

Chemo-ecologically mediated interactions among '*Candidatus Phytoplasma mali*', its vector *Cacopsylla picta*, and their host plant *Malus domestica*

Christoph J. MAYER^{1,2}, Andrea VILCINSKAS¹, Jürgen GROSS¹

¹Institute of Phytopathology and Applied Zoology, Justus-Liebig-University, Giessen, Germany

²Entomology/Chemoecology, Institute for Plant Protection in Fruit Crops, Federal Biological Research Centre for Agriculture and Forestry, Dossenheim, Germany

Abstract

Apple proliferation caused by the apple proliferation phytoplasma, '*Candidatus Phytoplasma mali*', causes major economic losses in European apple production. The apple proliferation phytoplasma is naturally spread by the two leaf sucker species *Cacopsylla melanoneura* and *C. picta* (Hemiptera: Sternorrhyncha: Psyllidae). It was investigated in a previous study that both psyllid species use chemical cues for orientation. In this study investigations were carried out on the behavioural reactions of *C. picta* on volatiles from healthy plants and those infected with apple proliferation in respect to the infection status of the psyllids themselves and to their previous host experience. The influence of the apple proliferation phytoplasma on the volatile emission of apple trees was investigated by head space collection followed by gas chromatography coupled with mass spectrometry.

The differences in the behavioural responses to the volatiles of infected versus non-infected plants as well as the respective differences detected among the volatile compounds will be presented and ecological interactions between the association of *C. picta* and '*Ca. P. mali*' will be discussed.

Key words: Apple proliferation, *Cacopsylla picta*, '*Candidatus Phytoplasma mali*', head space, *Malus domestica*, olfactory orientation, plant odours, plant volatiles, Psyllidae.

Introduction

Apple proliferation caused by the apple proliferation phytoplasma, '*Candidatus Phytoplasma mali*', causes major economic losses in European apple production. The apple proliferation phytoplasma is naturally spread by the two leaf sucker species *Cacopsylla melanoneura* (Foerster) and *Cacopsylla picta* (Foerster) (Hemiptera: Sternorrhyncha: Psyllidae) (Frisinghelli *et al.*, 2000; Tedeschi *et al.*, 2002; Jarausch *et al.*, 2003).

The univoltine lifecycle of *C. melanoneura* with its two migratory phases between reproduction hosts, transitional hosts and over-wintering hosts at mountainous sites was previously described in detail (Mayer and Gross, 2007).

The life cycle of the main vector *C. picta* is basically similar to that of *C. melanoneura*. Reproduction and juvenile development takes place on apple trees in spring, while the newly emerged adults emigrate after some days of feeding to other host plants like spruce. After overwintering on conifers re-immigration onto apple takes place in early spring. Transmission of apple proliferation by both emigrants and re-immigrants has been proofed by Italian and German working groups earlier (Frisinghelli *et al.*, 2000; Tedeschi *et al.*, 2002; Jarausch *et al.*, 2004).

It was investigated in a previous study that both psyllid species use chemical cues for orientation (Gross and Mekonen, 2005).

Materials and methods

In this study behavioural reactions of *C. picta* on volatiles from healthy plants and those infected with apple proliferation in respect to the infection status of the psyllids themselves and to their previous host experience was examined using Y-shaped olfactometer. Furthermore, the influence of the apple proliferation phytoplasma on the volatile emission of apple trees was investigated by head space collection followed by gas chromatography coupled with mass spectrometry.

Results and discussion

The composition of the volatile compounds detected in the headspace of the investigated plant (*Malus domestica*) showed differences both qualitative and quantitative, when the total ion chromatograms of odours of plants (healthy and infected by apple proliferation phytoplasma) were compared. Furthermore, the vector insects showed differences in the behavioural responses to the volatiles of infected versus non-infected plants, leading to the hypothesis, that '*Ca. P. mali*' manipulates the behaviour of its insect vector for better spreading in host plant population.

The ecological interactions between the association of *C. picta* and '*Ca. P. mali*' will be discussed.

References

- FRISINGHELLI C., DELAITI L., GRANDO M. S., FORTI D., VINDIMIAN M. E., 2000.- *Cacopsylla costalis* (Flor 1861), as a vector of apple proliferation in Trentino.- *Journal of Phytopathology*, 148 (7-8): 425-431.
- GROSS J., MEKONEN N., 2005.- Plant odours influence the host finding behaviour of apple psyllids (*Cacopsylla picta*; *C. melanoneura*).- *IOBC/wprs Bulletin*, 128 (7): 351-355.
- JARAUSCH B., SCHWIND N., JARAUSCH W., KRCZAL G., 2004.- Overwintering adults and springtime generation of *Cacopsylla picta* (synonym *C. costalis*) can transmit apple proliferation phytoplasmas.- *Acta Horticulturae*, 657: 409-413.
- JARAUSCH B., SCHWIND N., JARAUSCH W., KRCZAL G., DICKLER E., SEEMÜLLER E., 2003.- First report of *Cacopsylla picta* as a vector of apple proliferation phytoplasma in Germany.- *Plant Disease*, 87 (1): 101.
- MAYER C. J., GROSS J., 2007.- Seasonal dependency of the behavioural response towards host plant odours in *Cacopsylla melanoneura*, an insect vector of the apple proliferation phytoplasma.- *IOBC/wprs Bulletin*, in press.
- TEDESCHI R., BOSCO D., ALMA A., 2002.- Population dynamics of *Cacopsylla melanoneura* (Homoptera: Psyllidae), a vector of apple proliferation phytoplasma in northwestern Italy.- *Journal of Economic Entomology*, 95 (3): 544-551.

Corresponding author: Jürgen GROSS (e-mail: Juergen.Gross@agrar.uni-giessen.de), Institute of Phytopathology and Applied Zoology, Justus-Liebig-University, Heinrich-Buff-Ring 26-32, D-35392 Giessen, Germany.