Phytoseiid mites (Acari) are bio-indicators of agricultural practice impact on the agroecosystem functioning

F. Le Bellec, Julie Mailloux, P. Dubois, Amélie Rajaud, Serge S. Kreiter, Christian C. Bockstaller, Marie-Stéphane M.-S. Tixier, E. Malézieux

Phytoseiid mites (Acari) are bio-indicators of agricultural practice impact on the agroecosystem functioning : the case of weed management in citrus orchards

Le Bellec F. [1], Mailloux J. [1], Dubois P. [1], Rajaud A. [1], Kreiter S. [2], Bockstaller C. [3], Tixier M.S. [2], Malézieux E. [4]

[1]CIRAD, UPR Hortsys, Stn de Vieux-Habitants, Guadeloupe, 97119, Vieux-Habitants, France
[2] Montpellier SupAgro, UMR CBGP 1062 INRA/IRD/CIARD/SupAgro, CS 30016, 34988 Montferrier sur Lez cedex, France
[3] INRA, UMR 1121 Nancy-Université - INRA, IFR 110, BP 20507, 68021 Colmar, France
[4]CIRAD, UPR103, TA B-103/PS4 - Bd de la Lironde- 34398 Montpellier cedex 5, France
lebellec@cirad.fr

In tropical conditions, the weed management in citrus orchards is particularly problematic when the fields are not mechanized. To reduce competition between trees and weeds, the producers use herbicides in excess of the permitted annual dose, particularly for glyphosate. In the current context of a demand of pesticide reduction, the challenge is to develop sustainable innovative systems. Our participatory method to design innovative sustainable cropping systems for citrus production led to the selection of different prototypes of weed management (Le Bellec et al., 2009). The aim of our study is to create a weed management-related indicator of ecosystem disturbance. Predatory mites of the family Phytoseiidae (Acari: Mesostigmata) were chosen for their potential as a bio-indicator of agricultural practice impacts on the agroecosystem functioning (Zacharda, 2001; Moonen and Barbari, 2008).

Materials and Methods

Density and species richness of Phytoseiidae mites were monthly surveyed from October 2008 to July 2009 in six different ground cover management prototypes: 5 herbicide applications per year without mowing (Gly), 5 mowing per year without any herbicide application (PV), 5 mowing with one herbicide application in dry season (AV), late mowing without any herbicide application (LMV), cover crop (*Neonotonia wightii*, Fabaceae) without any herbicide application (PNeo) and the same cover crop with herbicide application in dry season (ANeo). Gly and PV are current practices in Guadeloupe. In order to compare species diversity and its variation overtime, the reciprocal Simpson's diversity index (1/D) was used. The density and species diversity of Phytoseiidae mites were used to rank the prototypes (Mailloux et al., 2009).

Results and discussion

Two classes of disturbance have been identified: i/ Gly, PV and AV with low Phytoseiid species diversity and densities and ii/ LMV, ANeo and PNeo with high phytoseiid mite diversity and high densities (Table). Herbicide and mowing were proved to equally reduce the density and the diversity of predacious mites (Figure). A three to four-month delay appeared to be necessary for phytoseiid mites to settle back. Reducing herbicide or mowing frequency seemed thus be a good alternative to let phytoseiid mites develop in the ground cover (Mailloux et al., 2009).

The disadvantage of this bio-indicator is its difficulty to be observed (very small, difficult to determine) which limits its direct use as an indicator. The results of our experiment allow us to link the level of disturbance to a number of interventions on weeds. Three classes were determined according to the number of interventions as follow: undisturbed environment A [$\leq$ 1 intervention per year], moderately disturbed B [2 or 3 interventions per year] and very disturbed C [$\geq$ 4 interventions per year]. The indicator of the disturbance level scores 0, 0.5 or 1.

Conclusions

Our study enables us to use the bio-indicator Phytoseiidae to link the frequency of ground cover treatment and the level of the agroecosystem disturbance. The number of interventions per year, which is an accessible data, is the variable we selected as an indicator of disturbance. This indicator will be associated with other ones to perform a multi-criteria assessment of the crop system. Results of the multi-criteria assessment will be used as support tools the decision allowing the user to evaluate the system to evolve it and make it more sustainable.

References

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Item	Diversity index values	Phytoseiid mite density per plot	Number of intervention/year
Gly	Low	Low (1.5 mites)	4
AV	Low	Low (1.2 mites)	5
PV	Low	Low (1.4 mites)	5
LMV	High	High (6.9 mites)	1
ANeo	High	High (13.5 mites)	1
PNeo	High	High (13.4 mites)	0

Table: Mean number of phytoseiid mites per item from October 2008 to July 2009

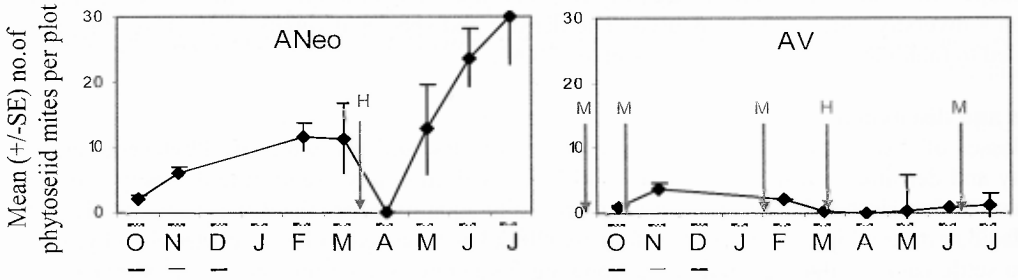

Figure: Seasonal densities of phytoseiid mites per plot and per sampling and treatments applications. ANeo: cover crop (*Neonotonia wightii*, Fabaceae) with herbicide application (dry season); AV: mowing with herbicide application (dry season); H = herbicide; M = Mowing