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Dynamics of grapevine fanleaf virus (GFLV) infection in the vineyard and study of the response of different rootstocks

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Planting is a major step in the life of a vineyard. The choices made at this stage, including that of the plant material, commits the winegrower for several decades[1]. The rootstock, which forms part of the terroir, can contribute to the longevity of the vineyard. Viral diseases represent one of the major causes of dieback today, though their prevalence remains difficult to quantify[2]. The effects of different rootstocks on the impact of viral diseases need to be determined if they are to be used to help control dieback and extend the life of vineyards.

Grapevine fanleaf virus (GFLV), the main agent of fanleaf degeneration, is one of the most widespread and damaging viticultural viruses[3]. Cultivation practices and the choice of plant material are crucial in limiting the spread of viruses. While the health of the plant material produced has improved greatly, GFLV can still spread rapidly within a young plot, especially if the plants are not completely virus-free at planting.

For the past 10 years, a study of the dynamics of re-infection by GFLV has been carried out on a plot (Bordeaux vineyard, Médoc) strongly affected by this virus before its uprooting. The plot was uprooted in 2012 and left fallow for 2 years during which time the change in the population of *Xiphinema index*, the nematode vector of GFLV, was monitored. In 2 years, the *X. index* population fell dramatically (by a factor of 125) around the sampling points spread over the plot (Figure 1, A), suggesting good soil sanitation and hence slower re-infection of the young plot. In 2014, the plot was planted with Cabernet-Sauvignon (CS, clone 169), grafted on 4 rootstocks conferring varying vigor (Nemadex A.B., 101-14 MGt, 420A MGt and Gravesac), at 9,100 vines per hectare on sandy-gravel brown soil. The vines are trained in double guyot, with an average of three buds per cane. Every year since 2014, the health status of the 3,600 vines in the trial has been tested by ELISA® to determine the year of infection and the lifespan of plants with the virus, and to monitor the speed of re-infection. The pruning wood weight, the nitrogen status in terms of assimilable nitrogen, the water status in terms of the $\delta^{13}C$ of the must, and the quantity and the quality of the harvest have been measured over 3 to 6 years depending on the parameter. Micro-vinifications have also been carried on recent vintages.

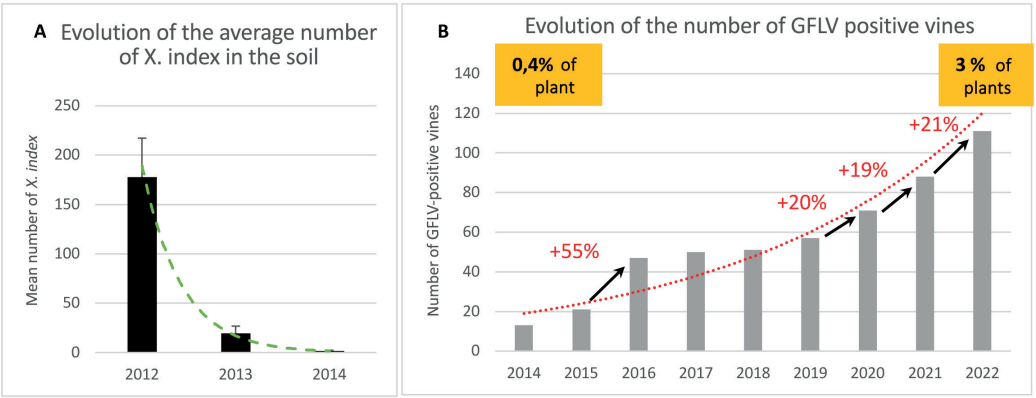


FIGURE 1. Evolution in the *Xiphinema index* population (in number of nematodes per kg of soil) between uprooting and planting (A) and evolution of thef number of vine contaminated by GFLV after planting (B).

On planting, 0.4 % of the vines were infected. Several isolated plants were tested positive for GFLV in the first 3 years, and the first symptoms of leaf discoloration and shoot deformation appeared in 2016. These symptoms were not very marked, did not occur every year and were limited to a few vines. Since 2019, an acceleration in the number of new infections has been observed (Figure 1, B). These appear in neighboring vines, forming aggregations that could constitute the start of an infection cluster. To date, 3.1 % of vines have been infected, which remains low, but the average yield loss for the affected plants is 25 to 50 % depending on the year, corresponding to 0.5 to 1 hL/ha/year for the past 3 years. Given the increase in infection, the yield loss is likely to be exponential, without taking account the increased in mortality that will lead to yield loss and additional costs for vine replacement.

However, not all rootstocks seem to react to GFLV infection in the same way and differences in yield loss have been observed. No plant grafted on Nemadex A.B. has tested positive. Even in aggregation zones, vines grafted on Nemadex A.B. remained virus free (Figure 2). These observations confirm the delay in infection conferred by this rootstock when planting after leaving the plot fallow[4]. Unfortunately, this rootstock has many limitations. It is sensitive to iron chlorosis, wet soil conditions in spring and drought. It is thus a niche rootstock in which the trial plot fits. In the first years after planting, the vines grafted on Nemadex A.B. could not be distinguished from those grafted on the other three rootstocks. From 2017 (4th leaf), a difference in plant growth could be measured (Figure 3). The difference with the other rootstocks has increased from year to year as the other rootstocks have become more vigorous over time. Thus, in 2020, rootstock 101-14 MGt began to stand out from the others by its superior conferred vigor, followed by 420A, while Gravesac and Nemadex A.B. maintained similar vigor to that of the early years. The differences became more pronounced in 2021.

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FIGURE 2. Spatial progression of GFLV infections since 2020 (Black = infected before 2020; Pink = new infection in 2020, Purple = new infection in 2021; Dark Blue = new infection in 2022) for Cabernet-Sauvignon vines grafted onto four rootstocks (Blue = Gravesac; Red = 420A MGt; Green = 101-14 MGt; Yellow = Nemadex A.B.).

This unexpected result, given that Gravesac is considered to confer more vigor than 420A and especially than 101-14 MGt, illustrates all the interest of multiplying experimental trialin different pedoclimatic conditions pedoclimate[5].

Yield differences between the rootstocks became apparent more quickly. In 2017, Nemadex A.B., while lower, gave a similar harvest weight to 420A, slightly lower than Gravesac and 101-14 MGt. Significant differences appear as from 2018, with higher yields for vines grafted onto 101-14 MGt than for the other rootstocks. Gradually, 420A has become the most productive of the 4 rootstocks tested. Yields for the CS grafted onto Nemadex A.B. remain low, as the bunch numbers and berry weights are lower. Nevertheless, they averaged 1.9 kg/vine in 2021, between 14 % and 30 % less than the other rootstocks. The delay in infection observed for Nemadex A.B. confirms the interest of crossings of this type in rootstock innovation, but with a need to correct their agronomic shortcomings. Regarding the other characteristics, in 2020, vines grafted onto Gravesac suffered more from water deficit than those grafted onto 101-14 MGt or 420A, but less than those onto Nemadex A.B. Berry nitrogen status was better for vines grafted onto Nemadex A.B. than for the other three rootstocks, certainly due to the lower berry weight. The 101-14 MGt gave the highest accumulation of sugars in the berries while 420A MGt retained a higher level of acidity[6]. These results could be explained by differences in the leaf/fruit ratio. In a context

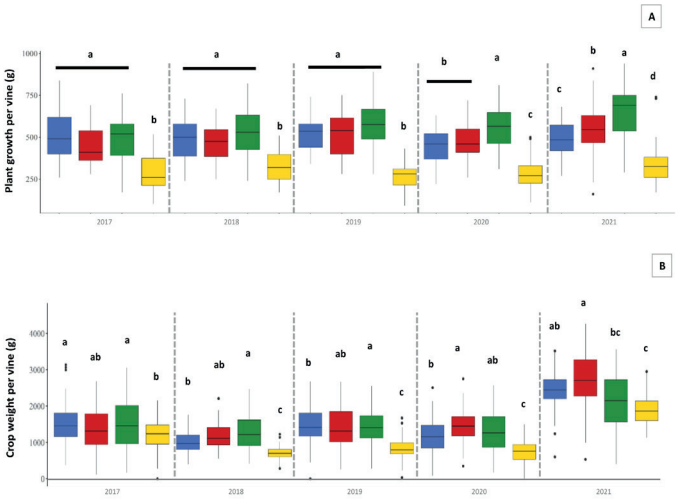


FIGURE 3. Evolution in A - pruning wood (weight of wood in g per vine) and B - yield (t in g per vine) since 2017 for four rootstocks (Blue = Gravesac; Red = 420A MGt; Green = 101-14 MGt; Yellow = Nemadex A.B.). The horizontal bar in each boxplot represents the median of the values for the modality and the year. The different letters above the boxplots indicate significant differences between modalities within each year.

of climate change, with increasing sugar levels, this balance could be a decisive factor in the choice of rootstock. It is therefore essential to develop our standards concerning the quality potential of rootstocks. These results from young vines should be confirmed over several years, especially when contamination rates will be higher. They should also be compared with results from other plots, to better define the constants of each rootstock in terms of its effect on vine growth, grape quality and the ability to maintain yield in the presence of the virus. ■

1 Dewasme, C., Roby, J-P., & van Leeuwen, C. (2022a). La plantation de la vigne : des préconisations pour éviter de se planter. *Union Girondine des vins de Bordeaux (Numéro spécial 2022-2023, L'Agroécologie au vignoble)*, 14-20.

2 Dewasme, C., & Inchboard., L. (2022c). Le court-noué : maladie sous-estimée car difficile à détecter. *Union Girondine des vins de Bordeaux (Fev., 2022)*, 50-53

3 Martelli, G.P., & Savino, V. (1990). Fanleaf degeneration. In: Person R.C., & Goheen, A. (eds.). *Compendium of Grape Diseases*, 48-49. APS Press, Saint Paul, USA.

4 Calverie, M., Audeguin, L., Barbeau, G., Beccavin, I., Desperrier, J. M., Dureuil, J., Esmenjaud, D., Gouttesoulard, M., Jacquet, O., Kuntzmann, P., Laveau, C., Ley, L., Leydet, F., Lusson, A., Mejean, I., Viguier, D., Uriel, G., van Helden, M., Vergnes, D., Vigues, V., Yobregat, O., & Ollat, N. (2016). *Nemadex AB : bilan des réseaux d'expérimentation en France. Progrès Agricole et Viticole*, (mars 2016), 17-29. https://hal.science/hal-02633254/

5 van Leeuwen, C., & Roby, J-P. (2001). Choix du porte-greffe. In : Un raisin de qualité : de la vigne à la cuve. J. *Int. Sci. Vigne Vin (Hors-Série)*, 61-66.

6 Dewasme, C., Mary, S., Tandonnet, J.P., Darrieutort G., Barbe, J.C., & Roby, J-P. (2022b). The use of rootstocks as a lever to face climate change and dieback. *2nd ClimWine Symposium I and XIVth International Terroir Congress, July 4-8, Bordeaux, France*. Available on IVES Conference Series: https://ives-openscience.eu/13140/

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