IVES Technical Reviews vine & wine
terclimpro
https://doi.org/10.20870/IVES-TR.2025.8486

This article is published in cooperation with the 2nd edition of TerclimPro (18–19 February 2025), Bordeaux & Cognac, France.

Improving the success rate of dead vine replacement

Coralie Dewasme[✉1], Elisa Marguerit[1], Séverine Mary[2], Lauren Inchboard[2], Guillaume Darrieutort[2], Philippe Vivin[1], Virginie Lauvergeat[1]

[1] EGFV, Univ. Bordeaux, Bordeaux Sciences Agro, INRAE, ISVV, F-33882 Villenave d'Ornon, France
[2] Vitinnov, Bordeaux-Sciences Agro, ISVV, 33170 Gradignan France

Dead vine replacement can be a very costly exercise in the event of failure, especially given that replacement vines take longer to reach full production than young plants from a completely replanted plot. Success, defined as the survival and healthy growth of the young plant that replaces the dead vine, is not guaranteed every year. Replacement plants compete for resources with adjacent healthy adult vines, disease control is more difficult with young plants, and they are more vulnerable to damage from wild animals and weedkiller. The environment of the young plant and vineyard practices, including the specific choice of plant material, are the two main factors that have an influence on successful replacement.

Vineyard dieback, defined as a multi-year decrease in the yield of the vine or its premature, sudden or gradual death[1], threatens viticulture throughout the world. Vineyard dieback results from many complex factors and interactions. A distinction is made between biotic stresses, such as viruses[2] and grapevine trunk diseases[3], and/or abiotic stresses[4 5]. In France, vineyard dieback has resulted in annual yield losses estimated at 4.6 hl/ha nationally between 2005 and 2015[1]. One consequence is an increase in the number of dead vines to be replaced. However, no precise data is available on mortality rates after dead vine replacement, and there have been very few studies of the factors for success[6 7]. The aim of this study was thus to quantify plant mortality after dead vine replacement in different vineyards and over several years, and to investigate the impact of the plant's environment. 7,502 plants in 83 batches were monitored over 4 vintages. The vines were planted between January and April and were never irrigated, either on planting or subsequently.

1- Most mortality occurs in the first year

At the start of production (3rd year), the mean mortality rate was 16.1 % (±2.4 %) of the replacement vines planted over 4 years (data not shown). This is considered a fairly good rate in the context of previously published work[6]. However, this mean average hides a wide disparity in mortality between plots. Cumulative mortality of replacement vines at the theoretical start of production ranged from 0 to 90 %, with one-quarter of batches showing a mortality rate below 5 % and an equal number at above 20 % mortality. Multi-year monitoring of plant survival revealed that 60 % of mortality occurred in the year following dead vine replacement, followed by 23 % and 10 % in the second and third years (Figure 1A). At the end of the first year, 14 % of batches had no dead vines and 39 % had a mortality rate below 5 %. The mean mortality rate across the batches was 11.3 % (±1.6 %). The mean mortality rate then fell to 3,92 % (± 1,3) in the second year and 1,85 % (± 1,4) in the third year (Figure 1A). This result highlights the importance of taking care of replacement vines, particularly in the year they are planted, both in terms of treatments against disease and in terms of irrigation to reduce water and heat stress.

Intra-annual variability in the mortality rate was also observed. After the first year, there was a significant difference in mortality depending on the time of year (Figure 1B). Mortality at the end of the growing season (GS) is much lower than mortality corresponding to the absence of budburst at the end of the winter rest (WR). This result could be attributed to a lower availability of reserves for certain plants. This unexpected result is interesting, as growers mainly attribute plant mortality to a significant water deficit leading to a plant desiccation in summer or to tillage when the soil is worked mechanically.

2. Significant effect of vintage and soil type

There is a significant vintage effect between batches planted in 2019 with the lowest mortality (4.8 % in average) and batches planted in 2021 with the highest mortality (17.3 % in average) (Figure 2A). Weather conditions during the respective seasons could explain these differences. Spring 2021 saw particularly high rainfall. In contrast,

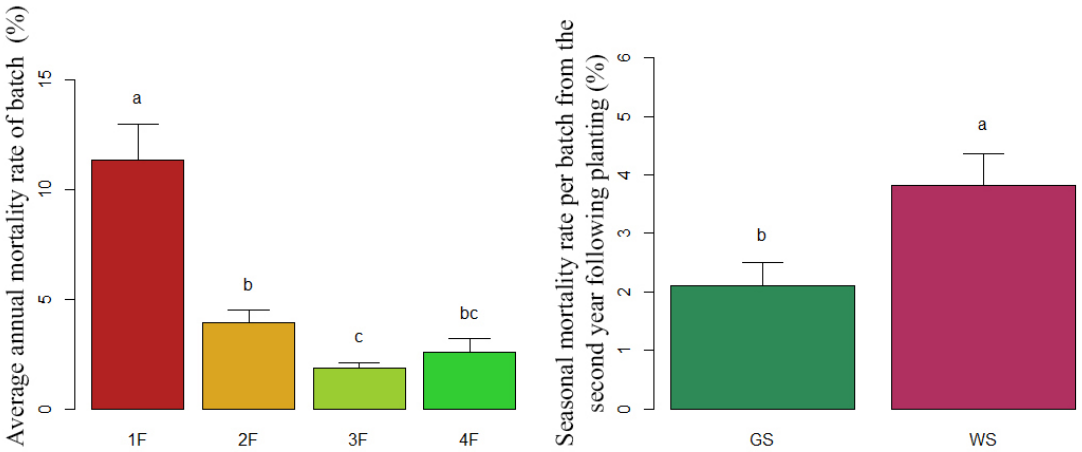


FIGURE 1. Mortality rate of batches from the year of planting of the replacement vines (1F) to the year following the first theoretical year of production (4F) (df = 3, χ^2 = 22.7, p <0.001) (A) and as a function of the time of year (excluding first leaf, 1F), distinguishing between growing-season (GS) mortality and mortality following winter rest (WR) (df = 1, χ^2 = 15.9, p <0.001) (B). The letters above the bars indicate significant differences between categories.

The translation of this article into English was offered to you by Moët Hennessy. Moët Hennessy

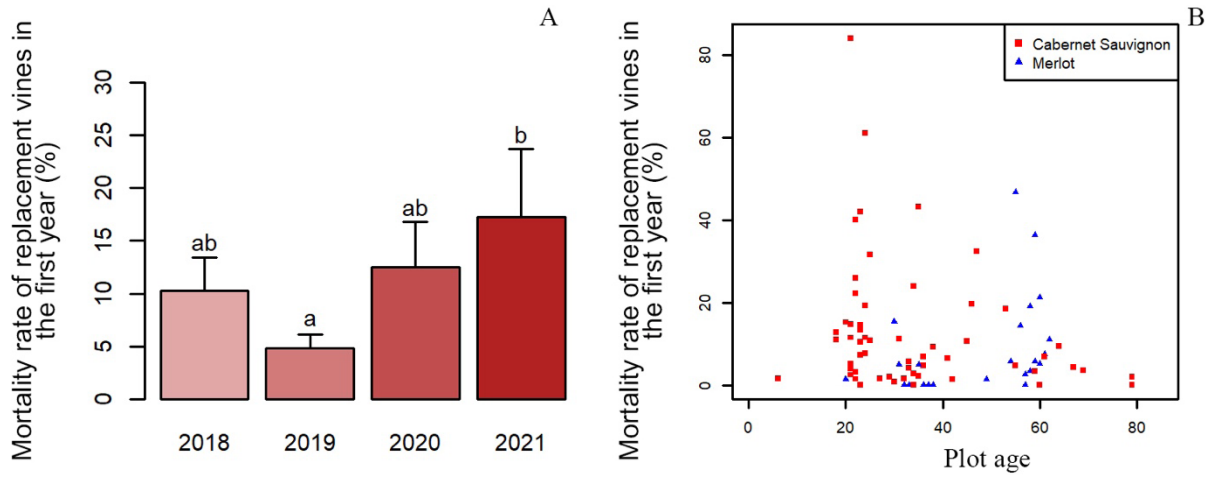


FIGURE 2. Mortality rate of replacement vines in the first year by vintage (df = 3, χ^2 = 10.9, p = 0.01) (A) and by plot age (df = 1, χ^2 = 0.03, p = 0.86) and grape variety (df = 3, χ^2 = 1.4, p = 0.23) (B). The letters above the bars indicate significant differences between categories.

2019 saw the lowest rainfall of the four years with just 454 mm between January and October, compared with 641 mm over the same period in 2021. In 2021, cumulative rainfall was 50 % higher than the 30-year average between April and June, which could have led to root asphyxia resulting in increased mortality.

On the other hand, the age of the plot in which the replacement vines were planted did not seem to have any impact on the mortality rate in the first year, contrary to the generally accepted idea that competition from older vines compromises the success of dead vine replacement. However, only a few batches were planted in young vineyards less than 15 years old in this study. No grape variety effect was demonstrated (Figure 2B).

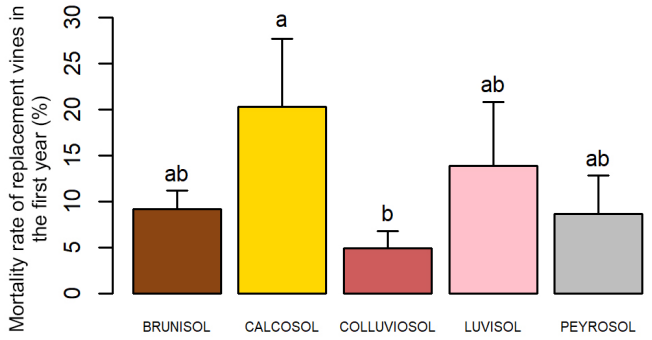


FIGURE 3. Mortality rate of replacement vines in the first year by soil type (df = 4, χ^2 = 9.1, p = 0.06). The letters above the bars indicate significant differences between categories.

A significant soil type effect was found among the 5 most common soil types in the study. In the first year after planting, mortality was 5 times higher on CALCOSOLS than on COLLUVIOSOLS (Figure 3). Mortality was also higher on LUVISOL, but the difference is not significant. For the CALCOSOLS, it could be hypothesized that the amount of clay in these soils could lead to temporary waterlogging, particularly in wet years. The waterlogging induced by clay in the CALCOSOLS could have caused root asphyxia and reduced nitrogen mineralization. Mortality due to tillage may be higher on heavier soils, which could explain the lower mortality observed on BRUNISOLS and PEYROSOLS. While it was noted that plants were uprooted by passing machinery, it was not possible to draw any conclusions on this point. However, our two-yearly scoring system was not ideally suited to assessment of this variable. Losses due to this variable could only be estimated by taking readings after each soil maintenance operation.

Conclusions

The factors affecting the success of dead vine replacement were studied and both vintage and soil type were found to have a significant effect. This experimental monitoring should provide answers as to the impact of the environment of the replacement plants on their survival over time, their growth and their production. It has been shown that the care provided in the first year is crucial to achieving a good success rate with dead vine replacement. However, the success of dead vine replacement results from a combination of many factors and their respective influence is not yet well understood. Other studies should be carried out to improve our knowledge of soil texture, for example, or the influence of spring weather conditions on the success of dead vine replacement. These initial results do, however, open up prospects for improving the survival of replacement plants in vineyards in production. ■

Acknowledgements: *This study was supported by the PNDV (Vitirhizobiome project). The authors would also like to thank the estates where the study was carried out.*

1 Riou, C., Agostini, D., Aigrain, P., Barthe, M., des Robert, M-L., Gervais, J-P., Jobard, E., Lurton, L., Moncomble, D., & Prêtet-Lataste, C. (2016). Action plan against declining vineyards: An innovative approach. *BIO Web Conf., 7* (2016) 01040. https://doi.org/10.1051/bioconf/20160701040

2 Fuchs, M. (2020). Grapevine viruses: A multitude of diverse species with simple but overall poorly adopted management solutions in the vineyard. *J. Plant Pathol.* 102, 643–653. https://doi.org/10.1007/s42161-020-00579-2

3 Dewasme, C., Mary, S., Darrieutort, G., Roby, J.P., & Gambetta, G.A. (2022). Long-term esca monitoring reveals disease impacts on fruit yield and wine quality. *Plant disease*, 106(12), 3076-3082. https://doi.org/10.1094/PDIS-11-21-2454-RE

4 Darriaut, R., Martins, G., Dewasme, C., Mary, S., Darrieutort, G., Ballestra, P., Marguerit, E., Vivin, P., Ollat, N., Masneuf-Pomarède, I., & Lauvergeat, V. (2021). Grapevine decline is associated with difference in soil microbial composition and activity. *OENO One*, 55(3), 67-84. https://doi.org/10.20870/oeno-one.2021.55.3.4626

5 Bortolami, G., Gambetta, G.A., Cassan, C., Dayer, S., Farolfi, E., Ferrer, N., Gibon, Y., Jolivet, J., Lecomte, P., & Delmas C.E.L. (2021). Grapevines under drought do not express esca leaf symptoms. *PNAS.* 118(43), 1-9 https://doi.org/10.1073/pnas.2112825118

6 Shavadze, L., & Papunashvili, V. (2020). Develop Efficient Rational methods to Manage Missing Plants in Vineyards Giving Full Crop. Slovak Republic Winemaking: Theory and Practice E-ISSN: 2500-1043 2020, 5(1): 11-15. https://doi.org/10.13187/winem.2020.1.11

7 Dewasme Laveau, C., Mary, S., Janoueix, A., & Lauvergeat, V. (2020). Effect of fungi addition and root preparation on the success of vine replacement in an established vineyard. XIIIth International Terroir Congress, November, Adelaide, Australia

This work is licensed under a Creative Commons Attribution 4.0 International License.