EFFECTIVENESS OF PYRIPROXYFEN AND DIFLUBENZURON FORMULATIONS AS LARVICIDES AGAINST Aedes aegypti

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ABSTRACT. The efficacy of technical pyriproxyfen and diflubenzuron was evaluated at the laboratory level against Aedes aegypti, where we achieved adult emergence inhibition (EI90) values of 0.048 and 1.59 ppb (μg/liter), respectively. We compared these data with values obtained for temephos. We prepared emulsifiable concentrate formulations of pyriproxyfen and diflubenzuron in the laboratory and obtained EI90 values of 0.01 and 0.02 ppb, respectively. We also obtained 100% adult emergence inhibition with 0.1% slow-release sand formulations of pyriproxyfen and diflubenzuron. In a simulated field study, the granular sand formulations of pyriproxyfen, diflubenzuron, and temephos remained active for over 4 mo. In a field study, a 0.2% granular formulation of diflubenzuron and 1% temephos showed a similar performance.

KEY WORDS Aedes aegypti, insect growth regulators, pyriproxyfen, diflubenzuron

INTRODUCTION

Dengue, whose principal vector is Aedes aegypti L., is the most important arboviral disease in the world today, affecting an estimated 100 million people annually. The principal method of Ae. aegypti control is still larviciding of oviposition sites, called focal treatment, especially in urban areas. Water containers with larvae should be treated only when removal and destruction are not feasible.

The major larvicide temephos (1% sand granules) has been used to control Ae. aegypti larvae in large-scale vector control programs. Although this formulation provides a good larvicidal effect for several weeks and is of very low cost, it is frequently rejected by inhabitants for application in their water containers due to its strong smell and slight turbidity. Also, it has the disadvantage of nontarget effects and the development of resistance (Mulla et al. 1986). Currently, Ae. aegypti resistance to temephos is widespread in the Americas (WHO 1992). Acquired resistance by Ae. aegypti to temephos was reported in Brazil (Lima et al. 2003, Macoris et al. 2003, Braga et al. 2004), Bolivia, and Argentina (Biber et al. 2006). Recently, incipient resistance to temephos was also reported in Ae. aegypti in Clorinda, Argentina, and Iguazú, Argentina (Seccacini et al. 2007).

Because of the problem of resistance to temephos, it is important to develop new larvicidal products for use in Ae. aegypti control (Ayesa et al. 2006). Insect growth regulators (IGRs) have been reported to be selective against target species, with considerable safety to the environment and nontarget organisms, including mammals (Mian and Mulla 1982, Mulla et al. 1986). As developmental inhibitors, IGRs are divided into 2 groups: juvenile hormone mimics and chitin synthesis inhibitors. Methoprene, fenoxycarb, and pyriproxyfen belong to the former group, and the benzoylurea compounds, diflubenzuron and novaluron, belong to the latter. Pyriproxyfen has been found to be highly active against a wide variety of insects of public health importance (Hirano et al. 1998, Ayesa et al. 2006). Through hormonal imbalance, pyriproxyfen suppresses insect embryogenesis, metamorphosis, and adult emergence (Miura et al. 1976, Itaya 1987, Kawada 1988, Koehler and Patterson 1991). Recently, pyriproxyfen (Sumilarv® 0.5 G) was evaluated under laboratory and field conditions in Malaysia (Vythingam et al. 2005), while a 10% emulsifiable concentrate (EC) formulation of novaluron was evaluated against Ae. aegypti (Mulla et al. 2003) as well as other species of mosquitoes in Chiapas, Mexico (Arredondo and Valdez Delgado 2006).

Besides temephos, the World Health Organization (WHO) recommendation was limited to the pyrethroid permethrin, the biolarvicide Bacillus thuringiensis var. israelensis, and the insect growth regulator methoprene for treating potable water (Chavasse and Yap 1997, Braga et al. 2005). Recently, both pyriproxyfen and diflubenzuron have been accepted by WHO for potable water treatments (WHO 2003, 2006).

The evaluation of IGRs against mosquito vectors is essential for providing new tools for vector control programs in Latin American countries. In this study, a technical and a 10% EC of diflubenzuron and pyriproxyfen were evaluated against Ae. aegypti in the laboratory. Laboratory-prepared slow-release sand granules...