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Molecular verification of dispersal of phytoseiid mites from groundcover plants to tree leaves in Japanese peach orchards

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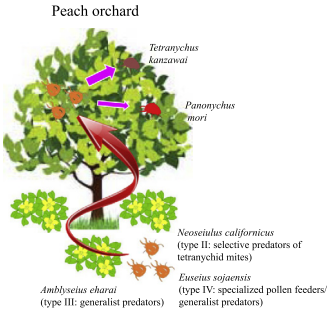
HIGHLIGHTS

- A population survey of phytoseiid and spider mites was conducted in peach orchards.
- Phytoseiid mite species composition changed seasonally and varied among orchards.
- Phytoseiid mite species of various feeding habits preferred *Tetranychus* to *Panonychus*.
- Phytoseiid mites move from groundcover to tree leaves.

GRAPHICAL ABSTRACT



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ABSTRACT

A population survey of phytoseiid mites and of spider mites on randomly selected trees and their groundcover plant *Paederia foetida* L. (Rubiaceae) was conducted in Japanese peach orchards that used different pesticide practices. An organic orchard with wild groundcover and no synthetic chemicals used for pest control and a conventionally managed orchard with bare ground had no trees on which spider mite density was beyond the control threshold density (one mite per leaf). On the other hand, spider mite densities in some trees at conventionally managed orchards with wild groundcover were temporary beyond the control threshold level. The phytoseiid mite species composition on peach leaves estimated by previously established method using quantitative sequencing changed during the survey period and varied among orchards. PCR amplification of the internal transcribed spacer (ITS) region of ribosomal genes of *Tetranychus kanzawai* Kishida and *Panonychus mori* Yokoyama from three phytoseiid mite species, *Neoseiulus californicus* (McGregor), *Amblyseius eharai* Amitai and Swirski, and *Euseius sojaensis* (Ehara), collected on peach leaves was conducted. Results showed that the feeding preference for the three phytoseiid mite species was greater for *T. kanzawai* than for *P. mori* in the field. PCR amplification of the ITS sequences of *Petrobia harti* (Ewing) inhabiting *Oxalis corniculata* L. (Oxalidaceae) showed that phytoseiid mites move from groundcover plants to peach leaves, possibly through ambulatory and aerial dispersal.

1. Introduction

Phytoseiid mites have been recognized as potential biological control agents to suppress pests such as spider mites, thrips, whiteflies, and other arthropods (Croft and Jung, 2001; Helle and Sabelis, 1985; McMurtry and Croft, 1997; Nomikou et al., 2002; van Lenteren, 2001). The importance of some groundcover plants has been suggested to promote the occurrence of phytoseiid mites

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Table 1
Location, area, and pest control of each study site.

Study site	Latitud longitude	Area (m^2)	Product applied	IRAC mode of action classification[a]	Study site	Latitud longitude	Area (m^2)	Product applied	IRAC mode of action classification[a]
Organic/groundcover	N34° 35′05.9″ E133° 39′36.7″	2440	BT (Apr 17)	11A	Conventional III/ groundcover	N34° 35′02.4″ E133° 39′37.8″	2900	Tolfenpyrad (Apr 16)	21A
								Thiacloprid (May 5)	4A
Conventional I/groundcover	N34° 35′02.7″ E133° 39′41.1″	1500	Adion (Apr 22)	3A				Alanycarb, buprofezin (Jun 1)	1A, 16
			Buprofezin (May 14)	16					
			Chlorantraniliprole, etoxazole (Jun 5)	28, 10B				Etoxazole (Jun 10)	10B
								Acetamiprid (Jun 23)	4A
			Thiacloprid (Jun 16)	4A				Thiacloprid, cyenopyrafen (Jul 12)	4A, 25
			Dinotefuran (Jun 25)	4A					
			Tolfenpyrad (Jul 5)	21A	Conventional IV/groundcover	N34° 35′06.7″ E133° 39′38.8″	1400	Permethrin (Apr 17)	3A
			DMTP (Sep 6)	1B				Alanycarb (Apr 29)	1A
			MEP(Oct12)	1B				Buprofezin (May 9)	16
Conventional II/no groundcover	N34° 35′04.0" E133° 39′40.2"	400	Adion (Apr 28)	3A				Alanycarb (May 22)	1A
			Chlorantraniliprole, etoxazole (Jun 6)	28, 10B				Acetamiprid, cyenopyrafen (Jun 4)	4A, 25
			Thiacloprid (Jun 17)	4A				Thiacloprid (Jun 14)	4A
			Dinotefuran (Jun 30)	4A				Dinotefuran (Jun 28)	4A
			Tolfenpyrad (Jul 7)	21A				Tolfenpyrad (early Jun)	21A
			Acetamiprid (Jul 19)	4A				Acetamiprid (mid Jul)	4A
			Flubendiamide (Aug 15)	28				Flubendiamide (early Aug)	28

[a] See IRAC (http://www.irac-online.org/teams/mode-of-action/).