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Strategies for adapting vineyards to a changing climate. (Re)-Learning from Mediterranean viticulture

>>> Mediterranean areas face high temperatures, heat waves, and episodes of drought. These episodes are becoming more frequent in non-Mediterranean areas due to climate change. This paper will address viticultural practices used by Mediterranean winegrowers as an example of (re)-learning how to adapt to global warming and a changing climate. <<<

The Mediterranean Basin has been classified as one of the most responsive regions to climate change[1]. However, since growers in Mediterranean areas have had to cope with high temperatures, heat waves, drought periods and extreme rainfall episodes for centuries, the growing systems they have developed may provide answers to a global adaptation of viticulture to climate change. This technical note will review considerations on soil, training systems and grape varieties.

■ Vineyard soils. Vigour control and water dynamics

Mediterranean winegrowers traditionally planted their vineyards in poor, deep, and frequently gravelly soils, located on slopes. In the springtime, the vineyard soils have absorbed the rainfall from the winter and early spring, but result in a moderate growth due to their low fertility. What is particularly relevant, is that in this type of soils there is a gradual transition from spring conditions, to the high evaporative demand and drought conditions that occur in the summer. A relatively slow progression towards stress-conditions allows for a better adaptation of the vines to drought circumstances through stomatal regulation. Also, a deeper water table allows the plant to access water for a longer period throughout the year that supports the photosynthetic activity during the ripening period.
More recently, some vineyards have been planted at lower altitudes in the valleys[2], where soils are more fertile, and sometimes shallower. Under these conditions, vines are more vigorous in the spring, produce higher yields but if not irrigated, may be incapable of sustaining this growth during the summer, resulting in incomplete ripening and/or berry shrivelling. Irrigation is certainly an option, but its usage would be more sustainable if applied to vineyards with less demanding needs due to better adapted canopy and soil characteristics. In addition, in many regions, water may not be available in the summer, due to water-scarcity restrictions. Thus, vineyards making use of winter or early spring irrigation (a traditional practice in many areas) can provide a more sustainable and secure production system.

■ Training systems. Decreasing water needs, minimizing trunk disease incidence

Vine plants have traditionally been trained as bush-vines in most Mediterranean winegrowing areas, naming them *vaso* in Spain, *gobelet* in France and *alberello* in Italy.

Figure 1. Some of the traditional training systems used in the Mediterranean area: (a) low *vaso* in La Mancha (Spain), (b) tall *vaso* in Mallorca (Spain), (c) horizontal *vaso* in Montilla-Moriles (Spain), (d) *alberello* in Pantelleria, Sicily (Italy), (e) *kouloura* in Santorini (Greece) and (f) *vara y pulgar* in Sanlúcar, Cádiz (Spain).

Bush-vines are usually untrained, though in some areas one stake per vine may be used to hold vegetation upright, to avoid wind damage and to increase bunch aeration. Bush-vines are, nevertheless, far from being the same everywhere. In each region, features have been adapted to meet the particular requirements of each climate. For instance, in La Mancha vineyards, where temperatures in summer are high and rainfall is scarce, the traditional *vaso* (Fig 1a) is very low to minimize water needs and evaporation through soil-shadowing. In Montilla-Moriles (Fig 1c), where summer temperatures are extremely high, the horizontal *vaso* is designed to protect sap-flow from direct sunlight, so all pruning wounds are isolated to the upper part of the arms. When located near the sea, trunk disease risk increases, and aeration becomes a key issue. Thus, some bush-vines in Sicily (*albarello*), Languedoc (*gobelets*), and Mallorca (*vasos*) (Fig 1b) have much longer fruit-bearing arms, which helps to decrease humidity in the bunch zone despite increasing water needs. Vines closer to the sea suffer greater disease pressure from higher humidity making aeration an important factor in disease prevention. For example, growers have designed systems such as the *Alberello di Pantelleria* (recognized by UNESCO as Intangible Cultural Heritage of Humanity), where arms are long, but remain as horizontal as possible to protected them from the wind (Fig 1d).
All of these training systems share pruning techniques that meticulously isolate the position of the pruning wounds on one side of the arm so as to minimise sap-flow disruption. This principle, found in all traditional training systems, is probably the most effective prevention tool against

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grapevine trunk diseases (GTD). As early as 1921, M. René Lafon[3] detected that the adoption of "new" training systems such as the Guyot was causing unprecedented vine mortality. Other very particular and specific systems, such as the Jerez (Fig 1f) or Santorini *kouloura* (Fig 1e) may even be more focused on reducing wound-associated risk of GTD, due to the characteristics of their climate and/or grape varieties.

What can we learn from Mediterranean viticulture in dealing with climate change?

➔ Soil is an important factor in maintaining vine-health during heat episodes since it acts as a water reservoir and as such helps to reduce water stress throughout the summer. Winter or spring irrigation can be a sustainable tool to restore water in the soil if rainfall is scarce.

➔ Traditional training systems are a tool for vine adaptation and for the prevention of trunk disease. The generalized adoption of vertical-shoot-positioned-cordon engenders a dramatic loss of adaptation. This aspect needs to be considered when designing new training systems.

➔ Many grape varieties from Mediterranean climates are usually well adapted to drought and heat waves and should be considered as an option in other regions for adaptation to future climatic conditions. Additionally, many minority and forgotten varieties that have been rediscovered in the last two decades provide extraordinary adaptation potential due to their unusually long ripening periods and high acidity levels – and, if reintroduced, may play an increasingly relevant role in future wine blends.

Lately, a shift toward the use of internationally standardised training systems has occurred in the Mediterranean basin. As a consequence, there is a generalized adoption of trellised, vertical shoot-positioned spur-pruned cordon or Guyot. The adoption of modern training and pruning techniques, which has, no doubt, advantages for mechanization, implies simplifications of the permanent vine-structure that result in increased GTD incidence and reduced vineyard longevity[4]. Although returning to traditional training systems may not be economically sustainable under certain conditions, growers from around the world need to consider these concepts in order to design new training systems that are better suited to the challenging growing conditions ahead of them.

■ Varieties. Drought tolerance, late ripening and higher acidity

It is common knowledge that traditional varieties from Mediterranean areas have the reputation of being well adapted to drought and heat waves. Agiorgitiko, Garnacha (syn. Grenache), Aglianico and Monastrell (syn. Mourvèdre) are some examples of widely grown red-wine cultivars that are well adapted to extreme climates. Gradually introducing some of these varieties to other areas where climate change is becoming an increasing concern, could be seen as a medium-term adaptation tool[5]. The prospecting missions performed in Mediterranean countries, in order to recover minority and forgotten varieties, have shown that some of these varieties have longer growing seasons and higher acidity levels than more commonly grown varieties. Since the reconstruction of vineyards in the last 150 years has considerably changed grape varieties, we are unable to trace these forgotten varieties back to their original use. We can only hypothesize that their use was never widespread. We can assert, however, that they probably played a purposeful role in increasing wine acidity and thus guaranteeing its conservation. Graciano grape variety (syn. Morrastel in France, Tinta Roriz in Portugal, Tintilla de Rota in Southern Spain) is a good, widespread example of their usage. This variety has rarely been used traditionally to make varietal wines, but its ability to produce low pH and high colour under hot conditions probably contributed to its generalized use in several distant growing regions. This varietal is a good example of how blending lesser known varieties may be beneficial in maintaining wine acidity when faced with climate change. ■

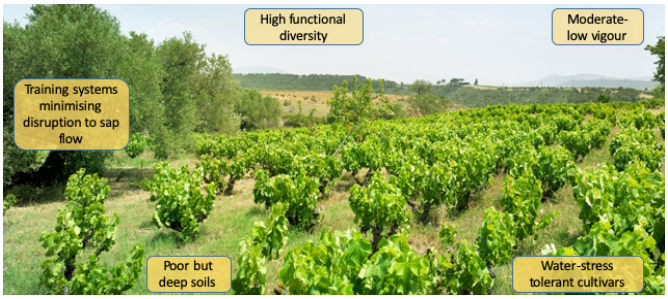

Figure 2. Certain features of traditional Mediterranean vineyards that should be considered in viticulture adaptation to climate change. The vineyard in the picture corresponds to an ancient Grenache vaso training system in Navarra (Spain), courtesy of Artazu winery.

Some other lessons

➔ Mediterranean vineyards have traditionally been integrated into a diversified landscape where olive and almond trees coexisted with natural vegetation. This diversity ensures environmental sustainability and landscape preservation, key points for business sustainability and wine tourism.

➔ Other practices such as co-plantation need to be re-evaluated since olive trees, apart from increasing production for the traditional grower, might also shade clusters and protect against spring frosts.

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