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Article

Larvicidal Efficiency of Nocoz and Lambda Cyhalothrin Against Fourth Instar Culex Pipiens Larvae

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Abstract: Culex pipiens L. (Diptera: Culicidae) serves as a significant vector for several illnesses. This mosquito is extensively distributed globally. The activity of pesticides can influence mosquito populations by regulating their numbers, interfering with biological control mechanisms, or fostering the development of insecticide resistance. The current study was conducted to determine the effect of various concentrations of the insecticides Nocoz and Lambda-cyhalothrin against fourth-instar mosquito larvae 6-24 hours after treatment. The highest larval mortality rate with Nocoz was 100.0% at a concentration of 0.01 ml/L, while the lowest mortality rate, 26.6%, was observed at a concentration of 0.0025 ml/L. Similarly, the results showed that the highest mortality rate of fourth-instar larvae treatment with Lambda-cyhalothrin was 100.0% at a concentration of 0.01 ml/L, and the lowest mortality rate, 73.3%, was observed at a concentration of 0.0025 ml/L. Therefore, the results demonstrate that both Nocoz and Lambda-cyhalothrin have a lethal effect on mosquito larvae. Conclusion: The findings of this study demonstrated that both Nocoz and lambda cyhalothrin exhibit high efficiency against fourth instar larvae of cheiving 100 mortality at high concentration. Clear dose dependent relationship was observed with larval mortality increasing as the concentration increased.

Keywords: Mosquitoes, Nocoz Insecticide, Lambda-Cyhalothrin Insecticide

1. Introduction

Culex pipiens mosquitoes belong to the Culicidae family, order Diptera. There are approximately 3530 species of mosquitoes in the world belonging to 43 genera[1]. Culex pipiens is one of the most widespread types of house mosquitoes in the world. This type of mosquito is called a house mosquito because of its close relationship with humans, as this genus can feed on humans and animals[2]. The Culex spp. genus is widespread in all tropical and temperate regions when suitable conditions are available[3]. Three species belonging to this genus, including, CX. quinqufe ascicitussay, and CX. molestus forska Linnaeus, are found in Iraq, where CX. molestus mosquitoes are the most common species in cities, rural areas, and suburbs, in basements of houses and sewage systems[4].

The medical importance of certain mosquito species, including CX. pipiens, lies in their transmission of viruses responsible for encephalitis, a disease affecting animals such as dogs, horses, and chickens, causing abortions and ultimately killing up to 40% of infected animals [5].

Mosquitoes also transmit numerous diseases to humans, including threadworms that cause lymphatic filariasis, Rift Valley fever, and lymphocytic chorioamnionitis; filariasis; West Nile virus; Plasmodium parasites that cause avian malaria and Zika fever[6]; dengue fever; and Chikungunya fever, an infectious arbovirosis caused by a virus transmitted by mosquitoes[7].

The species Culex pipiens is considered autogenous, meaning it can lay eggs without a blood meal. Other mosquito species are anautogenous, meaning they cannot lay eggs without a blood meal[8].

Mosquitoes are holometabolous insects, meaning they undergo complete metamorphosis. They begin as eggs, then larvae, and pass through four instars: larval, pupal, and finally adult. The first three instars (egg, larva, and pupa) live in water, while the adult is found on land[9].

Chemical pesticides are an important tool used to control and reduce the spread of disease vectors, including mosquitoes. Many modern chemical pesticides have emerged, offering a variety of formulations and application methods. Lambda-cyhalothrin is one example, which helps in selecting a pesticide with the appropriate characteristics in terms of specific toxicity and non-accumulation in the environment (Hadi). As for the principle of cyhalothrin, it is a non-systemic chemical insecticide and is traded under several trade names, including Icon. It works by disrupting the nervous system of insects through inhibiting the action of the acetylcholinesterase enzyme, whose function is slow depolarization of the nerve membrane. This affects the amplitude of the action potential, leading to a loss of the electrical signal to control a wide range of household pests and disease vectors[10]. As for the insecticide Nokoz, it is a non-systemic insecticide also known as 2-2-dichlorophenyl dimethyl phosphate (DDVP), and is also traded under the trade names Nuvan, VAPONA, and Dedevap. The molecular formula of the insecticide dichlorvos is C4H7Cl2O3P. The World Health Organization has selected Nokoz (dichlorvos) as a highly hazardous insecticide[11].Selection of the effectiveness of the recommended and sub-recommended concentrations of the insecticides lambda-cyhalothrin 10% and Nocoz 10% at concentrations of 0.0025, 0.005, 0.01 ml/L in controlling the fourth larval stage of the mosquito cx.pipiens in vitro.

2. Materials and Methods

Collect and arrange the egg boats

Black egg boats were collected from the surface of a rainwater pond in the agricultural lands of the Al-Nahrain area within Salah al-Din Governorate during May and April 2024. They were collected using medium-length wire clamps and placed in 100 ml plastic bottles, half-filled with pond water. The bottles were kept in the laboratory with good ventilation, and the openings were covered with tulle fabric. Mosquito rearing tanks, measuring 20 x 30 x 40 cm, were prepared in the laboratory. Half of the tank was filled with filtered pond water to maintain the insects' natural living conditions, and a small amount of dechlorinated tap water was added. Approximately 2-5 grams of laboratory mouse feed were added to the tanks to ensure complete egg hatching and larval development up to the fourth instar. The tanks were kept at a temperature of 28 ± 2°C with good ventilation and a light-to-dark cycle of 10:14 hours. The water was changed regularly to remove any mold that developed until control measures could be implemented [12]as in Figure 1.

Figure 1. Sample collection site for mosquito larvae cx.pipiens.

3. Results and Discussion

Testing the Effectiveness of The Insecticides Lembeda Cyhalothrin and Nocoz in The Larvae of Cx.pipiens Mosquitoes

The experiment was designed with three replicates for each of the concentrations under study. Each replicate was a 100 ml plastic bottle to which 50 ml of larval soil water was added, and 5 larvae of the fourth larval stage were placed in it. Then 1 ml of the previously prepared concentrations was added to the bottle for each concentration with three replicates by direct spraying of the water surface inside the bottle of the two pesticides separately at a temperature of 27 ± 2°C, humidity of 70-80%, and an illumination rate of 10:14 hours of light and darkness. The results were taken after 6, 12, and 24 hours of treatment (Ali: li at el, 2016, 2010) as in Figure 2.

Figure 2. Bottles for controlling the larvae of Cx.pipiens mosquitoes: Lambda-cyhalothrin and Nocoz insecticide.

Preparation of the pesticides lembedacyhalothrin and nocos:

10g of lambda-cyhalothrin pesticide was taken and diluted with 1000 ml of tap water, then

shaken well by hand to obtain a stock solution with a concentration of 0.01 g/ml. From this, the concentrations used in the study were. Also, 10 ml of Nocoz pesticide was taken and diluted with 1000 ml of tap water, then shaken well by hand to obtain a stock solution with a concentration of 0.01 ml/L. From this, the concentrations used in the study were prepared[13].

Table 1 shows the effect of Nocoz insecticide on the killing rates of fourth-instar mosquito larvae. The 0.01 ml/L concentration was superior to the other concentrations, resulting in a 100.0% killing rate after 6 hours of treatment, which increased to 100.0% after 12 and 24 hours, respectively. This was followed by the 0.005 ml/L concentration, which resulted in a 46.6% killing rate after 6 hours of treatment, reaching 100.0% after 12 and 24 hours, respectively. As for the 0.0025 ml/L concentration, it resulted in the killing of 26.6% and 73.3% of fourth-instar mosquito larvae after 6 and 12 hours, respectively. This percentage increased to 100.0% after 24 hours of treatment and remained constant for several days after treatment. In comparison, the control group had a 0% killing rate. There are significant differences between the average killing rates according to the concentrations. Average mortality rate according to the duration of exposure to the fourth larval instar.

Table 1. Effect of Nokoz insecticide on the killing rates of fourth instar larvae of CX-pipiens mosquitoes.

Insecticide	Concentration	Time/ hours			Mean of concentration	Mean of Insecticide
	0.0025	6 h	12 h	24 h		
Nocoz	0.005	26.6	73.3	100.0	66.6 c	82.9
	0.01	46.6	100.0	100.0	82.2 b	A
Mean (Time)		100.0	100.0	100.0	100.0 a	
		57.7 c	91.1 b	100.0 a		

Table 2 shows the effect of lambda-cyhalothrin insecticide on the mortality rates of fourth-instar mosquito larvae. The 0.01 ml/L concentration was superior to the other concentrations, causing a mortality rate of 86.6% after 6 hours of treatment, which increased to 100.0% after 12 and 24 hours, respectively. This was followed by the 0.005 ml/L concentration, which caused a mortality rate of 33.3% after 6 hours of treatment, reaching 73.3% after 12 hours, and then killing all larvae at a rate of 100.0% after 24 hours. As for the 0.0025 ml/L concentration, it caused the mortality of 13.3% and 53.3% of fourth-instar mosquito larvae after 6 and 12 hours, respectively, and this percentage increased to 73.3% after 24 hours of treatment. This percentage remained constant for several days after treatment. In the control models, where the killing rate was 0% of the treatment, there are significant differences between the average killing rate according to the concentrations and the average killing rate according to the duration of exposure to the fourth larval instar.

Table 2. Effectiveness of lambda-cyhalothrin insecticide in killing fourth-instar larvae of CX-pipiens mosquitoes

Insecticide	Concentration	Time/ hours			Mean of concentration	Mean of Insecticide
Lambda-	**0.0025**	**6 h**	**12 h**	**24 h**		**56.3**
cyhalothrin	**0.005**	13.3	53.3	73.3	**14.0 e**	**B**

0.01	33.3	73.3	100.0	**46.6 d**
	86.6	100.0	100.0	**68.9 c**
Mean (Time)	34.8 c	59.7 b	74.3 a	

Several studies prepared and characterized pyrethroid, such as alpha-cypermethrin, deltamethrin, lambda-cyhalothrin, and permethrin [14, 15]. The present study showed that both Nocoz and L exhibit Strong larvicidal activity against fourth instar larvae of culex pipiens, with complete mortality observed at the highest concentration within 6_24 hours. These results are consistent with previous studies showing that synthetic prethroid including L are highly effective against mosquito larvae due to their rapid neurotoxic action on sodium channels in the insect nervous system[16].

The concentration dependent increase in larval mortality observed in this study agree with findings[17] reported by who demonstrated that L can induced high mortality in susceptible and partially resistant mosquito including C. With prolonged toxicity effect even after exposure short period.

The high effectiveness of L observed in this study is agree with that showed LC50 value ranged between 10_27 indicating Strong toxicity against mosquito larvae under controlled condition[18]. In addition, L can achieve mortality rates up to 90_100 in C. Pipiens depending on concentration and exposure duration[19].

On the other hands, the lower mortality observed at the lowest concentration for Nocoz may indicate sublethal exposure. Resistant development in culex pipiens has been widely documented and is associated with detoxification enzyme activity and target site mutation[20]. A study by [21] indicated that alpha-cypermethrin, deltamethrin, and lambdacyhalothrin had the highest toxicity among insecticides, with LC50 values ranging from 10 to 43 μg/L, in contrast to permethrin, which had LC50 values ranging from 127 to 322 μg/L, against C. pipiens larvae. This finding pertains to the molecular structure of the pyrethroid class, namely that alpha-cypermethrin, deltamethrin, and lambda-cyhalothrin are cyano-derivatives. Nonetheless, permethrin is a non-cyano derivative. Literature indicates that cyano-derivatives of pyrethroids exhibit greater efficacy against certain pests compared to non-cyano derivatives. The field population AL-W exhibited a poor resistance to lambda-cyhalothrin and intermediate resistance to beta-cyfluthrin and bifenthrin. Low resistance levels were also observed in the Cx. quinquefasciatus field strain from Brazil [22]and Malaysia [23] against lambda-cyhalothrin.

5. Conclusion

The findings of this study demonstrated that both Nocoz and lambda cyhalothrin exhibit high efficiency against fourth instar larvae of cheiving 100 mortality at high concentration. Clear dose dependent relationship was observed with larval mortality increasing as the concentration increased.

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