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Resumption of the planting of grapevine varieties in France, referred to as "disease-resistant"

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This article investigates the beginning of the adoption of a new generation of "resistant" grapevine varieties (RVs) in France, in a European context in which varietal innovation has become more and more dynamic over the last thirty years.
Today, there is a growing interest in this plant material, because it constitutes a lever for adaptation to the combined impacts of climate change and fungal diseases in vineyards. Based on data from the French digital vineyard register (CVI: "*casier viticole informatisé*"), this paper provides RV maps of leading regions, as well as less involved ones, which show the implantation of these varieties.

Context, data and variables

Interspecific hybrid grapevine varieties were first studied and massively produced at the end of the 19th and beginning of the 20th centuries in response to the Phylloxera crisis in Europe[1]. These varieties also often exhibited crossed-resistance to downy mildew (Plasmopara viticola) and powdery mildew (*Erysiphe necator*). These dynamics of interspecific varietal creation came to a halt almost everywhere in Europe in the 20th century, with a few exceptions in Germany, Switzerland and Eastern Europe.
For authors such as Montaigne *et al.* (2016)[2] and Moustier & Moustier (2019)[3], these blockages can be explained by changes in the market (a decline in regular consumption) and in a wine sector (overproduction) regulated by a reinforced policy of quality based on terroir and *Vitis vinifera* grape varieties.
Grapevine breeding was relaunched in Europe around thirty years ago[4]. It is worth noting that these varieties are sometimes described as "partially resistant varieties" to avoid giving the impression that they are immune to all pest and fungus diseases. Nevertheless, the term "RV" is nowadays the most common expression in the wine industry.
The European Commission (2018)[5] issued a classification of authorised varieties to be planted for wine production purposes, among which 14 RVs have already been registered in the official French register, and 16 others are in temporary classification[6]. However, as Boyer & Touzard (2021) have underlined[7], the appropriation of RVs by the wine sector will occur over various spatial and temporal scales. The distribution analysis of the 1,208 hectares of RV vineyards, planted between 2017 and 2021, illustrates this trend in French vineyards.

Methods

We used planted RV-related surface data from the French digital vineyard register (CVI: "*casier viticole informatisé*") in each municipality to compute a cumulative amount of planted RV hectares per department from July 2017 to July 2021. It should be noted that at the time of writing this article the CVI data set was incomplete for 2022 and 2023. The data used to generate these maps are grouped in Supplementary Tables, which are available by request from the corresponding authors. According to the European Union classification of territorial units for statistics, the French departments correspond to the NTUS3 level and the French Regions to the NTUS2 level. The maps representing the data were created using methods adapted to the heterogeneity of the variables: geometric progression (Figure 2) and Jenks classification method (Figure 3). All maps were created with QGIS.3.28 (https://qgis.org/).

Results

Over the five-year period covered by our study, there was a steady increase in RV plantings (Figure 1A), illustrating the growing interest in RVs in France. The cultivars chosen during the 2017-2021 period were predominantly white grape varieties, with Souvignier Gris, Floréal, and Soreli accounting for 388 hectares, 247 hectares, and 116 hectares, respectively; and regarding the red grape varieties, the main ones were Artaban (153 hectares) and Vidoc (112 hectares) (Figure 1B). These cultivars are the result of various research programmes and policies, as shown in Paire *et al.* (2024)[8].
RV implantation has been quite moderate (1,208 ha of RVs compared to 786,847 ha of all varieties in France), but the trends may change over the coming years depending on the quality of the wines obtained from these cultivars, and the ones which will be newly registered[8].

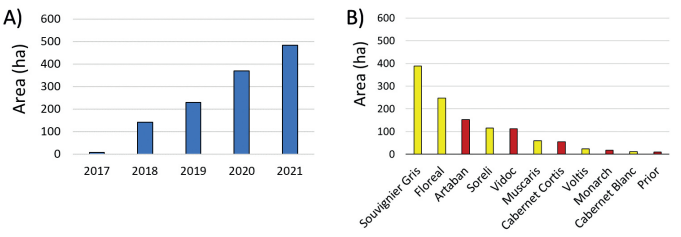


FIGURE 1. A) Annual planting areas (hectares: ha) of grape varieties, called "resistant to diseases", in France, sums from 2017 to 2021; B) Detail of the main grape varieties expressed in total surface area (ha), planted from 2017 to 2021 in France, yellow bars for white cultivars, red bars for red cultivars. Data source: C.V.I., "*casier viticole informatisé*", the digital vineyard register.

The adoption of RVs remains very low, because the diffusion of innovation in perennial crops is a long process, despite potential advantages of RVs, such as (i) better sustainability, (ii) a reduction in chemical inputs, and (iii) a decrease in production costs[4]. As pointed out previously[7, 9], French wine makers can take other pathways to adapt to climate change, notably the implementation of different cultural practices.
Furthermore, even though some changes in the regulation of Geographical Indications (GIs) have occurred (typicity of the PDO, Protected Designation of Origin[10]), legal constraints, such as the planting regulations and the controls by INAO (National Institute for Appellations of Origin), still slow down the diffusion of RV innovation[11, 2]. At the end of our observation period in 2021, Champagne was the only PDO wine region to ask for the inclusion of one RV, Voltis, in their specifications. It should be noted that it is more difficult to integrate a new variety within a PDO specification, because the experimentation period is long, which is not the case in the specifications of PGIs (Protected Geographical Indications) and wines without GI.

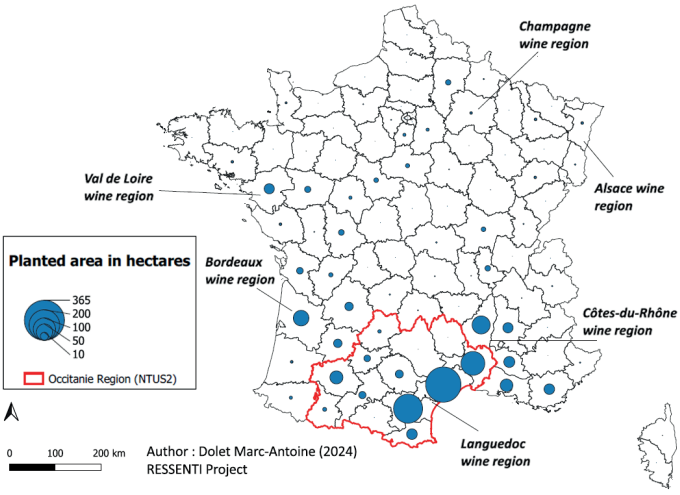


FIGURE 2. Areas (in hectares) planted with RVs (Resistant Varieties) in French departments between 2017 and 2021. Data source: C.V.I., "*casier viticole informatisé*", the digital vineyard register. NTUS2 stands for Nomenclature of Territorial Units for Statistics (European Union).

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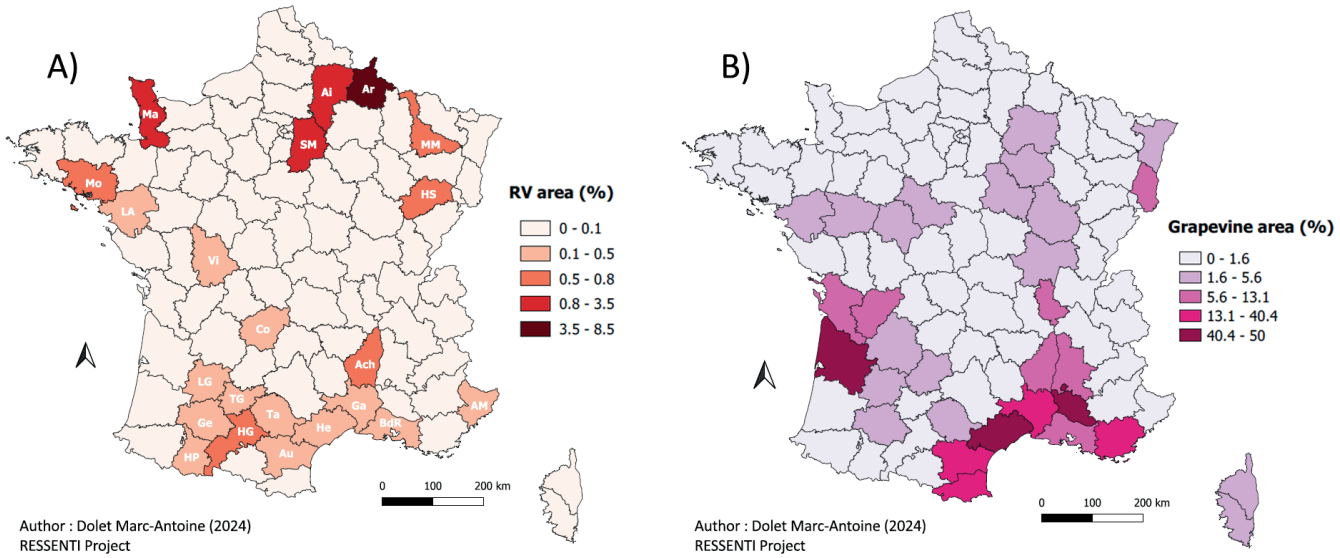


FIGURE 3. Proportions A) of areas planted with "resistant to diseases" grape varieties (RV) from 2017 to 2021, expressed in relation to the areas planted with all grapevine varieties in each department in France in 2021; B) of areas planted with grapevine expressed in relation to the Utilised Agricultural Area in each department.
Data sources: French Agricultural Census (2020) and C.V.I. ("*casier viticole informatisé*"), the digital vineyard register. Department abbreviations: Ai: Aisne; AM: Alpes-Maritimes; Ach: Ardèche; Ar: Ardennes; Au: Aude; BdR: Bouches-du-Rhône; Co: Corrèze; Ga: Gard; HG: Haute-Garonne; Ge: Gers; He: Hérault; LA: Loire-Atlantique; LG: Lot-et-Garonne; Ma: Manche; MM: Meurthe-et-Moselle; Mo: Morbihan; HP: Hautes-Pyrénées; HS: Haute-Saône; SM: Seine-et-Marne; Ta: Tarn; TG: Tarn-et-Garonne; Vi: Vienne.

Figure 2 shows that the planting of RVs in the French departments is not spread evenly across the territory. It highlights contrasting French RV implantations, with strong development in southern France compared to other traditional wine-growing areas. For example, Burgundy has been the most cautious among France's famous wine regions, though it recently launched the QANOPEE programme to partly promote RVs. Concerning the other wine-growing regions, the planting of RVs is more moderate than in the Languedoc vineyards.

Figure 3A shows that the proportion of RVs is relatively low compared to the classical varieties of *Vitis vinifera* across all the French departments. We observed that, surprisingly, certain northern departments stand out; for example, Ardennes, Manche, and Morbihan, among others. In these departments, vineyard surfaces are smaller compared to other French wine regions (Figure 3B), so the proportions of RVs easily reach high levels. This may be due to new winegrowers considering RVs for developing viticulture in new territories where there is no GI history background. These evolutions in northern France are linked to climate change, which is encouraging growers to explore new production areas, as many traditional wine regions in the world will be threatened by it[9]. Additionally, as mentioned previously, these RVs have advantages, either economical (fewer treatments, lower machine/staff costs, etc.) or environmental (better adaptation to humid climates, etc.). However, in some departments the presence of some large grapevine nurseries could modulate the RV area without a direct link to wine production.

We also observe (Figure 2) that the Occitanie Region (NTUS 2) in southern France is at the forefront of RV implantation nationally, representing 71% of the whole French RV area and reaching 858 ha from 2017 to 2021. Occitanie is also an important wine growing region representing almost 35% of the total French vineyard area (Supplemental Tables). This relative dynamism is particularly driven by the three departments located in the eastern part of this region, near the Mediterranean coast, in the 'Languedoc' region, departments which produce a lot of PGI wines, namely: Hérault, Aude and Gard (i.e., in total 759 ha, 63% of France RVs).

Issues, pros and cons

The slow implantation of RVs raises several questions related to the adoption and diffusion of RVs by various actors in the wine industry. The study by Doncieux *et al.* (2022)[11] on the dynamics of agrobiodiversity in the Gaillac territory suggests there is a trend of wine growers being cautious and considering RVs as an element of biodiversity, making it possible to limit production risks, mitigate market volatility and cope with environmental uncertainties.

However, national or regional financial aid to support the planting of these new RVs remains limited. As part of the "Défi Clé" Vinid'Occ initiative (funded by the Occitanie region), the RESSENTI project aims to weigh the pros and cons of the diffusion and adoption of RVs by producers, leading to more favorable regulatory measures and better funding to facilitate this process. This study will provide some insights to the decision-makers (politicians and administrators who must deploy aid in favor of wine growers) regarding RV adoption, which is a process influenced by individual characteristics of growers and collective parameters of professional networks. The study will benefit from bibliographic surveys that will give a prominent place to case studies in traditional wine-producing countries[12 13]. ■

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