

Optimisation of *Bacillus thuringiensis* var. *israelensis* (Vectobac®) applications for the blackfly control programme on the Orange River, South Africa

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Abstract

The Orange River, South Africa's largest river, is a critical water resource for the country. In spite of the clear economic benefits of regulating river flows through a series of impoundments, one of the significant undesirable ecological consequences of this regulation has been the regular outbreaks of the pest blackfly species *Simulium chutteri* and *S. damnosum* s.l. (Diptera: Simuliidae). The current control programme, carried out by the South African National Department of Agriculture, uses regular applications, by helicopter, of the target-specific bacterial larvicide *Bacillus thuringiensis* var. *israelensis*. While cost-benefit analyses show significant benefits to the control programme, benefits could potentially be further increased through applying smaller volumes of larvicide in an optimised manner, which incorporates upstream residual amounts of pesticide through downstream carry. Using an optimisation technique applied in the West African *Onchocerciasis* Control Programme, to a 136 km stretch of the Orange River which includes 31 blackfly breeding sites, we demonstrate that 28.5% less larvicide could be used to potentially achieve the same control of blackfly. This translates into potential annual savings of between R540 000 and R1 800 000. A comparison of larvicide volumes estimated using traditional vs. optimised approaches at different discharges, illustrates that the savings on optimisation decline linearly with increasing flow volumes. Larvicide applications at the lowest discharge considered (40 m³·s⁻¹) showed the greatest benefits from optimisations, with benefits remaining but decreasing to a theoretical 30% up to median flows of 100 m³·s⁻¹. Given that almost 70% of flows in July are less than 100 m³·s⁻¹, we suggest that an optimised approach is appropriate for the Orange River Blackfly Control Programme, particularly for flow volumes of less than 100 m³·s⁻¹. We recommend that trials be undertaken over two reaches of the Orange River, one using the traditional approach, and another using the optimised approach, to test the efficacy of using optimised volumes of *B.t.i.*

Keywords: *Simulium chutteri*, *Simulium damnosum*, Orange River, flow regulation, *Bacillus thuringiensis* var. *israelensis*, optimisation