INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560-8530/2004/06–5–806–809
http://www.ijab.org

Evaluation of Some Pyrethroids for the Control of House fly, *Musca domestica* L.

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ABSTRACT

The susceptibility of a laboratory reared strain of *Musca domestica* to cypermethrin 10EC, fenpropathrin 20EC, fenvalerate 20EC, and lambda cyhalothrin 2.5EC in a range of concentrations from 250 to 5000 ppm of the formulated insecticides in acetone was determined. These concentrations in a volume of 10 mL were added to 25 g of granulated sugar in a petri dish. House flies were allowed to feed on the insecticide coated sugar for 48 h. Knockdown and mortality data were observed after 1, 2, 4, 6, 8, 12, 24 and 48 h and subjected to probit analysis. The results showed that cypermethrin had the lowest LC_{50} (183 ppm) followed by fenvalerate (247ppm) at 48^{th} h. Fenpropethrin had lowest KD_{50} value (2879) at 1^{st} h of exposure to the insecticide. Toxicity of these insecticides via feeding method is discussed.

Key Words: Cypermethrin; Fenvalerate; Fenpropathrin; Lambda-cyhalothrin; Bioassay; Feeding; *Musca domestica*

INTRODUCTION

The house fly, *Musca domestica* L. is a well known cosmopolitan insect pest of both farm and house. This species is always found in association with humans or activities of humans. Not only are they a nuisance, but they can also transmit disease-causing organisms. More than 100 pathogens associated with the house fly may cause diseases in humans and animals, these diseases include typhoid, cholera, tuberculosis, anthrax, mastitis, bacillary dysentery and infantile diarrhea (Service, 1980).

The control of *M. domestica* is vital to human health. The threshold density for determining when to control flies depends on the area where control measures would be taken. The threshold density of the house fly at waste management sites was estimated to be 150 individuals per fly paper in 30 min (Hogsette *et al.,* 1993).

The most common control measures involved with the management of house fly are sanitation, use of traps and insecticides but in some cases integrated fly control has also been proposed.

Until now control of this important public health pest is mainly relied on the insecticides. Organophosphates, carbamates, pyrethroids and Insect Growth Regulators (IGRs) have been used to control house fly while many aerosols containing pyrethroid insecticides such as permethrin, fenvalerate, allethrin etc. are being used (Harris *et al.,* 1982; Ozaki & Kassai, 1984; Malinowski, 1993; Gebara *et al.*, 1997; Mostafa & Zayed, 1999; Kocisova, 2001; Hu *et al.,* 2001; Azzam & Hussein, 2002). Resistance of synthetic pyrethroids in the house fly has also been amply documented in these above studies (Keiding, 1995). Therefore, testing of newly developed insecticide is a routine resistance monitoring in house fly. As residual surface/aerosols application have increased chances of development of insecticide resistance in the house fly in many parts of the world. These sprays can also contaminate food and water. Hence, baiting is a good choice for the abatement of house fly. Efficacy of the insecticides should be known before adding them into the bait. The insecticides that can give quick and safer control are the best for a baiting system (Saito *et al.,* 1991; Gunjima & Saito, 1992).

Taking the preceding points into consideration the present work was started to investigate the toxicities of the different insecticides to house fly. For this purpose, a laboratory reared strain of house fly was exposed to lambda cyhalothrin 2.5EC, fenvalerate 20EC, cypermethrin 10EC, fenpropathrin, 20EC ranging from 250-5000 ppm mixed with sugar.

MATERIALS AND METHODS

Insecticides. The insecticides used their trade name, common name, formulation and concentration is listed below in the table.

Trade name	Common Name	Formulation	Concentration
Karate	lambda cyhalothrin	2.5EC	312-2500 ppm.
Sumiciden	fenvalerate	20EC	500-2000 ppm
Cypermethrin	cypermethrin	10EC	250-1000 ppm
Fenpropathrin	fenpropathrin	20EC	500-2000 ppm

The other materials were beakers, Petri dishes, cotton wool, distilled water, mesh cage, aspirator, granulated sugar, acetone.

Rearing of flies. House flies were reared for bioassay at room temperature in the Crop Pest Management Laboratory, Department of Agri. Entomology, and University of Agriculture Faisalabad. Cages, 40 cm long, 40cm wide and

40 cm high, were used for the rearing of house fly. The cages were covered with mesh screen with cloth sleeve opening at front. The adult flies were maintained in a mesh cage with granulated sugar and soaked cotton wool in petri dishes.

The newly emerged flies were also fed with full fat fresh milk soaked in cotton wool for three days after fly emergence to enhance egg production, after that they were given milk sugar solution in the way mentioned above. After 3 days of fly emergence, the beakers containing larval food were placed for egg laying. The beakers removed from cages after 2-3 days when eggs were visible, attached to food along the sides of beakers. The food was changed after 2-4 days depending upon the numbers of larvae per beaker. The beakers were kept in separate cage for fly emergence.

Diet. Larval media consisted of yeast, dry milk powder, wheat bran and water. The beaker of 500 mL was filled with this larval media and put in the cage with flies. After 2-3 days these beakers were removed from cages, and a piece of nylon mesh was fastened to the mouth of beakers held in a position by rubber band.

Bioassay procedure. A range of concentrations from 250-5000 ppm of the formulated insecticides was made in acetone to a volume of 10 mL. The 25 g of granulated sugar was put in a petri dish, 5 mL of each concentration was added into the sugar on petri dish and these petri dishes were left in fume cupboard overnight to let the acetone to evaporate. A batch of 50 flies was released in a smaller mesh cage with one concentration of an insecticide and these were repeated thrice. To obtain KD_{50}/LC_{50} of the insecticides, data on the knockdown effect and mortality were taken after 1, 2, 4, 6, 8, 12, 24 h and 48 h after treatment.

Statistical analysis. The dosage mortality and knockdown data were analyzed using Probit Analysis (Hewlett & Plackett, 1979) to obtain KD_{50}/LC_{50}, χ^2 value, slope, and fiducial limits.

RESULTS

Table I shows KD_{50} and LC_{50} values for the effect of various concentrations of cypermethrin on the adults of *M. domestica* via feeding method. The KD_{50} value increased during the 1, 2, and 4th h from 5686 to 7126 ppm, and at 6, 8, 12 h, this KD_{50} value dropped down to 1915 ppm. The slope values during this h were more than one but less than 2 (ranged between 1.12-1.71). There was no mortality in the 1st h of cypermethrin treatment but LC_{50} values were very high in 2nd and 4th h. At 24 h KD_{50} value was >1255550 ppm with χ^2 and H value 4.2 and 2.10, respectively, which indicates random response of the flies at this time point. In contrast to the KD_{50} values, the LC_{50} value was 1102 ppm at 24 h with χ^2 and H value 2.81 and 1.40, respectively. At 48th h LC_{50} was 183 ppm with χ^2 and H value, 1.85 and 0.48, respectively. The slope of the LC_{50} values was less than 1, which shows a steep line of the Probit data / analysis.

Table II shows KD_{50} and LC_{50} values for the effect of various concentration of fenpropathrin on the adults of *M. domestica*. The KD_{50} value was 2879 ppm with χ^2 and H value was 1.45 and 0.73, respectively during 1, 2 h. In 6, 8,

Table I. LC_{50} and KD_{50} of cypermethrin against *Musca domestica* L.

		Fit of Probit Line					Fit of Probit Line			
Time (hr)	**KD_{50} (ppm)**	**FL 95%**	**Slope±SE**	**χ^2**	**H**	**LC_{50} (ppm)**	**FL 95%**	**Slope±SE**	**χ^2**	**H**
1	5686	2456-76572	1.45±0.39	1.70	0.85	No mortality				
2	6806	2665-149445	1.34±0.37	1.85	0.93	>758550	*	0.3±0.51	0.18	0.09
4	7126	2735-151215	1.26±0.34	0.24	0.12	>277920	*	0.42±0.44	0.13	0.07
6	4590	2182-31882	1.32±0.31	0.95	0.48	50615	*	0.77±0.33	1.51	0.76
8	2674	1487-9984	1.12±0.23	0.05	0.03	7673	2701-232336	0.98±0.27	0.48	0.24
12	1915	1311-3865	1.71±0.29	1.16	0.58	12430	3083-7673182	0.73±0.24	0.49	0.25
24	>125500	*	0.39±0.36	4.20	2.10	1102	*	0.93±0.20	2.81	1.40
48	17590	*	1.40±0.70	2.45	1.22	183	*	0.37±0.18	1.85	0.43

FL: Fiducial limits; H, Heterogeneity * Fiducial limits are not calculated for data has has shown large “g” value, g is the index of significance for potency estimation.

Table II. LC_{50} and KD_{50} of fenpropathrin against *Musca domestica* L.

		Fit of Probit Line					Fit of Probit Line			
Time (hr)	**KD_{50} (ppm)**	**FL 95%**	**Slope±SE**	**χ^2**	**H**	**LC_{50} (ppm)**	**FL 95%**	**Slope±SE**	**χ^2**	**H**
1	2879	2006-5491	1.37±0.22	1.45	0.73	16545	*	2.01±1.31	0.26	0.13
2	2879	2006-5491	1.37±0.22	1.45	0.73	16357	5527-5186994	1.59±0.56	0.30	0.15
4	3117	2115-6362	1.33±0.23	0.04	0.02	16645	5801-981810	1.35±0.41	1.30	0.65
6	2873	*	1.31±0.22	3.16	1.56	11373	4905-153144	1.45±0.39	1.70	0.85
8	2098	1575-3328	1.45±0.21	1.72	0.86	8026	4012-44342	1.28±0.28	1.07	0.54
12	2608	1890-4495	1.48±0.23	0.60	0.30	6713	3470-32226	1.13±0.24	0.05	0.03
24	2681	2186-3770	2.97±0.46	0.73	0.37	3395	2144-8657	1.12±0.21	0.03	0.02
48	12090	4864-872629	1.81±0.01	0.47	0.24	902	721-1174	1.31±0.19	1.84	0.92

FL: Fiducial limits ; H, Heterogeneity* Fiducial limits are not calculated for data has has shown large “g” value, g is the index of significance for potency estimation

12 and 24 h KD_{50} value decreased from 2873 to 2681 ppm. The slope value during these hours was more than one. LC_{50} value during 1st, 2nd, 4th h was high and then decreased from 16645 to 902 ppm in 6, 8, 12, 24 and 48 h. Slope value was more than one but less than 2. χ^2 and H value data at 48th h was 1.84 and 0.92, respectively.

Table III shows KD_{50} and LC_{50} values for the effect of various concentration of fenvalerate. KD_{50} value dropped down from 53299 to 3292 ppm during 1, 2, 4, 6 h. KD_{50} value was very high at 48 h with χ^2 and H value 0.85 and 0.43, respectively. There was no mortality during 1st h and then LC_{50} dropped down from 26876 ppm to 248 ppm in 4, 6, 8, 12, 24 and 48 h. The slope line was less than 2 but more than one.

Table IV shows that KD_{50} and LC_{50} values of the effect of various concentrations of lambda cyhalothrin. KD_{50} values remained high at all the time points. LC_{50} value was very high (more than 100,000 ppm) during 4, 6, 8 h with χ^2 values 1.47, 0.26 and 0.71, respectively. The slope line during 1, 2, 4, 6, 8, 12 and 24 h was < 2 but > 1.

DISCUSSION

House fly, *M. domestica* is an important insect pest of household and public health because it transmits a number of deadly diseases like typhoid, cholera, tuberculosis anthrax, mastitis, bacillary dysentery and infantile diarrhea (Service, 1980).

Control of house fly has been mainly dependent upon the use of inorganic and synthetic organic insecticides with the field (Keiding, 1995; Kocisova, 2001).

In the laboratory the exposure of the house fly to the insecticide has been a routine research work in order to extrapolate the insecticide resistance level and its mechanisms. Most of the studies are based on the topical application of insecticides to the adults of house fly, *M. domestica* (Gunjima & Saito, 1992; Keiding, 1995).

Very few studies show the insecticide toxicity bioassay via feeding. This type of bioassay can help to develop an effective baiting system. The insecticide having the least KD_{50} value in less time should be the most effective.

Pyrethroids have been used with the assumption that they were the least hazardous to the environment (Malinowski, 1993; Mostafa & Zayed, 1999; Kocisova, 2001; Hu *et al.,* 2001; Azzam & Hussein, 2002). Pyrethroids used in aerosols provide an instant kill of the house flies but for the long lasting and persistent control; it is not clear whether pyrethroids can be effective. The insecticide having the least LC_{50} in less time was considered as the effective. In the present cypermethrin had the lowest LC_{50} (183ppm) followed by fenvalerate (247ppm) at 48th h. Fenpropethrin had lowest KD_{50} value (2879) at 1st h of exposure to the insecticide. The present result differ with Gebara *et al.* (1997) who found fenvalerate the least effective insecticide for the control of house fly. Probably testing was carried out by topical application of acetone solution containing insecticide in the latter case. Mostafa and Zayed (1999) had reported homogeneity in response to cypermthrin by a strain of *M. domestica*, which was not clearly seen in the result of present study.

No comparable data so for published parallel to the

Table III. LC_{50} and KD_{50} of fenvalerate against *Musca domestica* L.

	Fit of Probit Line					Fit of Probit Line				
Time(hr)	KD_{50} (ppm)	FL 95%	Slope±SE	χ^2	H	LC_{50} (ppm)	FL 95%	Slope±SE	χ^2	H
1	53299	*	0.76±0.28	0.41	0.21		No mortality		0.26	0.13
2	11388	4453-197377	0.91±0.24	0.42	0.21	26876	*	1.59±0.82	1.14	0.57
4	4240	*	0.92±0.21	3.76	1.88	10593	4770-100781	1.40±0.35	0.06	0.03
6	3292	2281-6363	1.51±0.25	0.97	0.49	7196	3551-57770	0.92±0.22	1.72	0.86
8	3750	2675-6950	2.05±0.34	0.52	0.26	2924	1862-7510	1.02±0.21	1.91	0.96
12	4005	*	2.37±0.44	2.56	1.28	2249	1516-4902	1.01±0.20	1.24	0.62
24	50103	*	1.23±0.59	0.40	0.20	997	729-1553	0.92±0.19	1.48	0.74
48	>461340	*	0.82±0.59	0.85	0.43	248	*	0.39±0.18	1.19	0.60

FL. Fiducial limits H, Heterogeneity* Fiducial limits are not calculated for data has shown large "g" value, g is the index of significance for potency estimation

Table IV. LC_{50} and KD_{50} of lambda-cyhalothrin against *Musca domestica* L.

	Fit of Probit Line					Fit of Probit Line				
Time(hr)	KD_{50} (ppm)	FL 95%	Slope±SE	χ^2	H	LC_{50} (ppm)	FL 95%	Slope±SE	χ^2	H
1	15304	6383-206590	1.32±0.34	0.24	0.12	3272	*	1.98±0.59	0.00	0.00
2	12400	5567-106232	1.17±0.28	0.83	0.42	39878	*	1.66±1.09	0.43	0.22
4	9899	4805-60372	1.12±0.25	0.26	0.13	>179490	*	0.52±0.58	1.47	0.74
6	4889	3153-11420	1.36±0.24	0.14	0.07	>201770	*	0.86±0.44	0.26	0.13
8	6389	3833-18277	1.37±0.26	1.36	0.68	>141930	*	0.67±0.29	0.71	0.36
12	15034	6214-182145	1.41±0.28	1.35	0.68	16253	6113-33277	0.95±0.25	0.01	0.01
24	29666	8557-4417848	1.12±0.35	0.72	0.36	10977	*	0.77±0.21	3.13	1.56
48	>111310	*	0.74±0.55	0.90	0.95	1972	*	0.34±0.18	1.23	0.62

FL. Fiducial limits H, Heterogeneity* Fiducial limits are not calculated for data has shown large "g" value, g is the index of significance for potency estimation present studies i.e., via feeding method was available; therefore, further investigation may be carried out to confirm the present data.

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(Received 14 February 2004; Accepted 20 August 2004)