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EFFICACY OF THREE INSECTICIDES ON RAT FLEA (*XENOPSYLLA CHEOPIS*) INFESTING RODENTS IN GIZA GOVERNORATE, EGYPT

By

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Abstract

The extensive use of insecticides in public health and agriculture sectors is the main reason for development of resistance in fleas associated in domestic rodents. The present work was planned to investigate the insecticidal efficacy of Lambda-cyhalothrin, Chlorpyrifos and Fenitrothion against rat flea (*Xenopsylla cheopis)* infesting rodent species in Giza Governorate, Egypt. The lethal concentration Lc_{50} and Lc_{90} of population percent were obtained from the established regression log concentrate-response lines. Data indicated that the values of lethal concentration (Lc_{50}) were 0.293, 1.725 & 2.328 % for Lambda-cyhalothrin, chlorpyrifos and Fenitrothion, respectively. The values of lethal concentration (Lc_{90}) were 0.467, 2.839 & 5.197% for Lambda-cyhalothrin, chlorpyrifos and Fenitrothion, respectively.

Key words: Rodent, Fleas, Lambda-cyhalothrin, Chlorpyrifos, Fenitrothion, Insecticides.

Introduction

Fleas have been associated with humans, livestock, pets and wild animals. They are responsible to transmit diverse pathogens of medical and veterinary significance, including viruses, bacteria, protozoa and helminthes (Cleaveland *et al*, 2001). The most severe infection spread by fleas is plague caused by *Y. pestis* (Stenseth *et al*, 2008) and still remains a health problem with occasional epidemics occurring in the world (Butler, 2013). The disease is typically carried by wild rodents, and transmitted to fleas bite them. The digestive system of an infected flea can become blocked by rapid reproduction of the bacteria, causing the flea to bite repeatedly in an attempt to avoid starvation. Humans typically contract the disease from the bites of infected fleas, or through skin abrasions that contact the blood of infected animals or the feces of infected fleas. Fleas are known as vectors of murine typhus. The causative organism is *Rickettsia typhi*, it is normally transmitted from rat to rat through the flea feces. This same mechanism is thought to be one of the ways in which humans contract the disease (WHO, 1987). Fleas have also been proven to harbor and sometimes transmit *Bartonella spp*., the agent of cat-scratch disease (Chomel *et al*, 2006; Billeter *et al*, 2008). Additionally fleas are hosting helminthes, *Dipylidium caninum* and *Hymenolepis diminuta* (Duchemin *et al*, 2006). Also, the attacks by fleas to people and domestic animals caused irritation, blood loss. *Xenopsylla cheopis* is widely disseminated on various species of rodents in different parts of the world. In Egypt records were given (Abdou and Smaan, 1962; Hoogstraal, 1956; Rifaat *et al*, 1969; Arafa *et al*, 1973; Morsy *et al*, 1982; Soliman *et al*, 2010).

The continuous use of insecticides that control arthropods vectors and pests in public health importance is the main reason selected individuals with resistance genes. Therefore, the aim of the work is to evaluate the efficacy of some insecticides used in public health to control the rat flea *Xenopsylla cheopis* infecting dominant rodent species in Giza Governorates, Egypt.

Materials and Methods

The method described by Rifaat et al. (1969), for capturing and transporting of rodent animals was following throughout the present investigation at Giza Governorate, Egypt. The studies were done from October

2015 to February 2016. Wire box traps were baited and distributed in some selected residential houses at sunset. Distributed traps will be collected next morning and enclosed in separate white bag to avoid escape fleas and transported to laboratory. In laboratory animals were anaesthetized with diethyl ether and fleas were collected on white sheet by using a stiff hard brush WHO (1970). Fleas collected were exposed to 4 concentrations of each insecticide (Lambdacyhalothrin, Chorpyrifos and Fenitrothion). Papers 5 cm long by 1.5 cm wide, tapered at one end impregnated with each concentration for each insecticide used was kindly provided by WHO. A test paper and a control paper impregnated with oil alone were inserted into each test tube. Into each tube, 10 fleas were transferred by an aspirator unit. Each tube was closed by fine-mesh gauze and the exposure period began. The tubes are placed vertically in rack under one of the halves of the kit box so that the fleas were kept in darkness during the exposure period. Each concentration was replicated 4 times with concurrent control. At the end of 60 minutes exposure period, the tubes were transferred to clean tubes containing clean non impregnated paper. After 24 hours, the fleas examined and mortality counts were calculated. The percentage of mortality was corrected by Abbott's formula (1925). All efficacy tests were conducted (WHO, 1970). The method described by Finney (1952) and the logarithmic-probability was used to evaluate the relationship between concentrations and mortality. Slope (b) function ratio was calculated.

Results

Table1: Response of fleas to different concentrations of insecticides.

Insecticide	Concentration %	No. of fleas	Died	Alive	Mortality%
Lambda-cyhalothrin	0.2	40	7	33	17.5
	0.3	40	19	21	47.5
	0.4	40	32	8	80
	0.5	40	38	2	95
Chlorpyrifos	1.0	40	4	36	10.0
	1.5	40	14	26	35.0
	2.0	40	24	16	60
	3.o	40	38	2	95
Fenitro-Thion	1.0	40	4	36	10
	2.0	40	16	24	40
	0.3	40	24	16	60
	4.0	40	34	6	85.0

Table 2: Insecticides efficacy against fleas after 60 minutes exposure period.

Insecticide	Lc values		Lc_{50}/Lc_{90}	Slop (b)	Toxicity index based on		Folds based on	
	Lc_{50}	Lc_{90}			Lc_{50}	Lc_{90}	Lc_{50}	Lc_{90}
Lambda-cyhalothrin	0. 293±0.266 & 0.318	0.467±0.417 & 0.555	0.627	6.313±0.868	100	100	7.94	11.13
Chlorpyrifos	1.725±1.572 & 1.894	2.839±2.484 & 3.507	.607	5.919±0.807	16.98	16.45	1.35	1.83
Fenitro-Thion	2.328±2.014 & 2.682	5.197±4.181 & 7.533	0.448	3.676±0.560	12.58	8.98	1	1

Discussion

In the present study, Lc_{50} were 0.293, 1.725 & 2.328 for Lambdacyhalothrin, chlorpyrifos and Fenitrothion, respectively after 60 minutes exposure period. The same data were obtained with Lc_{90} showed 0.467, 2.839 & 5.197 for Lambda cyhalothrin, chlorpyrifos and Fenitrothion, respectively. Data concerning slope of the established regression lines showed differences in response homogeneity to Lambdacyhalothrin, Chlorpyr\ifos & Fenitrothion. Slope values were 6.313, 5.919 & 3.676 for Lambdacyhalothrin, chlorpyrifos & fenitrothion, respectively. With values of lc_{50} and lc_{90} of Lambdacyhalothrin as a base line for comparison sun (1950), the relative frequencies of chlorpyrifos and Fenitrothion were 16.98 & 12.58 based on Lc_{50} and 16.45 & 8.98 based on Lc_{90}, respectively. With Lc_{50} & Lc_{90} for Fenitrothion as a base line for comparing relative frequencies of chlorpyrifos and Lambdacyhalothrin were 1.35 & 7.94 based on Lc_{50} and 1.83 &11.13 based on Lc_{90}, respectively. Soliman *et al*. (2015) reported that Lc_{50} for malathion**,** chlorpyrifos and deltamethrine were 1.972, 1.023 & 0.185%, respectively to *X. cheopis* associated rodent species in Cairo. Cai *et al*. (2015) reported that lambdacyhalothrin effect to fleas was very good, efficient, low toxicity and safe for human and it can be used to control the plague in the field. Total elimination rate of 0.15% lambdacyhalothrin was 95.11% to *Pulex irritans*, 100% to *Ctenocephalides f. felis* and 100% to *X. cheopis* at three villages selected from Jinhang country, China. Boyer *et al.* (2014) studied the susceptibility of 0.05% deltamethrin at 32 different *X. cheopis* populations. They showed that only two populations were susceptible to deltamethrin, four populations were tolerant and 26 populations were resistant. KD50 (50% Knock-down) & KD90 (90% Knock-down) times were determined, and differed substatically from 9.4 to 592.4 minutes for KD50 and 10.4 to 854.3 minutes for KD90 in Malagasy, Madagascar. Soliman and Mikhail (2011) found that Lc_{50} of bendicarb, diazi- non and pirimiphos-methyl were 0.389, 1.039 & 2.056 %, respectively to fleas collected from domestic rodents at Dakahlia Governorate. Shyamal *et al*. (2008) reported that the development of resistance in rat fleas to DDT-4,0%, Malathion 5.0%, Delta methrin 0.05% and tolerance to permethrin 0.75% in all blocks of Nilgiris hill district, India. Development of resistance may be due to the extensive use of insecticides in tea plantations. Arvind *et al.* (2007) reported that the mortality of malathion for *X. cheopis* and *X. astia* in Distt Baghpat of western Uttar Pradesh were 82.15% and 85.71%, respectively. Males showed more sensitivity to insecticide than females. Cai *et al*. (2006) showed that Lc_{50} of chlorpyrifos, phoxim & dichlorvos was 5.9615mg /liter, 6.7873mg /liter & 7.8343 mg/liter, respectively. WHO (2006) reported that the effective concentration used against adult and larval fleas to chlorpyriphos, malathion, fenitrothion and deltamethrin were 20, 50, 20 & 0.5g/kg. Luo *et al.* (2003) reported that killing rate of *X. cheopis* with 0.03% & 0.05% cyhalothrin were 80.30% & 100%, respectively. Cyhalothrin was effective to fleas in plague endemic area. Dehong Prefecture,. Mourya *et al.* (1998) found that *X. cheopis* was less susceptibility to DDT and deltamethrin as compared to colony stains, and susceptibility to malathion and propoxur was same as to colony strains. Ratovonjato (1998) reported that *X. cheopis* was resistance to DDT, deltamethrin, lambdacyhalothrin and permethrin, but was susceptible to 1% bendiocarb & pirimiphos-methyl at urban areas in Madagascar.

Conclusion

Giza Governorates were distinguished by high population density of rodents with huge fleas. Their association with man is risky as vectors of serious pathogens. Extensive use of insecticides in public health and agriculture is the main cause tolerance development of to Lambdacyhalothrin, Chlorpyrifos and Fenitrothion against *X. cheopis* infesting rodents in Giza Governorate.

Plague outbreaks in Libya near the Egyptian border and high density of rodents and fleas at most Governorates must be in mind.

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