

***Simulium* spp. Control Program in Rio Grande do Sul, Brazil**

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Insects of the Simuliidae family have been the object of control in Rio Grande do Sul since the 70s. Their constant attacks became a social-economical problem as well as a problem of Public Health, with serious consequences to men and to the economy of the areas in which the insects develop. At first, the control was done with a chemical larvicide Themephos ABATE 500 E, but an imperfect measuring of outflow to determine the quantity of the product made Simulium spp. resistant to it. From 1983 on, following a study of a new method for the outflow measuring, we started to use a biological larvicide Bacillus thuringiensis serovar israelensis based. The biological control uses the new method in 36.4% of the state area, assisting about 3,500,000 inhabitants.

Key words: *Simulium* spp. - biological control - *Bacillus thuringiensis* serovar *israelensis* - Rio Grande do Sul - Brazil

The hematophagic insects of the Simuliidae family (Diptera - Nematocera) are important in Brazil, where there are 81 species (Py-Daniel 1988). In Rio Grande do Sul (RS), 30 species have already been identified. Some of them have been reported as having attacked men and animals alike for decades (Souza 1984, Strieder & Corseuil 1992), causing damage to agriculture, cattle farming, and tourism, next to relevant aftermaths in public health.

From 1976 on, the Secretary for Health started to take action in the control of *Simulium* spp., first by deploying the organophosphorous chemical larvicide, Themephos ABATE 500 E. Throughout these controlling tasks, research carried out by the Coordination for the Political Control of Zoonoses and Vectors of the Secretary of Health (CPCZV) indicated that the species under control, *S. (Chirostilbia) pertinax*, was not susceptible to the concentrations being applied, what suggested that resistance had been developed by product misuse due to improper measuring of outflow (Ruas Neto 1984a). Research conducted by Andrade et al. (1987) in São Paulo indicated that the efficacy of the product over *S. (C.) pertinax* larvae was unsatisfactory.

In 1982 research was started on new methodologies of integrated control of *Simulium* spp. (Ruas Neto 1984b, Ruas Neto et al. 1985) and on effective ways of measuring outflow, meeting the specificities of the river basins in RS. The new methodology was developed by Silveira (1985) and implanted from 1983 on, making use of modified "Parshal" fixed outflow meter (Alfaro 1974) in the application of *Bacillus thuringiensis* serovar *israelensis* H14 de Barjac 1978 based formulations.

This methodology took into account the environmental characteristics in RS, where there are small and medium-size river basins with variable rainfall and where flood drain occurs within minutes or few hours. The device consists of fixed structures called outflow meters, or "Parshal" shallow gutters, built in the main streak of every basin (Fig. 1). This makes it possible to check the outflow on this assembled device and, in the sequence, to calculate dosage, concentration and delivery of the product. This is done according to charts that apply to the size of the outflow meters. There are five sizes that meet the different draining conditions of the river basins where the larvicide product will be used. Presently, the Control Program comprehends 170 municipalities, out of which 122 have 223 built-in fixed outflow meters. The remaining have already been surveyed as to entomology, epidemiology and hydrology conditions so that the fixed outflow meters can be built (Fig. 2).

Simulium spp. control in RS aims to reduce associated morbidity by means of its population control. This is carried out through biological control

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with *B. thuringiensis* var. *israelensis*, using methodology attentive to our specific environmental conditions. The program also aims to raise awareness, to foster environment recovery, and to give assistance to the population victimized by the insects. It is under the coordination, normatization, and technical assistance of the CPCZV, with the support of the municipal and regional bureaus of Emater, RS. The municipal governments are in charge of the execution and the control of the program.

The hydrologic study of the built-in fixed outflow meters, their effectiveness and other forms of outflow measuring are under permanent assessment through the integrated association with the Hydraulics and Sanitation Department of the Santa Maria Federal University (Silveira 1997, Mardini et al. 1998, Mardini & Souza 1998, Silveira & Tucci 1998, Silveira et al. 1998).

MATERIALS AND METHODS

Firstly, the entomological survey of immature and adult forms of *Simulium* spp., the epidemiological survey of the attacks to people in the area, and the study of the river basin are carried out by the CPCZV team. The site for the construction of the modified “Parshal” fixed outflow meter is determined taking into account its volume of water and its accessibility conditions.

The assessment of the outflows along the waterway, which is fundamental to calculate the concentrations of larvicide dosage, is made by using a micro screw current meter or, as in Amrine (1983), with a float system (ping-pong ball with 25 ml of water as ballast). The resulting measures served as the basis for the projects of five sizes of the modified “Parshal” fixed outflow meters: 10x90; 30x90; 40x180; 60x180; 100x270 (cm).

The fixed outflow meter in each river basin to be controlled made of masonry or concrete, makes it possible to correctly calculate the outflow of the waterway and to establish correlations with the other waterways in the same basin.

RESULTS

B. thuringiensis var. *israelensis* based formulations are widely used for controlling purposes in many countries (Undeen & Colbo 1980, Lacey 1982, 1998, Lacey & Undeen 1984, OCP/WHO 1994, Molyneux 1995, Hougard 1998). In Brazil, RS was the state to pioneer biological control, and its use has proved to be efficient in the control of *Simulium* spp. larvae without interfering in the aquatic organisms associated to the insects’ habitat (Mardini 1988, Mardini et al. 1993, 1998, 1999, Souza et al. 1994).

It is the Executive of the municipalities’ responsibility to do this control referring to the Technical and Operational Norms of the Secretary for Health, which describes the outflow measuring method to use the biological larvicide.

The efficacy of the biologic larvicide resulting from the correct outflow measuring has been reported in many papers (Ruas Neto et al. 1985, Souza et al. 1994, Mardini et al. 1998, 1999). Adaptations to this method have been studied and should determine that less fixed outflow meters be built, as suggested by the work developed in association

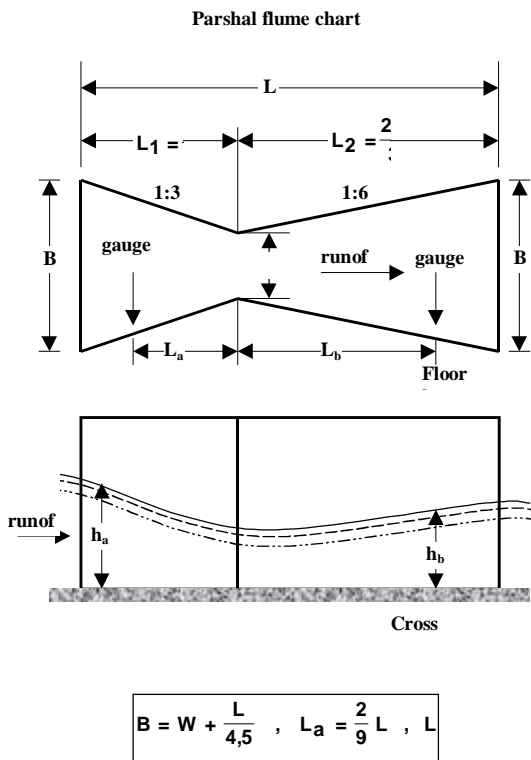


Fig. 1: “Modified Parshal Gutter” outflow meter

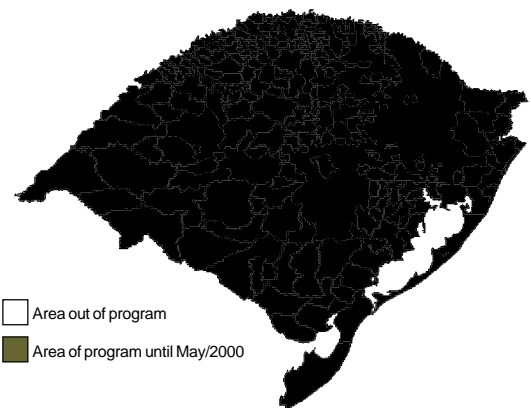


Fig. 2: area under *Simulium* spp. Control State Program in Rio Grande do Sul

with the Hydraulics and Sanitation Department of the Federal University of Santa Maria (UFSM/ Fapergs 1992, Souza et al. 1994, Silveira 1998).

From 1983 to April 2000, 223 fixed outflow meters were built, and 94 are still to be built (Table I). In all 170 municipalities requested to join the program from 1983 to May 2000, what corresponds to 36.4% of the municipalities in the state and nearly 3,500,000 people (Table II).

TABLE I

Number of fixed outflow meters projected and built

Fixed outflow meters projected	Fixed outflow meters built
94 ^a	223 ^b

a: number of total outflow projected; b: number of total outflow meters built since 1983.

TABLE II

Number of municipalities in Rio Grande do Sul per year of joining the Control Program from 1983 to May 2000

Year	No. of municipalities	% of municipalities
1983	3	0.9
1988	22	6.6
1994	68	15.6
1996	107	24.5
1997	116	26.5
1998	135	31.6
2000	170 ^a	36.4

a: until May 2000

DISCUSSION

The effectiveness of biological control, given the environmental specificities at play, requires a correct methodology of measuring outflow. The successful experience in using *Simulium* spp. biological control in RS leads to deem the method of fixed "Parshal" outflow meters adequate to small rural river basins. The integrated use of control methods, environmental recovery and preservation, and continued education of communities are fundamental to the success of *Simulium* spp. control programs in whatever region to be considered.

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