## SCIENTIFIC NOTE

# Predacious Mites in Papaya (*Carica papaya* L.) Orchards: In Search of a Biological Control Agent of Phytophagous Mite Pests

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Ácaros Predadores em Pomares de Mamoeiro (*Carica papaya* L.): Em Busca de um Agente de Controle Biológico de Ácaros Fitófagos

RESUMO - Com o objetivo de selecionar ácaros predadores com potencial de controle de ácaros fitófagos do mamão, foram realizadas, de janeiro de 1999 a fevereiro de 2000, amostragens bimensais de ácaros em dois pomares, um orgânico (Silva Jardim, RJ) e outro com controle químico de pragas, doenças e invasoras (Linhares, ES). Todas as espécies presentes nas brotações laterais, folhas novas, folhas velhas e botões florais dos mamoeiros e nas folhas das plantas invasoras foram quantificadas e identificadas ao menos até família. Apesar da relativamente diversa fauna de ácaros, somente representantes de uma família de predadores, Phytoseiidae, foram encontrados. Dentre estes, *Neoseiulus idaeus* Denmark & Muma destacou-se por sua abundância e freqüência nas diferentes épocas do ano no pomar de Linhares, coincidindo principalmente com as flutuações na abundância dos tetraniquídeos. Tal ocorrência em um sistema de produção com grande emprego de acaricidas, aliada às características biológicas favoráveis dessa espécie, recomendam-na como candidata a agente de controle biológico de ácaros pragas do mamão, em especial *Tetranychus urticae* Koch.

PALAVRAS-CHAVE: Acari, Phytoseiidae, *Neoseiulus idaeus*, controle biológico

ABSTRACT - This study was conducted to search for potential mite predators to control phytophagous mites in papaya orchards. Bimonthly surveys, from January 1999 to February 2000, were carried out in two orchards, one in Silva Jardim (RJ), where pests are naturally controlled, and one at Linhares (ES), where pests are chemically controlled. All mite species collected from buds, new leaves, old leaves, and floral buttons of papaya trees and from weed leaves were quantified and identified to at least family level. Despite the relatively diverse mite fauna, we found representatives of only one family of predacious mites, i.e. Phytoseiidae. Among these, *Neoseiulus idaeus* Denmark & Muma was the most abundant and frequent during all seasons in the Linhares orchard, coinciding mainly with the fluctuations in abundance of tetranychid mites. Such occurrence in a production system with large use of acaricides, together with its favorable biological traits reported in the literature, lead us to recommend this species as a good candidate for biological control of papaya mite pests, especially *Tetranychus urticae* Koch.

KEY WORDS: Acari, Phytoseiidae, *Neoseiulus idaeus*, biological control

The broad mite, *Polyphagotarsonemus latus* (Banks) (Tarsonemidae) and some mites of the family Tetranychidae, especially the two-spotted spider mite, *Tetranychus urticae* Koch, are the main pests of papaya (*Carica papaya* L.) in Brazil (Flechtmann 1981, Santa-Cecília & Reis 1986). Broad mites attack mainly the terminal buds; severe infestations inhibit new stem growth, with consequent reduction in fruit production. Two-spotted spider mites feed more commonly on older leaves, which initially turn yellow on the upper side and silver on the lower side, followed by necrotic areas and eventually leaf drop. This damage directly influences photosynthesis and increases exposure to the sun, with

negative consequences for fruit production and marketability. The broad mite reaches higher population densities in the wet season, whereas the two-spotted spider mite predominates in the dry season. For this reason, pesticide applications in papaya orchards occur year-round, with the well-known risks to the environment and human health (Marin *et al*. 1995).

A safe alternative to chemical control of phytophagous mites in papaya growing areas of Brazil is the use of predacious mites. Since the 1960s, biological control of phytophagous mites, mainly with phytoseiid mites, has been implemented worldwide in several crops, both in the field and in greenhouses (McMurtry 1983). In Brazil, for example, a program was successfully implemented in apple orchards to control phytophagous mites using the phytoseiid *Neoseiulus californicus* (McGregor) (Monteiro 1994). Other studies suggested the use of several predacious mite species for the integrated management of phytophagous mites in citrus orchards (Gondim *et al*. 1996; Reis & Alves 1997 a,b). To date, nothing is reported on the role of predacious mites in papaya orchards in Brazil, and this has hindered the development of biological control programs in this agroecosystem.

One of the prime requirements for a predacious mite to be selected as an efficient control agent is its adaptability to the prey's habitat (Jepson *et al*. 1975). Thus, it is recommended that any search for such agent should be first attempted in the agroecosystems where the pest is a problem (Rice *et al*. 1976, Ferla & Moraes 1998). With that in mind, we conducted a survey in two three-year old papaya orchards (cultivar Golden, group Solo), one cultivated under the organic system (i.e., without pesticides, in Silva Jardim, Rio de Janeiro State) and the other under the conventional system (i.e., with pesticides, in Linhares, Espírito Santo State), with 3 ha and 5 ha, respectively. Both orchards are located in Brazil's southeastern tropical coastal plain, a region with great insolation, annual average temperature between 21°C and 23°C, and more than 1200 mm of precipitation (Neto *et al*. 1983).

Bimonthly samplings on papaya trees and weeds were carried out from January 1999 to February 2000. On each sampling date, we randomly selected 10 sampling sites, and, in each site, five trees, totaling 50 trees per orchard. From each papaya tree we collected one new leaf (small and light green, from the apical region), one old leaf (completely expanded and intense green, from the lower part of the canopy), one lateral bud (counted as one leaf), and one flower, which, together, constituted one sample. Whenever possible, we also collected five weed plants from each site sampled. Weeds were sometimes absent because growers usually control them chemically to keep away aphids that may carry the papaya ringspot virus (Marin *et al*. 1995).

Each sample was put in a paper bag properly identified. All bags were placed in cooler boxes and transferred to the Laboratory of Plant Protection, at the Universidade Estadual do Norte Fluminense. The material sampled was inspected under a stereoscopic microscope. All mites found, independently of their role in the ecosystem, were counted and preserved in a mixture of ethyl alcohol, glacial acetic acid, glycerol, and sorbitol, in the proportion of 8:1:1:1 (Gutierrez 1985). Finally, they were mounted on slides in Hoyer's medium for further identification. Among the

Table 1. Number of mites collected on papaya trees and weeds in Silva Jardim (RJ) and Linhares (ES) from January 1999 to February 2000[1].

| Family | Species | Papaya trees | | Weeds | |
|---|---|---|---|---|---|
| | | Silva Jardim (without pesticides) | Linhares (with pesticides) | Silva Jardim | Linhares |
| Tarsonemidae | *Polyphagotarsonemus latus* (Banks) | 0 | 24675 | 0 | 0 |
| Tetranychidae | *Tetranychus* spp. | 6801 | 23822 | 677 | 219 |
| Phytoseiidae | *Amblyseius impeltatus* Denmark & Muma | 1 | 0 | 0 | 0 |
| | *A. operculatus* DeLeon | 10 | 0 | 0 | 0 |
| | *A. tamatavensis* Blommers | 20 | 5 | 0 | 0 |
| | *Neoseiulus idaeus* Denmark & Muma | 0 | 337 | 0 | 0 |
| | *Typhlodromalus aripo* DeLeon | 0 | 17 | 0 | 0 |
| | *T. limonicus* (Garman & McGregor) | 56 | 34 | 0 | 4 |
| | *T. manihoti* (Moraes) | 20 | 0 | 0 | 0 |
| | *T. peregrinus* (Muma) | 27 | 0 | 0 | 0 |
| | *Typhlodromips* sp. | 6 | 0 | 0 | 0 |
| Acaridae | | 17 | 19 | 5 | 0 |
| Ascidae | *Proctolaelaps* sp. | 6 | 9 | 0 | 0 |
| Laelapidae | *Pseudoparasitus* sp. | 5 | 0 | 0 | 0 |
| Oribatidae | | 3 | 2 | 5 | 1 |
| Pyemotidae | | 14 | 0 | 0 | 0 |

[1] Seven sampling dates

Table 2. Abundance of phytoseiids in two papaya orchards (Silva Jardim, RJ and Linhares, ES), from January 1999 to February 2000.

| Species of phytoseeiid mites | Abundance (average number of mites/sample)[1] | |
|---|---|---|
| | Silva Jardim (without pesticides) | Linhares (with pesticides) |
| *A. impeltatus* | 0.01 | 0.00 |
| *A. operculatus* | 0.06 | 0.00 |
| *A. tamatavensis* | 0.13 | 0.03 |
| *N. idaeus* | 0.00 | 2.20 |
| *T. aripo* | 0.00 | 0.10 |
| *T. limonicus* | 0.37 | 0.20 |
| *T. manihoti* | 0.13 | 0.00 |
| *T. peregrinus* | 0.18 | 0.00 |
| *Typhlodromips* sp. | 0.04 | 0.00 |

[1] Average of seven samplings and 50 papaya trees per sampling; plant parts sampled: new leaves, old leaves, lateral buds, and flowers

phytophagous mites, special attention was paid to the number of broad mites and tetranychid mites found per sampling date, in order to compare their fluctuations in abundance with those of the predacious mites.

Overall, we found a relatively low diversity of mites in both orchards (Table 1). Representatives of seven families were found in Silva Jardim (organic orchard) and six in Linhares (conventional orchard). Most families (Acaridae, Ascidae, Oribatidae, Phytoseiidae, and Tetranychidae) were represented in both places, but some were present only in one of the orchards (Laelapidae and Pyemotidae in Silva Jardim, Tarsonemidae in Linhares). This last result was very striking, because *P. latus*, the only tarsonemid in Linhares and the most abundant mite in this orchard, was completely absent from the organic orchard throughout the year. Tetranychids, on the other hand, were abundant in both orchards. The low incidence of mites on weeds, except for *Tetranychus* spp., may be explained, at least in part, by the herbicides periodically applied by the growers to control these plants, which turned this resource very unpredictable in time for phytophagous mites and, most importantly, for thir predators.

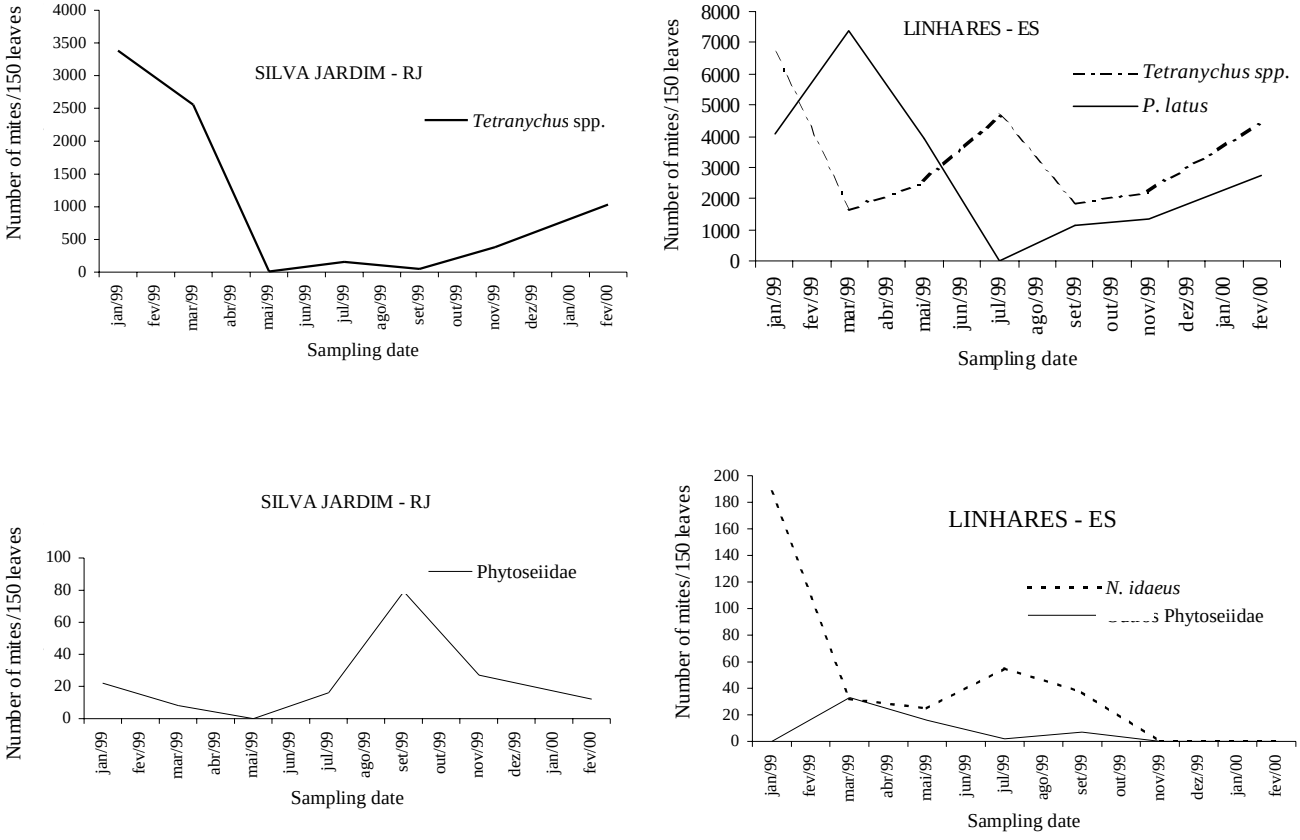


Figure 1. Population dynamics of phytophagous mites (A) and phytoseiids (B) in Silva Jardim and Linhares from January 1999 to February 2000.

In terms of predacious mites, only one family, Phytoseiidae, was represented in both orchards (Tables 1 and 2). In the organic orchard, seven phytoseiid species were found; among these, *Typhlodromalus limonicus* (Garman & McGregor), *T. peregrinus* (Muma), *T. manihoti* (Moraes), and *Amblyseius tamatavensis* Blommers were the most abundant. However, the average number of mites of each species per sample (< 0.5) was relatively low (Table 2). Similarly, there was a relatively low incidence of phytophagous mites throughout the year. Besides the absence of the broad mite, the density of the tetranychids never reached levels of severe infestation (Fig.1A). Because there was no association between the population levels of tetranychids and predacious mites (Fig.1A,B), probably the phytoseiids found in this orchard, included in the category of generalist predators by McMurtry & Croft (1997), rely mainly on food sources other than the main pests of papaya.

In the conventional orchard, only four phytoseiid species were found, namely *Typhlodromalus aripo* DeLeon, *T. limonicus*, *A. tamatavensis*, and *Neoseiulus idaeus* Denmark & Muma, the latter being the dominant species; we found more than two *N. idaeus* individuals per sample (Table 2). Fluctuations in its abundance coincided with those of the tetranychids found in the orchard (Fig. 1A,B). In a recent review, McMurtry & Croft (1997) concluded that predacious mites relatively specialists, represented by the genera *Neoseiulus* (in part, including *N. idaeus*) and *Galendromus*, usually are dominant in highly disturbed agroecosystems, but less common in more natural ecosystems. Our findings support this notion — although completely absent in the organic papaya orchard, *N. idaeus* was the most abundant in the conventional orchard.

*N. idaeus* belongs to a group of selective predators of tetranychid mites, but its prey range is relatively broad within these web-producers (McMurtry & Croft, 1997). In their absence, *N. idaeus* can survive on plant exudates (Mégavand & Tanigoshi 1995) and possibly feed on mites of other families (McMurtry & Croft 1997). These characteristics, along with its ability to disperse and reproduce rapidly and its adaptability to changing conditions of agricultural systems, make *N. idaeus* a very strong candidate for biological control of mite pests of papaya, especially *T. urticae*. The year-round presence and abundance of *N. idaeus* in this chemically-controlled environment indicates that it may easily develop resistance to pesticides, which furthers its potential as a control agent in integrated pest management programs.

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## Literature Cited

**Ferla, N.J. & G.J. Moraes. 1998.** Ácaros predadores em pomares de maçã no Rio Grande do Sul. An. Soc. Entomol. Brasil 27: 649-654.

**Flechtmann, C.H.W. 1981.** Ácaros de importância agrícola, 4. ed. São Paulo, Nobel, 189p.

**Gondim, M.G.C., Jr., G.J. Moraes, J.V. Oliveira, R. Barros & J.L.L. Pereira. 1996.** Biologia de *Neoseiulus anonymus* (Acari: Phytoseiidae). An. Soc. Entomol. Brasil 25: 451-455.

**Gutierrez, J. 1985.** Mounting techniques, p. 351-353. In W. Helle & M. Sabelis, Spider mites, their biology, natural enemies and control. Amsterdam, Elsevier Science, 406p.

**Jepson, L.R., H.H. Keifer & E.W. Baker. 1975.** Mites injurious to economic plants. Berkeley, University of California Press, 614p.

**Marin, S.L.D., J.A. Gomes, J.S. Salgado, D.S. Martins & E.A. Fulin. 1995.** Recomendações para a cultura do mamoeiro dos grupos Solo e Formosa no estado do Espírito Santo, 4. ed. Vitória, EMCAPA, Circ. Téc. 3, 57p.

**McMurtry, J.A. 1983.** Phytoseiid predators in orchard systems: a classical biological control success story, p. 21-26. In M.A. Hoy, G.L. Cunningham & L. Knutson (eds.), Biological control of pests by mites. Berkeley, ANR Publications, University of California, 185p.

**McMurtry, J.A. & B.A. Croft. 1997.** Life-styles of phytoseiid mites and their roles in biological control. Annu. Rev. Entomol. 42: 291-321.

**Mégevand, B. & L.K. Tanigoshi. 1995.** Effects of prey deprivation on life table attributes of *Neoseiulus idaeus* Denmark & Muma (Acari: Phytoseiidae). Biol. Control 5: 73-82.

**Monteiro, L.B. 1994.** Manejo integrado de *Panonychus ulmi* em macieira: primeiras experiências com a introdução de *Neoseiulus californicus*. Rev. Bras. Frut. 16: 46-53.

**Neto, M.F., M.A. Marinho, J.M.G. Tomasi, A.G. Ribeiro & M.B. Machado. 1983.** Capacidade de uso dos recursos naturais renováveis, p. 629-681. In Projeto Radambrasil, folhas SF.23/24 Rio de Janeiro/Vitória, Levantamento de Recursos Naturais, vol. 32, 780p.

**Reis, P.R. & E.B. Alves. 1997a.** Biologia do ácaro predador *Euseius alatus* DeLeon (Acari: Phytoseiidae. An. Soc. Entomol. Brasil 26: 359-363.

**Reis, P.R. & E.B. Alves. 1997b.** Criação do ácaro predador *Iphiseiodes zuluagai* Denmark & Muma (Acari: Phytoseiidae) em laboratório. An. Soc. Entomol. Brasil 26: 565-568.

**Rice R.E., R.A. Jones & M.L. Hoffman. 1976.** Seasonal fluctuations in phytophagous and predaceous mite populations on stonefruits in California. Environ. Entomol. 5: 557-564.

**Santa-Cecília, L.V. C. & P.R. Reis. 1986.** Pragas do mamoeiro. Inf. Agropec. 12: 49-52.

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