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Research Note

SUSCEPTIBILITY OF *SIMULIUM (CHIROSTILBIA) PERTINAX* KOLLAR, 1832 (DIPTERA, SIMULIIDAE) TO *BACILLUS THURINGIENSIS* VAR. *ISRAELENSIS* IN AN ATYPICAL BREEDING HABITAT

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Simulium (Chirostilbia) pertinax is the most common anthropophilic blackfly species in the southeastern and southern states of Brazil. In areas where *S. pertinax* populations are not controlled they represent a serious biting nuisance. The larvae of this species were believed to be indicators of unpolluted streams, where they tipically occur on rocks in sites of fast-running water, but high larval densities have been recently recorded in streams polluted by seepages from garbage embankments and from human, poultry and industrial origin (A. L. Lozovei et al., 1986, I Seminário Sobre Vetores Urbanos e Animais Sinantrópicos – São Paulo, SP, Abstracts p. 25; E. L. G. Guimarães, 1988, III Reunião Brasileira sobre Simulídeos, Porto Alegre, RS, Abstracts p. 82-83).

Blackfly control in Brazil has been undertaken by governmental agencies and private entities but in many cases programmes to monitor larval susceptibility are lacking. Resistance to Temephos^{R}, the larvicide most widely used against blackflies, was detected as early as 1984 in Rio Grande do Sul (A. L. Ruas Neto, 1984, *B. Saúde Porto Alegre, 11:* 27-31) and in 1987 in coastal areas of São Paulo and Rio de Janeiro (C. F. S. Andrade et al., 1987, XI Congresso Brasileiro de Entomologia – Campinas, SP, Abstracts p. 406). This problem led the present authors to recently propose two techniques to detect Temephos-resistant blackfly populations under field conditions (C. F. S. Andrade & A. Castello Branco Jr. 1990, *Mem. Inst. Oswaldo Cruz, 85:* 291-297).

Bacillus thuringiensis var. *israelensis* (Bti) has been evaluated as a substitute to chemical larvicides in many blackfly abatement projects, such as the Athabasca River Project in Canada, the Onchocerciasis Control Programme in West Africa, and in Central America (A. H. Undeen & M. H. Colbo, 1980, *Mosquito News, 40:* 181-184; P. Guillet et al., 1982, *Cah. ORSTOM, sér. Ent. méd. et Parasitol., 220:* 175-180; A. H. Undeen, 1981, *Mosquito News, 41:* 37-40).

Due to a lower toxicity to non-target organisms and to the development of resistance to Temephos, Bti formulations have been also evaluated against *S. pertinax* in Brazil under field conditions (A. L. Ruas Neto, 1984, *B. Saúde Porto Alegre 11:* 21-26; C. J. P. C. Araújo-Coutinho & L. A. Lacey, 1990, *Bol. Of. Sanit. Panam., 108:* 213-219; C. F. S. Andrade & A. Castello Branco Jr., 1991, *Rev. Saúde Publ., 25:* 29-32). The aim of the present note is to discuss the susceptibility of a *S. pertinax* larval population to Bti, under field conditions, in a stream polluted by domestic and poultry farm effluent.

Bioassay methodology follows that described by C. F. S. Andrade & A. Castello Branco Jr., 1991 (*loc. cit.*). The species evaluated was *S. pertinax,* but some larvae of *S. (Inaequalium)* sp. and *S. (Psaroniocompsa)* sp. were also recorded at the locality. The stream originates from springs in the Bairro da Cachoeira (Guarujá – São Paulo), providing a breeding site 200 m long. A small flow rate of 120 l/min with a low superficial velocity of 770 cm/s was measured in the place on the stream where the bioassay troughs were established. The water course received sewage effluent from three dwelling places as well as from a small pond where nearly two dozen ducks and chickens were maintained. The average water temperature was 20 °C and the pH 6.0.

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TABLE I

Median lethal time (LT_{50}), confidence limits and efficiency to *Simulium pertinax* larvae treated with *Bacillus thuringiensis* var. *israelensis*

Concentration [ITU/l/(10 min)]	1,800	3,600	7,200	14,400	28,800
LT_{50} (min)	–	–	248.5	102.1	48.3
IL (min)	–	–	175.9	95.9	43.8
SL (min)	–	–	351.1	108.7	53.1
% mort. 3 h	0.0	17.0	39.0	76.0	100.0
% mort. 4.7 h	3.7	25.7	54.1	94.4	–

IL = inferior limit; SL = superior limit.

The larval susceptibility was evaluated using LT_{50} and LC_{50} criteria, as well as total mortalities 3 and 4.7 h after application. An average of 127 late instar larvae of *S. pertinax* were used per treatment. Various concentrations of Vectobac 12 AS^R, an aqueous suspension formulation supplied by Abbott Laboratories, and possessing 1200 ITU/mg were evaluated in 10-minute dropping treatments. Data were subjected to log-probit analysis computed in a BASIC-PC programme (C. F. S. Andrade, unpublished).

A tentative five concentration spectrum ranging from 1,800 to 28,800 ITU/l was evaluated. Total mortalities less than 50% where obtained with the two lower concentrations (Table I). The LT_{50} was obtained for the three concentrations where calculations were reliable. The time period necessary for 50% mortality showed a range from 248 to 48 min, for concentrations ranging from 7,200 to 28,800 ITU/l. It must be noted that under typical breeding conditions like those found at Promirim river (Ubatuba-São Paulo), the LT_{50} obtained was ca. 71 min, with only 3,744 ITU/l (C. F. S. Andrade & A. Castello Branco Jr., 1991, *loc. cit.*).

Three LC_{50} values were calculated relative to three time periods after application (Table II). In this polluted habitat, the larvae showed 50% mortality with 7,688.6 ITU/l after 2.6 h (=LC_{50}/ 158 min) and 39% mortality to 7,200 ITU/l after 3 h (Table I). The same species in typical habitats (non-polluted water with flow rates between 5 and 10 m3/min) showed mortalities ranging from 85.5 to 100%, 3 to 4 h after application respectively, when subjected to the concentration of 3,744 ITU/l, practically half of the one used here (C. F. S. Andrade & A. Castello Branco Jr., 1991, *loc. cit.*).

TABLE II

Median lethal concentration (LC_{50}) and confidence limits to *Simulium pertinax* treated with *Bacillus thuringiesis* var. *israelensis*

Time after application (min)	88	158	282
LC_{50} [ITU/l/(10 min)]	19,599.8	7,688.6	5,723.7
IL [ITU/l/(10 min)]	10,158.7	5,229.7	5,040.3
SL [ITU/l/(10 min)]	37,815.1	11,303.6	6,499.7

IL = inferior limit; SL = superior limit.

It is concluded that when *S. pertinax* larvae occur in high densities in polluted habitats new control concentations, higher than those commonly used in unpolluted habitats, must be calculated.