1.5 Current status of insecticide resistance among mosquito vectors in Rajasthan State - a collaborative study

Principal Investigator(s) : *Dr. Karam V. Singh, Scientist 'F', DMRC and Additional Director, DM&HS, Govt. of Rajasthan, Jaipur*

Co- Principal Investigator(s): *Entomologist, DM&HS, GOR, Jaipur*
Collaborators: *1. Dr. Aarti Prasad, Head, Zoology Department, MLS Univ., Udaipur*
2. Prof. N. P. Singh, Department of Zoology, Rajasthan Univ., Jaipur

Commencement: April 1, 2014 **Duration:** Three Years **Status:** Ongoing
Funding Agency: Desert Medicine Research Centre, Jodhpur (Intra-mural)

OBJECTIVES

1. To determine the current status of insecticide resistance against the compounds being used under national control programme for adults and larval forms in the state,
2. To determine the biochemical mechanisms involved in the development of insecticide resistance among vectors in view to elucidate cross-resistance and develop resistance management strategies

PROGRESS

To determine the current insecticide resistance status of mosquito vector species during the report period the studies have been carried-out in 04 districts *viz.*, Banswara, Barmer, Jaisalmer and Jodhpur. In each district, as per project protocol, two PHCs having high malaria incidence were to be selected and in each PHC two villages, again on the basis of malaria cases reported during previous year. In Banswara district the studies were conducted in four villages i.e. Bhagora, Kheda, Potalia and Kotda, in Jaisalmer district in four villages i.e. Away, Sakaria, Jhalaria and Mandwa, in Barmer district in two villages i.e. Jasol and Korna and in Jodhpur district only in one village i.e. Narwa. The mosquito collection was done during dawn hours using sucking tube method. The collected anopheline mosquitoes were stored in Burraud cages and transported to the laboratory for conducting the experiments. The tests for determining the insecticide resistance were conducted as per the standard WHO method. The tests were conducted against four insecticides i.e. DDT, Malathion, Alpha-cypermethrin and Cyfluthrin, which are being used under national malaria control programme. The insecticide susceptibility tests were conducted on three malaria vector species *viz., Anopheles annularis, An. culicifacies* and *An. stephensi* collected from the study districts (Tables 1 & 2).

In Jaisalmer district, the experiments were conducted with *An. culicifacies* in villages Away and Sakaria against DDT and the species was found susceptible (MORTALITY: 100.0%) and intermediate resistant (MORTALITY: 80.0%) respectively (Table 1). In villages Jhalaria and Mandwa the susceptibility tests were conducted with *An. stephensi* against DDT, Alpha-cypermethrin and Cyfluthrin and the species was found intermediate resistant (IR) to DDT however, against Alpha-cypermethrin and Cyfluthrin it was found susceptible (MORTALITY: 100.0%).

Table 1. Susceptibility status of malaria vector species collected from desert districts against insecticides being used under national programme

District	Name of Village	Mosquito Species	Insecticide tested with diagnostic dose	Percent Mortality (%)	Susceptibility Status*
Jaisalmer	Awai	*An. culicifacies*	DDT - 4.0%	80.0	IR
	Madasar	*An. Culicifacies*	DDT - 4.0%	94.4	IR
	Jhalaria	*An. Stephensi*	DDT – 4.0%	90.0	IR
			Alpha-cypermethrin-0.05%	100.0	S
	Mandwa	*An. Stephensi*	DDT – 4.0%	80.0	IR
			Alpha-cypermethrin-0.05%	100.0	S
			Cyfluthrin – 0.15%	100.0	S
Barmer	Jasol	*An. Stephensi*	DDT – 4.0%	46.7	R
			Alpha-cypermethrin-0.05%	100.0	S
			Cyfluthrin – 0.15%	100.0	S
			Permethrin – 0.75%	100.0	S
	Korna	*An. Stephensi*	DDT – 4.0%	80.0	IR
			Alpha-cypermethrin-0.05%	100.0	S
			Cyfluthrin – 0.15%	100.0	S
			Permethrin - 0.75%	100.0	S
Jodhpur	Narwa	*An. Stephensi*	DDT - 4.0%	60.0	R
			Alpha-cypermethrin-0.05%	90.0	IR
			Cyfluthrin – 0.15%	100.0	S
			Permethrin - 0.75%	90.0	IR

*S- Susceptible, IR- Intermediate Resistance, R- Resistant

In Barmer district the studies were conducted in two villages i.e. Jasol and Korna and in both the villages *An. stephensi* was tested against four insecticides *viz*., DDT, Alpha-cypermethrin, Cyfluthrin and Permethrin and the results of the experiments revealed that the species is resistant or intermediate resistant to DDT in Jasol and Korna villages respectively (MORTALITIES: 46.7 & 80.0%) and susceptible to Alpha-cypermethrin, Cyfluthrin and Permethrin (MORTALITIES: 100.0%).

In Jodhpur district the studies could be conducted only in one village i.e. Narwa, where the *An. stephensi* was tested against test insecticides and the results of the experiments revealed that the species is resistant to DDT and susceptible (MORTALITY: 100.0%) to Alpha-cypermethrin, Cyfluthrin and Permethrin (Table 1).

Table 2. Susceptibility status of malaria vector species collected from non-desert district against insecticides being used under national programme

District	Name of Village	Mosquito Species	Insecticide tested with diagnostic dose	Percent Mortality (%)	Susceptibility Status*
Banswara	Bhagora	*An. Culicifacies*	DDT - 4.0%	48.0	R
			Malathion - 5.0%	80.0	IR
			Alpha-cypermethrin-0.05%	100.0	S
			Cyfluthrin - 0.15%	100.0	S
		An. Annularis	DDT - 4.0%	46.7	R
			Malathion - 5.0%	84.4	IR
			Alpha-cypermethrin-0.05%	100.0	S
			Cyfluthrin - 0.15%	100.0	S
	Kheda	*An. Culicifacies*	DDT - 4.0%	100.0	S
		An. Annularis	DDT - 4.0%	70.0	R
			Alpha-cypermethrin-0.05%	100.0	S
		An. Stephensi	Alpha-cypermethrin-0.05%	100.0	S
	Potalia	*An. Culicifacies*	DDT - 4.0%	55.0	R
			Malathion - 5.0%	60.0	R
			Alpha-cypermethrin-0.05%	100.0	S
			Cyfluthrin - 0.15%	100.0	S
		An. Annularis	DDT - 4.0%	40.0	R
			Malathion - 5.0%	85.0	IR
			Alpha-cypermethrin-0.05%	100.0	S
			Cyfluthrin - 0.15%	100.0	S
	Kotada	*An. Culicifacies*	DDT - 4.0%	91.4	IR
			Malathion - 5.0%	100.0	S
			Alpha-cypermethrin-0.05%	100.0	S
			Cyfluthrin - 0.15%	100.0	S

*S- Susceptible, IR- Intermediate Resistance, R- Resistant

In Banswara district from four villages three vector species were tested against diagnostic doses of DDT, Malathion, Alpha-cypermethrin and Cyfluthrin and the results revealed that *An. culicifacies* is resistant and intermediate resistant against both DDT (Susceptible in Kheda village) and Malathion, however, against Alpha-cypermethrin and Cyfluthrin, the species was found susceptible. *An. annularis* in this district, against DDT and Malathion, was found resistant against DDT but against Malathion, resistant and intermediate resistant in one village each (Table 2). *An. stephensi* against Alpha-cypermethrin was found susceptible (MORTALITY: 100.0%).