

The Short-term Effects of Atrazine Herbicide on Soil Oribatid Mites in a Mango Orchard

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ABSTRACT.—Oribatid mites are a group of soil dwelling arthropods. The short-term effect of an atrazine herbicide on them was studied in a mango orchard, which had never been treated with atrazine. The experiment design was a randomized completed block (RBC) with three replications. The soil samples were randomly collected from two atrazine-treated plots (at the rates of 1,729 and 5,184 g active ingredients/ha) and a control plot. The soil sampling was done monthly and was extracted by using Berlese-Tullgren funnel. Oribatid mites density between a control plot and atrazine-treated plots were not significantly different after atrazine application in each month. Oribatid mites seem to be not affected from atrazine at both rate of application during the experimental period.

KEY WORDS: herbicide; atrazine; soil fauna; oribatid mites; Thailand

INTRODUCTION

Mites (Acari) with the greatest abundance and diversity in most soil are the oribatid mites (Suborder Oribatida). They are usually fungivorous or detritivorous. Through their feeding activities, they are important in the decomposition process and nutrient cycling in soil (Seastedt, 1984). The use of pesticides to control insect pests and weeds may have negative effects on non-target organisms such as oribatid mites, the decomposition process and nutrient cycling may be disturbed finally. In Thailand, the study of this effect on these animals had never been done, particularly herbicides such as atrazines. An atrazine herbicide, 2-chloro-4-ethylamino-6-isopropylamino-s-triazine, ranked third of all imported pesticides to Thailand

(Hutangkabadee and Uyvirat, 1996). It was used to control broad-leaf weeds in field crops such as corns, pineapples and in orchards. Its effects on soil fauna vary greatly from site to site due to the differences in microorganisms and soil properties. This study aims to investigate the effects of atrazine on oribatid mites in soil of a mango plantation in Ayutthaya province, central Thailand.

MATERIALS AND METHODS

The experiment was conducted in an abandoned and untreated atrazine mango orchard in Ayutthaya province. Randomized Complete Block (RBC) method was used as the experimental design for data processing as described by Rattanadakul (1978) and Cockfield and Potter (1983). The plots were 5 x 5 m² and 3 m

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apart from each other. Each of two doses of atrazine, 1729 g/ha and 5184 g/ha, which is the minimal and maximal recommended rates for mango orchards respectively (Sangsuwan et al., 1984), were sprayed onto each treatment plot at the beginning of the experiment (August 1, 2000). The control plots were sprayed with water only. The soil pH was measured by a soil tester. The air and soil temperatures as well as the soil moisture were measured as described by Al-Assiuty et al. (1993). Five soil samples to depth of 5 cm were collected after 7 days of spraying with atrazine and monthly from August to November 2000 using a soil core 6.5 cm in diameter. The soil microarthropods were extracted from soil samples by using Berlese-Tullgen funnels for 7 days and collected in 70% ethyl alcohol. Oribatid mites were then separated, counted and preserved in 70% ethylalcohol. Lactic acid was used to clear the specimens before the slide mounting. The classification and identification of oribatid mites were carried out according to Balogh and Balogh (1992).

The identification results were verified by Dr. Sandor Mahunka (Hungary). The differences of population densities of oribatid mites between plots were tested by Kruskal-Wallis test.

RESULTS

The fluctuation of soil moisture, soil temperature and soil pH are shown in Figure 1. The differences among plots of these parameters were not detected. This indicated that atrazine at both rates of applications may not effect some soil properties in first four months. In this study, 2229 soil oribatid mites were collected from the studied plots and represented 16 species (Table 1). The three most abundant species were *Scheloribates* sp., *Masthermannia* sp. and *Cyrthermannia* sp., respectively. They were selected to illustrate the population changes of oribatid mites (Fig. 2). From Table 1, the number of individuals of most species and the total number of oribatid mites in plot 1 were

TABLE 1. List of collected oribatid mites in the study site and numbers of individuals (N) throughout the experimental period (Plot 1 = control, Plot 2 = atrazine minimal rate, Plot 3 = atrazine maximal rate).

Species	Plot 1		Plot 2		Plot 3	
	N	Relative density (%)	N	Relative density (%)	N	Relative density (%)
<i>Sphaerochthonius</i> sp.	78	9.01	38	4.99	44	7.32
<i>Hoplophorella</i> sp.	38	4.39	25	3.28	24	3.99
<i>Epilohmannia</i> sp.	13	1.50	13	1.71	8	1.33
<i>Cyrthermannia</i> sp.	90	10.39	101	13.25	48	7.99
<i>Masthermannia</i> sp.	119	13.74	161	21.13	75	12.48
<i>Hermanniella</i> sp.	20	2.31	1	0.13	15	2.50
<i>Berlesezetes</i> sp.	9	1.04	12	1.57	13	2.16
<i>Furcoppia</i> sp.	19	2.19	4	0.52	17	2.83
<i>Oppia</i> sp.	38	4.39	32	4.20	16	2.66
<i>Multioppia</i> spp.	72	8.31	67	8.79	54	8.99
<i>Perxylobates</i> sp.	46	5.31	34	4.40	30	4.99
<i>Protoribates</i> sp.	28	3.23	17	2.23	13	2.12
<i>Scheloribates</i> sp.	153	17.67	107	14.04	103	17.14
<i>Lamellobates</i> sp.	33	3.81	22	2.89	28	4.66
<i>Pergalumna</i> sp.	51	5.89	51	6.69	54	8.99
<i>Rostrozetes ovulum</i>	59	6.81	47	6.17	59	9.82
Total	866	100.00	762	100.00	601	100.00

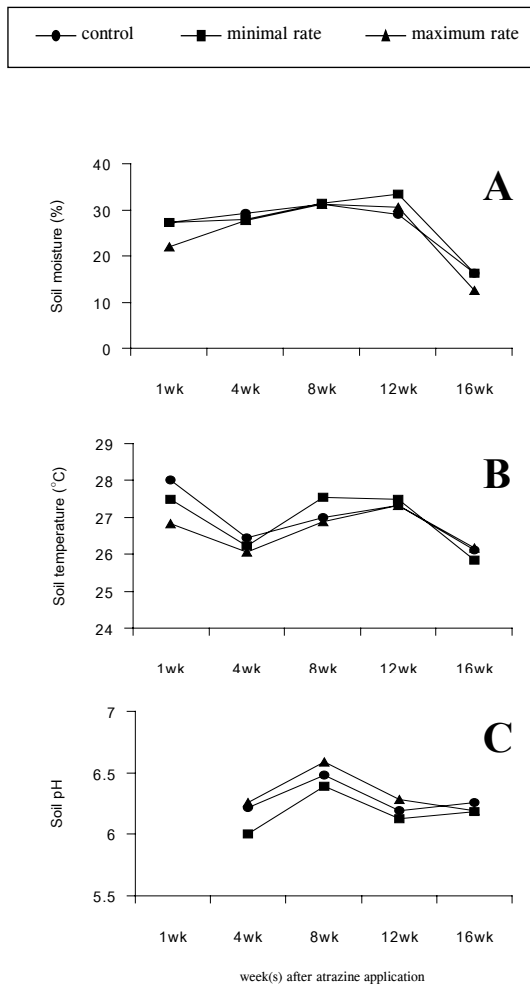


FIGURE 1. The fluctuation of soil moisture (A), soil temperature (B), and soil pH (C).

highest, followed by plot 2 and plot 3. Although this showed a tendency of a reduction of oribatid mites numbers under the application of atrazine, but there was no significant difference (Kruskal-Wallis test, $p > 0.05$) in the abundance of each species (Fig. 2) and of total oribatid mites (Fig. 3) between plots. However, we noted that there was different pattern in their population density changes. The density of *Scheloribates* sp. and *Masthermannia* sp. seemed to be less fluctuated (Fig. 2A and 2B), but *Cyrthermannia* sp. gradually declined through the experiment period (Fig. 2C).

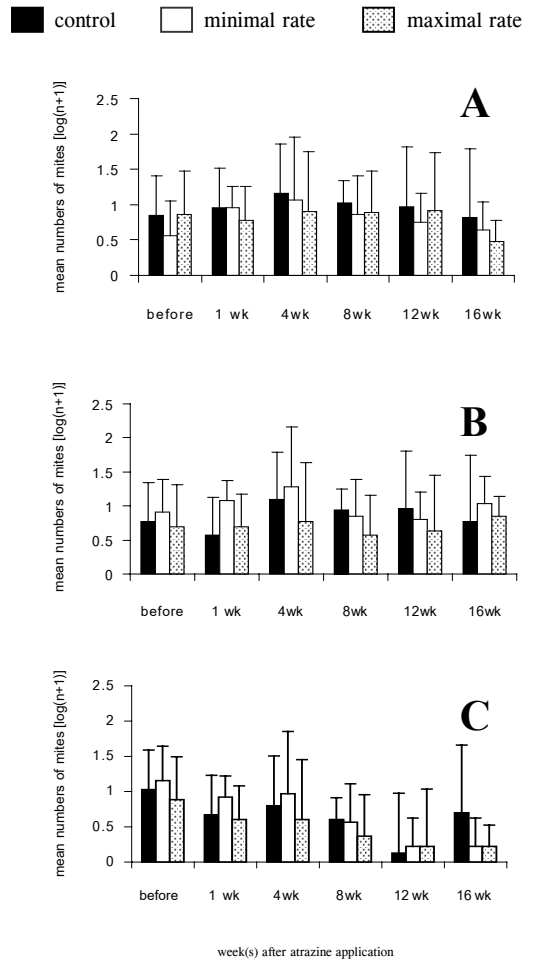


FIGURE 2. Mean individual numbers of three selected oribatid mites species (transformed data and standard error): (A) *Scheloribates* sp., (B) *Masthermannia* sp., and (C) *Cyrthermannia* sp.

DISCUSSION

This study did not detect an effect of atrazine on oribatid mite populations in a mango orchard. The nil effect of this herbicide on soil microarthropods (Acarina and Collembola) were also reported in maize fields (Popovici et al., 1977; Fratello et al., 1985). There may be save to oribatid mites when atrazine at the recommended rates were applied. However, atrazine persisted for more than six months

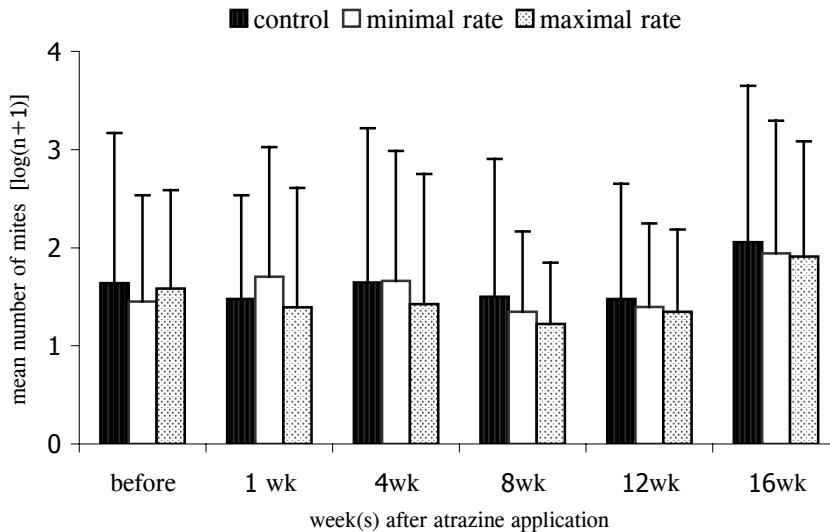


FIGURE 3. Mean number of oribatid mite individuals (transformed data and standard error) sampled before and after the application of atrazine.

(Luangarpapong, 1998) and oribatid mites have little capacity to respond numerically to the short-term environment alteration such as toxic impact (Lebrun and Van Straalen, 1995). The long-term effect of atrazine should be studied since its metabolites may affect soil organisms.

In addition to the direct effects of atrazine, oribatid mites could be affected indirectly by a reduction of the herbaceous layer (Curry, 1994) where is their food sources, organic matters. Although some weeds were excluded by atrazine, in this study, the major sources of organic matters were mango trees.

Although the effect of atrazine on oribatid mites was not found, the population change of selected species are noted that there are different trends. *Cyrthermannia* sp. of the family Nanhermanniidae declined at the end of the experiment (Fig. 2C) with the reduction of soil moisture (Fig. 1A) since the attractive environment of Nanhermanniid mites is high humidity (Behan-Pelletier, 1997). *Masthermannia* sp., however, is in the same family of *Cyrthermannia* sp. but their population seems to be more stable. They may tolerate to drought condition more than *Cyrthermannia* sp. One of the most abundance oribatid mites in this study is

Schelorbitates sp. their population tend to be stable as well. Behan-Pelletier (1999) suggested that many species in this genus are drought-tolerant ubiquitous species. They have a worldwide distribution (Balogh and Balogh, 1992).

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