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# Comparative efficacy of spinosad with conventional acaricides against hard and soft tick populations from Antalya, Turkey

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ABSTRACT

The acaricidal efficacy of ceramic tiles treated at field application rates with either spinosad (Mozkill© 120 SC, 0.01 g ai/m$^2$), deltamethrin (Impotek Deltamethrin© EW, 0.01 g ai/m$^2$), permethrin + esbiothrin (Chrysamed©, 0.1 g ai/m$^2$), chlorpyrifos-methyl (Chlortoks© EC 50, 0.2 g ai/m$^2$) or a mixture of alpha-cypermethrin/tetramethrin/piperonyl butoxide (Ecorex Alfa© SE, 0.01 g ai/m$^2$), against larval *Rhipicephalus turanicus* and *Argas persicus* ticks was determined in laboratory bioassays. All ticks were initially exposed to treated tiles for 15 min then removed to non-treated containers and mortality evaluated for 15 min, 1 h, 6 h, and 24 h postexposure. Generally, *A. persicus* proved to be the most susceptible of the two species to all treatments. The alpha-cypermethrin/tetramethrin/piperonyl butoxide mixture was the quickest acting acaricide against larval *A. persicus* where 100% mortality was observed 15 min postexposure. For the rest of the treatments complete mortality was obtained at 1 h except for permethrin/esbiothrin which occurred at 6 h postexposure. Complete mortality of larval *R. turanicus* occurred to deltamethrin and spinosad at 1 h postexposure with all acaricides providing 100% control at 6 h except permethrin/esbiothrin which only achieved 92% control through the end of the study (i.e. 24 h). Our results showed that spinosad would be a useful addition in a tick control program as an alternative for pyrethroids and organic phosphorus acaricides against both tick species.



## 1. Introduction

Ticks are vectors of many types of pathogens such as babesiosis, brucellosis, plague, salmonellosis, listeriosis, borreliosis (Lyme disease), tropical theileriosis, anaplasmosis, and Crimean-Congo hemorrhagic fever (CCHF). During the last 6 years, CCHF has become well known among the Turkish public because of the deaths it has recently caused. Between 2002 and 2008 more than 2000 individuals were infected in Turkey with this disease; with nearly 5% of the cases resulting in death (The Ministry of Health of Turkey, 2008). Turkey's tick fauna is composed of about 32 species from 2 families and 10 genera (Aydin and Bakirci, 2007). Most of these species transmit a variety of pathogenic organisms to humans and animals (Göksu and Tüzer, 1981; Karaer et al., 1997). Several acaricides, including organic phosphorus and synthetic pyrethroids, recommended by the World Health Organization (WHO) are also approved by the Turkish Ministry of Health for tick control. Many municipalities and pest control companies are widely applying these chemicals to gardens, parks, and picnic areas which are suitable harborage sites for ticks. But these two pesticide classes are also known to be toxic to humans, animals, and other non-target organisms.

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Alternatives to these conventional acaricide classes may be useful for tick management in public areas.

Spinosad (a combination of spinosyn A and spinosyn D) is derived from a naturally occurring soil dwelling bacterium *Saccharopolyspora spinosa*. It has been used to control a variety of insect pests, including Diptera and Lepidoptera and has shown slight toxicity to birds, moderate toxicity to fish, and slight to moderate toxicity to aquatic invertebrates (Cetin et al., 2005; Semiz et al., 2006; Wyss et al., 2003). Spinosad has also been reported to have no adverse effects on predatory insects (Copping and Menn, 2001; Williams et al., 2003). The bacterium's acaricidal activity against *Rhipicephalus* (*Boophilus*) *microplus* and *R.* (*Boophilus*) *annulatus* has been reported by Davey et al. (2001, 2005).

In this study we compared the acaricidal effects of spinosad with the conventional insecticides alpha-cypermethrin, chlorpyrifos-methyl, esbiothrin, deltamethrin, permethrin, and tetramethrin in laboratory bioassays at field rates recommended by the World Health Organization (WHO) against larval *R. turanicus* and *A. persicus*, two common tick species in Antalya, Turkey.

## 2. Materials and methods

### 2.1. Ticks

Larvae of the soft tick, *Argas persicus*, and the hard tick, *Rhipicephalus turanicus*, were used in this study. Gravid females of *A. persicus* were obtained from chicken houses, and gravid females of *R. turanicus* were collected from dog houses in the Varsak region, Antalya, Turkey. Ticks were identified using the taxonomic keys of Karaer et al. (1997). They were held at 26 °C and 60% RH in an incubator. After egg hatch, 10–15-day larvae were used in all tests.

### 2.2. Acaricides

A synergized synthethic pyrethroid mixture of alpha-cypermethrin/tetramethrin/piperonyl butoxide (Ecorex Alfa© SE, 65 g ai/L, Entosav Ilaclama-Peyzaj Insaat Temizlik Hiz. Isl. Ltd. Sti., Kocaeli, Turkey), deltamethrin (İmpotek Deltamethrin© EW, 50 g ai/L, Biotek Haşere Kontrol, Sağlık, Sosyal Hizmetler, Kimyevi Maddeler San. Tic. Ltd., İstanbul, Turkey), a mixture of permethrin + esbiothrin (Chrysamed© SC, 12 g ai/L, Chyrsamed Kimya San. Dış. Tic. Ltd. Sti., Izmir, Turkey), the organic phosphate chlorpyrifos-methyl (Chlortoks© EC, 500 g ai/L, Kontrol Kimya, İlaç, Makine, İnşaat San. Tic. A.S., Izmir, Turkey), and spinosad (Mozkill 120 SC, 120 g ai/L, Entosav Ilaclama-Peyzaj Insaat Temizlik Hiz. Isl. Ltd. Sti., Kocaeli, Turkey) were evaluated against the ticks.

### 2.3. Bioassays

Laboratory bioassays were conducted using the methods of WHO (2006). Briefly, acaricides were mixed with distilled water and applied within 1 h of dilution using a hand held trigger sprayer (0.5 L capacity) ~20–25 cm from the surface to 400 $cm^2$ glazed ceramic tiles. Concentrations used were field application rates recommended by WHO and were as follows: 0.01 g ai/$m^2$ for alpha-cypermethrin/tetramethrin/pbo, deltamethrin, and spinosad; 0.1 g ai/$m^2$ for permethrin/esbiothrin; and 0.2 g ai/$m^2$ for chlorpyrifos-methyl. Distilled water only was applied to ceramic tiles as controls. Tiles were allowed to dry in the laboratory for 24 h before testing under ambient conditions of 26 ± 2 °C and 60 ± 5% RH (WHO, 1981a,b; Busvine, 1971).

Ten non-engorged larvae of each species were placed onto separate tiles. All ticks were initially exposed to treatments for 15 min then removed to non-treated containers. At the time of exposure, individual ticks were not physically confined on the tiles but were gently pushed back with a very thin brush if they approached the border. After initial exposure, mortality was evaluated for 15 min, 1 h, 6 h, and 24 h postexposure using a binocular microscope. Ticks were considered dead if their legs did not move when prodded with a fine pin. Tests were repeated twice. Studies were conducted in the laboratory at 26 ± 2 °C and 60 ± 5% RH under a photoperiod of 12:12 h (light/dark) conditions.

### 2.4. Statistical analyses

Mean percent mortality data were transformed via arc sine and then subjected to one-way analysis of variance (ANOVA) and Student-Newman-Keuls (SNK) to determine differences within treatments by time and between time by species (Sokal and Rohlf, 1981; SAS Institute, 2002). Untransformed data are presented in Table 1. The *t*-test was performed on mean number of dead ticks to compare acaricide susceptibility between tick species within treatment (Ott, 1977). All differences were considered significant at $P \leq 0.05$.

## 3. Results

After the initial 15 min exposure period, complete mortality of larval *R. turanicus* was observed at 1 h to deltamethrin and spinosad-treated tiles while ticks exposed to the alpha-cypermethrin mixture and chlorpyrifos were all dead at 6 h (Table 1). However, tick mortality at 1 h and 6 h to the alpha-cypermethrin mixture were not significantly different from one another. Generally, larval reduction of this tick species on permethrin/esbiothrin-treated tiles was significantly lower than the other treatments at 15 min, 6 h, and 24 h and never exceeded 92% through the end of the study period. The highest mortality of larval *A. persicus* occurred at 15 min post-exposure for the alpha-cypermethrin mixture-treated tiles compared with the other acaricides at any time period (Table 1). After 1 h, all treatments exhibited complete mortality with the exception of permethrin/esbiothrin which produced 100% larval mortality at 6 h. However, *A. persicus* mortality to permethrin/esbiothrin at 1 h, 6 h, and 24 h was not significantly different from one another.

Generally at 15 min, larval mortality was significantly greater for larval *A. persicus* compared with *R. turanicus* for all acaricides except the alpha-cypermethrin mixture where there was no species difference in susceptibility