

How can historical cultivars mitigate the effects of Climate Change?

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Keywords: indigenous grapevine cultivars, French patrimony, collections, repositories, Catalogue, INRAE, IFV, INAO, ampelography

Abstract

IFV, INRAE and the national network “Partenaires de la Sélection Vigne” representing 37 organizations from the different wine regions, have been working increasingly closely over the last 2 decades towards the preservation of the French varietal patrimony. There are approximately 600 patrimonial varieties according to INRAE and Institut Agro experts. In the context of a drastic reduction in such varieties from the mid 1980’s in favor of mainstream varieties, it was essential to carry out an inventory of old vines and vineyards. INRAE Vassal collection plays a key role here as it holds the largest diversity available, offering us the opportunity to document and double check the identity of a cultivar. The work is carried out in several stages, from verifying the existence of a variety in a small region, through to rehabilitation. Since 2008, 41 historical cultivars have been registered in the national Catalogue. Most of these have been neglected in the past due to late maturity, lack of sugar and high titratable acidity at harvest time. Such characteristics are today considered as positive qualities, not only in mitigation of the effects of climate change, but also as an opportunity for restoring diversity, or options against standardization... A specific focus within regions such as the Alps, Champagne, Cognac and the South-West will provide details of the full procedure. Chardonnay rose, Corbeau, Hibou, Bouysselet and the aptly named Tardif, are some of the cultivars that have followed this procedure. Furthermore, a recent regulation established by INAO in 2018 on “varieties of interest for adaptation purposes” might boost uptake by growers.

Introduction

Nearly 600 grape varieties can be considered as originating from France. In 2008, 240 varieties (including 209 traditional French cultivars) were registered in the official national catalogue for wine production. Nevertheless, the 40 major varieties represented 88% of French vineyard in 2008, while they only represented 53 % of the vineyard in 1958 (Lacombe, 2012.). To cope with the genetic erosion of wine heritage and to preserve the historical richness of the varietal and clonal assets, French conservation and selection has been organized at several levels:

- an international ampelographic collection located at domaine de Vassal-INRAE (Marseillan) which includes 5788 accessions of cultivated *Vitis vinifera* from 54 countries
- a clone collection located at domaine de l’Espiguette-IFV (Grau-du-Roi), which includes 4612 clones representing 615 varieties (table grapes, wine grapes, rootstocks)
- 178 regional intra and intervarietal conservatories in which around 20000 accessions are stored

IFV, INRAE and the national network “Partenaires de la Sélection Vigne” representing 37 organizations from the different wine regions collaborate to preserve and enhance intra and intervarietal diversity through registration of varieties and clones in the official national catalogue.

Changing plant material is a major adaptation lever to temperature rising and advanced phenology due to climate change (van Leeuwen et al., 2019). Budbreak date, which is an important characteristic for adaptation to late frost, ranges from 12 days before Chasselas B to 26 days after Chasselas B in INRAE Vassal collection (Boursiquot et al., 1995). Veraison and maturity dates are also essential parameters as berry composition (sugar and acid concentrations) is influenced by climatic conditions during ripening. In Vitadapt collection planted near Bordeaux, the average veraison date of 52 varieties span over 34 days (Cortázar-Atauri et al., 2017). In

INRAE Vassal collection, maturity dates range from 2,5 weeks before Chasselas B to 7,5 weeks after Chasselas B (Boursiquot et al., 1995). Grapevine varieties also differ in their tolerance to drought, a characteristic that is of rising interest as hydric deficit will probably increase with less precipitations and/or more evapotranspiration. Varieties adapted to climate change may be traditional forgotten cultivars, varieties from other wine regions, or creations obtained from intra or interspecific crossings. Since 2008, efforts have been redoubled to propose varietal diversity to growers: 93 varieties have been registered in the official national catalogue for wine production, including 41 French traditional cultivars, 29 cultivars from foreign countries, 11 intraspecific crossings and 12 interspecific hybrids. Most of the French traditional cultivars have been registered for patrimony and diversification purpose but some of them may be adapted to climate change as they are late ripening, poor in sugar, rich in acidity, or tolerant to drought. In 2018, INAO allowed French “organismes de défense et de gestion”, organisms in charge of “Appellation d’Origine” specifications, to select and experiment “varieties of interest for adaptation purposes”. Traditional cultivars are of particular interest as they already have an history in French wine regions.

Materials and methods

Years of registration in national catalogue were collected from legifrance (<https://www.legifrance.gouv.fr>). Origins of the cultivars, phenological, agronomical and technological data were collected from pl@ntgrape (<https://plantgrape.plantnet-project.org>), INRAE domaine de Vassal, and bibliography.

Results and discussion

The first step towards rehabilitation of forgotten local cultivars is to find them in the native vineyard. Each summer, local organizations coordinate prospecting of old plots, with the help of ampelography specialists from INRAE, Institut Agro and IFV. Cultivar identity is confirmed by comparison with plants conserved in Vassal collection and/or by molecular ampelography with genetic markers. Some virtually disappeared varieties are sometimes found out, such as Magdeleine Noire des Charentes, Pleau, Grain or even some unknown individuals that have not been previously conserved in Vassal collection. These genetic resources are thus introduced in the ampelographic Vassal collection.

Plants are checked for main viruses (GFLV, ArMV, GLRa-V 1, 2 and 3) and healthy clones are introduced in local conservatories. Some accessions may also be conserved in the clone collection of domaine de l’Espiguette. For some cultivars of interest, if there are no virus free plants, an in vitro apex culture may be used to obtain a healthy clone.

To be cultivated in France, grapevine varieties must be registered in the national official catalogue and classified for wine production. New varieties must be described through a specific protocol to evaluate their agronomic, technological and environmental value. For traditional cultivars, existing bibliography may be sufficient and, if not, a simplified protocol may be applied. For at least 2 years, 60 plants of the cultivar are observed and compared with a well-known cultivar, agronomic traits are noted, and microvinifications are conducted. Bibliography and/or experimental results are analyzed by CTPS (Comité Technique Permanent de la Sélection) and official registration is decided by agriculture ministry.

Since 2008, 41 traditional cultivars followed this procedure (see Table 1). For example, Bia B which was historically cultivated around Lyon in the department of Loire, Isère and in Savoie was registered in 2011. It was a very appreciated cultivar which produced fine wines. Seven plants of Bia B were found out in an old plot in Apremont (Savoie) where it was called Muscat d’Apremont. All plants were contaminated with GFLV and an in vitro apex culture has been conducted to select a virus free clone. This cultivar has a late maturity and conserves acidity at the harvest. Corbeau N was the main cultivar of Savoie until 1958 but it rapidly disappeared because it was not registered in the official catalogue. It is although known as Bonarda in Argentina where it represented 19135 ha in 2015 (“Grapevine Varieties’ Area by Country 2015,” OIV.). This variety has a low alcohol and low tannins accumulation potential and it was assembled with Mondeuse N or Persan N. It seems to be tolerant to drought, but it is highly susceptible to downy mildew. Hibou N was historically cultivated in some french alp valleys in the department of Savoie. It is also known as Avana in Italy where it represented 30 ha in 2000 (Robinson et al., 2013). It is a late variety (1 to 2 weeks after Mondeuse N) with very large bunches and berries, a low alcohol, tannins and color potential but it used to produce fruity wines.

Table 1. Traditional cultivars registered in the French official national catalogue since 2008.

| Cultivar name | Origin | Year of registration | Budbreak (days/Chasselas) | Maturity (weeks/Chasselas) |
|-----------------------|----------------------------|----------------------|---------------------------|----------------------------|
| Bia B | Isère | 2011 | 5 | 3.5 |
| Bouysselet B | Haute-Garonne | 2017 | 7 | |
| Brustianu B | Corse | 2020 | 7 | 3.5 |
| Carignan gris G | Languedoc | 2017 | 12 | 6 |
| Chardonnay rose Rs | Bourgogne | 2018 | 1 | 2.75 |
| Chichaud N | Ardèche | 2019 | 8 | 2.5 |
| Chouchillon B | Loire | 2016 | -3 | 2.75 |
| Corbeau N | Savoie, Isère | 2008 | 2 | 2.5 |
| Cualtacciu B | Corse | 2020 | 9 | 1.75 |
| Dousset N | Savoie | 2019 | 5 | |
| Dureza N | Ardèche | 2013 | 11 | 3.25 |
| Enfariné N | Jura | 2020 | 5 | 3.5 |
| Felen B | Aveyron | 2020 | 12 | 2 |
| Genouillet N | Indre | 2011 | 5 | 2.5 |
| Gibert N | Lot | 2018 | 9 | 4.25 |
| Gouais B | Central Europe | 2021 | 1 | 2.5 |
| Gueuche noir N | Jura, Ain | 2021 | 4 | 2.5 |
| Hibou noir N | Savoie | 2016 | 1 | 3 |
| Mècle N | Isère | 2011 | 2 | 3 |
| Melon rouge Rg | Loire-Atlantique | 2019 | 9 | 1 |
| Monbadon B | Charentes, Gironde | 2012 | 6 | 3.5 |
| Mondeuse grise G | Savoie, Ain | 2016 | 0 | 3 |
| Mornen N | Loire | 2011 | 8 | 2 |
| Negret Pounjut N | Haute-Garonne | 2020 | 0 | 1 |
| Noual B | Lot | 2018 | 15 | 4.75 |
| Œillade noire N | Languedoc | 2006 | 9 | 3 |
| Onchette N | Isère | 2016 | 3 | 2.75 |
| Pardotte N | Gironde | 2014 | 6 | 3 |
| Peloursin N | Isère | 2016 | 5 | 2.5 |
| Petite Sainte-Marie B | Savoie | 2018 | 0 | 2.5 |
| Pougnat N | Ardèche | 2021 | 4 | 4 |
| Raisaine B | Ardèche | 2016 | -4 | 1.75 |
| Ribier noir N | Drôme, Ardèche | 2021 | 6 | 3.5 |
| Robin noir N | Isère, Drôme | 2015 | 5 | 1.75 |
| Rossula Bianca B | Corse | 2020 | 7 | 4.25 |
| Sérénèze N | Drôme, Isère | 2012 | 4 | 3 |
| Tardif N | Gers, Pyrénées-Atlantiques | 2017 | 0 | 2.75 |
| Trousseau gris G | Charentes | 2011 | 1 | 1.5 |
| Uva Bianca B | Corse | 2020 | 8 | 5.5 |
| Verdanel B | Tarn | 2016 | 3 | 2.5 |
| Vintaghju N | Corse | 2020 | 7 | 3 |

It is rustic, not very sensitive to cryptogamic diseases. Tardif N is an ancient grape from South-West that was cultivated in Gascogne. Its name means « late » in French, and it ripens 2 weeks a half to 3 weeks after Chasselas B. Tardif N wines are intensely colored and have strong spices aromas (pepper). Enfariné N was cultivated in Jura vineyard. Its budburst date is 6 days after Poulsard N and 3 days after Trousseau N and it ripen 2 weeks after those two traditional cultivars.

In 2018, INAO permitted the experiment of “varieties of interest for adaptation purposes” in wine with a denomination of origin. In each AOP, up to 20 cultivars may be chosen among varieties registered in the official national catalogue. They may represent up to 5% of the area of a wine estate and up to 10% of the wine blend. A few AOP already took advantage of this new possibility. Among them, Savoie wine organization selected 6 traditional cultivars: Bia B, Petite-Sainte-Marie B, Mondeuse grise G, Corbeau N, Dousset N and Hibou N. This wine region already uses many traditional cultivars and wine growers are particularly attached to their patrimony. Some of those varieties are potentially well adapted to climate change such as Bia B, Corbeau N and Hibou N as previously described. As another example, AOP “Cote du Jura” selected Enfariné N among other varieties for its late maturity. Other AOP are considering the opportunity to test patrimonial varieties.

Conclusion

Traditional forgotten cultivars have a strong territorial and heritage identity, are intended to counterbalance a certain standardization, particularly through the valorization of direct marketing channels via oeno-tourism. They also may contribute to climate change adaptation as some of them were abandoned because of their late maturity, low alcohol potential or high acidity, characteristics that are rather positive today. Growers are now authorized and even encouraged to test them in large plots and most agronomical and technological data are going to be collected in the next few years. Prospecting of old vines will also continue to potentially find out and preserve some interesting forgotten genetic resources.

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