SELECTIVITY OF RYNAXYPYR FOR THREE SPECIES OF PHYTOSEIID MITES RELEVANT TO COFFEE IN BRAZIL

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ABSTRACT: Among the predaceous mites, those of the Phytoseiidae family are the most important and studied. The phytophagous mites *Brevipalpus phoenicis* (Geijskes, 1939) (Tenuipalpidae) and *Oligonychus ilicis* (McGregor, 1917) (Tetranychidae), on coffee trees (*Coffea* spp.), are frequently found in combination with the predaceous mites *Iphiseiodes zuluagai* Denmark & Muma, 1972, *Amblyseius herbicolus* (Chant, 1959) and *Euseius citrifolius* Denmark & Muma, 1970, among others. The purpose of this research was to study the effects of the insecticide rynaxypyr (chlorantraniliprole 200 SC) on these three species of Phytoseiidae, relevant to coffee and citrus, following standard laboratory procedures. Mated female mites were exposed to fresh-dried residues on a glass surface, with 7 treatments, 5 mites per glass plate and 6 replicates, in a completely randomized experimental design. Each test lasted 8 days, with a daily count of the surviving females and of eggs laid. Rynaxypyr, in all tested concentrations (15, 30, 50, 100 and 500 mg a.i./liter of water), was selective for the studied species, *A. herbicolus*, *I. zuluagai*, and *E. citrifolius*. Overall the treatments resulted in low mortality rates and negligible impact on the reproduction. Therefore, based on IOBC standards, rynaxypyr can be classified as not harmful (Class 1), comparable to the agrochemical hexythiazox equivalent to a harmless standard of selectivity in the laboratory. Rynaxypyr is therefore a complement to programs of integrated pest management, to preserve the populations of predatory mites in crops of coffee and citrus, among others, in Brazil.

Key words: *Iphiseiodes zuluagai, Amblyseius herbicolus, Euseius citrifolius*, chlorantraniliprole, *Coffea arabica*.

1 INTRODUCTION

Among the predaceous mites, those belonging to the Phytoseiidae family are the most important and the most studied (McMURTRY; CROFT, 1997; MORAES, 1991).

The phytophagous mites *Brevipalpus phoenicis* (Geijskes, 1939) (Tenuipalpidae) and *Oligonychus ilicis* (McGregor, 1917) (Tetranychidae), on coffee (*Coffea* spp.), are frequently found in combination with the predaceous mites *Iphiseiodes zuluagai* Denmark & Muma, 1972; *Euseius alatus* DeLeon, 1966; *Amblyseius herbicolus* (Chant, 1959), *Amblyseius compositus* Denmark & Muma, 1973, and *Euseius citrifolius* Denmark & Muma, 1970 (Acari: Phytoseiidae) (PALLINI FILHO; MORAES; BUENO, 1992; REIS et al., 2000b).

On citrus (*Citrus* spp.), the species of Phytoseiidae most often mentioned as being frequently associated with the pest mites *Phyllocoptruta oleivora* (Asmed, 1879) (Eriophyidae) and particularly *B. phoenicis* are *E. alatus*, *A. herbicolus*, *A. compositus*, *E. citrifolius*, and *Euseius concordis* (Chant, 1959) (GRAVENA et al., 1994; KOMATSU; NAKANO, 1988; MOREIRA, 1993; REIS et al., 2000a; SATO et al., 1994).

For complete success in the integrated management of mites, with the use of agrochemicals being a tactic, the products used must not affect predaceous mites, and studies in this regard have been developed in both the laboratory and the field (REIS et al., 2006).

Rynaxypyr (chlorantraniliprole 200 g a.i./liter) is a new anthranilic diamide insecticide developed worldwide with a novel mode of action. Rynaxypyr activates ryanodine receptors via stimulation of the release of calcium stores from the sarcoplasmic reticulum of muscle cells (i.e. for chewing insect pests) causing impaired regulation, paralysis and ultimately death of sensitive species. It is active on

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chewing pests primarily by ingestion and secondarily by contact and demonstrates good ovi-larvicidal and larvicidal activity. In Europe, it has been developed for foliar applications in top fruit, vegetable crops, grapes and potatoes at rates of 10 to 60 g a.i./ha, which are highly effective on many important pests yet selective to predatory mites and other beneficial arthropods (DINTER et al., 2008; LAHM et al., 2007). In Brazil, it is being developed for use on fruits and vegetables, as well as coffee and it is logical to consider the IPM fit of rynaxypyr for these crops, until now, the products based on rynaxypyr are registered for soybeans, cotton, rice, potatoes, coffee, sugar cane, apple, melon, corn, cabbage, cucumber, peaches and, tomatoes.

The purpose of this research was to study the effects of the product rynaxypyr (chlorantraniliprole 200 SC) on three species of predaceous mites belonging to the Phytoseiidae family, relevant to coffee, while taking exposure factors into account.

2 MATERIAL AND METHODS

Origin of the mites - The mites *I. zuluagai, A. herbicolus* e *E. citrifolius* used in these studies came from colonies reared and maintained in laboratory at 25 ± 2°C, 70 ± 10% RH, and 14 photophase hours (REIS; ALVES, 1997), which originated from mites taken from coffee trees that had never been sprayed with pesticides to ensure that the research was done on a population that did not experience any selective pressure toward pesticide resistance.

Laboratory (bio-tests) - The method used was residual spraying on a glass surface, which is the recommended standard for laboratory testing of adverse effects on predaceous mites (REIS et al., 1998), with the laboratory at 25 ± 2°C, 70 ± 10% RH, and 14 photophase hours. Glass slides measuring 20 x 20 mm, of the type used in microscopy, floating in water in a Petri dish measuring 5 cm in diameter and 2 cm in depth, uncovered, were used as a surface for the application of the products, and as a support for the mites. Under these conditions, the slide remained more or less in the center of the dish, not touching its sides, with the water being present for the mites to ingest and to prevent them from escaping.

Application of the pesticides - The products were sprayed in a Potter tower at a pressure of 15 psi, with the tower's spraying table at a distance of 1.7 cm from the spraying tube. Each slide received a deposit of spray of about 1.7 mg/cm^2. These procedures are in compliance with the recommendations of the IOBC/WPRS (HASSAN et al., 1994; OVERMEER, 1988), which provides for a fresh deposit of 1.5 to 2 mg/cm^2 of spray for glass surfaces or leaves. This amount of product was obtained by repeated weighings of a glass slide after being sprayed with water, on a scale with an accuracy of 0.01 mg.

After application of the test products, the slides were placed to dry, under environmental conditions in the laboratory for about one hour, and then placed in water where they received a small amount of castor bean pollen (*Ricinus communis* L.) as food for the surviving mites. Five mated females were transferred, to each slide with the aid of a fine camel brush.

For each species of predaceous mite, rynaxypyr was tested in 5 concentrations (15, 30, 50, 100 and 500 mg a.i./liter of water), hexythiazox was tested in one concentration (15 mg a.i./liter of water) (standard of selectivity in the experiment), and the control received only distilled water, with 6 replications for each treatment, using a completely randomized experimental design.

Criteria used in evaluating the effect of the tested products - Each test lasted 8 days, with a daily count of the live females and the number of eggs laid that resulted in viable larvae, and dead females were removed. The adverse or total effect (*E %*) was calculated by taking into account mortality in treatment, corrected in function of the control mortality, and the effect on reproduction, according to the IOBC/WPRS (BAKKER et al., 1992; OVERMEER, 1988), with $E\% = 100\% - (100\% - M_c)\ x\ E_r$, were: *Mc* = corrected mortality (ABBOTT, 1925) and E_r = effect on reproduction.

The effect on reproduction (*Er*) was obtained by dividing the average egg production of the females in treatment (*R*) by the egg production in the control group ($Er = R_{Treatment} / R_{Control}$). The average egg production per female (*R*) was obtained by the relationship:

$$R = number\ of\ viable\ eggs / \ number\ of\ live\ females$$

The only tests to be considered valid were those in which the mortality in the control group was ≤ 20% (BAKKER et al., 1992).

The total effect values found for each product were classified in toxicity classes 1 to 4 according to the criteria established by the IOBC/WPRS for classifying plant protection products on the basis of the adverse effect caused to beneficial organisms in laboratory tests (BAKKER et al., 1992; HASSAN et al., 1994), which are: class 1 = $E < 30\%$ (innocuous, not harmful), class 2 = 30% < E < 79% (slightly harmful), class 3 = 80% < E < 99% (moderately harmful), and class 4 = $E > 99\%$ (harmful).

3 RESULTS AND DISCUSSION

The product rynaxypyr (chlorantraniliprole 200 SC), in all tested concentrations, was selective for the three species of phytoseiids studied, *A. herbicolus, 1. zuluagai* and *E. citrifolius.* The product can be classified as not harmful (toxicity class 1), equaling to the hexythiazox standard of selectivity in the experiment. The results of the effect of the tested products on predaceous mites are presented in Table 1.

All the treatments caused low mortality rates among mites and a low impact on their reproduction (Table 1). The species *A. herbicolus* proved to be stronger in smaller concentrations of rynaxypyr and more sensitive in the largest. The most resistant of the three species was *I. zuluagai*, even at the highest concentrations. Of the three species of predaceous mites in the study, the most sensitive was *E. citrifolius*, however, the total effect (*E %)* was under 30% (Table 1).

Rynaxypyr (chlorantraniliprole 200 SC) is proposed for use at field concentrations that range up to 300 ppm, in chemical control of lepidopteran larvae and other pests. It is highly potent and efficacious against a wide range of economically important Lepidoptera species, and is also effectively in controlling selected species from other orders such as Coleoptera, Diptera, Hemiptera and Isoptera.

In this worst-case protocol with full exposure of predatory mites to the product, it was shown to be harmless (toxicity class 1). Tier 1 laboratory tests are designed as worst-case exposure experiments to test lethal and sub-lethal effects (BLÜMEL et al., 2000). A harmless or selective classification result indicates that there is no need for additional testing. It can be expected that products demonstrating selectivity in laboratory tests will demonstrate a similar effect under field conditions (FRANZ et al., 1980; REIS et al., 2006).

Table 1 – Toxicity of rynaxypyr (chlorantraniliprole 200 SC) on the phytoseiid mite predators *Amblyseius herbicolus* (Chant, 1959), *Iphiseiodes zuluagai* Denmark & Muma, 1972 and *Euseius citrifolius* Denmark & Muma, 1970, in a residual laboratory toxicity test at 25 ± 2°C, 70 ± 10% RH, and 14 photophase hours (residue of 1.68 ± 0.36 mg/cm² on a glass surface) (n = 30).

Treatments	ppm[1]	*Amblyseius herbicolus*				*Iphiseiodes zuluagai*				*Euseius citrifolius*				Toxicity Class[6]
		$M_C^2(\%)$	R^3	E_r^4	E^5	$M_C^2(\%)$	R^3	E_r^4	E^5	$M_C^2(\%)$	R^3	E_r^4	E^5	
Control (water)	-	-	5.80	-	-	-	1.76	-	-	-	5.60	-	-	-
Rynaxypyr	15	4.0	7.25	1.25	-20.00	24.0	2.16	1.23	6.82	0.00	4.73	0.85	15.48	1
Rynaxypyr	30	-12.0	6.18	1.07	-19.31	8.0	1.52	0.86	20.45	3.33	4.55	0.81	21.42	1
Rynaxypyr	50	-4.0	5.15	0.89	7.59	0.0	1.80	1.02	-2.27	3.33	4.07	0.72	29.76	1
Rynaxypyr	100	-8.0	5.15	0.89	4.14	8.0	2.04	1.16	-6.81	3.33	4.07	0.72	29.76	1
Rynaxypyr	500	16.0	6.00	1.03	13.80	16.0	2.43	1.38	-15.91	16.67	5.52	0.99	17.86	1
Hexythiazox	15	-4.0	4.04	0.70	27.59	8.0	2.17	1.24	-13.64	3.33	4.45	0.79	23.21	1

[1]Concentration (mg of active ingredient / liter).
[2]M_c = corrected mortality (%). M_c = (live mites tested - live mites treated)/ live mites tested x 100.
[3]R = average egg production per females. R = No. viable eggs / No. females.
[4]Effect on reproduction. $E_r = R_{Treatment} / R_{Control}$
[5]Total or adverse effect. $E = 100\% - (100\% - Mc) \times E_r$.
[6]Classes of toxicity according to the IOBC/WPRS: class 1 = $E < 30\%$ (innocuous, not harmful); class 2 = 30 < E < 80 (slightly harmful); class 3 = 80 < E < 99 (moderately harmful), and class 4 = $E > 99\%$ (harmful).

4 CONCLUSIONS

Chlorantraniliprole 200 SC (rynaxypyr) is a product used as a tactic in an integrated pest management strategy, since it was found to be innocuous on predaceous mites of the Phytoseiidae family that are naturally occurring in various crops in Brazil, as well as coffee and citrus, among others.

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