RESIDUAL EFFICACY OF DELTAMETHRIN 2.5 WP (K-OTHRIN) SPRAYED ON DIFFERENT TYPES OF SURFACES AGAINST MALARIA VECTOR *ANOPHELES CULICIFACIES*

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Abstract. Residual efficacy of deltamethrin 2.5 wp on various types of surfaces was tested against *Anopheles culicifacies* under field conditions using WHO standard procedure. Deltamethrin was most effective on the thatched surface and produced 100% mortality of *An. culicifacies* adults up to 12 weeks, even when exposed at the lowest dose @12.5 mg/m^2. It was least effective on brick surface and 100% mortality was observed only for three weeks. The efficacy was observed for 8 and 7 weeks on mud and cement surfaces, respectively. However, at the higher rate of application, *ie* 25 mg/m^2, 100% mortality of this species was obtained for 12, 10, 9 and 12 weeks on mud, cement, brick and thatch surfaces, respectively.

INTRODUCTION

Anopheles culicifacies, a principal vector of malaria is responsible for 70-80% transmission in northern plain areas of India. The species has become resistant to DDT and HCH in most parts of the country and also to malathion in Maharashtra and Gujarat states (Sharma, 1983). In view of environmental hazards and wide-spread resistance to DDT and HCH, synthetic pyrethroids have been developed for control of malaria vectors in different ways under different situations (Sharma *et al*, 1989; Jana Kara *et al*, 1995; Ansari and Kapoor, 1996). They are environmentally safe due to photodegradability and low mammalian toxicity. They have broad spectrum activities against variety of domestic pests (Jana Kara *et al*, 1995). Results of field trials carried out so far have clearly demonstrated the residual efficacy of pyrethroids in controlling indoor resting populations of malaria vectors and the disease (Rajavel *et al*, 1986; Ansari *et al*, 1990; Mariappan *et al*, 1985). However, the residual efficacy and persistence of insecticide varied on different types of surface material used in construction of houses in rural areas (Das and Kalyan Sundaram, 1984). It was, therefore, considered desirable to determine the residual efficacy of 2.5% WP deltamethrin against *An. culicifacies* on various surfaces before commencing indoor residual spraying in rural area of Ghaziabad district in Northern India).

MATERIALS AND METHODS

Deltamethrin 2.5 WP (K-othrin), a synthetic pyrethroid was supplied by M/s Roussel Pharmaceuticals (India) Ltd. The study was undertaken during 1987-1988 in three villages of Razapur PHC in Ghaziabad District, UP during monsoons and post-monsoon months (July to October). K-othrin was sprayed in three different doses to determine its impact on malaria transmission. The residual efficacy was determined on various surfaces, namely, mud, cement, brick and thatched roofs, using bioassay tests as per WHO standard procedure. Field collected full-fed female *An. culicifacies* from unsprayed areas were used for bioassay. Weekly bioassays were carried out on four types of surfaces and at three different application rates of deltamethrin. The bioassay tests were conducted by fixing plastic cones to the surface. Fifteen blood fed mosquitos were introduced in each cone and the knock down time (in minutes) was observed. On complete knock down (maximum time observed upto 60 minutes) mosquitos were taken out with the help of an aspirator and kept in the holding tube for recovery upto 24 hours at 28°C and 80% RH. Mortality was recorded in each holding tube after 24 hours. The weekly bioassays were continued for atleast 12 weeks and corrected mortality was calculated using Abbot's formula.

RESULTS AND DISCUSSION

Residual effects of deltamethrin on various surfaces, and at different application rates against *An. culicifacies* are summarized in Table 1. The efficacy of deltamethrin was variable. Deltamethrin 2.5 WP was most effective on thatched surfaces, where it produced 100% mortality in exposed adult *An. culicifacies* upto 12 weeks of observation even at the lowest dose of 12.5 mg/m². It was least

Table 1

Knock-down effect and mortality of *An. culicifacies* exposed to deltamethrin sprayed surfaces.

Surface	Dose (mg/m²)	Residual efficacy after 1 hour exposure in weeks					
		50% mortality		90% mortality		100% mortality	
		Knock-down	After 24 hour recovery	Knock-down	After 24 hour recovery	Knock-down	After 24 hour recovery
Mud	12.5	11	12	7	8	5	8
Cement		8	11	7	7	7	7
Brick		11	11	3	6	1	3
Thatch		12	12	7	12	7	12
Mud	20	12	12	12	12	12	12
Cement		12	12	11	11	9	11
Brick		12	12	10	10	10	10
Thatch		12	12	11	12	9	12
Mud	25	12	12	12	12	12	12
Cement		12	12	9	10	8	10
Brick		12	12	8	9	8	9
Thatch		12	12	11	12	11	12

The bioassay tests were conducted as per WHO standard procedure using full fed.
Female mosquitos: The tests were conducted only upto 12 weeks.

Table 2

Residual efficacy of deltamethrin against *An. culicifacies* sprayed on different surfaces.

Type of surface	Dose (mg/m²)	Percent mortality successive weeks												
		0	1	2	3	4	5	6	7	8	9	10	11	12
Mud	12.5	100	100	100	100	100	95	100	100	100	87.5	87.5	75	55
Cement		100	100	100	100	100	100	100	100	87.5	75	62.5	62.5	33
Brick		100	100	100	100	95	90	90	80	87.5	62.5	62.5	62.5	33
Thatch		100	100	100	100	100	100	100	100	100	87.5	100	100	100
Mud	20	100	100	100	100	100	100	100	100	100	100	100	100	100
Cement		100	100	100	100	100	100	100	100	100	100	87.5	100	87.5
Brick		100	100	100	100	100	100	100	100	100	100	100	87.5	87.5
Thatch		100	100	100	100	100	100	100	100	100	100	100	100	100
Mud	25	100	100	100	100	100	-	100	-	100	100	100	100	100
Cement		100	100	100	100	100	100	100	100	100	100	100	87.5	95
Brick		100	100	100	100	100	100	100	100	100	100	87.5	87.5	95
Thatch		100	100	100	100	100	-	100	-	100	100	100	100	100

effective on brick surfaces at similar dosage as 100% mortality was obtained only for 3 weeks. However, at 20 and 25 mg/m² the residual effect (100% mortality) was evident for 9 to 10 weeks. The residual effect at 12.5 mg/m² on mud and cement surfaces lasted for 8 and 7 weeks, respectively. The residual effect at 20 and 25 mg/m² on mud and cement surfaces lasted for 12 and 11 weeks, and 12 and 10 weeks, respectively.

Table 2 gives the percent mortality of *An. culicifacies* after 24 hours recovery period in successive weeks, when exposed to three different concentrations of deltamethrin on various surfaces. Deltamethrin 12.5 mg/m² has produced 100% mortality in *An. culicifacies* for 8, 7, 3 and 12 weeks, respectively on mud, cement, brick and thatch surfaces. The percent mortality on mud, cement, brick and thatch surfaces was 55%, 33%, 33% and 100%, respectively after 12 weeks. Deltamethrin, 20 mg/m², produced 100% mortality in *An. culicifacies* on these surfaces for 12, 11, 10 and 12 weeks, respectively. After 12 weeks the percent mortality against cement and brick surfaces was 87.5%. At the highest rate of application of deltamethrin (25 mg/m²), 100% mortality on these surfaces was obtained for 12, 10, 9 and 12 weeks, respectively. The percent mortality on cement and brick surfaces

Table 3

Residual efficacy of deltamethrin against *An. culicifacies* sprayed on different surfaces.

Type of surface	Dose (mg/m²)	Percent knock-down (week)												
		0	1	2	3	4	5	6	7	8	9	10	11	12
Mud	12.5	100	100	100	100	100	100	85	95	80	40	80	50	0
		(12)	(2)	(40)	(45)	(50)	(50)	(60)	(60)	(60)	(60)	(60)	(60)	(60)
Cement		100	100	100	100	100	100	90	100	60	40	35	50	0
		(15)	(25)	(45)	(40)	(50)	(50)	(60)	(60)	(60)	(60)	(60)	(60)	(60)
Brick		100	100	80	90	85	80	55	50	70	60	40	50	0
		(20)	(45)	(60)	(60)	(60)	(60)	(60)	(60)	(60)	(60)	(60)	(60)	(60)
Thatch		100	100	100	100	100	100	80	100	70	80	70	90	50
		(15)	(20)	(40)	(50)	(50)	(55)	(60)	(60)	(60)	(60)	(60)	(60)	(60)
Mud	20	100	100	100	100	100	100	100	100	100	100	100	100	100
		(10)	(15)	(25)	(25)	(30)	(30)	(35)	(35)	(45)	(60)	(60)	(60)	(60)
Cement		100	100	100	100	100	100	100	100	100	100	80	90	60
		(10)	(25)	(30)	(35)	(35)	(35)	(40)	(45)	(45)	(60)	(60)	(60)	(60)
Brick		100	100	100	100	100	100	100	100	100	100	100	80	80
		(12)	(30)	(35)	(35)	(35)	(35)	(35)	(45)	(50)	(60)	(60)	(60)	(60)
Thatch		100	100	100	100	100	100	100	100	100	100	80	90	60
		(10)	(15)	(25)	(25)	(30)	(35)	(35)	(50)	(55)	(60)	(60)	(60)	(60)
Mud	25	100	100	100	100	100	-	100	-	100	90	100	100	100
		(7)	(10)	(25)	(25)	(30)	-	(40)	-	(45)	(60)	(60)	(60)	(60)
Cement		100	100	100	100	100	100	100	100	100	90	55	60	80
		(10)	(20)	(25)	(25)	(35)	(35)	(40)	(45)	(45)	(60)	(60)	(60)	(60)
Brick		100	100	100	100	100	100	100	100	100	80	80	80	55
		(10)	(20)	(25)	(25)	(35)	(35)	(35)	(45)	(45)	(60)	(60)	(60)	(60)
Thatch		100	100	100	100	100	-	100	-	90	90	85	100	80
		(10)	(15)	(25)	(25)	(30)	-	(35)	-	(60)	(60)	(60)	(60)	(60)

Figures in parenthesis indicate time in minutes.

after 12 weeks was 95%.

Table 3 shows duration of 100% knock-down (in minutes) of *An. culicifacies*, when exposed to three different doses, on different surfaces in successive weeks. Deltamethrin 12.5 mg/m^2 produced 100% knock-down in exposed adults on mud, cement, brick and thatch for 5, 5, 2 and 7 weeks, respectively. The knock-down time at 12.5 mg/m^2 on 1st day was 12, 15, 20 and 15 minutes on mud, cement, brick and thatched surfaces, respectively, which increased gradually in successive weeks. After 12 weeks only 0, 0, 0 and 50% knock-down effect was observed within 60 minutes of exposure on four types of surfaces. At 20 and 25 mg/m^2 doses, 100% knock-down on 4 types of surfaces lasted for 12, 9, 10 and 9 weeks and 12, 8, 8 and 6 weeks, respectively.

The present study has clearly shown that the residual efficacy of even the same dose of deltamethrin varies when sprayed on different types of surfaces. Among various surfaces examined in the present study, thatched surfaces produced the longest duration of the residual effect followed by mud, cement and brick surfaces. The residual effect of deltamethrin, like any other insecticides, depends on the nature of the treated surface and the type of formulation used. Some surfaces like wood, straw, glass, thatch, metal, which are smooth and do not absorb insecticide particles produce longer duration of residual effect, while others such as brick, cement and those coated with lime (highly alkaline surfaces) absorb and thus result in a shorter duration of residual effect.

Besides the type of treated surface, the residual effect of deltamethrin also depended on the rate of application. Higher doses of deltamethrin produced longer duration of residual effect. This was evident when the dose was increased from 12.5 to 20 mg/m^2, but not much difference was observed between 20 and 25 mg/m^2 doses, indicating a threshold level of the dose is required for maximum effect beyond which efficacy is not affected. Earlier workers have reported the residual effect of deltamethrin up to 20 weeks on thatched surfaces against *Culex quinquefasciatus, An. stephensi* and *Aedes aegypti* at 50 mg/m^2 dosage (Das and Kalyan Sundaram, 1984). However, the effect on cement surface lasted for 3, 0 and 3 weeks only against these species. The present study has revealed that deltamethrin sprayed at the rate of 20 mg/m^2 on various surfaces can produce effective control (100% mortality) of *An. culicifacies* for 9 to 12 weeks.

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