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What could be the architectural forms of future vines adapted to climate change: a new challenge! Let's discuss the Gobelet (Bush Vine)

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The architectural form of a vineyard is the result of the training system (plant spacing, geometry, pruning, trellising), the vigour of the plant material (soil x climate x cultivar/rootstock) and other cultural practices implemented each season. The vine is a liana and lends itself well to the diversity of training systems which are currently used and to those that have been used over the History of Viticulture. Despite the diversity of possible training systems, only a few are implemented as a consequence of vineyard mechanization. However, the ancient Gobelet is still present in commercial vineyards. The aim of this review is to present the diversity of the Gobelet training systems and to demonstrate that it still is an optional training system for Mediterranean dry farming.

History of grapevine training systems

The vine architecture of northern Italy, at least as far south as Tuscany, is undoubtedly the most diverse in the world; if we include the rest of Italy and Sicily, we are likely to find all possible types of vine architecture[1, 2, 3].

Fregoni (1991)[4] distinguished two major juxtaposed influences in Italy, which rarely became intermingled over the course of time:

. The Greek and Middle eastern influence in Sicily and the South of Italy, which are typical of dry Mediterranean climates, where Gobelet is the model architectural form.

. The Etruscan influence in the more humid, more wooded northern regions, where the vines were trained up trees and later held up by various types of supports.

Columelle and Pliny the Elder (1st Century) described 6 major types of vine architecture (figure 1)[1, 2, 3, 4]:

1) Low, mushroom-shaped in very dry zones.
2) Gobelet in typical Mediterranean areas.
3) Short trunk attached to a wooden picket in more humid areas.
4) Long trunk with at least partially hanging shoots of intensely vigorous vines, again with trellising.
5) Vines near to houses or verandas, trellised on a pergola, forming an overhead canopy.
6) Cultivated vines growing amongst trees, which could reach an enormous size.

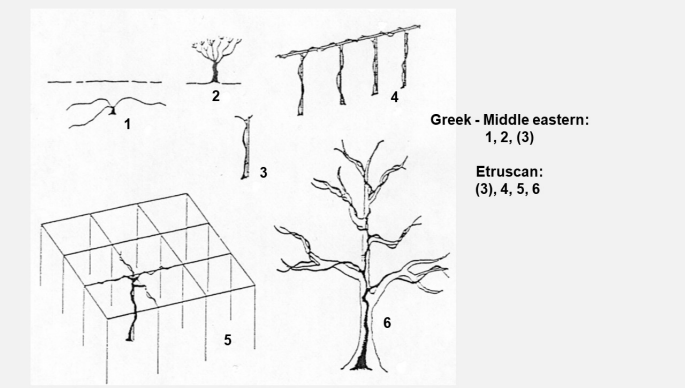


FIGURE 1. The six types of vine architecture described by Pliny the Elder (1st Century).

Gobelet or Bush Vine

Focussing on the training system/vine architecture called Gobelet (bush vine), this form was very widespread for long periods; this basic form existed even during the Roman times. Until recently, it was present in several viticulture regions of France - Languedoc, Roussillon, Provence, Lot, Bordeaux, Haute Garonne, Beaujolais – but is now diminishing because of imposing labour costs. Gobelet is still widely used in Spain, usually in dry-grown areas, or in some situations with marked irrigation water shortage (Figure 2): Madrid, Calatayud, Campo de Borja, Priorat, Ribeira Sacra, Ribera del Duero, Rioja, etc. It is still present in other Mediterranean areas such as Portugal (Alentejo), Italy (Marsala) and Greece (Santorini)[5]. The general characteristic of all these vineyards is that they are mostly old vines, as nowadays vineyard mechanization is a key factor to ensure that viticulture is economically sustainable, and therefore training systems are being imposed.

A Gobelet trained vine consists of a trunk of variable height from which the arms extend outwards and upwards forming a kind of vase, open to a greater or lesser extent. We can distinguish various types of Gobelet depending on the site (soil x climate) and grapevine variety (figure 3). A Gobelet can be spur or cane pruned, although spur pruned is more common. The vegetation may be free-standing or attached to wooden pickets. Whether or not Gobelet vines are trellised, or free-standing would depend on the viticultural region, climate conditions and the natural growth habit of the foliage (drooping or erect) (figure 3).



FIGURE 2. Examples of Gobelet vineyards in Spain: (a) Castilla-La Mancha Gobelets in winter and (b) during midsummer; (c) Gobelet arms in and old vineyard turning closer from mid height to favour tractor pass along alley – Extremadura; d) Four-year-old Garnacha Gobelets in Daroca (Zaragoza).

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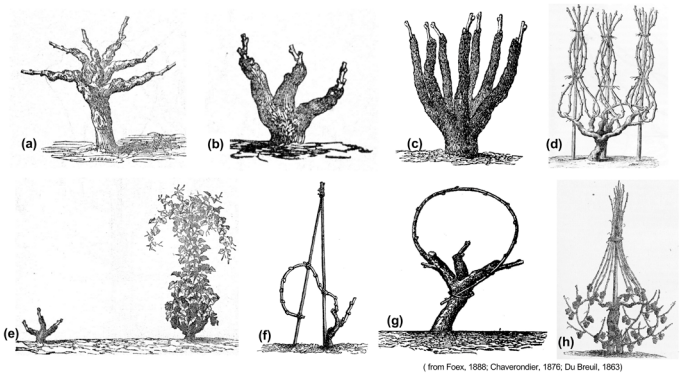


FIGURE 3. Examples of different types of Gobelet (Bush Vines) (Adapted from Deloire *et al.*, 2001)[2]. (a) Classical Gobelet used in the Mediterranean wine regions: the height of the trunk depends on soil water availability (short trunk and no poles in dry land); (b, e) Gobelet used in Beaujolais (transformed in VSP for today's mechanisation); (c) Gobelet used in Lot (19th Century); (d) Gobelet used in Bordeaux (19th Century); (f) Vines could be supported by poles (example of Viognier at Condrieu); (g) Vines in Gobelet could be spur or cane pruned; (h) Gobelet used in Jura (19th Century).

What could be the architectural forms of future vines adapted to climate change: a new challenge

Considering that the grapevine is a liana, it is possible to create new training systems adapted to drought and warm-hot temperatures. What should the future training systems look like? That's a difficult question and an interesting practical challenge in the context of global warming[6]. Let's share some thoughts:

1) Avoiding "big" training systems in dry regions, i.e., VSP may alleviate plant water deficits through reduced total and exposed leaf area per hectare.

2) However, berries should be protected from excessive sunlight and high temperature and thus some natural or artificial shading would be beneficial, and leaf removal around the bunch zone should be avoided. Even though light is important to fruit composition, the Gobelet, as for all training systems, should not over-expose bunches. Indeed, the Gobelet allows a 360° canopy and bunch exposure and careful positioning of foliage (with or without the use of poles) may be required to achieve the correct fruit zone microclimate.

3) Reducing planting density (distance in the row x distance between rows) may lessen water demand per hectare by reducing light-radiation interception at the vineyard level[6].

The bush vine training system is an inexpensive training system: almost no structure is needed, pruning cost is less when compared to any trellis system, and mechanical pre-pruning is also possible. The main inconveniences are: i) the low yield and ii) hand harvest is compulsory. Bush trained vineyards make sense if the bottle price is sufficiently high. Emerging viticultural areas and wineries committed to achieving a circular economy, with most of them under organic management, strive to maintain their economic activity in balance with the available environmental resources. This is possible if customers appreciate low yields (3-5 t/ha), reduced inputs, no- or very litte- use of ground water, and landscape value. All need to be reflected in the bottle price. Wine tourism offers an open communication pathway to inform the public of this balance between economic and sustainability drivers. Despite this, hand harvesting is still the biggest challenge to overcome for the bush vine system to gain popularity.

Conclusion

Aside from the implementation of a training system such as the Gobelet that is well adapted to dry farming, it is likely that a blend of strategies is required to address global warming within a particular wine region: this may include reducing planting density, leaf area per vine and per hectare. These cultural adaptations to drought will obviously lead to yield reduction and a shift in wine aromatic profiles. The interactive factors of drought, yield reduction, vineyard sustainability and winery profitability all need to be managed in a manner that is specific to each wine region, and even to each vineyard. ■

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