RESIDUAL ACTIVITY OF CYHALOTHRIN 20% EC ON CATTLE AS DETERMINED BY MOSQUITO BIOASSAYS

I Vythilingam,[1] Ridhawati,[2] RA Sani[3] and K Inder Singh[1]

[1] Institute for Medical Research, Jalan Pahang, Kuala Lumpur; [2] Department of Parasitology, University of Indonesia; [3] Department of Pathology and Microbiology, University Pertanian, Malaysia

Abstract. The residual effectiveness of 0.005mg/ml of cyhalothrin applied to cattle was determined against three species of mosquitos: *Anopheles maculatus* Theobald. *Anopheles dirus* Peyton and Harrison *Mansonia uniformis* Theobald. Twenty-four hour post exposure mortality and the degree of successful blood engorgement were determined by exposing mosquitos for 10 minutes to cattle. Three replicated assays were conducted and mortality determined at 1, 2, 7, 14 and 21 days after each treatment. An initial mortality of 92 - 94% for *An. dirus* and *Ma. uniformis* and 79% for *An. maculatus* was obtained. Percentage mortality declined to 10%, 18% and 31% for *An. maculatus, An. dirus* and *Ma. uniformis* respectively on day 7 post application. On day 21 post application, percentage mortality was 2 - 3% for the three species of mosquitos.

INTRODUCTION

Vector-borne diseases still remain a serious public health problem in many developing coun tries. Of these malaria and filariasis still persist in many parts of the rural areas in Malaysia. Thus, the effective control of vectors of these diseases is urgently needed.

Mosquito pupulations are routinely combated by adulticidal application of insecticides. Such procedures, although effectively reducing the frequency of biting attacks on humans, fail to provide lasting protection from continuously developing mosquito populations (McLaughlin *et al,* 1989). Some species of mosquitos like *Anopheles maculatus, An. dirus* and *Mansonia uniformis* aggregate near cattle herds, because they are attracted more to cattle than man (Prakash and Musoiny, 1974; Reid, 1968; Rubis *et al,* 1981; Samarawickrema, 1968). *An. maculatus* is the main vector of malaria in Peninsular Malaysia (Loong *et al,* 1990), *An. dirus* is the main vector of malaria in Thailand (Harinasuta, 1984), whereas *Ma. uniformis* is an important vector of filariasis caused by *Brugia malayi* (WHO 1984; Wharton, 1978; Das, 1976).

Proposed integrated management strategies against these mosquitos have included the suggestion that cattle could be used as the focal point of adulticidal actions, because these species prefer cattle as its primary host. Since mosquitos require a blood meal to become fully fecund, residual treatment of host animals might furnish an opportunity to kill the mosquitos prior to oviposition.

The chemical adulticides with relatively long persistence that are registered for use on cattle are synthetic pyrethroids. One of these that is reported to be highly active is cyhalothrin. This chemical incorporates a cyano group in 3-phenoxybenzyl esters which is associated with an in creased insecticidal activity (Zerba, 1988; Elliot, 1976).

The objectives of the present study were to determine the duration of residual activity of cyhalothrin on cattle by bioassay with caged *An. maculatus, An. dirus* and *Ma. uniformis* and to determine the effect of cattle treatment on mosquito blood feeding.

MATERIALS AND METHODS

The experiments were carried out on the farm of the University Pertanian Malaysia, Serdang from May to July 1992. Three Jersey calves were used for testing, two for treatment and one for control. The age of these calves were about 3 months when the test started.

The insecticide used in this study was cyhalothrin 20% EC. PP 563 (Grenade®). This is formu-

lated as an emulsifiable concentrate. One ml of cyhalothrin 20% EC was diluted in 4,000 ml of water giving a final working concentration of 0.005 mg/ml of cyhalothrin in water. The insecticide solution was sprayed on the entire calves until run off, using knapsack sprayer. The control calf was sprayed with water using the same procedure.

The bioassay consisted of exposure of unfed 2 - 5 day old female mosquitos. *An. maculatus* (Pos Betau, Pahang strain) and *An. dirus* (Perlis strain) used in this study were from the colony maintained in the insectary of the Institute for Medical Research, Kuala Lumpur, Malaysia. *Ma. uniformis* were collected from Batang Berjuntai, Selangor, which is about 60 km from Kuala Lumpur.

The day before testing, female mosquitos were transferred to exposure cups covered with cotton net. Each cup contained 10 - 15 mosquitos and they were exposed to the top and side areas of the calf. Four exposure cups for each species were placed on each animal. Two near the line on the upper curvature area (top) and two along the belly (side) for ten minutes. Exposure times were fixed for 10 minutes since it has been a standard time fixed by other workers. The calves were tethered to a post during the mosquito exposure period.

After assay on the calves the mosquitos were transferred to paper cups and mortality readings were recorded 24 hours later. Tests were carried out on days 1, 2, 7, 14 and 21 after spraying. Replicated applications were made on 5th May, 2nd June and 1st July 1992. The calves were kept in cattle sheds throughout the study.

RESULTS

Table 1 shows the mortality rate of the three different species of mosquitos after treatment. *Ma. uniformis* and *An. dirus* had high mortality rates on days 1 and 2 after treatment (more than 90%). While *An. maculatus* had a mortality of 79% on day 1 and 69% on day 2. After 7 days of treatment, the efficacy of insecticide dropped

Table 1

Mean percentage mortality (± SE) of three sepecies of mosquitos exposed to cattle treated with cyhalothrin. Data are the average percentage mortality of 3 replicates, 4 cages per animal, 2 animals each treatment, with an average of 15 mosquitos per cage, for assays conducted at the indicated number of days post applications.

Days post application	Area	Percentage mortality ± SE		
		An. maculatus	*An. dirus*	*Ma. uniformis*
1	Top	75 ± 17.1	96 ± 8.6	90 ± 15.2
	Side	84 ± 0.6	93 ± 8.5	98 ± 0
	Mean	80 ± 4.6	95 ± 1.3	95 ± 5
2	Top	72 ± 26.4	93 ± 8.9	96 ± 6.7
	Side	68 ± 23.5	93 ± 9.1	91 ± 10.1
	Mean	70 ± 2.1	93 ± 0.4	93 ± 2.8
7	Top	9 ± 13.2	15 ± 23.6	39 ± 32.3
	Side	13 ± 18.3	22 ± 33.9	25 ± 28.8
	Mean	11 ± 1.7	18 ± 3.3	31 ± 3.8
14	Top	13 ± 23	10 ± 14.7	24 ± 28.2
	Side	13 ± 8.8	3.8 ± 7	22 ± 34.4
	Mean	13 ± 0.4	7 ± 3.1	23 ± 0.8
21	Top	5 ± 6.5	9 ± 11.1	3 ± 7.5
	Side	1 ± 2.8	8 ± 8.3	3 ± 4.3
	Mean	3 ± 2.1	9 ± 0.4	3 ± 0.4

In all tests on the control animals the mortality was less than 5%.

rapidly and was virtually non-effective on day 21. No significant difference was observed between the side and the top areas of the cattle ($p > 0.05$).

As shown in Fig 1 *An. maculatus* had the lowest initial mortality, and *Ma. uniformis* the highest overall. There was significant difference observed between *An. maculatus* and *Ma. uniformis* and also between *An. maculatus* and *An. dirus* ($p < 0.05$), whereas between *An. dirus* and *Ma. uniformis* there was no significant difference statistically ($p > 0.05$).

Fig 2 shows that the percentage engorgment of *Ma. uniformis* was significantly greater than *An. maculatus* and *An. dirus* in treated calves ($p < 0.01$). The percentage engorgement of three species of mosquitos from treated calves were significantly lower than control except for *Ma. uniformis* on day 21, there was no significant difference ($p > 0.05$).

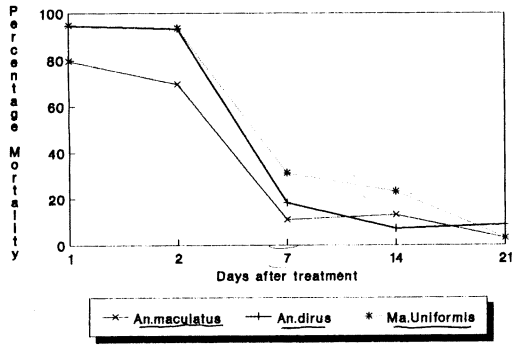
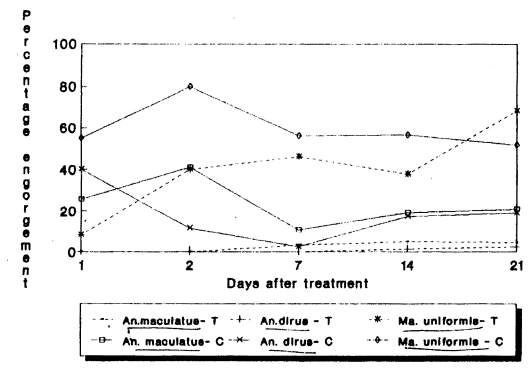


Fig 1—Percentage mortality of three species of mosquitos exposd to cattle treated with cyhalothrin at 0.005 mg/ml.



T- treated, C- control

Fig 2—Percentage engorgement of mosquitos on cattle treated with cyhalothrin at 0.005 mg/ml and on control cattle.

DISCUSSION

The results obtained in this study are similar to those obtained by McLaughlin *et al* (1989) who worked with *An. quadrimaculatus* Say. Studies carried out by Semanchuck *et al* (1991) on evaluation of permethrin (a synthetic pyrethroid) for protection of cattle against mosquitos showed that cattle treated with 100 ml of permethrin in 5.0 g/l of water gave protection from mosquitos for at least 72 hours. However, the dosages used in their study was much higher than that used in this study. Perhaps with higher dosage cyhalothrin would have given protection over a longer period. Since this was the first study of its kind conducted here it was decided that the dosage used by the farmers will be followed for this study.

Ewald (1987) studied the efficacy of synthetic pyrethroids in the control of diptera on grazing cattle and found that cyhalothrin (0.2 g per animal), permethrin (1 g per animal) and cypermethrin (0.5 g per animal) protected animals for 4 - 5 weeks. Sparks and Biford (1988) reported that combination of cyhalothrin with PB (piperonyl butoxide) or DET (SSS tributyl phosphorotrithionate) yielded 1.4 - 1.6 fold synergism, and resulted in a decreased level of resistance amongst the fly population on cattle. Perhaps the combination of cyhalothrin with a synergist in this study would have given a longer period of protection.

There was no difference in mortality between mosquitos tested on the top and side areas of the calves. This may be due to usage of an EC formulation. McLaughlin *et al* (1989) conducted comparative studies between an EC formulation and oil formulation and reported a progressively downward migration of the oil formulation as evidence by adherence of dirt and a generally oily sheen to the hair. Their data from assay of the oil formulation at 2 and 3 weeks showed that mortality was greater on the lower parts of the animals than on the upper parts.

Cyhalothrin, like other synthetic pyrethroids, has been reported to be contact toxicant that causes rapid irritation to insects (Shemanchuck, 1981). In this study mosquitos attempted to feed but quickly returned to the walls of the cups after

tarsal contact with hair. The degree of this reaction varied with time post application. The average percentage engorgement of the three species of mosquitos on treated calves was significantly lower than on a control calf. These results are in agreement with those of Nasci *et al* (1990) and Focks *et al* (1991) who reported that treatment of cattle with insecticide will reduce blood feeding effectively.

The percentage engorgement of *An. maculatus* and *An. dirus* was lower than that of *Ma. uniformis* both in treated and control calves. This might be due to the fact that *Ma. uniformis* are more attracted to cattle. Samarawickrema (1968), in comparative trapping experiments found that man: calf ratio for *Ma. uniformis* to be 1: 49.6. However in Peninsular Malaysia and Sabah this species appears to be less attracted to cattle than in Sri Lanka, the ratio being 1:2.8 (Chiang, 1991). For *An. maculatus* Loong *et al* (1990) reported that the preference for man to cattle is 1:2 in Pos Betau, Malaysia. These indicate the primary zoophagic nature of these Anophelines.

Another important factor to be considered is the repellent effect of cyhalothrin. Further studies have to be carried out to determine if cyhalothrin has a repellent effect on mosquitos.

This trial suggests that *Ma. uniformis* may be controlled if cattle can be sprayed with cyhalothrin or other suitable insecticides. Further experiment have to be carried out in order to determine if there will be a reduction in the wild population of *Mansonia* in areas where cattle have been treated with suitable insecticides. This will determine whether host management (*ie* insecticide application to cattle) has potential as a control method for *Mansonia.*

ACKNOWLEDGEMENTS

The authors wish to thank Dato Dr M Jegathesan, Director, Institute for Medical Research for his permission to publish this paper, Dr Daljeet Singh and staff of Farm in University Pertanian Malaysia for assisting us during the study on the farm, Dr Loges of Pitman Moore for the supply of cyhalothrin, and staff of the Animal Entomology Division, IMR, for their technical assistance. This project was partially funded by SEAMEO TROPMED.

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