

A report on the susceptibility status of *Anopheles minimus* (Theobald) against DDT and deltamethrin in three districts of Assam

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Laboratory bioassays were carried out to study the susceptibility status of *Anopheles minimus* the major vector of malaria in three districts of Assam—Sonitpur, Darrang and Kamrup against the commonly used insecticide DDT (for indoor residual spray) and deltamethrin used for treating the bednets. WHO standard technique was followed for the test using insecticide impregnated papers supplied by them. It was revealed in the study that the species is still susceptible to DDT (4% x 1 hour) as 97.5, 98.3 and 96.3% mortality was observed in the tests carried out with mosquitoes collected from the field of Districts Sonitpur, Darrang and Kamrup respectively. Against deltamethrin (0.05% x 1 hour) 100% mortality was observed in *An. minimus* in all the three districts.

Since the inception of National Malaria Control Programme (NMCP) in early 1950's later during National Malaria Eradication Programme (NMEP) and Modified Plan of Operation (MPO), Assam state is regularly under two rounds of indoor residual spray (IRS) with DDT¹.

At the beginning, residual spray of DDT had a tremendous impact on the principal malaria vector *An.*

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minimus. As a result this species was reported to have disappeared from Assam¹. There were similar reports from the other states of northeastern part of India during early 1970's^{2–7}. But this was short-lived as the species reappeared in the area and was incriminated in the foothills of Nagaland during 1982^{8–9} and later in different parts of Assam¹⁰.

The Assam state including the three study districts is under two rounds of residual spray of DDT @ 1 g/m² for the control of *An. minimus* vis-a-vis malaria¹. Insecticide treated bednets (ITBNs) were introduced by the National Anti Malaria Programme (NAMP) now known as National Vector Borne Diseases Control Programme (NVBDCP), during 2000–2001 in the state to control malaria in few high risk areas of the state¹¹. For treating these bednets synthetic pyrethroids — deltamethrin 2.5% SC @ 25 mg/m² and cyfluthrin 5% SC @ 50 mg/m² have been used. There were no reports available on the susceptibility status of *An. minimus* to these insecticides from the study areas. The latest report on the susceptibility status of the species in Assam is from District Nagaon, PHC Jakhalabandha, during the year 1996, where this species was reported to be completely susceptible to DDT, dieldrin and malathion¹². This report provides

the present susceptibility status of this vector to DDT and deltamethrin in the study areas.

The study was carried out in PHC Balipara, District Sonitpur; PHC Udalguri in District Darrang; and PHC Sonapur, District Kamrup during the months of March and April 2002. PHC Balipara is situated in the foothills of Arunachal Pradesh, whereas PHC Udalguri lies in the Indo-Bhutan border and foothills of Arunachal Pradesh and Sonapur in the foothills of Meghalaya.

Female *Anopheles* mosquitoes resting indoor in the human dwellings were collected during early hours of the day (0600–0930 hrs) by hand catch method using an aspirator and a flashlight¹³. In each PHC, collections were made from three high risk villages which were selected for the distribution of ITBN¹¹. Within an hour of collection, mosquitoes were brought to the field laboratory in a cloth cage covered by wet towel. These were identified to species using a standard key¹⁴ and *An. minimus* were used for the study. Susceptibility status to the insecticides was determined using the standard WHO method and kit¹⁵. Batches of 20–25 full-fed healthy females were introduced into different exposure tubes lined from inside with insecticide impregnated papers—DDT 4% and deltamethrin

0.05%. After one hour exposure mosquitoes were transferred to the holding tubes and kept for 24 h for observation (recovery period) with 10% glucose soaked pad for nutrition. Control experiments were run simultaneously. Mortality count was made after 24 h of recovery period. Since there was no mortality observed in any of the control replicates the Abbot's formula was not applied¹⁵. Tests were conducted at an ambient room temperature 27±1°C and relative humidity of 75–80%. A minimum of 2–3 replicates were exposed against the insecticides tested and two replicates for control.

The results of the study are presented in Table 1. *An. minimus*, the vector in this area showed 97.5, 98.3 and 96.3% mortality against DDT in PHCs Balipara, Udalguri and Sonapur respectively while it was completely susceptible to deltamethrin in all the study areas.

Bertram¹⁶ used DDT and gammexane for the first time in upper Assam to control the larvae of this species and found these to be very effective. Similar findings on susceptibility status of this species from Mikir hills (presently the Karbi Anglong district) during 1951¹⁷ and in 1958 from Tangla, Khairabari area, District Darrang¹⁸.

Table 1. Insecticide susceptibility status of *Anopheles minimus* to DDT and deltamethrin in districts Sonitpur, Darrang and Kamrup of Assam

District/ PHC	Insecticide (% impregnation)	No. of mosquitoes		% mortality
		No. exposed (Replicates)	No. dead (after 24 h)	
Sonitpur/ Balipara	DDT (4)	80 (4)	78	97.5
	Deltamethrin (0.05)	40 (2)	40	100
	Control	40 (2)	0	0
Darrang/ Udalguri	DDT (4)	60 (3)	59	98.3
	Deltamethrin (0.05)	40 (2)	40	100
	Control	40 (2)	0	0
Kamrup/ Sonapur	DDT (4)	80 (4)	77	96.3
	Deltamethrin (0.05)	60 (3)	60	100
	Control	40 (2)	0	0

In spite of the continued use of residual spray of DDT for almost five decades in the study areas DDT resistance has not precipitated in the principal malaria vector *An. minimus*. In these areas the cash crops such as sugarcane and areca nuts are cultivated sparsely. Paddy cultivation is prevalent with minimal or no use of pesticides. The cropping pattern thus does not involve increased input of pesticides. High susceptibility level to DDT in *An. minimus* in the present study in Assam indicated good efficacy of DDT in indoor residual spraying (IRS). Likewise, the species was completely susceptible to deltamethrin that is being used for impregnation of the bednets. Thus use of deltamethrin impregnated bednets offer an alternative intervention strategy specially in areas with difficult terrain in northeastern parts of the subcontinent where logistically IRS is not operationally feasible to a greater extent with inherent lapses.

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