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Studies on the transmission of bois noir to weeds and potential ground-cover plants by *Hyalesthes obsoletus* Signoret (Auchenorrhyncha: Cixiidae)

M. Maixner, H. Darimont and H.D. Mohr
BBA, Institute for Plant Protection in Viticulture, D-54470 Bernkastel-Kues, Germany, m.maixner.bba@t-online.de

Abstract: Transmission experiments with *Hyalesthes obsoletus* allow to test the ability of herbaceous plants to serve as hosts for the phytoplasma associated with Bois noir. The planthoppers were caught in the field and fed on individual plants. From six species of feeding plants of the vector, only *Ranunculus bulbosus* became inoculated. However, this species has no significance as a source of infection for the vector, since infected plants died within a few weeks. This is consistent with the lack of evidence of infected *R. bulbosus* in the field and the observation the infestation of vectors living on this plant is low. Four of five potential cover crop species were inoculated by *H. obsoletus* and are therefore not suitable for vineyards were the disease occurs. One species, *Hieracium pilosella*, could not be infected. This plant builds dense stands through runners and is able to decrease the density of *Convolvulus arvensis*, the main source of the phytoplasma. *H. obsoletus* inoculated all herbaceous plants with a significantly higher efficiency than grapevine.

Key words: Planthopper, vector, weeds, phytoplasma, grapevine yellows

Introduction

The planthopper *Hyalesthes obsoletus* Signoret is the only known vector of Bois noir ('Vergilbungskrankheit') in Germany (Maixner et al., 1995). A few herbaceous plants are known to host the phytoplasma associated with this grapevine yellows. The range of food- and breeding-plants of the transmitting insect is much wider, including several common vineyard weeds. The direct control of *H. obsoletus* – e.g. by application of insecticides – is impossible because it feeds on grapevine only occasionally and is not restricted to vineyards. Furthermore, eggs and all larval stages live in the soil where they feed on the roots of herbaceous plants. Weed control by herbicides is possible in vineyards but not in surrounding areas where infected plants might grow. Fallow fields, in particular, are significant sources of both the vector and the phytoplasma. The most important host of the bois noir phytoplasma and its vector is bindweed (*Convolvulus arvensis*) which is common on such fields as well as in vineyards. Cover crops could be useful to suppress this weed, but those plants should not be potential hosts of the pathogen themselves.

We carried out transmission experiments with *H. obsoletus* to various herbaceous plants in order to identify resistant species of potential cover crops that are suitable especially for severely affected vineyards on steep slopes. In addition, weeds on which *H. obsoletus* was frequently found were included in the transmission studies.

Methods

All plants except of grapevine were grown from seeds. Grapes were grown from cuttings after a hot water treatment of the dormant wood. Adult planthoppers were collected with a motorized leaf-blower from stands of bindweed with a high proportion of infected plants. Groups of four to five insects were kept on individual plants for a period of 5 to 7 days. After that the vectors were frozen for subsequent PCR testing and the plants were kept in a greenhouse and checked for symptoms weekly. All plants were tested by PCR within two to four months after the end of transmission trials. The probability of transmission was calculated as $p_{IO} = 1-(1-R_{IO})^{1/N}$ (Swallow, 1985) from the number N of vectors per plant and the proportion R_{IO} of successfully inoculated plants. The efficiency of inoculation was estimated from the former parameter and the fraction of infected vectors p_{FI} as $p_{eff}=p_{IO}/p_{FI}$ (Irwin & Ruesink, 1986)

Results and discussion

Six hundred *H. obsoletus* were fed on 141 plants. PCR tests revealed an average infestation level of the vectors of 43 %. The phytoplasma could be detected in 24 experimental plants. They all developed disease symptoms.

Transmission to natural host plants

Only one of six species of natural host plants of *H. obsoletus* (*Artemisia vulgaris, Cirsium arvensis, Leontodon autumnalis, Ranunculus bulbosus, Taraxacum officinale, Urtica dioica*) was successfully inoculated. Seven of 11 plants of *R. bulbosus* developed severe symptoms like phyllody, yellowing, and wilting and died within six to eight weeks after the end of the experiment. This extremely high susceptibility is most likely the reason that we failed so far to identify infected *R. bulbosus* in the field, although it is quite common in vinyards and enables *H. obsoletus* to build up high population densities. Infected plants that die fast are not available to the vector for hibernation and acquisition of the pathogen. Consequently, *R. bulbosus* has no significance as a source of inoculum of bois noir and infestation levels of *H. obsoletus* collected from this host plant are usually low (2% to 7%).

Transmission to potential cover crop species

Four of five species of potential cover crops (*Dianthus deltoides*, *Lotus corniculatus*, *Silene vulgaris*, *Vicia villosa*) were successfully inoculated by *H. obsoletus*. The phytoplasma was readily detected in those plants and they developed symptoms like yellowing and stunting but, unlike *R. bulbosus*, they did not die. Their role as possible host plants of the bois noir pathogen excludes them from practical use on viticultural sites affected by bois noir, although they may be suitable cover crops from the viticultural point of view.

One species, however, *Hieracium pilosella*, could not be inoculated although the planthoppers fed and survived well on it. The results of 1999 obtained from 12 plants of *H. pilosella* and 60 planthoppers (17% infected vectors) were confirmed in 2000 with 19 plants and 76 insects (46% infected vectors). A disadvantage of this plant is, however, the laborious planting of seedlings in the vineyard, although, once established, it builds dense mats that cover the soil completely and supersede *C. arvensis*.

Efficiency of inoculation

H. obsoletus transmitted the phytoplasma associated with 'Vergilbungskrankheit' with a significantly higher effectiveness to herbaceous plants than to grapevine. The probability of transmission – the risk of a plant to become infected through feeding of one – varied within the herbaceous plants between 10% and 47% compared to 5% for grapevine. The efficiency of inoculation – the chance of a plant to get inoculated through feeding of one infectious vector – amounted to 27% to 79% for herbs and only 13% for grapevine. The reason for this difference is most probably the feeding preference of *H. obsoletus* for herbaceous plants that prevents epidemic outbreaks of bois noir in spite of the high level of infestation of the vector populations.

The results presented here provide preliminary information on the suitability of various plants as cover crops in vineyards where *H. obsoletus* is present and active as a vector of bois noir. Field trials have been set up for a further evaluation of those plants in the vineyards. For fallow fields, where control of alternative host plants of bois noir is pressing, additional plants such as grasses could be useful alternatives to broadleaf cover crops. Even though *H. obsoletus* cannot be bred in the laboratory, collections of insects with a sufficient level of infestation by bois noir proved to provide suitable material for transmission experiments.

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