.; Armstrong P. M. and Bajwa W. I. (2010(. Studies On Hibernating Populations Of Culex Pipiens From A West Nile Virus Endemic Focus In New York City: Parity Rates And Isolation Of West Nile Virus. Journal Of the American Mosquito Control Association, 26(3):257–264.

Barbosa, S.; Black, W. C. and Hastings, I. M. (2011). Challenges in estimating insecticide selection pressures from mosquito field data. PLoS Neglected Tropical Diseases, 5 (11): 1387-1398.

Bass, C.; Puinean, A. M.; Andrews, M.; Culter, P.; Daniels, M.; Elias, J.; Paul, V. L.; Crossthwaite, A. J.; Denholm, I.; Field, L. M.; Foster, S. P.; Lind, R.; Williamson, M. S. and Slater, R. (2011). Mutation of a nicotinic acetylcholine receptor β subunit is associated with resistance to neonicotinoid insecticides in the aphid Myzus persicae. BMC Neuroscience, 12:51.

Bhubaneshwari, D. M. and Dhananjoy, C. S. (2018). New records of *Culex (Culex) pipiens Linn*. from Manipur India. International Journal of Mosquito Research, 5(2): 52-55.

Brogdon, W. G. and Chan, A. (2010). Guidelines for evaluating insecticide resistance in vectors using the CDC bottle bioassay.methods in *Anopheles* research. CDC Atlanta USA CDC Tech Rep, 1:1-28.

David, J. C.; Robert, S. L. and Kenneth, G. C. (2011): Crop ecology: productivity and management in agricultural systems, Second Edition.Current Biology, 32: 237–246.

El- Kady, G. A. E.; Kamel, N. H.; Mosleh, Y. Y. and Bahgat, I. M. (2008). Comparative toxicity of two bio-insecticides (Spinotoram and Vertemic) compared with methomyl against *Culex pipiens* and *Anopheles multicolor*. World Journal of Agricultural Sciences, 4 (2): 198-205.

Field, E. N.; Shepard, J.J., Clifton, M.E.; Price, K.J.; Witmier, B.J.; Johnson, K. *et al.*,.(2022): Semi-field and surveillance data define the natural diapause timeline for *Culex pipiens* across the United States. Communications Biology, 5:1300

Finney, D. J. (1971). Probit Analysis. 3rd ed. Cambridge Univ. London, 333 pp.

Garza-Robledo, A. A.; Martinez-Perales, J. F.; Rodriguez-Castro, V. A. and Quiroz-Martinez, H. (2011). Effectiveness of Spinosad and temephos for the control of mosquito larvae at a tire dump in Allende, Nuevo leon, Mexico. Journal of the American Mosquito Control Association, 27(4): 404-407.

Harrington, L. C. and Poulson, R. L. (2008). Considerations for Accurate Identification of Adult *Culex* restuans (*Diptera: Culicidae*) in Field Studies. Journal of Medical Entomology, 45(1): 1-8. insecticides. Journal of Economic Entomology., 43(1): 45-53.

Isaacs, A.T.; Lynd, A. and Donnelly, M. J. (2017). Insecticide-induced leg loss does not eliminate biting and reproduction in *Anopheles gambiae* mosquitoes. Scientific Reports, pp.1-5.

Karaagac, S. U. (2012). Insecticide resistance. Insecticides-Advances in Integrated Pest Management, PP.469-478.

Kemabonta, K. A. and Nwankwo, A. E. (2013). Larvicidal effectiveness of Spinosad and temephos on *Anopheles gambiae* & *Aedes aegypti*. International Journal of Science and Nature, 4(2): 214-222.

Kirst, H. A. (2010). The spinosyn family of insecticides: realizing the potential of natural products research. The Journal of Antibiotics, 63(3):101-111.

Liu, H. Xie, L.; Cheng, P.; Xu, J.; Huang, X.; Wang, H.; Song, X.; Liu, L.; Wang, H.; Kou, J.; Yan, G.;Chen, X.-G.and Gong, M. (2019) Trends in insecticide resistance in Culex pipiens pallens over 20 years in Shandong, China. Parasites& Vectors, pp: 12-167

Liu, H.; Cupp, E. W.; Micher, K. M.; Guo, A. and Liu, N. (2004). Insecticide resistance and cross-resistance in Alabama and Florida strains of *Culex quinquefasciatus*. Journal of Medical Entomology, 41(3): 408-413.

Liu, N.; Xu, Q.; Li, T.; He, L. and Zhang, L. (2009). Permethrin resistance and target site insensitivity in the mosquito *Culex quinquefasciatus* in Alabama. Journal of Medical Entomology, 46(6): 1424-1429.

Marina, C. F.; Bond, J. G.; Muñoz, J.; Valle, J.; Chirino, N. and William, T. (2012) Spinosad: a biorational mosquito larvicide for use in car tires in southern Mexico. Parasites & Vectors, pp: 5-95

Mazzarri, M. B. and Georghiou, G. P. (1995). Characterization of resistance to organophosphate, carbamate, and pyrethroid insecticides in field populations of *Aedes aegypti* from Venezuela. Journal of the American Mosquito Control Association, 11(3) : 315–322.

Moreno-Gómez, M.; Bueno-Mari, R. and Miranda, M. A. (2021). A three-pronged approach to studying sublethal insecticide doses: Characterising mosquito fitness, mosquito biting behaviour, and human/environmental health risks. Insects, 12 (6): 546.

Moselhy, W. A.; Zayed, A. B.; Mostafa, A. A.; Mahmoud, H. I.and Hamed, S. (2015) Spinosad as an Alternative Larvicide for Mosquito *Culex pipiens* Contro. Current Science International, 4(4): 646-657.

Müller, G. C.; Junnila, A. and Schlein, Y. (2010). Effective Control of Adult *Culex pipiens* by Spraying an Attractive Toxic Sugar Bait Solution in the Vegetation Near Larval Habitats. Journal of Medical Entomology, 47(1): 63-66.

Nagaa, W.; Shahen, M..; Soliman, M. A. and Meshrif , W. S. (2022) Effect Of 1,2,4-Triazine Derivatives On The Mosquito *Culex Pipiens* And Its Biological Characteristic. Egyptian Journal of Zoology, 77: 1-13.

Paul, A.; Harrington, L. C. and Scott, J. G. (2006). Evaluation of novel insecticides for control of dengue vector *Aedes aegypti* (Diptera: Culicidae). Journal of Medical Entomology, 43(1): 55- 60.

Pridgeon, J. W.; Pereira, R. M.; Becnel, J. J.; Allan, S.A.; Clark, G. C. and Linthicum. K. J. (2008). Susceptibility of *Aedes aegypti*, *Culex quinquefasciatus* Say, and *Anopheles quadrimaculatus* Say to 19 pesticides with different modes of action. Journal of Medical Entomology, 45(1): 82-87.

Ramzi, A.; El Ouali Lalami, A.; Annemer, S.; Ez zoubi, Y.; Assouguem, A.; Almutairi, M. H.; Kamel, M.; Peluso,I.; Ercisli,S.; Farah, A. (2022). Synergistic Effect of Bioactive Monoterpenes against the Mosquito, *Culex pipiens (Diptera: Culicidae).* Molecules, 27, 4182.

Salgado, V. L. (1998). Studies on the mode of action of Spinosad: Insect Symptoms and Physiological correlates.Pesticide Bio- chemistry and Physiology, 60: 91- 102.

Scott, J. G.; Yoshimizu, M. H. and Kasai, S. (2015): Pyrethroid resistance in *Culex pipiens* mosquitoes. ScienceDirect Pesticide biochemistry and physiology, 120: 68-76.

Sun, Y. p. (1950). Toxicity index-an improved method of comparing the relative toxicity of

Thompson, G. D.; Dutton, R. and Sparks, T. C. (2000). Spinosad- a Case Study: An Example from a Natural Products Discovery Programme. Pest Management Science, 56(8): 696-702.

Watson, G. B. (2000). Resistance and cross-resistance to the spinosyns–a review and analysis. Pesticide Biochemistry and Physiology, 102(1):1-10.

WHO, (2005). Malaria control in coplex emergencies. WHO/HTM/MAL /2005.1107.

WHO, (2006). Pesticides and their applications, For the control of vectors and pests of public health importance. WHO/CDS/NTD/WHOPES/GCDPP/2006.1

World Health Organization. (2014). Malaria rapid diagnostic test performance: results of WHO product testing of malaria. Geneva: World Health Organization

Yuki, H. and Lindy, M. (2022). Origin and status of *Culex pipiens* mosquito Ecotypes. Current Biology, 32(5):237–246.

Zahran, Hossam El-Din M. (2014) Comparative Toxicity of Some Conventional Insecticides Against Culex Pipiens L. Mosquito Larvae from Different Districts in Egypt. Journal of the Advances in Agricultural Researches, 19 (4): 712-721

تأثير بعض المبيدات العضوية والحيوية على الحشرات البالغة من بعوض الكيولكس بيبينز بمحافظة القاهرة في مصر

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المستخلص

يعتبر البعوض المنزلي (*Culex pipiens (Diptera: Culicidae*) من أهم آفات الصحة العامة المنتشرة في مصر ، لذلك كان الهدف من هذا البحث دراسة التأثير السمي لبعض المبيدات العضوية والحيوية على طور البعوض البالغ الذي تم جمعه. من مواقع مختلفة بمحافظة القاهرة في مصر، خلال الفترة من ٢٠٢٠–٢٠٢٢ في وحدة أبحاث السموم البيئية . كلية الزراعة جامعة عين شمس. تم استخدام ثلاثة مبيدات حشرية عضوية (كلوربيريفوس، لامبدا سيهالوثرين،إيميداكلوبرايد) واثنين من المبيدات الحيوية (إيمامكتين بنزوات ، سبينوساد) بتركيزات مختلفة (٠,٠١ ، ٠,١ و ١ جزء في المليون) وتم معاملة الحشرة الكاملة وسجل قيمة التركيز المميت النصفى والسمية ومعدل المقاومة للمبيدات المختلفة علي السلالات

ISSN 1110-0826
ONLINE ISSN 2636 - 3178

الحقلية والسلالة الحساسة بعد ٢٤ ساعة من المعاملة. أظهرت النتائج أعلى تأثير على السلالة الشرقية ثم السلالة الشمالية في حالة الكلوربيريفوس. وفي حالة لامبدا سيهالوثرين كان أعلى مقاومة في السلالة الجنوبية وفي ايميداكلوبرايد كان معدل المقاومة مرتفعًا في السلالة الجنوبية ، وكان ايمامكتين بنزوات أعلى في المقاومة في السلالة الشرقية ، بينما سبينوساد سجل اعلى مقاومة في السلالة الجنوبية مقارنة بالسلالة الحساسة. كانت الفاعلية النسبية للسبينوساد أعلى في جميع السلالات على البالغين من *culex pipiens* كان السبينوساد أعلى في مؤشر السمية للبعوض البالغ مقارنة بالمبيدات الأخرى.

الكلمات المفتاحية: كيولكس بيبينز، كلوربيريفوس، لامبدا سيهالوثرين، إيميداكلوبرايد، إيماماكتين بنزوات وسبينوساد.