Leaf ionome profile of susceptible and resistant olive cultivars infected by Xylella fastidiosa

Giusey D’Attoia1, Leonardo De La Fuente2, Massimiliano Morelli3, Pasquale Saldarelli4, Maria Saponari1, Annalisa Giampetruzzi1, Donato Boscia1, Vito Nicola Savino1, Paul A. Cobine4

1. CNR, Istituto per la Protezione Sostenibile delle Pianta, Bari, Italy
2. Department of Biosciences, Phytology, Pathology and Veterinary Public Health, University of Salento, Al, USA
3. Dipartimento di Scienze del Suolo della Pianta e degli Alimenti, Università degli Studi di Bari Aldo Moro, Bari, Italy
4. Department of Biological Sciences, Auburn University Auburn, AL, USA

INTRODUCTION

Xylella fastidiosa (Xf) is a vector-borne plant pathogen bacterium known to cause serious diseases on many crops of agronomic relevance, i.e. Pierce’s disease on grapevine, citrus variegated chrysanthemum (CVC) and almond leaf scorch (ALS). Diseases caused by Xf have been confirmed to the presence of the disease in Italy. In particular, olive cv ‘Ciliegio di Nocera’ and ‘Ogliarola salentina’ are highly susceptible to the bacterial infection, while the resistant cv ‘Leccino’ shows milder symptoms that often do not advance (Boscia et al., 2017).

The mechanism by which Xylella fastidiosa causes the disease is not fully understood. The most likely hypothesis is that the bacterium is responsible for blocking xylem vessels and thus transporting water and nutrients from the roots to the canopy, resulting in desiccation symptoms. Several studies have been done to understand how the plant interacts with the pathogen and how tolerance and/or resistance phenomena can develop.

A number of experiments have demonstrated important roles of mineral elements for Xf in vitro and during infection in plants. The analysis of the ionome of field-grown grapevines, strawberry and pear cv were performed in the olive bacterium infected plants showing significant changes in mineral element contents among infected and non-infected samples (De La Fuente et al., 2013). Similarity, virulence traits such as adhesion, gelatin formation and motility are modulated by mineral elements (Lehle et al., 2002; Cruz et al., 2012).

Based on recent findings, a field survey was carried out on naturally infected olive groves to determine if the leaf ionome profile of two cultivars showing a different response to Xf infection. This study allows us to suggest hypotheses about the elements that may be involved in the success of the infection and/or in the development of symptoms.

MATERIALS AND METHODS

RESULTS

Populace size of Xylella fastidiosa within the two cultivars

Xf detection showed that all plants selected for the analysis were infected by Xf. The estimation of the bacterial concentration showed that Xf was about one order of magnitude higher in the ‘Ogliarola salentina’ than in ‘Leccino’, although in Field 1 the difference in Xf population was statistically significant (p < 0.05).

The quantification of the bacterial population in the two cultivars grown in the field under high infection pressure confirmed the resistance of ‘Leccino’ to X. fastidiosa infection, since the growth of the bacterium is restricted and leads to milder symptoms when compared to ‘Ogliarola salentina’.

Two fields were selected in the Xf-infected area for the presence of both cultivars grown under the same agronomic regime. For each tree, five symptomatic and five asymptomatic branches were selected and mature leaves were used for the analyses. qPCR was performed to estimate the bacterial population within the tissues, by using a standard curve established with 10-fld serial dilutions of Xf DNA. Symptomatic leaves and asymptomatic leaves were subjected to the analysis of the ions content by Inductively coupled plasma – optical emission spectrometry (ICP-OES), prior dilution in mineral-free concentrated nitric acid.

Changes in element content in olive ‘Leccino’ versus olive ‘Ogliarola salentina’

Changes in element content in symptomatic leaves versus asymptomatic leaves

CONCLUSIONS

Our data suggest hypotheses about elements that may be involved in the success of the infection and/or in the development of symptoms. Ionomics revealed potential phenotypic differences between the susceptible and the resistant cultivar, extending the knowledge about the differential response to X. fastidiosa infection. This is relevant, as the discovery of traits of natural resistance represents the most promising strategy to coexist with the pathogen in the area affected by the disease and prevent its spread in the European territory. Extending this under control conditions, we are ongoing to test the hypotheses and further define the role of mineral elements in host-pathogen interaction.

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REFERENCES


Leccino/ ‘Ogliarola salentina’

Changes in element content in symptomatic leaves versus asymptomatic leaves

Numbers indicate the percentage of change in element concentration in symptomatic leaves compared to asymptomatic leaves. Numbers in bold indicate significant differences according to Student’s t-test (p < 0.05).

Data revealed a significant increase in N, P, and S levels in symptomatic leaves of both cvS in the two fields, suggesting a physiological role of these elements. Moreover, the transition from asymptomatic to symptomatic phenotypes in leaves showed a remodeling of the ionome, particularly a higher Ca content in symptomatic leaves of ‘Leccino’.

Leccino/ ‘Ogliarola salentina’