Field Trial of Relative Efficacy of Abate and *Bacillus thuringiensis* Against *Simulium himalayense* Larvae (*Diptera simuliidae*)

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Abstract

Simulium himalayense (*Diptera simuliidae*) are known pests which cause severe biting nuisance in North-East region and breed in its fast flowing rivers and rivulets. A field trial was undertaken to control this nuisance with the help of larvicides and to help ascertain relative efficacy of Abate and *B. thuringiensis* against *Simuliidae*. Abate proved to be an effective larvicide for river treatment wherein 0.1 PPM resulted in 100% larval reduction while in small streams, the treatment with Teknar (*Bacillus thuringiensis*) with 10 PPM for 10 minutes resulted in 80% larval reduction. The results of the present study showed that Abate was more effective in rivers while *B. thuringiensis* proved to be useful in controlling the breeding in the rivulets. An integrated approach using chemical and biological agents is recommended and considered ecologically sound as it does not affect the fish and potability of water.

MJAFI 2003; 59 : 111-113

Key Words : Larvicidal control; *Simuliidae*

Introduction

The vector control measures vary in efficacy, duration of impact, resource requirement and potential for community participation. A sustainable control program adopted to local needs requires a thorough understanding of the problem, knowledge of the vector, human host and the environment [1]. The analysis of this information permits critical comparison between different interventions. The success in vector control depends upon systematic review of available vector control options and their selective use [2].

The use of larvicides continues to be an important component of *Simuliidae* control, but requires to take into account insecticide resistance and safety, cost effectiveness and environmental management [2]. Larval control with chemicals and biological agents is relevant as the sole method of vector control since high proportion of breeding sites lie within the flying range of the community and can be located and are accessible for larvicidal operation. The two larvicides compared in the trial are (i) Abate, (ii) *Bacillus thuringiensis*.

Simuliidae which cause onchocerciasis or river blindness is not known to be vector of any disease in India but are notorious pests and known in the North East for their biting nuisance and causing local allergic reactions in sensitized individuals. There can be extreme allergic reactions even to a single bite and children are known to suffer seriously. Many kinds of mild and severe allergic reactions can be experienced, most of them acute and some chronic and protracted for several months. Repeated human biting can cause a medically recognized syndrome called Black Fly

Fever and is characterized by symptoms like headache, fever, lymphadenitis and psychological depression [1].

Nearly 31 species of *Simuliidae* are known to occur in India and these are prevalent in sub Himalayan tract, Kashmir and Maharashtra [3]. These *Simuliidae* are known pests in North East region of India and its two predominant species in this area are *S. himalayense* and *S. indicum* [4]. There are no known cases of onchocerciasis in this region. However, the missing element here is not only the parasite but also a significant human population. It is probable that current changes in settlement pattern due to migration of large number of people for road construction and timber activity may lead to the development of disease foci [2].

The project was designed to provide baseline data regarding susceptibility status to Abate and *B. thuringiensis* and establish indices of information regarding their use. The aims of the study are listed below:-

1. To ascertain the density of *Simulium* larvae in the river and streams of Tenga Garrison.
2. To study the relative efficacy of the various larvicides on the aquatic stage of *Simulium* including the use of biological agents e.g. *B. thuringiensis*.
3. To bring about a reduction in the density of *Simulium* in Tenga Garrison.

Material and Methods

The present study was carried out in Arunachal Pradesh, Tenga Valley which is located at 27° latitude and 92°

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Table 1

Field evaluation of abate and tekmar on control of breeding

Stream or river	Length of experimental sec (km)	Discharge rate (m ² /sec)	Concentration (PPM)	Treatment time	Larval density per 1000	Larval reduction after 24 hrs
Abate :						
Jiding KHO	6	0.20	0.10	30	1000	65
Dunuk KHO	6	0.35	0.05	30	380	50
Dikhang DKHO	5	0.20	0.05	30	750	34
Dahung stream	6	0.25	0.10	30	270	70
Dumdum nallah	6	0.35	0.02	120	77	-
Tenga Chu River I	6.5	9.50	0.10	30	300	100
River I	7	10.00	0.05	30	300	40
River II	6	9.50	0.10	30	360	100
River III	3	9.50	0.10	30	310	100
Tekmar :						
Jiding KHO	6	0.10	10.0	10	760	80
Dunuk KHO	6	0.25	10.0	10	410	80
Dahung	6	0.25	05.0	30	300	60
Tenga Chu River I	6	0.10	05.0	30	312	10
Tenga Chu River II	6	0.20	10.0	150	64	22
Tenga Chu River III	7	10.00	10.0	10	260	15

longitude in Kamenga district. The need for field trial for evaluating the susceptibility status of black fly larvae in this area was felt on account of the increased use of insecticide in agriculture in recent past and increase in the biting nuisance. The valley is located at a height of 4000 feet above sea level and surrounded by mountains which are 600-700 metre high. The area receives about 610 mm precipitation annually. The mountain topography with extensive drainage basin, supplies the requirement of clean, well oxygenated, fast flowing water that can support large black fly population. The study area consisted of upper reaches of Tenga Chu river from 4 km upstream of Tenga townsite to 3 km downstream. The river bed consists of shallow layer of gravel interspersed with large boulders, while the embankment is that of soft cohesive clay. There are five prominent rivulets which showed a high density of breeding.

The earliest attempt to control this nuisance was made in early 60s, when susceptibility of *Simulidae* larvae to insecticide was tested using DDT and BHC by Pertiz and Lopez [7]. The *Simulidae* control in this area was again taken up in 1988 by Defence Research Laboratory Tezpur, which tested the susceptibility of *Simulidae himalayense* larvae to Tekmar and Abate in this region [4].

River Treatment : The hydraulic measurement i.e. velocity of the river water was determined using a pitot tube manufactured locally by Defence Research Laboratory (DRL), and discharge rate calculated. Larvae density was estimated using artificial substrate consisting of white plastic strips measuring 25 cm x 01 cm x 0.1 cm. To assess the degree of control achieved in the abatement operations two groups of three cone sets with floats on top and anchor below were established about a week prior to estimated treatment date. The larvicides were sprayed from a bridge using 12 litre knap sack sprayers. This improved dispersion and

insecticide mixing, thereby reducing the time lag required for complete mixing and insecticide hot spots. The river was treated with Abate and Tekmar in varying concentrations and results tabulated.

Rivulets and Streams :- There are five prominent rivulets with high density of breeding. The treatment of hill streams with varying doses of Abate and *B. thuringiensis* were tried out using different dose-time relationship. The dose time relationship tried earlier by DRL in 1988 were followed to facilitate comparison and estimate development of resistance subsequent to DRL trial.

Results

Abate : The results are tabulated in Table 1. It will be seen that the river when treated with 0.1 PPM of Abate for 30 minutes yielded 100% larval reduction while same dose in the streams resulted only in 65% to 70% larval reduction.

***B. thuringiensis* :** The river treatment with 10 PPM yielded 15% to 22% larval reduction up to 3 and 5 kms respectively and when the dosage was increased to 30 ppm there was no appreciable change in the larval reduction. In small streams, treatment with 10 PPM for 10 minutes resulted in 80% larval reduction.

Discussion

The results of the study with Abate and Tekmar are in confirmation with earlier field observations made by Shri SC Das during the trial in 1988, showing thereby that the susceptibility status remains unaltered since the trial conducted by DRL.

The integrated approach of using Abate in 0.1 PPM in the river coupled with the use of *B. thuringiensis* in the dosage of 10 PPM for 10 minutes in the hilly streams