

THE DEVELOPMENT OF THE VITICULTURE FOR A HIGH QUALITY TROPICAL WINE PRODUCTION IN THE WORLD

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Summary

A lot of grapes are produced in the tropics, but only a little part is used to winemaking, what represents some million liters of tropical wines produced per year. The present industry of tropical wine production began 30 years ago. Today, there are many commercial wineries in several countries in the tropical zone of the globe, like in Brazil, India, Thailand and Venezuela. Considered a challenge in the past, producing quality wines in the tropics became reality. This article analyses the tropical viticulture for wine production, where grapevines are constantly growing. The concept of tropical viticultural climate, main characteristics and production systems in tropical zones are presented. Considering that almost everything is new in terms of viticulture science and technology, the main lacks of know-how are analyzed. The concept of “just-in-time quality” for some tropical wines is also presented. Our analysis indicates that it is possible to predict, for the near future, the achievement of a high quality production of tropical wines with expressive amount, despite marketing challenges and competitive opportunities in the global market.

INTRODUCTION

A lot of grapes are produced in the tropics (Possingham, 2008), but only a little part is destined to winemaking, representing some million liters of tropical wines produced per year.

The present tropical wine production industry began 30 years ago. Schaefer (2008) accounts 69 commercial wineries in 14 countries in the tropical zone of the globe. The biggest producers include Brazil (Soares and Souza Leão, 2009; Camargo *et al.*, 2008), India (Chadha, 2008; Karibasappa *et al.*, 2006), Thailand (<http://www.thaiwineassociation.com/>) and Venezuela.

Besides a challenge in the past, producing quality wines in the tropics became reality. Considering that almost everything is new in terms of viticultural science and technology, know-how has been quickly achieved in comparison to traditional viticulture regions (temperate climate condition) and important steps in wine quality are being obtained.

This article analyses the tropical viticulture for wine production, where the grapevines are constantly growing. This viticulture is different from that placed in temperate zones, where grapevines have only one cycle/harvest a year, undergoing a dormant period with a vegetative repose (condition found also in some intertropical producing regions).

TROPICAL VITICULTURAL CLIMATE

A definition to be used for regions with a hot climate where it is possible to have more than one cycle per year is the “viticultural climate with intra-annual variability”. It corresponds to the regions where, under natural climate conditions, “viticultural climate class” (concept of the “Géoviticulture Multicriteria Climatic Classification System” - MCC System) changes according to the period of the year in which grapes can be produced (Tonietto and Carbonneau, 2004). To exemplify, the MCC System showed three different climate groups in the São Francisco River Valley vineyard, Northeast of Brazil, located at 09° S, in a tropical semi-arid region. In this condition, Tonietto and Teixeira (2004) described the viticultural climate considering 36 potential harvests (each 10 days period) during the year, including characterization of the inter-annual variability in this region.

In tropical climate we can find a big range of temperatures. Normally, the idea is that in tropical climates the viticulture is under high temperatures during all the year. Many geographic situations (latitude, altitude, others...) allow to identify viticultural conditions with very mild thermal climate. For example, Três Corações or Cordislândia (22° S in the SouthEast of Brazil), a tropical region with altitude between 865 and 873 m in the state of Minas Gerais, Brazil, may have viticulture in two cycles per year. The cycle in the counter season (harvest in July-August), period of very low rainfall, have average temperatures ranging from 15 to 17 °C (monthly average maximal temperature of 24 to 26 °C; monthly average minimal temperature ranging from 9 to 11 °C). In this state, an increasing gradient of temperatures is found in the viticultural regions from João Pinheiro, Uberaba, Pedra Azul, Pirapora to Ituiutaba (Ituiutaba, the hottest region, having monthly average maximal temperature ranging from 31 to 33 °C in July-August) (Amorim *et al.*, 2005; Favero *et al.*, 2008).

Two main situations, concerning viticultural cycles, are observed in the present tropical vineyard of the world:

a) Double pruning and single harvesting system on the driest period of the year: this system is used to produce quality wines in regions alternating, during the year, a period very wet (monsoon climate in Asia, for example) with another dry. In this case, grapes are harvested only once a year in the dry period. This is the case of producing regions in Minas Gerais state (Tonietto *et al.*, 2006) or São

Paulo state in Brazil (Marin *et al.*, 2008) or in some hot tropical conditions in India (Chada, 2008) or in Thailand.

b) More than one cycle per year with one or more harvest per year programmed by the wineries: this system is used to produce quality wines in regions alternating, during the year, a not so wet period (tropical semi-arid climate in Brazil, for example) with another dry. With this climate it is possible to distribute the harvest of grapes throughout the year. It is possible to have even 5 cycles in two years, depending on the genetic and cycle duration of each grape variety. Normally, producers avoid producing with harvest in the rainy months. To obtain grapes with better enological quality, producers choose the best climatic conditions over the year to harvest grapes for winemaking process. Camargo (2007) explains how to program viticultural cycles along the year to produce grapes with better quality in the case of the São Francisco Valley region in Brazil, considering cycle duration of different varieties. Bois and Pérard (2009) also present possibilities for viticultural cycles to produce wines with better quality in Vietnam.

WHAT IS DIFFERENT IN THE TROPICAL VITICULTURE FOR WINEMAKING?

Some characteristics can define what is different in tropical viticulture for wine production comparing to the traditional temperate viticulture. Some points are:

a) Successive cycles: after harvest, grapevines have a period of restoration (without dormancy). After pruning and total leaf suppressing (current use of hydrogenate Cyanamid for stimulate homogenous bud burst and to reduce apical dominance), in few days bud burst occurs starting the development phase, differentiation of non latent buds and grape harvest (Carbonneau, 2010);

b) Shorter vegetative cycle: comparing to regions of temperate viticulture, where the vegetative cycle begins after winter, in tropical viticulture, the higher temperatures in all vegetative cycle, reduce the duration of the bud burst-flowering period and also the flowering-veraison period; 34 days shortest average cycle were observed comparing four varieties in tropical semi-arid São Francisco Valley with subtropical humid region of Serra Gaúcha in southern Brazil (Camargo *et al.*, 2004; Pereira and Bassoi, 2008).

c) Irrigation: irrigation is normally necessary in tropical viticulture; this is due to high evapotranspirative demands in tropical climate, normally associated with regions with less climatic availability of water (a basic zoning criteria for selecting viticultural regions: less diseases and good maturity of grapes);

d) Adapted varieties: the agronomic adaptation of vines to tropical climate is easier for some varieties than others. Many are the reasons why traditional varieties may not adapt to produce in tropical climate – low fertility and/or low bud burst, irregular yield among cycles, vine or bunch diseases as a result of climate favorability (temperature, humidity, rainfall), low enological quality of grapes ripening in hot climate. Normally, grapes may present high sugar concentrations, low acid level due to the malic acid combustion, high pH levels with consequent lower longevity, and incomplete phenolic maturation due to

the accelerated metabolism. However, viticulture for winemaking in tropical condition reveals that some varieties are well adapted in different regions of the world. This is the case of Shiraz (syn. Syrah) and Chenin Blanc for example. Other varieties are being adapted for tropical conditions like Cabernet Sauvignon, Ruby Cabernet, Tempranillo, Petit Verdot, Moscato Canelli, Sauvignon Blanc, Colombard, Viognier, among others.

Finally, tropical viticulture produces grapes with particular chemical characteristics in terms of sugar, acidity, pH, tannins, antocyanins and aromatic compounds, what results in wines with original characteristics and different typicity comparing to wines produced in temperate climate regions.

SCIENCE AND TECHNOLOGY FOR TROPICAL WINES

The knowledge to produce quality wines in tropical conditions is being developed quite quickly. Considering that almost everything tested is new in tropical viticulture, new developments generate big impact in the production sector.

On the other hand, there are innumerable topics that remains in need of further research for better understanding and improvement - zoning, viticulture, enology and marketing (Tonietto *et al.*, 2007; Kanchan, 2008). Some topics are presented below:

a) Zoning

Viticultural zoning studies for regions in “viticultural climate with intra-annual variability” needs to include methods to characterize geographical indicators – climate and soil, their distribution and interaction, also considering which are the best climates along the year for better wines (Tonietto and Teixeira, 2004; Gomez-Miguel, 2007; Tonietto, 2008).

Some important topics for research and development in viticultural zoning includes: definition of the climatic periods of the year to produce better grapes for high quality wines (Pereira *et al.*, 2008); characterization of the soils in tropical regions and their potential for quality in tropical conditions; zoning new tropical regions with climate/soil potential to produce high quality wines; climate change risks in the present viticultural regions in tropical climate.

b) Viticulture

The adoption of a certain number of cultivation practices allows more than one cycle per year in the tropical viticulture. In Brazil, vineyards were initially installed in the Pergola system, currently used to produce table grapes. Today the systems are in evolution, with vineyards in espalier, lyre and others. Also, the yield and microclimate of the plant control is increasing, also at a bunch level, to optimize the quality of grapes for quality or high quality wines (Pereira and Bassoi, 2008).

Some important topics for research and development in tropical viticulture includes: Varieties – introduction, evaluation and adaptation of variety clones with potential to produce grapes with high quality in different terroir (some works in this topic are presented by Karibasappa and

Adsule, 2008 and Camargo *et al.*, 2007); Rootstocks - evaluation and/or creation of rootstocks adapted for each variety to obtain high quality wine production (Pereira *et al.*, 2007), also avoiding risks associated to soils and natural enemies and to provide appropriate levels of vegetative vigor and yield (notice that some rootstocks created in Brazil for tropical viticulture includes 'IAC 572' - *Vitis caribaea* x 101-14 Mgt, 'IAC 313' - Golia x *Vitis caribaea* and 'IAC 766' - 106-8 x *Vitis caribaea*); Training and Trellising Systems - adopting better systems to produce better quality grapes in tropical conditions (studies are beginning concerning trellis system on wine quality); optimizing the microclimate for the grapevine, at the leaves and bunch levels, also defining yield for quality for different varieties; Vine Ecophysiology in Tropical Regions - grapevine functioning in tropical climate related to bud biology, acrotonie, fruit bud differentiation, bud burst, apical dominance, photosynthesis, phenology and associated bioclimate, etc. (Favero *et al.*, 2010); Irrigation - definitions concerning the water management throughout the year, in particular during the vegetative cycle, including the ripening period of the grapes (effect of water stress levels in the grape and wine quality); Soils - requirements in soils of tropical regions for better quality and sustainability; Grape Quality for Wines - studies on the evolution of the ripening to define the stage of ripeness for winemaking considering ambient factors and technological improvements to produce red and white wines, traditional sparkling, Muscat sweet sparkling and dessert vines (Lima *et al.*, 2007; Guerra and Zanus, 2007; Mota *et al.*, 2010).

QUALITY TROPICAL WINES

Producing wines in tropical conditions requires particular techniques for grape quality and harvesting techniques, must and mash treatment, pressing and fermentation systems, temperature control, aging and stabilization of wines (Schaefer, 2008). Some characteristics or problems are present in winemaking, like quality and stability of tannins and antocyanins, pH levels of grapes and wines, longevity of wines, among others.

Technology available for winemaking of tropical wines still needs adaptations and developments of enological practices to maximize quality and typicity in white wines - aromatic or not, young red and aged wines, traditional sparkling and Moscatel sparkling.

Production cost in tropical regions is also another important factor to consider; it may include irrigation, to have more than one cycle per year and winery infrastructure that may be utilized all over the year in some regions.

Physical, chemical and organoleptic characterization will differentiate tropical wines coming from different regions, their elements of typicity and differences in comparison to wines from temperate zones (Neto *et al.*, 2009; Araújo *et al.*, 2010).

New concepts may be developed for some wines, like the "Just-in-Time Quality" concept, in zones where grape and wine production are possible throughout the year (with possibility of blending wines from different harvests along the year, like in the São Francisco Valley, Brazil). This concept could be applied to wines produced all over the

year, with constant quality and typicity, linked to the origin of the product, with regular production and market supply all over the year. This could be the case of wines like "nouveau" style or sweet Muscat sparkling, where better organoleptic characteristics and quality for optimal consumption are achieved for a relatively short period (normally few months) between elaboration and consumption (Tonietto, 2008).

Presently, producing tropical wines with good quality became a reality. Considering potential developments in science and technology that tropical viticulture may obtain in the near future, it is possible to predict a high quality production of tropical wines with significant amounts.

However, there are big challenges related to marketing tropical wines, since this product is not yet well known and recognized by consumers. Beyond of producing quality, some strategies will be needed to better develop tropical wine markets, add value and promote an image for tropical wines.

A lot of empiric know-how has been developed during the last decades in different tropical wine producing countries. It is time to promote experience exchange between producers. In terms of science and technology, the "International Symposium on Tropical Wines" (2004 and 2009 in Brazil; 2011 in Thailand), carried out by Embrapa in cooperation with many international partners (OIV, GIESCO, UNESCO Chaire "Culture & Traditions of Wines", ISHS, among others), is becoming a forum to help the development of this new frontier of wine production.

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