Bulletin of Insectology ***64*** *(Supplement): S141-S142, 2011*
ISSN 1721-8861

Development of innovative methods for trapping phytoplasma vectors by attractive infochemicals

Jürgen Gross, Christoph J. Mayer, Astrid Eben
Julius Kuehn-Institute, Federal Research Centre for Cultivated Plants, Institute for Plant Protection in Fruit Crops and Viticulture, Schwabenheimer Str. 101, 69221 Dossenheim, Germany

Abstract

Some examples of attempts to develop biotechnical control methods for psyllids vectoring fruit tree phytoplasmas by sticky traps lured with newly detected infochemicals are reported. The apple psyllid *Cacopsylla picta* is the main vector of '*Candidatus* Phytoplasma mali', the agent associated with apple proliferation disease in Germany and most neighbouring countries. Complex interactions between *Malus domestica,* the psyllid *C. picta*, and the phytoplasma were investigated in laboratory and field experiments. Results showed that emigrants of *C. picta* are able to distinguish the odours of healthy and infected apple trees and preferred the odours of infected trees. This means that the phytoplasma directly manipulates both the plant physiology by producing an attractive compound, and the psyllid behaviour, resulting in a better spread within its host plant population. The compound responsible for the attraction of the vector was collected from the headspace of infected apple plants and identified by gas chromatography coupled with mass spectrometry. It attracted both genders of *C. picta* and will be used for the development of traps for monitoring or mass trapping.

Key words: '*Candidatus* Phytoplasma mali', apple proliferation, *Cacopsylla picta, Cacopsylla melanoneura*, infochemicals, monitoring, mass trapping.

Introduction

During their evolution, pathogens and their hosts must pursue different strategies to avoid reciprocal detrimental effects. Investigating multitrophic systems, up to now only limited information is available on the evolution of interactions between plants, phytoplasmas, and their insect vectors. The results of investigations on the chemically mediated interactions of the cell wall-lacking bacterium '*Candidatus* Phytoplasma mali', its host plant apple tree (*Malus domestica*), its main vector *Cacopsylla picta* and the (partial) vector *C. melanoneura* (Hemiptera: Psyllidae) (Mayer *et al*., 2009) are reported. The apple proliferation phytoplasma causes major economic yield losses by inducing tasteless dwarf fruits on its host plant. It can modify the emitted volatiles of its host plant, resulting in their increasing attractiveness for its vector, compared to a closely related non-vector (Mayer *et al*., 2008a, 2008b, 2011). Furthermore, we present our attempts to use these findings for the development of innovative biotechnical control methods for psyllid species vectoring fruit tree phytoplasmas by sticky traps lured with newly detected infochemicals.

Materials and methods

Investigations were done by measuring the population dynamics of closely related species on their alternate host plants. Infections of vector insects and plants were analyzed by PCR using specific primers selective for fruit tree phytoplasmas. Further, the olfactory preferences of psyllids were investigated in Y-shaped olfactometer bioassays. Fitness parameters of insects were measured on infected and non-infected plants. Host plant odours were collected using different headspace sampling methods, thermodesorption and afterwards analysed using gas chromatographs coupled with mass spectrometers.

Results and discussion

We could show that the phytoplasma directly manipulates the plant physiology and indirectly the vector behaviour by attracting *C. picta* to infected plants, leading to a better spread within its host plant population (Mayer *et al*., 2008a, 2008b). In contrast, its vector evolved mechanisms to minimize harmful effects emanated by the phytoplasma: the infection is tolerated by adults and detrimental effects to the offspring are avoided by an adapted oviposition behaviour (Mayer *et al*., 2011). The compound responsible for the attraction of the vector was collected from headspace of infected apple plants and identified by gas chromatography coupled with mass spectrometry. The sesquiterpene ß-caryophyllene attracted both genders of *C. picta* and will be used for the development of traps for monitoring and/or mass trapping of *C. picta* (Gross and Mayer, 2010).

Acknowledgements

We thank the German Research Foundation (DFG) for funding (GR 2645/1,2). J.G. is grateful to the Stifterverband für die Deutsche Wissenschaft for a generous research award.

References

GROSS J., MAYER C. J., 2010.- Nuove prospettive per il monitoraggio e la difesa biomolecolare.- *Frutta e vite*, 34(1): 39-41.

MAYER C. J., VILCINSKAS A., GROSS J., 2008a.- Pathogen-induced release of plant allomone manipulates vector insect behaviour.- *Journal of Chemical Ecology*, 34: 1518-1522.

MAYER C. J., VILCINSKAS A., GROSS J., 2008b.- Phytopathogen lures its insect vector by altering host plant odor.- *Journal of Chemical Ecology*, 34: 1045-1049.

MAYER C. J., JARAUSCH B., JARAUSCH W., JELKMANN W., VILCINSKAS A., GROSS, J., 2009.- *Cacopsylla melanoneura* has no relevance as vector of apple proliferation in Germany.- *Phytopathology*, 99: 729-738.

MAYER C. J., VILCINSKAS A., GROSS J., 2011.- Chemically mediated multitrophic interactions in a plant-insect vector-phytoplasma system compared with a partially nonvector species.- *Agricultural and Forest Entomology*, 13: 25-35.

Corresponding author: Jürgen GROSS (e-mail: juergen.gross@jki.bund.de) Julius Kuehn-Institute, Federal Research Centre for Cultivated Plants, Institute for Plant Protection in Fruit Crops and Viticulture, Schwabenheimer Str. 101, 69221 Dossenheim, Germany.