

EFFICACY AND PERSISTENCE OF *BACILLUS SPHAERICUS*, *BACILLUS THURINGIENSIS* VAR. *ISRAELENSIS*, AND METHOPRENE AGAINST *CULISETA INCIDENS* IN TIRES

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ABSTRACT

Used tires are an important larval habitat for many species of mosquitoes, some of which are important disease vectors. Tires pose a special problem for mosquito control because it is difficult for pesticides to penetrate the larval habitat, and many tire-breeding mosquitoes are resistant to some of the commonly used pesticides. The bacterial pathogens, *Bacillus sphaericus* and *Bacillus thuringiensis* var. *israelensis* (*Bti*), and the insect growth regulator, methoprene, may provide other options for mosquito control agencies.

Bacillus sphaericus has demonstrated prolonged larvicidal action in some treated habitats, and dead mosquito larvae have been shown to serve as growth medium for the bacteria. This study compared the persistence, growth, and control potential of *B. sphaericus* at three dosage rates in tires containing cadavers of *Culiseta incidens*, and in tire water with all dead larvae removed.

Liquid formulations of *Bti* and methoprene are generally effective for only a short time, but their efficacy may be prolonged in the shade. This study evaluated the efficacy and persistence of *B. sphaericus*, *Bti*, and methoprene against *Cs. incidens* larvae in tires exposed to full sunlight as opposed to tires shaded by a dense canopy of trees.

Field studies were conducted at two sites. At site #1, 2 liters of water and 50 second instar *Cs. incidens* were added to each of 21 tires, which were then inoculated with either 3.75 ppm, 7.5 ppm, or 15 ppm of *B. sphaericus* (2362), or were not inoculated (controls). At each dosage rate, dead larvae were either removed from or left in the tire water. Percent mortality was determined three days post-treatment. Seven days after the *B. sphaericus* inoculation, larvae were again added to each tire and the percent mortality determined. This procedure was repeated weekly over a ten week period.

The efficacy of *B. sphaericus*, *Bti*, and methoprene against *Cs. incidens* larvae in tires was evaluated in open sun versus shaded habitats at site #2. Tires containing 2 liters of water and 50 second instar *Cs. incidens* larvae were inoculated at dosage rates of 15 ppm *B. sphaericus*, 15 ppm *Bti* (Vectobac™ AS, 600 ITU), 2.5 ppm methoprene (Altosid™ SR10), or were not inoculated (controls). There were three replicates of each of the four treatments in both the sun and the shade. The percent mortality was evaluated three days post-inoculation in the *B. sphaericus* and control tires, and two days post-inoculation in the *Bti*-treated tires. Since methoprene prevents adult emergence, its efficacy was assessed by checking the tires every two days for pupae, which were removed and placed in individual emergence containers for observation. Every week, for up to 13 weeks, larvae were added to the tires and the mortality or emergence rate determined as above.

At site #1, there was greater than 90% mortality for ca. two weeks post-treatment in tires treated with 7.5 and 15 ppm *B. sphaericus* and containing cadavers, and for ca. one week in the other treated tires. Mortality exceeded 50% for nine weeks in all tires treated with 15 ppm *B. sphaericus*, for nine and six weeks in the 7.5 ppm treated tires with and without cadavers, respectively, and for four weeks in all 3.75 ppm tires. In all tires, there was an initial decline in the mortality rate and then an increase approximately four to six weeks post-inoculation, suggesting an amplification of the pathogen. At the lower treatment rates, the continual presence of dead larvae in the tire water apparently increased the effectiveness of *B. sphaericus*, since mortality rates were generally higher in tires with cadavers. At 15 ppm, mortality rates were similar in tires with or without cadavers.

At site #2, both *B. sphaericus* and *Bti*¹³⁹ provided prolonged control of *Cs. incidens* larvae in shaded tires (>90% mortality for five and two weeks, >50% mortality for ten and four weeks, with the two bacteria, respectively), and controlled mosquitoes in sun-exposed tires adequately for

approximately one week. Methoprene inhibited the emergence of ca. 90% of the larvae present at the time of treatment, but not of larvae subsequently introduced into either the sun-exposed or shaded tires.

