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Effect of Chlorpyrifos on Field Strains of *Culex Pipiens* in their Breeding Habitats in Beni Suef Governorate, Egypt

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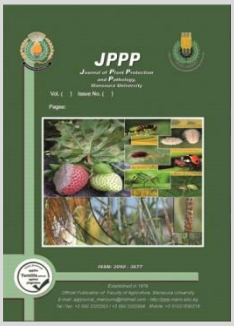

ABSTRACT

Culex pipiens was the main vector of *Bancroftian filariasis* that causes filariasis disease in Egypt. Effect of chlorpyrifos on field strains of *C. pipiens* in laboratory and their field breeding habitats were evaluated in village of Saft, Beni Suef Governorate, Egypt. Under laboratory conditions, all tested concentrations (0.5-25 ppm) of chlorpyrifos caused complete mortality of the larval instars compared to the control treatment. While, the pupal mortality significantly increased with increasing concentrations of chlorpyrifos and the highest pupal morality of *C. pipiens* was obtained at 25 ppm. Under semi field trials, the highest morality in immature stages of *C. pipiens* was obtained at concentration of 25 ppm which were 100.0, 100.0 and 96.7% for second and fourth larval instars and pupal stage, respectively after 48 h. While in under field conditions, the complete reduction in density of immature stages of *C. pipiens* in treated cement tanks with chlorpyrifos was at 25 ppm after 24 h. The reduction in *C. pipiens* density was slightly lower in other breeding habitats (Agriculture canals and drains). In agricultural canals, the percentages of reduction in density of second and fourth instars and pupal stage were 95.3, 81.9 and 87.5%, respectively after 24 h, while in drains were 87.0, 70.9 and 50.0%, respectively. Our results were indicated that chlorpyrifos was effective on *C. pipiens* in most of their breeding habitats.

Keywords: *Culex*, Mosquitoes, Drains, Agriculture canal, Breeding habitats

INTRODUCTION

Mosquitoes are well–known as a vector of borne diseases (Clement, 1992). Mosquitoes were including more than 3500 species all over the world and most of these species act as vectors of different pathogens (Stone, 1975). The common mosquito-borne diseases included the filariasis and west Nile fever viruses are transmitted by *Culex* genus (Hawking, 1973; Southgate, 1979), *Aedes* genus is known as a vector of several viruses such as Zika, yellow fever, rift valley fever, dengue and chikungunya (Jupp *et al*., 2002; Mutebi *et al*., 2004; Zhou *et al*., 2021) and *Anopheles* genus is a main vector of malaria (Warrel, 1993; Elgendy, 2018). *Culex pipiens* Linnaeus was recorded in most of Egyptian Governorates and this species was the main vector of *Bancroftian filariasis* which causes filariasis disease in Egypt (Southgate, 1979; Harb *et al*.,1993; Kenawy *et al*., 2014). To eradicate mosquitoes, a good knowledge and understanding of the relevant ecology and biology of the target species is of paramount importance.

Control of mosquito species is becoming challenging because spread distribution of mosquito species and strongly increase the associated risk of vector borne diseases and up to date control of mosquito species by chemical insecticides, such as organophosphate, gave a good control for mosquito species (Eissa *et al*., 2020). However, no studies aimed to control *C. pipiens* in its different breeding habitat sites in Beni Suef Governorate. The aim of the present study therefore is to determine the effect of chlorpyrifos on *C. pipiens* densities in breeding habitats of Beni Suef Governorate, Egypt.

MATERIALS AND METHODS

Control of immature stages of *C. pipiens* by chlorpyrifos

1. Under laboratory conditions

The field strain of *C. pipiens* was obtained from different breeding habitats in Beni Suef Governorate, Egypt. The colony was maintained under the laboratory conditions of 27±2°C and 75±5% R.H. The second and fourth instars larvae and pupae were collected for the bioassay tests.

Six concentrations from Triphos 48% EC (chlorpyrifos) (0.50, 5.0, 10.0, 15.0, 20.0 and 25.0 ppm) were used against the second and fourth larval instars and pupal stage of *C. pipiens*. Ten larvae and pupae were put in clean plastic cup with 50 ml stored tap water and treated with chlorpyrifos concentrations. Each concentration was replicated three times and control treatment was performed only by using tap water. Dead larvae and pupae were recorded after 24 h. The mortality was corrected according to Abbott's formula (1987) and mortality data were transformed by arcsine prior to ANOVA. One-way ANOVA was used to compare the differences between mortality of different concentrations.

2. Under semi field conditions

The semi field experiments were carried out in plastic tank capacity (20 L) locality in the same breeding habitats sites in village of Saft, Beba, Beni Suef Governorate, Egypt. Three plastic tanks were used for each stage, fifty larvae and pupae were put in each plastic tank contained water treated with the recommended dose of chlorpyrifos (25 ppm). Dead larvae and pupae were recorded after 24 and 48h.

3. Under field conditions

The field experiments were carried out in different breeding habitats (cement tank, agricultural canals and drains)

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in Saft (Beba) village, Beni Suef Governorate, Egypt. This village contained almost mosquito species different breeding habitats mainly *Culex pipiens*. Chlorpyrifos was applied using the recommended dose of 25 ppm in all breeding habitats.

Treatment of chlorpyrifos was applied by spraying of the required amount of insecticide, in which the hand compression sprayer was used. Prior to spraying, density of larvae and pupae was estimated by dipper sampling method using a standard dipper. Density of larvae and pupae per dip was monitored in control and treated habitats after 1 and 24 h. by Mulla *et al*. (1971).

Statistical analysis

The data was subjected to one-way analysis of variance by using SPSS 21.0 Software (SPSS, Chicago, IL, USA). Tukey's HSD test was used to separate means in case of significant ($F \leq 0.05$).

RESULTS AND DISCUSSION

Control of immature stages of *C. pipiens* by chlorpyrifos

1.Under laboratory conditions

The mortality percentages of larval instars and pupae of *C. pipiens* treated by chlorpyrifos at different concentration under laboratory conditions are shown in Table (1).

Table 1. Mortality percentage of larval and pupal stages of *Culex pipiens* after 24 h exposure to different concentrations of chlorpyrifos. under laboratory conditions

Concentration (ppm)	% Mortality after 24 h.		
	Second larval instar	Fourth larval instar	Pupal stage
0.0	0.0	0.0	0.0e
0.5	100.0	100.0	60.0d
5.0	100.0	100.0	63.3cd
10.0	100.0	100.0	70.0cd
15.0	100.0	100.0	76.7bc
20.0	100.0	100.0	86.6b
25.0	100.0	100.0	100.0a

Mean values with the same letters within a column are not significantly different ($P < 0.05$).

All tested concentrations caused complete mortality of larval instars compared to the control treatment. While, the pupal mortality percentage significantly increased with increasing concentration of chlorpyrifos and the complete pupal morality of *C. pipiens* was obtained at concentration of 25 ppm.

2.Under semi field conditions

The efficacy of chlorpyrifos against *C. pipiens* was evaluated in plastic tanks as semi field conditions. These plastic tanks were treated with recommended dose of chlorpyrifos (25 ppm) in comparison with untreated as control. The data presented in Table (2) indicate the larval and pupal mortality percentages were significantly increased with increasing exposure period to chlorpyrifos and the highest morality percentages in immature stages of *C. pipiens* were obtained at concentration of 25 ppm after 48 h**.** These percentages were 100.0, 100.0 and 96.7% in second and fourth larval instars and pupal stage, respectively.

Table 2. Mortality percentages in immature stages of *Culex pipiens* after 24 and 48 hours exposures to 25 ppm of chlorpyrifos in plastic tank

Concentration	% Mortality		
	Second larval instar	Fourth larval instar	Pupal stage
0.0	0.0 c	0.0 c	0.0 c
25.0 after (24 h)	98.0 b	96.0 b	93.6 b
25.0 after (48 h)	100.0 a	100.0 a	96.7 a

Mean values bearing the same letters within a column are not significantly different ($P < 0.05$).

3.Under field conditions

The efficacy of chlorpyrifos against *C. pipiens* was evaluated in cement tank, agriculture canals and drains. These different habitats of *C. pipiens* were treated with recommended dose of chlorpyrifos (25 ppm) in comparison with untreated as control. *C. pipiens* was the predominant *Culex* species found in these habitats.

The percent reduction in density per 5 dip of immature stages (larvae and pupae) of *C. pipiens* in treated cement tanks with chlorpyrifos is presented in Table (3). At 25 ppm, percent of reduction in density of immature stages in cement tanks was increased with increasing exposure period of chlorpyrifos and the complete reduction (100%) of larval and pupal density were achieved after 24 h.

Table 3. Percentage reduction in the density of *Culex pipiens* immature stages per five dips after exposure for 1 and 24 h. with chlorpyrifos at 25 ppm in three breeding habitats (cement tank, Agriculture canal and drain) under field conditions

Concentration	Percentage reduction								
	Second larval instar			Fourth larval instar			Pupal stage		
	Cement tank	Agriculture canal	Drain	Cement tank	Agriculture Canal	Drain	Cement Tank	Agriculture canal	Drain
0.0	0.0 c	0.0 c	0.0 c	0.0 c	0.0 b	0.0 b	0.0 c	0.0 c	0.0 c
25.0 after(1 h)	83.4 b	52.7 b	33.3 b	37.5 b	66.2 a	60.6 a	29.2 b	50.0 b	33.3 b
25.0 after (24 h)	100.0 a	95.3 a	87.0 a	100.0 a	81.9 a	70.9 a	100.0 a	87.5 a	50.0 a

Mean values with the same letter within a column are not significantly different ($P < 0.05$).

The percent of reduction in immature stage densities of *C. pipiens* inagriculture canals was increased with increasing exposure period of chlorpyrifos at 25 ppm and reduction percentages in density were 95.3, 81.9 and 87.5% for second and fourth larval instars and pupal stage, respectively after 24 h .(Table 3). The same trend was obtained in breeding habitat of drain but the percentages of reduction in larval and pupal densities of *C. pipiens* were lower than cement tanks and agriculture tanks, where the percentages of reduction using at 25 ppm of chlorpyrifos were 87.0, 70.9 and 50.0% in second and fourth larval instars and pupal stage, respectively after 24 h. (Table 3). Similar results were obtained by Gharib (2021) who found that chlorpyrifos showed the highest larvicidal effect against field strain larvae of *C. pipiens* with LC_{50} and LC_{90} (0.068 and 0.255 ppm) . Further, Begum (2001) observed that LC_{50} value of chlorpyrifos was 0.065 ppm against third and fourth instars larvae of *Culex quinquefasciatus.* Cetin *et al*. (2006) tested chlorpyrifos-methyl of 0.04, 0.08, and 0.12 ppm, and found that the larval reduction in septic tanks from single- and multifamily dwellings treated significantly greater than pretreatment levels and control tanks for the duration of the study. Laboratory bioassays of septic tank water treated at field application rates, without daily dilution, revealed that complete larval mortality was achieved after 21 days at each application rate. Also, Aney *et al*. (2018) evaluated the effect of chlorpyrifos on third instar larvae of *C. quinquefasciatus* from Savar area of Dhaka, Bangladesh and found that LC_{50} and LC_{90} values were 0.127 and 0.984 ppm, respectively. The Authors were indicated that chlorpyrifos was effective against the third instar larvae of *C. quinquefasciatus*. Our results showed that chlorpyrifos is effective insecticide on immature stages of *C. pipiens* in different breeding habitats particularly in plastic and cement tanks more than agriculture canals and the lowest reduction of density was obtained in drains. These differences between breeding habitats may be attributed to the most polluted breeding sites such as drains and canals that induce the spread of *C. pipiens* more than other breeding habitats (Harb *et al*., 1993; Oringanje *et al*., 2011).

In conclusion based on the results of present study the chlorpyrifos is an effective insecticide against immature stages of *C. pipiens* (Second and fourth larval instars and pupal stage) in the three examined trails (laboratory, semi field and field trials). The complete mortality of immature stages were achieved in plastic and cement tanks treated with chlorpyrifos more than that in the agriculture canals and the lowest reduction of density was obtained in the treated drains. This knowledge may be useful in Integrated Pest Management programs of *Culex* mosquito as the most important vector of several diseases.

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تأثير الكلوروبيروفوس على بعوضة الكيوليكس فى بيئات توالدها المختلفة فى محافظة بنى سويف – مصر

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تعتبر بعوضة الكيوليكس هى الناقل الرئيسى للمسبب المرضى الذى يحدث داء الفيلاريا فى مصر. تم تقييم تاثير مبيد الكلوروبيروفوس على الاطوار غير البالغة لبعوضة الكيوليكس فى المعمل والحقل فى بيئات توالدها فى قرية صفت – مركز ببا – محافظة بنى سويف – مصر. احدثت كل التركيزات المستخدمة من المبيد (0.5 -25 جزء من المليون) موت كامل لليرقات بالمقارنة بالكنترول تحت الظروف المعملية بينما زادت نسب الموت بزيادة التركيز فى العذارى حتى وصلت الى اعلى نسب موت فى تركيز 25 جزء من المليون. اما فى التجربة نصف الحلقية فى الاحواض البلاستيكية بتركيز 25 جزء من المليون احدثت نسب موت 100% لليرقات ووصلت الى 96.7% للعذارى بعد 48 ساعة. بينما فى التجارب الحقلية حدث انخفاض كامل فى تعداد اليرقات والعذارى فى الاحواض الاسمنتية بعد 24 ساعة بتركيز 25 جزء من المليون , نسب الخفض فى التعداد قلت فى بيئات التوالد الاخرى (القنوات الزراعية والمصارف) حيث وصلت نسب الخفض فى تعداد للعمر اليرقى الثانى والرابع والعذارى الى 95.3, 81.9, 87.5% على الترتيب فى القنوات الزراعية وقلت اكثر فى المصارف حيث وصلت الى 87.0, 70.9, 50.0% على الترتيب عند نفس التركيز بعد 24 ساعة . نتائجنا اوضحت ان مبيد الكلوروبيروفوس فعال على بعوضة الكيوليكس فى معظم بيئات توالدها.

الكلمات الدالة : الكيوليكس , البعوض , المصرف, القناة الزراعية , بيئات التوالد