INFLUENCE OF RAINFALL ON MITE DISTRIBUTION IN ORGANIC AND CONVENTIONAL COFFEE SYSTEMS

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(Recebido: 11 de maio de 2009; aceito: 3 de julho de 2009)

ABSTRACT: Climate changes, such as temperature rise, prolonged drought and heavy rainfall, impair human activities, especially the food production sector. Rainfall is one of the most important natural, life-sustaining factors on the planet and it is essential in agriculture, not only to water plants, but also in regulating pest organisms in crops through mechanical control. The mites *Brevipalpus phoenicis* (Geijskes, 1939) and *Oligonychus ilicis* (McGregor, 1917) (Acari: Tenuipalpidae, Tetranychidae) are important coffee pests influenced by the rainfall regime. The aim of this work was to study the distribution of coffee predatory (Phytoseiidae family) and phytophagous (*B. phoenicis* and *O. ilicis*) mites in function of rainfall, between June/2006 and June/2008, in organic and conventional coffee cultivation systems. The experiments were conducted at Cachoeira (organic coffee production) and Taquaril (conventional system) farms, located in the municipality of Santo Antonio do Amparo, Minas Gerais state, in Brazil. Leaves were removed monthly from the middle part of coffee plants from both systems. It was concluded that rainfall influences the populations of pest and predatory mites in the different coffee production systems, but this effect was less intense in the organic coffee.

Key words: Agricultural acarology, *Coffea arabica*, rainfall, population dynamics.

INFLUÊNCIA DO REGIME PLUVIOMÉTRICO NA DISTRIBUIÇÃO DE ÁCAROS EM CAFEEIROS CONDUZIDOS EM SISTEMAS ORGÂNICO E CONVENCIONAL

RESUMO: *As mudanças climáticas, por meio da elevação de temperatura, estiagem prolongada, chuvas intensas, prejudicam a vida do homem e a produção de alimentos. A precipitação pluvial é um dos fatores naturais mais importantes para a manutenção da vida no planeta e fator indispensável na agricultura, não somente pela água disponível para as plantas, mas também por ser um regulador de organismos-praga nas culturas, por meio do controle mecânico. Os ácaros Brevipalpus phoenicis (Geijskes, 1939) e Oligonychus ilicis (McGregor, 1917) (Acari: Tenuipalpidae, Tetranychidae) são importantes pragas da cafeicultura e também são influenciados pelo regime pluvial. Objetivou-se, com a realização deste trabalho, estudar a distribuição dos ácaros predadores (família Phytoseiidae) e fitófagos do cafeeiro (B. phoenicis e O. ilicis), em função da precipitação pluvial, entre os meses de junho 2006 a junho 2008, em dois sistemas de produção de café, orgânico e convencional. Os ensaios foram conduzidos nas fazendas Cachoeira, com produção de café orgânico, e Taquaril, no sistema convencional, localizadas no município de Santo Antônio do Amparo, MG. Mensalmente, foram coletadas folhas no terço médio das plantas de cafeeiro Coffea arabica L., no sistema orgânico e convencional. Os ácaros foram retirados pelo método de lavagem. Concluiu-se que a precipitação pluviométrica influencia as densidades dos ácaros-praga e predadores nos dois sistemas de produção de café, mas com menor intensidade no café produzido no sistema orgânico.*

Palavras-chave: Acarologia agrícola, Caffea arabica, precipitação pluvial, flutuação populacional.

1 INTRODUCTION

Rainfall, an important life-sustaining element, is also indispensible to agricultural production. In the last decades, there has been an increasing worldwide concern with global warming, a process triggered by the burning of fossil fuels, among others, by man. Temperature rise has a direct effect on rainfall and, in Brazil, may lead a reduction in precipitation levels between 10% and 30%, impacting its food production segment (MOLION, 2008).

Rainfall, through mechanical action, reduces the populations of important pests in various crops and there are many studies on its influence on the

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density of insect and mite populations (DEMITE & FERES, 2007; FRANCO et al., 2008; REIS et al., 2000a,b; REIS & SOUZA, 1986a; SILVA et al., 2006; SOUZA & CARVALHO, 2002). Custódio et al. (2009) found a lower incidence of coffee leafminer, *Leucoptera coffeella* (Guérin-Mèneville & Perrottet, 1842), in coffee produced in a center pivot irrigation system.

Among coffee tree pests, *Brevipalpus phoenicis* (Geijskes, 1939) (Acari: Tenuipalpidae), also known as the flat mite, transmits the ringspot vírus (Rhabdovírus group) (CHAGAS, 1973; MATIELLO et al., 1995). Ringspot disease leads to leaf fall (CHAGAS, 1988) and affects beverage quality due to the entry of opportunist fungi in the lesions opened in the fruits (REIS et al., 2000c; REIS & CHAGAS, 2001; REIS & ZACARIAS, 2007).

Oligonychus ilicis (McGregor, 1917) (Acari: Tetranychidae), or the red spider mite, is also an important pest mite due to the damage it inflicts on coffee leaves. The mite destroys leaf cells to feed on their contents, affecting photosynthesis and, consequently, production (REIS & SOUZA, 1986b).

Predatory mites (Phytoseiidae family) have been widely studied and are the most important biological control agents of pest mites in open field crops. These predators are associated to the main pest mites of coffee systems (MINEIRO & SATO, 2008; PALLINI FILHO et al., 1992; REIS et al., 2000b; REIS & ZACARIAS, 2007).

The aim of this work was to assess the annual distribution of important predatory mites (Phytoseiidae family), such as: *Euseius concordis* (Chant, 1959), *Iphiseiodes zuluagai* Denmark & Muma 1972, *Amblyseius herbicolus* (Chant, 1959), *Euseius alatus* DeLeon 1966, *Amblyseius compositus* Denmark & Muma, 1973 and *Euseius citrifolius* Denmark & Muma 1970, and of the phytophagous mites *B. phoenicis* and *O. ilicis*, in function of rainfall, between June 2006 and June 2008, in conventional and organic coffee systems.

2 MATERIAL AND METHODS

The experiment was carried out in the municipality of Santo Antônio do Amparo, Minas Gerais State, Brazil, between June 2006 and June 2008. At Cachoeira farm (20º53’08"S, 44º57’05’’W), in a 1.0 hectare *Coffea arabica* L. plantation, Catuaí cultivar trees managed in an organic system were used. Pest control was done with neem extract obtained on the property, when necessary. Rust (*Hemileia vastatrix* Berk et Br) was controlled with copper hydroxide and soil fertility was corrected using composted coffee husk, castor bean cake and remains of adventitious plants after mowing between the lines. At Taquaril farm (20º56’33"S, 44º55’29’’W), also in a 1.0 hectare area, the same cultivar was managed in a conventional system. Coffee leafminer, *Leucoptera coffeella* (Guérin-Mèneville & Perrottet, 1842) (Lepidoptera: Lyonetiidae), and rust were controlled with thiametoxan + cyproconazole, while control of the coffee berry borer, *Hypothenemus hampei* (Ferrari, 1867) (Coleoptera: Scolytidae), was done with endosulfan. Soil fertility was corrected conventionally with soluble macro and micronutrients, such as nitrates, phosphate and potassium, among others.

In each system, 10 leaves from the central part of the inner side of each plant were collected monthly from 15 coffee plants selected randomly; therefore, a total of 20 leaves were collected in each system per month, during 25 months. The leaves were conditioned in 5 liter plastic bags and transported to the Epamig Sul de Minas/EcoCentro laboratory, in Lavras, Minas Gerais state, where they were stored in a refrigerator at approximately 10ºC until sampling. The samples were made up to three days after picking through the leaf washing method (SPONGOSKI et al., 2005).

The resulting material was analyzed in a stereoscopic microscope. The mites found were removed with a brush, placed in microscopic slides in a modified Hoyer medium (MORAES & FLECHTMANN, 2008) and identified at the Epamig Sul de Minas/EcoCentro Acarology Laboratory, in Lavras, Minas Gerais State. Meteorological data were obtained from a pluviometer installed at Cachoeira farm, 2.5 km from the organic experimental area and 3 km from the conventional. The data were transformed into $\sqrt{x+0,5}$ and subjected to variation analysis by the Scott-Knott test, at 5% (FERREIRA, 2000). The SIGMA PLOT® statistical program was used to determine the Spearman correlation coefficient.

3 RESULTS AND DISCUSSION

In the organic coffee, eight species of predatory mites (Phytoseiidae family) were found, *E. concordis*, *I. zuluagai*, *A. herbicolus*, *E. alatus*, *A. compositus* and *E. citrifolius*, as well as two phytophagous species, *O. ilicis* and *B. phoenicis*, and seven species of a generalist mite family, *Tarsonemus confusus* Ewing, 1939, *Tydeus* sp., *Fungitarsanemus* sp., *Lorrya formosa* Cooreman, 1958, *Rhizogliphus* sp., *Daidalotasonemus* sp., *Tarsonemus bilobatus* Suski, 1965 and Wintershimidttiidae. In the conventional system, only six predators were found, *E. concordis*, *I. zuluagai*, *A. herbicolus*, *E. alatus*, *A. compositus*, *E. citrifolius*, along with two phytophagous species, *O. ilicis* and *B. phoenicis*, and seven species of generalist mite families, *T. confusus*, *Tydeus* sp., *Fungitarsanemus* sp., *L. formosa*, *Rhizogliphus* sp., *Daidalotasonemus* sp, *T. bilobatus* and Wintershimidttiidae.

Rainfall influenced the number of phytoseiid and phytophagous mites in the period studied, regardless of the production system (Figures 1 and 2). This influence was more pronounced in the conventional coffee (Table 1). Meanwhile, during the months in which rainfall was reduced or did not occur at all, mean mite numbers were higher (Table 1). Reis et al. (2000b) observed a smaller *B. phoenicis* population in coffee between October and March, a period of high temperatures and precipitation levels. The authors also point out that predatory mite numbers are also affected by rainfall.

Pallini Filho et al. (1992) observed that the period of lowest *O. ilicis* incidence coincided with the rainy season, a result corroborated by Franco et al. (2008). Reis et al. (2000a) also observed a decrease in the phytoseiid predatory mite population in citrus trees in function of the rainfall regime in Lavras, Minas Gerais State.

In the literature there are no studies on the effect of rainfall on mite populations in organic coffee systems.

Rainfall correlation was negative for the number of mites found in both systems, demonstrating that precipitation affects both pest and predatory mite populations in coffee. However, only in the conventional system was the correlation between occurrence and rainfall significant. This is perhaps due to the system's lower environmental balance, as there is a larger population of phytophagous mites which, consequently, are subject to greater mechanical action (Figures 1 and 2). In the organic system, the phytophagous mite population did not increase with more intense predatory action and the number of phytophagous mites remained low. Therefore, there were fewer population oscillations during the year (Table 2).

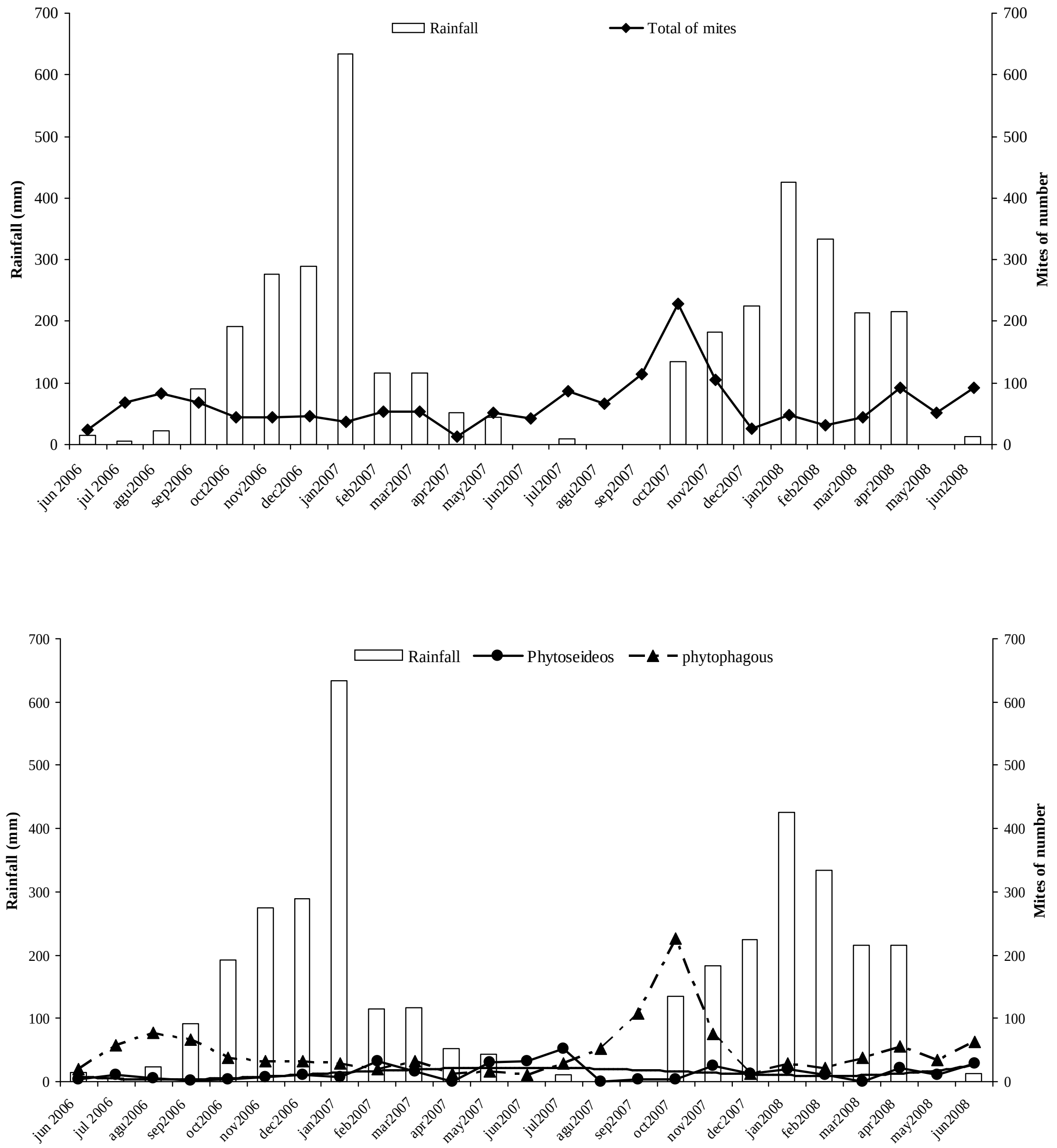
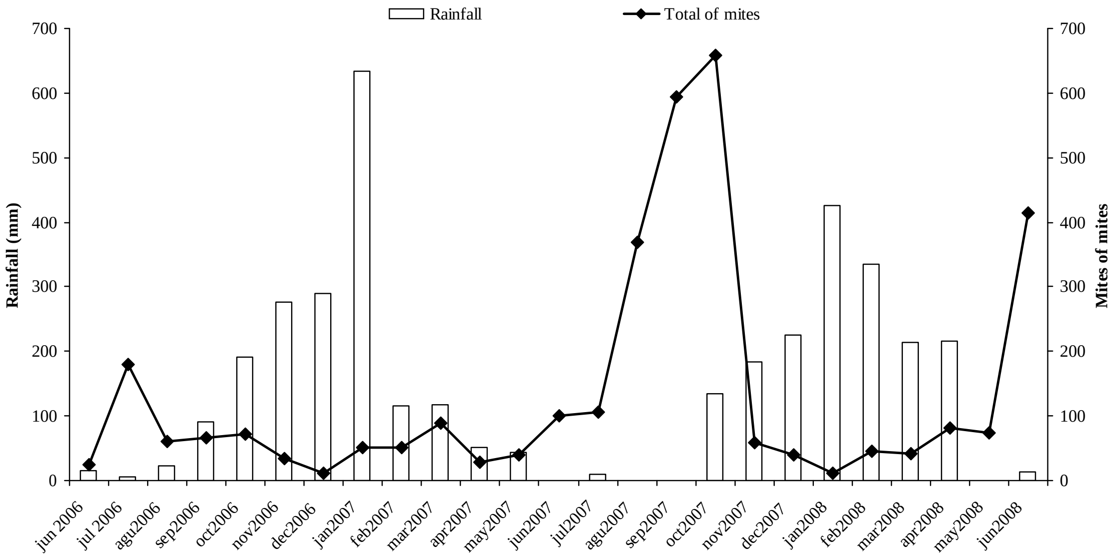


Figure 1 – Distribution of mites in the organic system, in function of rainfall. a) total number of specimens collected. b) total number of predatory phytoseiid and phytophagous mites. Santo Antônio do Amparo, MG, June 2006 to June 2008.



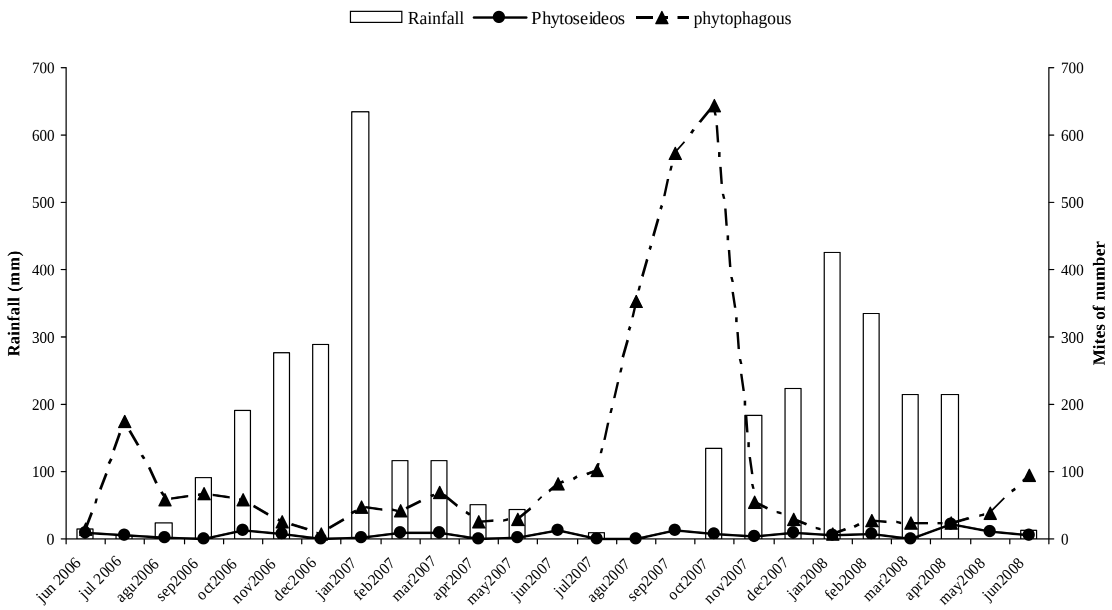


Figure 2 – Distribution of mites in the conventional system, in function of rainfall. a) total number of specimens collected. b) total number of predatory phytoseiid and phytophagous mites. Santo Antônio do Amparo, MG, June 2006 to June 2008.

Table 1 – Mean (standard-error) number of mites found monthly in organic and convention coffee systems, between June 2006 and June 2008. Santo Antônio do Amparo, Minas Gerais State

	Months/year																								
	jun/06	jul/06	agu/06	sep/06	oct/06	nov/06	dec/06	jan/07	feb/07	mar/07	apr/07	may/07	jun/07	jul/07	agu/07	sep/07	oct/07	nov/07	dec/07	jan/08	feb/08	mar/08	apr/08	may/08	jun/08
Rainfall (mm)	15.0	5.0	23.0	91.0	191.5	275.5	289.5	634.0	115.5	116.5	51.5	43.5	0.0	10.0	0.0	0.0	135.0	183.0	224.5	425.5	334.0	214.5	215.0	0.0	12.5
Total of mites																									
Coffee plants organic	1.6 a (0.41)	12.0 a (3.10)	5.47 a (1.14)	4.53 a (1.17)	2.93 a (0.76)	3.00 a (0.78)	3.07 a (0.79)	2.40 a (0.62)	3.60 a (0.93)	3.60 a (0.93)	0.87 b (0.22)	3.47 a (0.90)	2.87 b (0.74)	5.73 a (1.48)	4.40 b (1.14)	7.67 b (1.99)	3.71 b (0.94)	7.0 a (1.81)	1.73 a (0.45)	3.20 a (0.83)	2.13 a (0.55)	2.93 a (0.76)	6.20 a (1.60)	3.40 a (0.88)	6.2 b (1.60)
Coffee plants conventional	1.6 a (0.41)	4.6 b (1.19)	4.00 a (1.03)	4.47 a (1.15)	4.73 a (1.22)	2.33 a (0.60)	0.73 b (0.19)	3.40 a (0.88)	3.40 a (0.88)	5.93 a (1.53)	1.87 a (0.48)	2.60 a (0.68)	6.73 a (1.74)	7.07 a (1.83)	24.53 a (6.33)	39.67 a (10.24)	6.57 a (1.33)	3.93 b (1.02)	2.67 a (0.69)	0.80 b (0.21)	3.07 a (0.79)	2.80 a (0.72)	5.40 a (1.39)	4.93 a (1.27)	27.6 a (7.13)
CV (%)	30.5	34.97	32.24	37.68	37.98	43.41	42.46	39.73	36.18	36.11	31.85	42.59	30.38	32.83	50.78	27.9	49.87	30.49	37.34	30.88	33.44	31.76	25.71	35.57	35.6
Total of mites																									
Coffee plants organic	1.33 a (0.35)	11.66 a (3.01)	5.13 a (1.33)	4.40 a (1.14)	2.47 a (0.64)	2.07 a (0.53)	2.20 a (0.57)	1.47 b (0.38)	1.27 a (0.33)	2.00 b (0.52)	0.80 a (0.21)	0.47 b (0.12)	0.53 b (0.14)	1.20 b (0.31)	2.87 b (0.74)	6.93 b (1.80)	14.87 b (3.84)	5.07 a (1.30)	0.80 a (0.21)	1.87 a (0.48)	0.80 a (0.21)	1.60 a (0.41)	2.20 a (0.57)	1.67 a (0.43)	3.27 b (0.84)
Coffee plants conventional	1.00 a (0.26)	3.87 b (0.99)	3.87 a (0.99)	4.47 a (1.15)	3.87 a (0.99)	1.73 a (0.45)	0.53 b (0.14)	3.20 a (0.83)	2.73 a (0.71)	4.47 a (1.15)	1.60 a (0.41)	1.93 a (0.50)	5.47 a (1.41)	6.80 a (1.76)	23.07 a (5.96)	38.13 a (9.84)	42.60 a (10.99)	3.60 a (0.93)	1.80 a (0.47)	0.33 b (0.09)	1.60 a (0.41)	1.60 a (0.41)	1.60 a (0.41)	2.53 a (0.65)	6.33 a (1.64)
CV (%)	28.3	36.29	34.2	40.71	39.82	43.44	44.12	41.78	50.87	46	36.85	49.81	36.02	39.36	56.24	29.76	26.13	32.93	41.81	37.62	44.6	36.76	38.66	43.14	43.34
Total of mites																									
Coffee plants organic	0.26 a (0.07)	0.33 a (0.09)	0.33 a (0.09)	1.13 a (0.03)	0.40 a (0.10)	0.93 a (0.24)	0.87 a (0.22)	0.93 a (0.24)	2.33 a (0.60)	1.60 a (0.41)	0.07 a (0.02)	3.00 a (0.78)	2.33 a (0.60)	4.53 a (1.17)	1.53 a (0.40)	0.73 a (0.19)	0.40 a (0.10)	1.93 a (0.50)	0.93 a (0.24)	1.33 a (0.34)	1.33 a (0.34)	1.33 a (0.34)	3.67 a (0.95)	1.73 a (0.45)	2.93 a (0.76)
Coffee plants conventional	0.6 a (0.16)	0.73 a (0.19)	0.13 a (0.03)	0.00 a	0.80 a (0.21)	0.60 a (0.16)	0.20 a (0.05)	0.13 b (0.03)	0.60 b (0.16)	1.33 a (0.34)	0.07 a (0.02)	0.53 b (0.14)	1.13 b (0.29)	0.13 b (0.03)	0.53 a (0.14)	1.27 a (0.33)	1.07 a (0.28)	0.33 b (0.09)	0.80 a (0.21)	0.47 b (0.12)	0.80 a (0.21)	0.40 a (0.10)	1.87 b (0.48)	1.07 a (0.28)	0.47 b (0.12)
CV (%)	31.8	34.9	34.27	17.37	35.03	41.85	36.37	34.3	34.67	33.37	18.02	38.7	33.29	36.02	41.36	43.9	45.8	35.33	37.26	33.76	36.25	54.2	31.73	42.23	36.44

Means followed by the same letter in the columns did not differ in the Scott-Knott test at 5% significance.

Table 2 – Correlation between rainfall and populations of predatory and phytophagous mites in organic and conventional coffee systems, between June 2006 and June 2008. Santo Antônio do Amparo, Minas Gerais State.

Production systems	Total number of mites collected	Total number of phytophagous mites	Total number of Predatory mites
Organic	-0.333	-0. 122	-0. 051
	0.102	0. 559	0. 807
Conventional	-0.587	-0. 609	-0. 034
	0.002**	0.001**	0. 867

**Significant correlation in the Spearman test at (p<0.05).

4 CONCLUSIONS

Rainfall influences the density of mite populations in organic and conventional coffee systems.

During the periods in which rainfall is reduced, a larger mite population is found in both organic and conventional systems.

In the organic coffee system, oscillation of mite populations was lower.

5 ACKNOWLEDGEMENTS

To FAPEMIG and CNPq for the scholarships awarded. To the proprietor of Cachoeira farm, Fernando Paiva, and the proprietor of Taquaril farm, Daniel Paiva, for allowing the experiments to be set up on their property.

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