THE EFFECT OF METHOPRENE (*) ON *Musca domestica*: LABORATORY BIOASSAYS

ML Vignau[1], JR Romero[2], A Baldo[2], MA Risso[3], MP Silvestrini[2]

[1]Cátedra de Parasitología y Enfermedades Parasitarias. [2]CEDIVE.
[3]Cátedra de Bioestadística. Facultad de Ciencias Veterinarias.
Universidad Nacional de La Plata

ABSTRACT: *To determine methoprene's (MTP) effect on fly* Musca domestica *emergence were performed laboratory bioassays using a technical formulation identified as MK55, in the form of a granulated insoluble in water. Concentrations of 1.625, 4.5 and 10 ppm of MTP were mixed directly with poultry manure, and larvae I of* Musca domestica *were fed (test 1). The same MTP concentrations (1.625, 4.5 and 10 ppm) were added to chicken feed and then, the manure produced by the chicken was used as feed to* M. domestica *larvae I (test 2); each test involved five assays and one untreated check, in both larvae II and III were grown by feeding manure. Pupae were controlled until fly adults emergence. The percentage of fly growth in each assay decreased in relation to the increase of MTP concentrations and 77.1% of efficacy was shown when 10 ppm was used directly mixed with manure. And 83.7% of efficacy was demonstrated when used as a feed additive. However, a high variability of results was observed in low concentrations. MTP should be used at the highest doses and integrated with other methods to control* M. domestica *fly in poultry farms.*

KEY WORDS: methoprene, *Musca domestica,* control, poultry farms

EFECTO DEL METHOPRENE SOBRE *Musca domestica*: ENSAYOS DE LABORATORIO

RESUMEN*: Con el propósito de evaluar el efecto del methoprene (MTP) sobre la emergencia de adultos de* Musca domestica*, se realizaron ensayos bajo condiciones de laboratorio con una formulación granulada insoluble en agua, identificada como MK55. Concentraciones de 1.625, 4.5 y 10 ppm de MTP fueron mezcladas directamente con estiércol de gallina y ofrecidas como alimento a larvas I de* M. domestica *(test 1). Las mismas concentraciones de MTP (1.625, 4.5 y 10 ppm) fueron adicionadas al alimento balanceado para gallinas y luego la materia fecal producida por esos animales se usó como fuente alimenticia de larvas I de* M. domestica *(test 2); cada test involucró cinco ensayos y un control sin tratar, en ambos, larvas II y III se desarrollaron alimentándose con estiércol de gallina. Las pupas fueron controladas hasta la emergencia de los adultos. El porcentaje de moscas nacidas en cada ensayo disminuyó en relación al aumento de la concentración de MTP y se demostró una eficacia del 77,1% y del 83,7% cuando se utilizó 10 ppm mezclado directamente en las heces, y como aditivo en el alimento, respectivamente. No obstante, en bajas concentraciones se observó gran variabilidad en los resultados. El methoprene debería ser usado en concentraciones elevadas y en combinación con otros métodos para un control óptimo de adultos de* M. domestica *en explotaciones avícolas.*

PALABRAS CLAVE: methoprene, *Musca domestica,* control, explotaciones avícolas

(*) Anularva ® de Protegram S.A. de Argentina.

Fecha de recepción: 25/11/03 Fecha de aprobación: 04/03/04

Dirección para correspondencia: María Laura Vignau. Cátedra de Parasitología. C.C. 296, (B1900AVW) La Plata, ARGENTINA.
E-mail: mlvignau@fcv.unlp.edu.ar

INTRODUCTION

The proliferation of synanthropic dipteran species is a frequent problem in poultry farms, especially in commercial caged-layer houses where accumulated manure is important.

In Brazil, De Queiroz and De Carvalho (1) identified larvae III from eleven dipteran species, among them *Musca domestica, Fannia canicularis* and *Hydrotaea* sp. Collected from areas of accumulated housing garbage and compost production plants.

Since the early spring *F. canicularis* and *M. domestica* are frequently found in our area of research (La Plata and Chascomús, Province of Buenos Aires). *M. domestica* is also found during the summer and autumn. Environmental conditions favor the development of several generations of flies in a short period.

M. domestica can spread at a distance ranging from 1 to 30 km and it is a potential source of transmission of more than 100 different disease organisms harmful both to confined humans and animals, including protozoans, bacteria, virus, fungi and vermis.

Fly control basically depends on effective manure handling strategies and biological control agents, such as predator acari or microhymenopteran parasitoids and insecticides (larvicides and/or adulticides) were employed to reduce fly population (2, 3).

Several investigators have evaluated the effect of methoprene (MTP) (an insect juvenile hormone analogue that affects the ontogenic evolution and limits the adults development) in acari, *Dermatophagoides farinae* (4), and insects: *Ctenocephalides felis* (5), *Culex* sp and *Anopheles* sp (6) and *Aedes* spp (7).

Adams et al (8) detected a 77% decrease on *M. domestica* emergence in manure samples by adding 10 ppm of MTP as a poultry feed additive.

Breeden et al (9) observed a partial reduction on *M. domestica* adults emergence in chicken houses that had received 7.5 and 10 ppm of MTP in the feed. Emergence percentages varied from 49% to 87%.

The purpose of this work is to evaluate the efficacy of MTP in the control of *M. domestica* adults emergence under laboratory conditions.

MATERIALS AND METHODS

Methoprene: a technical formulation identified as MK 55 in the form of a granulated insoluble in water was used.

Laboratory tests. Two tests were performed involving five assays for each one of the following concentration of MTP: 1.625, 4.5, 10 ppm and one untreated check.

Test 1: 3119 *M. domestica* larvae were grown in poultry manure mixed with the technical formulation of MTP in the described concentrations, as well as 1035 larvae were grown in untreated poultry manure (Table 1).

Test 2: The effect of MTP, dosed in feed of three groups of hens at the previously described concentrations, was analyzed (Table 2). The technical formulation was premixed in bran at a rate of 3200 ppm and then mixed with treated feed up to reaching the previously described concentrations. Animals were regularly fed for at least 3 days. Later, manure was collected and used as feeding substratum for the recently developed larvae. This process was performed on 2001 larvae on a treated substratum and on 734 untreated larvae.

Egg collection, larvae growth and emergence control in adults. A population of *M. domestica*, fed with a mixture of honey and powdered milk was kept in a wire netting cage. Capsules of Petri with untreated fresh manure were daily placed. Females were attracted by manure and some of them laid eggs.

Eggs were collected every 12 hours and collocated by groups of 100-200 units, in 50 ml plastic buckets on 45 g of manure directly mixed with MTP, or coming from chicken fed with treated feed with the addition of MTP at the concentrations described previously. Each bucket was covered with a fine mesh to avoid larvae escape.

Buckets were kept at laboratory temperatures (20 – 27 °C). Every day, larvae I, II, III, and pupae were recorded, and dead individuals were discarded. Pupae were taken to 50 ml plastic buckets filled with sand, covered with a fine mesh and controlled until fly adults emergence. After 35 days, empty pupae were considered dead.

Analyses results. The adults emergence efficacy rate in controls of manure without MTP was considered null (E=0).

The efficacy of MTP in different concentrations was established by comparing the emergence rates in the 5 assays per each concentration with the assays of the control group using the following formula: (AC-AT/AC) X 100 (AC= adults emergence rate controls in each test; AT= rate corresponding to each concentration of MTP) (10).

X^2 test was used to analyze the adults emergence results in relation to MTP concentrations.

RESULTS

Table 1 shows the number of adults of *M. domestica* obtained from larvae growth in a chicken manure substratum mixed with 1.6, 4.5 and 10 ppm MTP, adults emergence percentages and the efficacy of MTP per each concentration used.

Table 2 shows the number of adults of *M. domestica* obtained from larvae growth in manure from chickens fed with treated feed mixed with 1.6, 4.5 and 10 ppm MTP, adults emergence percentages and the efficacy of MTP per each concentration used.

DISCUSSION

The efficacy of MTP in test 1 was similar in concentrations of 1.625 ppm and 4.5 ppm; and higher than 50%; whereas a 77.1% of efficacy was obtained with 10 ppm .

The efficacy of MTP in test 2 was 83.7% with 10 ppm, however, in lower concentrations, it could not be differentiated from the control efficacy.

The results obtained are similar to those of Adams et al (8) who detected a 77% decrease in adult emergence using 10 ppm.

Breeden et al (9) also obtained similar percentages, but with a subsequent increase of adults emergence probably due to the progressive loss of

Table 1: *Musca domestica* adults obtained from larvae growth in a chicken manure substratum (Test 1) mixed with 1.625, 4.5 and 10 ppm MTP.
Tabla 1: Adultos de *Musca domestica* obtenidos de larvas alimentadas en un sustrato de estiércol de gallina (Test 1) mezclado con 1.625, 4.5 y 10 ppm de MTP.

	0 ppm		1,625 ppm		4,5 ppm		10 ppm	
Assay	**eggs**	**adults**	**eggs**	**adults**	**eggs**	**Adults**	**eggs**	**Adults**
1	203	45	202	74	202	2	201	19
2	202	25	203	3	215	5	210	18
3	206	106	200	1	203	55	208	26
4	222	128	222	78	222	74	222	17
5	202	42	202	2	203	4	204	0
% emergence		33,4		15,4		13,4		7,7
% efficacy		**0[a]**		**54,1[b]**		**59,9[b]**		**77,1[c]**

Different supraindices indicate significant differences (P<0.05)
Diferentes supraíndices indican diferencias significativas (P<0.05)

TABLE 2: *Musca domestica* adults obtained from larvae growth in manure from chickens fed with treated feed (Test 2) mixed with 1.6, 4.5 and 10 ppm MTP.
TABLA 2: Adultos de *Musca domestica* obtenidos de larvas alimentadas sobre estiércol de gallinas engordadas con alimento balanceado mezclado con 1.625, 4.5 y 10 ppm de MTP.

	0 ppm		1,625 ppm		4,5 ppm		10 ppm	
Assay	**Eggs**	**Adults**	**eggs**	**adults**	**eggs**	**Adults**	**eggs**	**adults**
1	201	12	203	70	200	24	200	8
2	204	65	147	52	111	86	201	19
3	110	26	58	58	109	34	101	8
4	104	76	110	0	157	1	100	0
5	115	46	103	0	101	65	100	0
% emergence		30,7		29,0		31,0		5,0
% efficacy		**0[a]**		**5,4[a]**		**0[a]**		**83,7[b]**

Different supraindices indicate significant differences (P<0.05)
Diferentes supraíndices indican diferencias significativas (P<0.05)

the effect, which may correspond to the lengthy use with an induction of resistance.

In Argentina, Crespo et al (2) demonstrated how the integrated use of adulticides and larvicides, as well as the biological control added to adequate handling measures, were the most efficient control of Muscidae in commercial caged-layer houses.

In our work, the efficacy of treatments at doses lower than 10 ppm MTP was variable, either used as chickens feed additive or when it was directly added to larvae growth substratum. The result variance became more noticeable in test 2 since the distribution in feed, the process of ingestion and the digestive transit constitute sources of variance of the final concentration.

MTP should be used at the highest doses and integrated with other control methods in order to improve the results and avoid the induction of resistance, which would reduce its useful life in the market.

ACKNOWLEDGMENTS

This work was partially supported by Protegram S.A. and CONICET/Argentina.

REFERENCES

1. De Queiroz SMP, De Carvalho CJB. Chave pictórica e descrições de larvas de 3° instar de *Diptera* (Calliphoridae, Muscidae e Fanniidae) em vazadouros de resíduos sólidos domésticos em Curitiba, Paraná. An Soc Entomol Brasil 1987; 16: 265-288

2. Crespo CD, Lecuona RE, Hogsette, JA. Biological control: an important component in integrated management of *Musca domestica* (Diptera: Muscidae) in caged-layer poultry houses in Buenos Aires, Argentina. Biological Control 1998; 13: 16-24

3. Farkas R, Hogsette JA. Current and prospective control possibilities of Filth-breeding flies in livestock and poultry production, in Papp L. and Darvas B. Eds, Manual of Paleartic Diptera, vol 1 General and Applied Dipterology. Science Herald, Budapest, 2000; p. 889-904

4. Downing AS, Wright CG, Farroier MH. Population growth of *Dermatophagoides farinae* Huges (Acari: Epidermoptidae) suppressed by methoprene and hidroprene. J Med Entomol 1993; 30: 531-536

5. Kawada H, Hirano M. Insecticidal effects of the insects growth regulators Methoprene and Pyriproxyfen on the cat flea (Siphonaptera: Pulicidae). J Med Entomol 1996; 33: 819-822

6. Baruah I, Das SC. Evaluation of Methoprene (Altosid) and Diflubenzuron (Dimilin) for control of mosquito breeding in Tezpur (Assam). Indian J Malariol 1996; 330: 61-66

7. Kline DL. Small plot evaluation of a sustained-releases sand granule formulation of methoprene (SAN 810 I-1,3 gr) form control of *Aedes taeniorhynchus*. J Am Mosq Control Assoc 1993; 9:155-157

8. Adams AW, Jackson ME, Pitts CW. A feed additive to control flies in poultry manure. Poult Sci 1976; 55: 2001-2003

9. Breeden GC, Turner EC, Beane WL, Miller RW, Pickens LC. The effect of Methoprene as a feed additive on house fly emergence in poultry houses. Poult Sci 1981; 60: 556-562

10. Sokal RR, Rohlf FJ. Biometry: the principles and practice of statistics in biological research. 2nd Ed. W.H. Freeman and Company. San Francisco (E.U.A), 1981; 859 pp.