GRAPE PHYLLOXERA LEAF-FEEDING POPULATIONS IN COMMERCIAL VINEYARDS – A NEW BIOTYPE ?

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Abstract:

Context and purpose of the study - Grape Phylloxera (*Daktulosphaira vitifoliae* Fitch) ordinarily has great difficulty establishing leaf galls on the European Grapevine (*Vitisvinifera*L.). Yet populations of leaf-feeding Phylloxera are increasingly being observed throughout commercial vineyards world-wide. Effective plant protection strategies including quarantine actions are currently missing to fight, grape phylloxera populations in affected vineyards and combat linked negative effects on vines and yield. Contrary to the otherwise mandatory continuous infestation pressure from externally established populations (e.g. from populations developed on rootstock foliage or other interspecific hybrids, these leaf-feeding populations seem to establish themselves annually. The biotypes currently known (A-G) are differentiated based on their host-adapted performance on groups of *Vitis* plants (*Vitis vinifera* (E), American *Vitis* species (A), hybrids (ExA) and (AxA). A standardized protocol (double isolation chamber system) is employed to verify the hypothesis that these populations stem from a biotype, which is better adapted to create galls on *V. vinifera* leaves.

Material and methods –In the present study we monitored above- and belowground insect life table and host performance parameters of leaf-feeding grape Phylloxera strains collected from infested commercial vineyards. Standard phylloxera strains belonging to the biotypes A, B and C are used as anchor lineages for comparisons of phylloxera performance on the host plants: Teleki 5C, Riesling, Fercal and Marechal Foch. Three grape phylloxera strains from vineyards in Italy, Austria and Germany were monitored rating life table (insect based) and host performance (root- and leaf-gall based) parameters once per week for 40 days.

Results – our preliminary results clearly identified Grape Phylloxera lineages showing host-adapted performance attributed to Biotype G indicating superior performance on leaves of *V. vin*. cv. Riesling if compared with standard biotypes. These lineages maintained the traits over several asexual life cycles under controlled quarantine conditions and serve as experimental reference strains to further elucidate the mechanisms of these shifts in host performance. Studies on the impact of elevated temperatures to enhance fitness and population size of Biotype G Phylloxera are underway; as is research on the Phylloxera – grapevine interaction under climate change conditions, which may shed further light on the new phenomenon in commercial vineyards.
In conclusion biotype together with host plant genotype, environmental conditions, altered vineyard technology and management may affect the ecological network in vineyards leading enhanced susceptibility against leaf-feeding Phylloxera. Understanding and modeling of these factors is essential for the development of vineyard management strategies in phylloxerated wine areas.

Keywords: Grape Phylloxera, Leaf galls, Biotypes, Vineyard management, Host plant adaptation.

1. Introduction.

Grape Phylloxera Leaf-Feeding Populations in Commercial Vineyards – A New Biotype?

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Abstract

Grape Phylloxera (*D. vitifoliae* Fitch) normally has great difficulty establishing leaf galls on the European grapevine (*V. vinifera* L.). Yet reports of leaf-feeding phylloxera populations observed in commercial vineyards are globally increasing (Fig. 1).

Contrary to the continuous infestation pressure from externally established grape phylloxera leaf populations, some phylloxera populations are observed to infest leaves of *V. vinifera* L. autonomously. Practical plant protection strategies including quarantine measures are currently not efficient to prevent the spread of grape phylloxera populations to other viticultural areas.

Grape phylloxera biotypes are differentiated based on their host adapted performance on roots and leaves of different *Vitis* genotypes (Forneck et al. 2016). Here we present the preliminary screening results to date of the identification of a grape phylloxera strain belonging to biotype G.

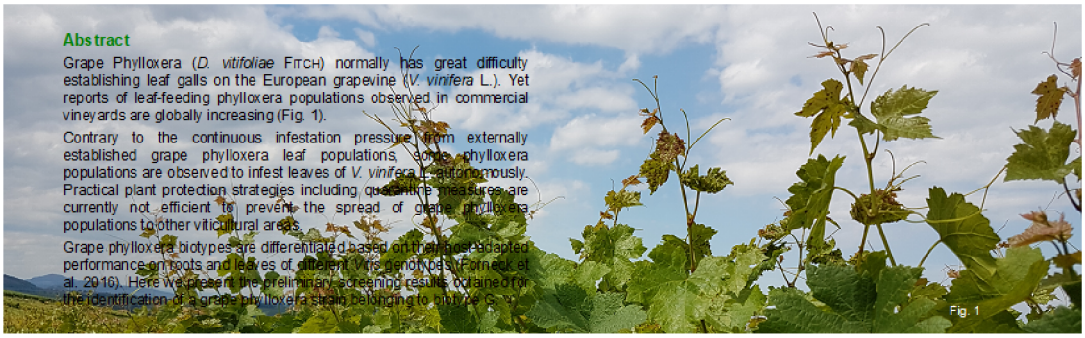


Fig. 1

Preliminary Results

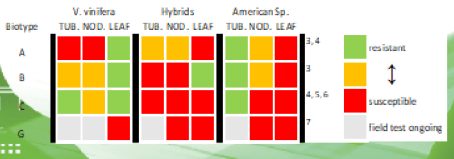
Population increase defined by the amount of second generation galls per first generation galls indicates how well phylloxera is adapted to the host plant (8):

- Control Biotype C has significantly increased population growth in the second insect generation, relative to the first generation, on Teleki 5C and Maréchal Foch, compared with Müller Thurgau (Fig. 2A).
- Biotype G shows the contrary: Population increase is significantly higher on the *Vitis vinifera* compared with the American hybrid (Fig. 2B).

Here a single phylloxera strain collected in southern Germany is exemplarily shown. Further "G" strains from commercial vineyards on *V. vinifera* and "PIWI" (interspecific fungi tolerant crosses) cultivars in Europe are currently screened.

In order to evaluate climate change as a potential cause for these events, the role of an increased temperature on the ability of phylloxera to infest grapevine leaves is examined.

Table 1: Biotype differentiation according to host performance



Outlook

At present, further experiments are being conducted to answer the following urgent research questions:

I. How widespread is biotype G across Europe´s commercial vineyards?

II. What effect does climate change have on the occurrence of phylloxera biotypes adapted to *V. vinifera* foliage?

III. What effects do these alarming population densities have on plant longevity and grape yield?

IV. What pest management strategies are needed to combat leaf-feeding phylloxera in commercial vineyards?

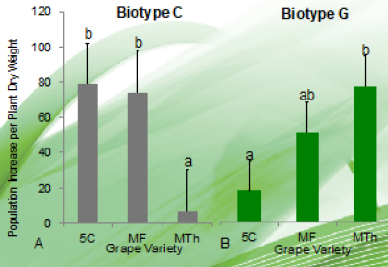


Figure 2: Phylloxera population increase per plant dry weight
Biotypes C and G (table 1) are inoculated on the leaves of Teleki 5C (*V. berlandieri* x *V. riparia*) [5C], the interspecific grapevine hybrid Maréchal Foch (*V. vinifera* x (*V. riparia* x *V. rupestris*) [MF] and *V. vinifera* L. Müller-Thurgau [MTh], in simple isolation chambers according to (5) and shown in Fig. 3 for 35 days. The two strains are originally taken from infested leaves of rootstock hybrids (biotype C) and *V. vinifera* cv. Chasselas (biotype G). Lower case letters indicate significant differences obtained by ANOVA and Tukey tests (n=7; $p<0.05$).

Fig. 3