

# A Study on Grape Cultivation Practices in Tropical Agro-Climatic Zones

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**Abstract:** *Even though grapevines may grow in a variety of climates, the optimum grapevine cultivation occurs in areas that satisfy particular climatic conditions. In what are known as tropical regions—the latitudes between the Tropics of Cancer and Capricorn—grapes are also widely grown. Viticulture has grown dramatically in the tropical areas in recent years, and nations in the tropical and subtropical regions, including Brazil, Venezuela, India, and Thailand, provide quality table grapes, wine, grape juice, and raisins. Grapes are grown in tropical locations using different production techniques than in conventional temperate regions. Table, raisin, and wine grape characteristics are present in the majority of grapes cultivated in these areas. Tropical grape varieties need to have short growth seasons, early ripening times, and strong resistance to fungus-related illnesses.*

**Keywords:** Viticulture, Grapes, Tropics, Cultivation, Climate, Soil, Irrigation, Varieties

## I. INTRODUCTION

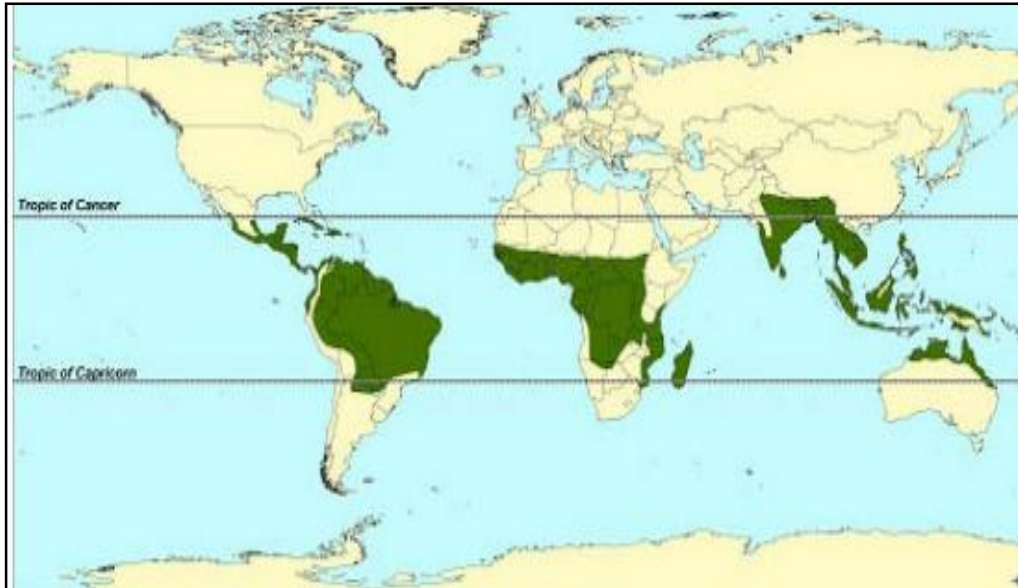
Around the globe, viticulture is practiced in various temperature regimes that provide ideal conditions for producing grapes of superior quality (de Blij, 1983). The temperate climate belt, which includes the majority of the world's viticultural areas, is situated between latitudes 40° and 50°N in the northern hemisphere and between latitudes 30° and 40°S in the southern hemisphere (Iland et al., 2009).

Tropical viticulture has garnered a lot of attention lately, and commercial grape cultivation in tropical areas dates back around 50 years (Jogaiah et al., 2013). There are several grape-growing areas in the intertropical zone, which lies between the tropics of Capricorn and Cancer.

The region of the globe that is between 23° north and south latitudes is known as the tropic of Cancer and the tropic of Capricorn. The Tropic of Cancer passes across Mexico, the Bahamas, Egypt, Saudi Arabia, India, and southern China. It is situated 23° north of the equator. The Tropic of Capricorn passes across Australia, Chile, southern Brazil, and northern South Africa. It is located 23° south of the equator. It is evident that Brazil, India, Thailand, and Venezuela are among the nations with tropical climates that contribute significantly to the global production of tropical grapes, which are found in Bolivia, Colombia, Peru, Guatemala (in South America), Madagascar, Namibia, Tanzania (in Africa), and Vietnam, China (in Asia) (Jogaiah et al., 2013).

The tropics, which are a region of land and sea mass around the equator, are often delineated by the tropics of Capricorn to the south and Cancer to the north (Figure 1). At least once throughout the solar year, the sun passes directly above in tropic areas, which are hotter due to their proximity to the sun. Additionally, the earth's axial tilt results in a far larger shift in the sun's axis with respect to the earth, which causes the sun's rising and set locations to vary greatly during the year.

Thus, grape quality and grape growth will be impacted by both facts (Commins et al., 2012). Furthermore, the climatic zones that are frequently located next to the tropics are known as subtropical areas. These regions are normally found in both hemispheres between 23° and 40° latitude. The cold season is milder and wetter in subtropical climates, whereas the hot season lasts longer.



**Figure 1. The tropical regions of the world**

Although table grapes make up the majority of vineyards in tropical climates, there are also rising vineyard sections dedicated to producing high-quality wine grapes (Tonietto and Pereira, 2012).

According to Camargo et al. (2006), grape cultivation was brought to Brazil during the colonial era in the 16th century, and it wasn't until the 20th century that it became a profitable enterprise in the southern sections of the nation with moderate climates.

Production is limited to fewer varieties due to general adaptation issues with the classic *Vitis vinifera* variations (bud dormancy, apical dominance, poor fertility, and susceptibility to fungal infections) and *Vitis labrusca* variants (dormancy, lack of vigor). The primary germplasm used in the crossing program came from *Vitis vinifera* and *Vitis labrusca* varieties, interspecific hybrids, and wild tropical species in order to create new grape varieties that combine the qualities of adaptation, productivity, disease resistance, and grape quality (Camargo, 2000). Grapes can only be produced once a year in traditional wine-growing regions, which are found in temperate climatic zones. Brazil, Venezuela, Thailand, and India have all produced sophisticated tropical wines. For instance, wine is produced in the northeastern part of Brazil, where grapevines may yield two or three harvests year, depending on the cycles of the various grape kinds.

Pereira et al. (2010) identified the physical-chemical and aromatic properties of a few tropical wines made from grapes picked in November 2008 in the Northeastern region of Brazil.

According to Possingham (2004), with a global output of more than 3 million tons, grapes are perhaps the most widely produced temperate fruit crop in the tropics and subtropics. The world's largest producer, India, produces more over one million tonnes, followed by Brazil, which produces less than one million tonnes in the tropics. Yemen (163,000 t), Peru (136,000 t), Thailand (40,000 t), Colombia (19,000 t), Tanzania (14,000 t), and Venezuela (11.5 t) are the other tropical grape-growing nations.

Changes in temperature, precipitation, and altitude provide a great deal of environmental variety in the tropic and subtropical regions. Grapevines are evergreen, grow continually, and may have one cropping cycle each year with careful trimming in the moist, humid tropics. Conversely, grapevines often undergo two or three cycles year in the arid tropics and subtropics (Possingham, 2004).

The enhancement of fundamental understanding about adaptation to tropical temperatures and associated limits, the testing of novel growing techniques, and the socioeconomic pressures of such locations are the primary problems of tropical viticulture, according to Carbonneau (2010). Controlling vigor, which is typically excessive, controlling microclimate and architecture, controlling water and mineral management, controlling harvest date,

and controlling sanitary status, particularly in wet tropical and subtropical zones, are the primary technical challenges for a high-quality tropical viticulture.

Growing grapes in hot climates is not the same as growing them in temperate locations, where grapevines only produce once a year.

The current review's objective is to illustrate the variations in grape cultivation across the temperate and tropical climatic belts.

**Some Characteristics of Tropical Regions  
Climate**

As a species with a temperate climate, *Vitis vinifera* L. is mostly grown between latitudes 30°N and 50°N and between 30°S and 40°S, which correspond to isotherms of 10 °C and 20 °C. Extreme heat, poor winter chilling, and water scarcity are the main obstacles to grape cultivation near the equator (Mullins et al., 1992).

Table 1 below provides a broad summary of the climatic features of tropical areas, which include a wide variety of temperatures (Düring, 2014);

**Table 1. Vegetation and climatic characteristics in tropical regions**

Region	Vegetation	Precipitation	Temperature
Inner tropics	Evergreen, rain forest	More than 1500 mm, even spread	Frost free, more than 25°C, difference between day and night: 0-6°C
Outer tropics	Savanna	Less than 1500 mm, dry season, wet season	High difference between day and night

**Precipitation**

The yearly rhythm of grapevine development, dormancy, and harvest timing are determined by the precipitation circumstances.

**High temperature**

Grapevines and their organs are affected differently by high temperatures seen in tropical regions. It speeds up grapevine growth and development, speeds up the first harvest (18 months after planting), improves grape development, must, and wine quality, permits two to three harvests annually, raises evapotranspiration, which raises water demand, and reduces lack of cool stimulus, which causes irregular bud breaking.

**Photosynthetically active radiation (PAR)**

The quantity of light in the 400–700 nm wavelength range that is accessible for photosynthesis is known as photosynthetically active radiation. Season, latitude, and time of day may all affect it. In tropical areas, apical photosynthetically active radiation levels may approach 2000–2200 μmolm<sup>-2</sup>s<sup>-1</sup>, yet dormancy is not induced.

**Day length**

It is evident that the equator experiences 12 hours of daylight every day, whereas short days experience 8–12 hours.

**Wind**

In coastal regions, persistent breezes have a diminishing impact on agricultural productivity and grapevine development, whereas predominant winds are crucial for grapevines.

**Annual Rhythm of Growth and Dormancy**

Shortly after the shoots were topped or pruned, buds burst (Table 2). The speed at which buds burst is an indication of apical dominance. In tropical climates, grapevines do not go through a vegetative hibernation; instead, they grow continuously as long as they get enough food and water.

**Table 2. Bud dormancy of grapevines and bud break**

	Correlative predormancy	Endogenous dormancy	Exogenous postdormancy
Principle of dormancy	Apical dominance	Chemical inhibitors	Low temperature
Induction of bud breaking	Decapitation, topping of shoot	Cool stimulus, hydrogen cyanamide	Increasing temperature

**Major Points of Tropical Grape Growing**

**Choice of grape varieties and rootstocks**

Important traits for grape types utilized in the tropical belt include high crop output and grape quality, resistance to fungal disease, and tolerance to harsh climatic conditions. Thompson Seedless, Black Corinth, Regina, Alphonse Lavallée, Cardinal, Perlette Emperor, Almeria, Flame Tokay, Muscat Hamburg, Muscat of Hamburg, Perle de Csaba, Ruby Seedless, Emerald Seedless, and Regina are the most commonly planted grape types in this area for table and raisin grapes. However, the grapes that are selected for wine include Riesling, Moscato Canelli, Chenin Blanc, Cabernet Sauvignon, and Petit Syrah.

Consumer demand, genotype-environment correlations, rootstock selection that is appropriate for the grape variety, and soil properties should all be taken into consideration when selecting a grape variety to grow in tropical areas. For table, wine, and juice grapes, strong rootstocks like IAC 572, IAC 313, IAC 766, and Campinas are often used for their balanced vegetative growth and increased output. Less active rootstocks, such as SO4 and Harmony, are used to produce high-quality grapes for seedless and wine grape types.

**Training, trellising and pruning of grapevine**

Grapevines are typically planted at a planting density of between 952–3333 plants per hectare, with rows spaced 3–4 meters apart and 1.5–3 meters between grapevines. The horizontal overhead-wired trellis technique is used to create a homogeneous and appealing cluster (Souza Leão, 2003). To form a bilateral cordon, the grapevines are first trained to one side and then separated along the training wire. Later, each side of the main arm alternates with the cross arms.

In terms of grape processing, such as juice and wine, the climatic heterogeneity that distinguishes nations in the Tropical Belt intertropical zone due to changes in height, elevation, and continentality enables the selection of the production location according to the desired product type. Pruning is necessary twice a year in a cycle that alternates between five and seven months because *Vitis vinifera* cultivars are too developed. Depending on the production region and the level of precocity of preferred varieties, the technology allows for the choice of different production systems, such as 1) two cycles and two harvests per year; 2) two cycles and one harvest per year; 3) five cycles and three harvests per two years; or 4) five cycles and two harvests per two years (Camargo, 2005). Regions that do not get rainfall throughout the year are excellent for production in successive cycles due to the minimal risk of disease incidence. However, in areas that experience an excessive amount of precipitation (about five months of wet season), it may be recommended to use a system with five cycles, which would provide three harvests every two years, and to plant short-cycle types in the dry season. To produce high-quality grapes, however, two prunings and one harvest should be carried out annually in areas with a wet season longer than six months. The production cycle should also be timed for the dry period.

**Canopy management of grapevine**

As is well known, canopy management may include choices about irrigation, rootstock selection, training and pruning techniques, row and grapevine spacing, and, most importantly, summer trimming. In tropical viticulture, it may also be used to typical canopy management techniques including leaf removal, cluster thinning, cluster tipping, shoot thinning, shoot topping and tipping, and grape thinning, if grapevines need summer pruning.

**Diseases control**

Excessive humidity limits grape growth in hot areas and degrades grape quality by causing bacterial and fungal diseases (such as bacterial canker, mildew, anthracnose, leaf spot, rust, ripe rot, and die back).

Climate-wise, areas with little rainfall or prolonged dry spells are more suited for growing table and wine grape varieties. However, in areas with higher levels of wetness, American or hybrid cultivars should be used because of their strong resistance to fungal infections.

#### **Grape harvest**

Grape quality is deteriorated by bacterial and fungal diseases (such as bacterial canker, mildew, anthracnose, leaf spot, rust, ripe rot, and die back) and restricted growth in hot climates due to excessive humidity.

In terms of climate, table and wine grape varieties grow better in regions with limited rainfall or protracted dry periods. However, because to their excellent resilience to fungal diseases, American or hybrid cultivars should be utilized in regions with higher amounts of moisture.

## **II. CONCLUSION**

Despite the fact that grape cultivation has historically taken place in nations with temperate climates, there has been a recent surge in grape cultivation in tropical regions. The world's tropical climate belt is widely dispersed, and its climate is distinct from that of the temperate zone. Among the crops cultivated in the tropical climate belt, grapes and grape products play a significant part in the exports of nations with tropical climates. Understanding tropical ecosystems and how to manage them to provide the necessary number and quality of goods has advanced somewhat in recent years.

Grapevines behave differently in tropical climates than in temperate ones, and two harvests may be produced year and harvested there with appropriate watering and pruning practices. Growers may harvest grapes at periods when prices are higher thanks to tropical viticulture, and farming grapes in tropical areas is quite profitable.

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