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## Effects of sublethal concentrations of bifenthrin on the two-spotted spider mite, *Tetranychus urticae* (Acari: Tetranychidae)

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### Abstract

Bifenthrin is a broad-spectrum insecticide and acaricide that is widely used in China. We evaluated the effects of sublethal concentrations ( $LC_{10}$  and  $LC_{25}$ ) of bifenthrin on the eggs and adult females of the two-spotted spider mite, *Tetranychus urticae*, in the laboratory at  $26\pm1^{\circ}\text{C}$ , 80% RH, and a 16 h: 8 h (L: D) photoperiod. The sublethal doses of bifenthrin decreased the intrinsic and finite rate of increase, net reproductive rate, survival rate, and reproductive value. The sublethal doses also increased the mean generation time, total pre-ovipositional period, and duration of the larval and nymphal stages. The intrinsic rate of increase dropped from 0.252/day in the control to 0.222 and 0.208/day in response to  $LC_{10}$  and  $LC_{25}$  treatments, respectively. Following  $LC_{10}$  and  $LC_{25}$  treatments, the net reproductive rate dropped from 60.65 offspring/individual in the control to 45.19 and 40.81, respectively. These laboratory results indicate that sublethal concentrations of bifenthrin may decrease the developmental rate of *T. urticae*, are unlikely to result in the resurgence of *T. urticae* populations, and might therefore be useful in the integrated management of this pest.

**Key Words:** *Tetranychus urticae*, Bifenthrin, Sublethal concentration, Life table

### 1. Introduction

The two-spotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae), is a cosmopolitan and destructive pest of agricultural crops in China and elsewhere. Pesticides are widely used against *T. urticae*. Such pesticides include bifenthrin, which is a pyrethroid insecticide and acaricide that is widely used against many insect and mite pests of the agricultural crops and orchards. The current study concerns the effects of sublethal concentrations of bifenthrin on *T. urticae*.

When too little pesticide has been applied or when the pesticide has degraded, pests are likely to be exposed to sublethal concentrations. In some cases, sublethal concentrations of pesticides can contribute to pest management. For example, sublethal pesticide concentrations may increase pest developmental time and reduce adult longevity and fecundity (Wang *et al.* 2009; Song *et al.* 2013; He *et al.* 2013). In other cases, however, sublethal doses of insecticides can cause a resurgence of the pest population (Hall 1979; Liu *et al.* 1998). Therefore, an understanding of sublethal effects is fundamental to understanding the efficacy and risk of pesticide application (Desneux *et al.* 2007).

Pyrethroid insecticides like bifenthrin interfere with the insect nervous system, resulting in trembling or paralysis, which is usually followed by death. Because of their rapid action and excellent contact toxicity against a broad-spectrum of arthropod pests, pyrethroids are often used to control insects and spider mites (Herron *et al.* 2001; Zhang *et al.* 2012). The effects of lethal and