Experimental training systems in Champagne: an overview of agronomical and qualitative parameters

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Abstract
Vine implantation in Champagne is strictly regulated. Row spacing is limited to 1,50 meter and the canopy height can not exceed 1,40 m. The traditional training system is therefore characterized by narrow spaced vines.
From the late eighties, different vine training systems, such as lyres, have been tested in the Champagne area. The aim is to assess their interests in the terroir of Champagne, which is characterised by its cool climate, soil profile and its customs.
Whereas the lyre training showed its limits in the Champagne context, some other training systems have been implemented such as half-widely-spaced vines. These devices are characterised by a row spacing of two meters, a consistent cover crop and a canopy up to two meters. The plots are located in various places in the area and are strictly followed each year since 2006 (and 2000 for the first sites). Phenological, agronomical and ripening parameters are controlled and compared to the traditional training system plots. Experimental vinifications are done each year so that sensory analysis can be undertaken to assess the ability of these vines to produce wines with a Champagne typicality.
The results of this experimental device show interesting conclusions on the agronomical behaviour of experimental widely-spaced vines in a cool climate region. Spring frost resistance, cover crop management and ripening are some elements which show differences between the reference traditional system (REF) and the widely-spaced vines (VSL).

Introduction

The Appellation d'Origine Contrôlée Champagne has limited; distance of vine spacing (m) plus distance of row spacing (m) to 2.5m. This has been set in order to limit the vigor, and the yield, of the individual vine [Bonal, F. 1984]. These factors are considered favourable for the maturity of the grapes and their quality.

High density plantations however, are also associated to higher implantation, labour and specialised machinery costs, a greater demand for phytosanitary products, and in Champagne especially, an interrow management with elevated herbicide consumption and erosion susceptibility.

The appeal of VSL is therefore both financial and environmental. However, in order to satisfy both factors, the concept of vine balance is of paramount importance.

A fundamental principle of vineyard management is that total potential productivity is dependant on the quantity of intercepted photosynthetically active radiation (PAR), required for nutrient assimilation [Bates, S. 2010]. For vertical shoot positioned vines, canopy height (H) to row distance (E) is the primary consideration for light interception [Carbonneau, A. et al. 2007]. Optimal values of H/E are between 0.6 and 0.8 depending on viticultural practices and targets.

There have been few trials which have combined row spacing with an adaptation in vine architecture [Carbonneau, A. et al. 2007], and those studying the relationship of row spacing on vine physiology, yield, and berry composition often produce contradictory results [Archer, E. & Strauss, H.C. 1991]. This has been largely attributed to variances in vine vigor – influenced by scion and rootstock genetics, soil composition and texture, water availability, and cultivation practices such as; trellising, pruning, cover crops and fertilization [Steyn, J. et al. 2016] – all of which directly affects the results of vine spacing trials. As such, to understand the effects and feasibility of this mode of conduct in the Champagne appellation, 15 experimental parcels, approved by the INAO, have been established by a network of authorities and domains under the name « Mode de Conduite et Enherbement ».

Materials and Method

Experimental VSL parcels and their associated reference modalities, are scattered over the region and represent the 'experimental poles' of Champagne - reflecting the widest possible spectrum of climatic conditions and soils, whilst remaining true to the regions typical varieties, rootstocks and strict vitivinifcation procedures. The 15 parcels are comprised of 12 planted sites totalling 9 Ha and 1 Ha of 'transformed' vines in which traditional modalities have every second row removed and its canopy restructured accordingly.

Agronomic monitoring

The following data has been collected on sites at Essoyes and Plumecoq since 2000, on transformed sites at Chouilly, Verzernay and Mézy-Moulins as of 2007 and all sites as of 2012 :

- Load (number of buds / ha)
- Watch (number of clusters / m²)
- Fertility (number of clusters / bud)
- Foliar index: (exposed leaf area (m² / m²)
- Vigor : (dry matter g/m²)
- Average weight per cluster (g)
- Potential degree (% vol)
- Total acidity (gH2SO4 / L)
- Yield (kg / ha)
- Monitoring wood disease (esca)

In the case of climatic accidents, notations of frost or hail damage are made. Similarly, if there is a strong grey mould pressure, the affected cluster frequencies are indicated.

Vinification and tasting

Depending on the year and with the agreement of the domains, vinifications of 160 kg of grapes are carried out according to a strictly similar protocol at the CIVC's experimental winery. Complementary vinifications of 4000Kg are sometimes carried out by the domains and brought to the CIVC for tirage, aging and disgorgement. Triangular tests in black glasses are carried out on the base wine as well as 15 and 36 months after tirage to determine the existence or not of significant differences between VSL and REF. To date, 191 tasting comparisons have been conducted.

Additional studies

Production costs: An economic study was carried out comparing the production costs between VSL and REF. This study made it possible to apprehend all the factors (material investments, manpower, time of works, etc.) relating to the vegetative season and the production.

Life cycle analysis (LCA): LCA is a multi-criteria analysis that quantifies the environmental impacts of a product from the extraction of raw materials, to the disposal or recycling of the product by considering the manufacturing, logistics and use phases.

Results:

Charge: The bud load is, by definition, dependent on planting density, but also impacted by pruning systems. Differences measured are, on average, between 22 and 38% less in VSL than REF depending on the sites and years.

Fertility: Directly related to the vigor of the shoot, fertility is higher in VSL. This can also be explained by microclimatic conditions (notably sunshine) more favourable to floral initiation.

Foliar index: Exposed leaf area and the dry matter produced are always lower in VSL than REF. However, the difference between the two modalities is lower, on average, in the transformed sites (4% difference, all sites and all vintages combined) than in the planted sites (17% difference).

Average bunch weight: Cluster weights are generally higher in VSL, with all grape varieties, vintages and size systems combined - a difference of 11%.

Yields: Yields are 15-20% lower in VSL. This is explained by the density, and therefore the load in buds. VSL parcels pruned and trained as simple Guyot are, in general, producing the highest yields.

Frost sensitivity: VSL demonstrates a slightly lower sensitivity to spring frost, explained by an often later budburst, as well as by the higher average position of the buds.

Must composition: Of the entirety of the musts, all vintages combined, more differences occur according to the vintage and soils than by the mode of driving. However, on average, VSL musts contain a 5% increased total and ammonia nitrogen (mg N/L), 4 % increase in malic acid, 2 % in total acidity and a marginal elevation in pH.

Sensory results: In two out of three cases, the wines are not differentiated. There is no preference for one profile or the other of the wines. All the wines present a profile considered typical of the Champagne wines. Greatest differences are noted on Pinot Noir and Pinot Meunier.

Production costs: Results show that production costs for planting, seasonal work and mechanization are much lower in VSL. This is very logically explained by the density of plantation (reducing costs by 20%), minimizing the time of work (by 38%), and allowing above all, the use of vineyard tractors.

Life cycle analysis: For both VSL and REF systems, phytosanitary protection and soil maintenance are preponderant in terms of environmental impacts. VSL appears to be an interesting lever for reducing this impact with a 39% lower demand on resources than REF, and a 33% less impact on climate. These results are explained by reduced vineyard establishment materials, reduced tractor passing's and associated fuel consumption, and reduced phytosanitary requirements.

Conclusions and discussion

VSL offers an alternative mode of conduct to traditionally planted vines in the Champagne appellation, with both reduced production costs and impact on the environment. Furthermore, in the context of climate change and preserving Champagnes typicity, VSL demonstrates elevated levels of acidity, notably malic, without conclusive sensory differences (especially in Chardonnay).

While yields of VSL are typically lower, they do consistently meet the appellation's annually regulated and permitted yields, 'rendement de l'appellation'. However, additional yields that may be vinified for cellaring 'rendement reserve indivduelle' may not always be reached in VSL. It should be noted that differences in yield must not be simply filled by a higher load, a phenomenon that can be observed, especially in cases with double Guyot, which can compromise the vigor of the vine too much.

However, as the understanding of VSL management progresses, the economic viability of the system strengthens, and why this mode of viticulture is of continued interest. In 2017 (a spring frost year) for example, across all experimental plots observed, VSL yielded an average approximately the same as the traditional reference (-1%).

Due to large variances in performances between vineyard sites, further studies are required to better understand the characteristics of the vineyard (soil structure and fertility, water availability, etc.) where VSL performs most efficiently, allowing precise recommendations to be provided for the implementation of this mode of conduct in the Champagne appellation – subject to political approval.

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