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Policy Study

What is tropical wine and what defines it? Thailand as a case study

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Abstract

A recently concluded symposium discussing tropical wine has raised the question as to what defines this new entry into the world of wine and whether or not the differences between tropical and temperate viticulture and oenology are significant enough to warrant separate study.

This paper looks at what is meant by the term tropical, our understanding of this and the implications for wine production. The study is intended to examine considerations in seeking an ideal vineyard site, in this case in Thailand, and the readily available data that could be applied in this search. These considerations in effect define tropical wine. Meso-climate is particularly important in the search for the perfect *terroir*/cultivar matching.

The conclusions are that there are significant differences that in some cases require different techniques. However, in the main our store of knowledge on viticulture and oenology may be suitably adapted to tropical regions, once the differences are recognized. It is not advocated that tropical regions are deserving of a special science, rather there is a need to enhance our knowledge and understanding of what we are dealing with.

Keywords: viticulture, oenology, radiation, climate, soil, irrigation, tourism, new latitude wines.

Introduction

It would appear that our knowledge of viticulture, built-up over centuries, but largely confined to temperate climates, is being applied and adapted to the tropics, much on a trial and error basis, using cultivars mostly developed in cooler zones. Some international experts are of the view that the viticulture practices are not that much different [1, 2]. However, the chances of success in producing wine could be greatly enhanced if we had a clearer understanding of exactly what we are dealing with when it comes to the tropics [3].

The tropics are an area of land and sea mass on our planet surrounding the equator. It is generally defined by the Tropic of Cancer to the north and the Tropic of Capricorn to the south (Figure 1). These latitudes correspond to the axial tilt of the Earth. In the tropics, the Sun reaches a point directly overhead at least once during the solar year. We can draw two simple facts from this. It is hotter because it is “closer” to the Sun. Also the axial tilt means a much greater variation in the Sun’s axis relative to the Earth, that is, the extreme variation between where the Sun rises and sets throughout the year. Both of these facts have implications for viticulture and wine.

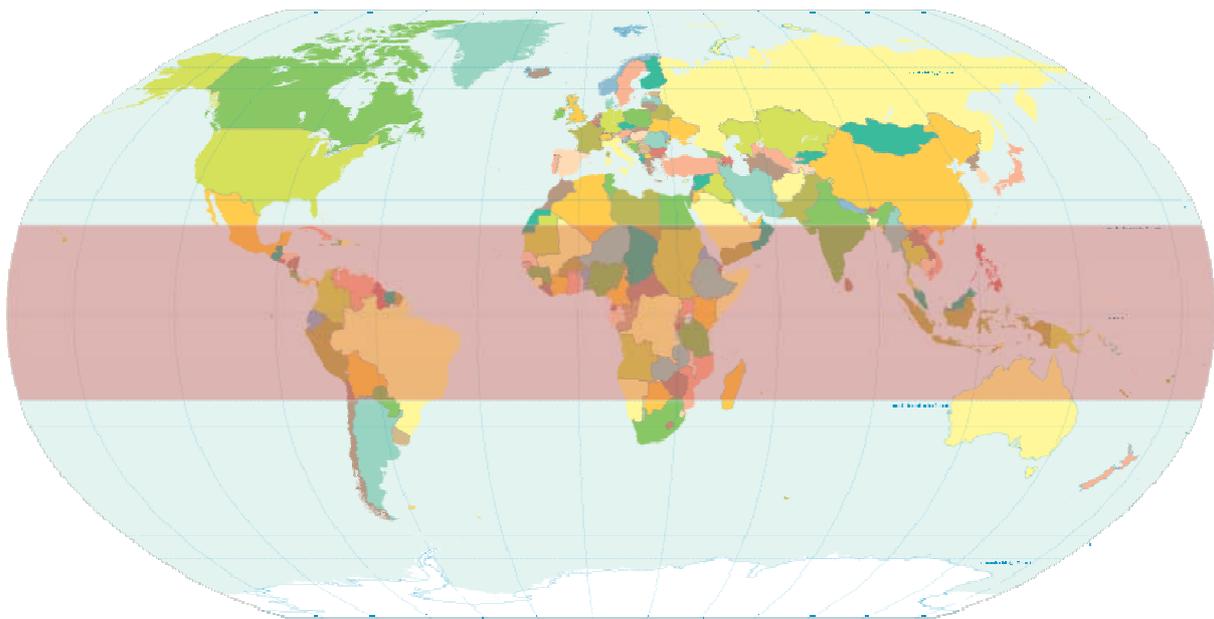


Figure 1. The tropics, defined by the Tropic of Cancer to the North and the Tropic of Capricorn to the South.

Source: Wikimedia Commons.

It can be seen that a large proportion of Brazil, much of Africa and most of South East Asia fall within this zone. The term ‘tropical’ is often used to describe a climate being warm to hot

and moist all year round, in a region of the world covered by lush vegetation. Although such areas exist, they are far from typical. Many tropical areas have a clearly defined dry and wet season. A wet season month is generally defined as one where rainfall exceeds 60 millimetres.

Regions within the tropics may well not have a tropical climate. It is possible to find alpine tundra and snow-capped peaks. Much of the area within the geographical tropics is classed not as "tropical" but as "dry" (arid or semi-arid), including the Sahara Desert and the Australian Outback.

When the wet season occurs during the warm season, or summer, precipitation falls mainly during the late afternoon and early evening hours. This is a time in the tropics when air quality improves, freshwater quality improves and vegetation grows significantly, leading to crop yields late in the season. Soil nutrients diminish and erosion increases.

When it is considered that over two-thirds of the world production of grapes, including table grapes, comes from India and Brazil [3], the study of viticulture in the tropics takes on a new significance.

Radiation

Numerous studies have shown how the Sun, or radiation, is an important factor in both plant vigour and berry composition and ripening [4]. Radiation is also an important factor in helping to control diseases usually associated with moisture [5]. With the sun comes heat. It is not difficult to imagine that the tropics are typified by bright sunny days with lots of cloudless skies, therefore radiation should be plentiful. While it is usually hot and the radiation is usually intense, at least half of the year is characterized by rainfall and to have rainfall, you must have clouds. As such, much of the radiation is diffuse. Also, in a newly industrializing country such as Thailand, you can expect a lot of pollution. This pollution causes haze and haze also helps to diffuse the solar radiation.

More detailed study needs to be undertaken on the radiation preferences and requirements of various grape cultivars. This could be a major step in determining their potential for adaptation in different growing regions.

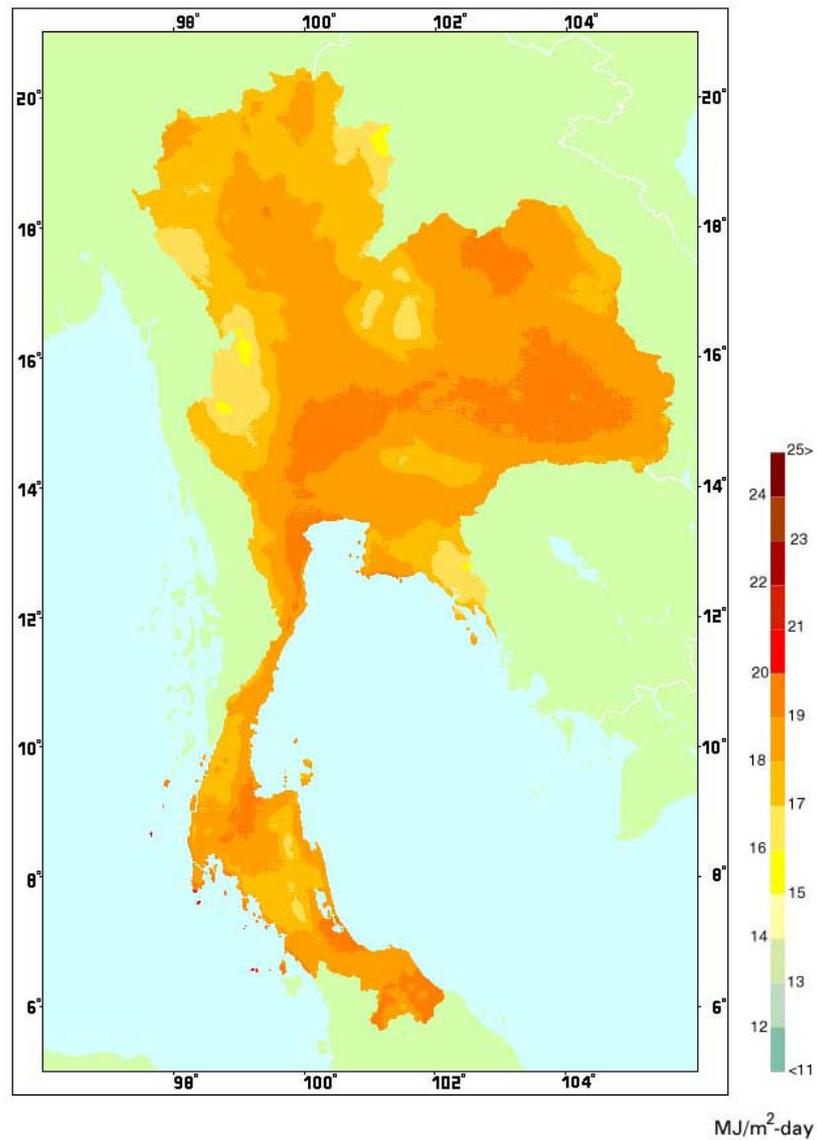


Figure 2. Solar Radiation Map for Thailand.

Source: Department of Energy Development.

From Figure 2 it can be seen that most areas range from light to dark orange, with a few lower or yellow areas. Otherwise it is fairly uniform with no extremes. The average is around 18-19 MJ/m² per day. This translates into about 1,825 – 1,950 KWh/m² per day, which enables us to make a comparison with a temperate wine growing region, in this case France.

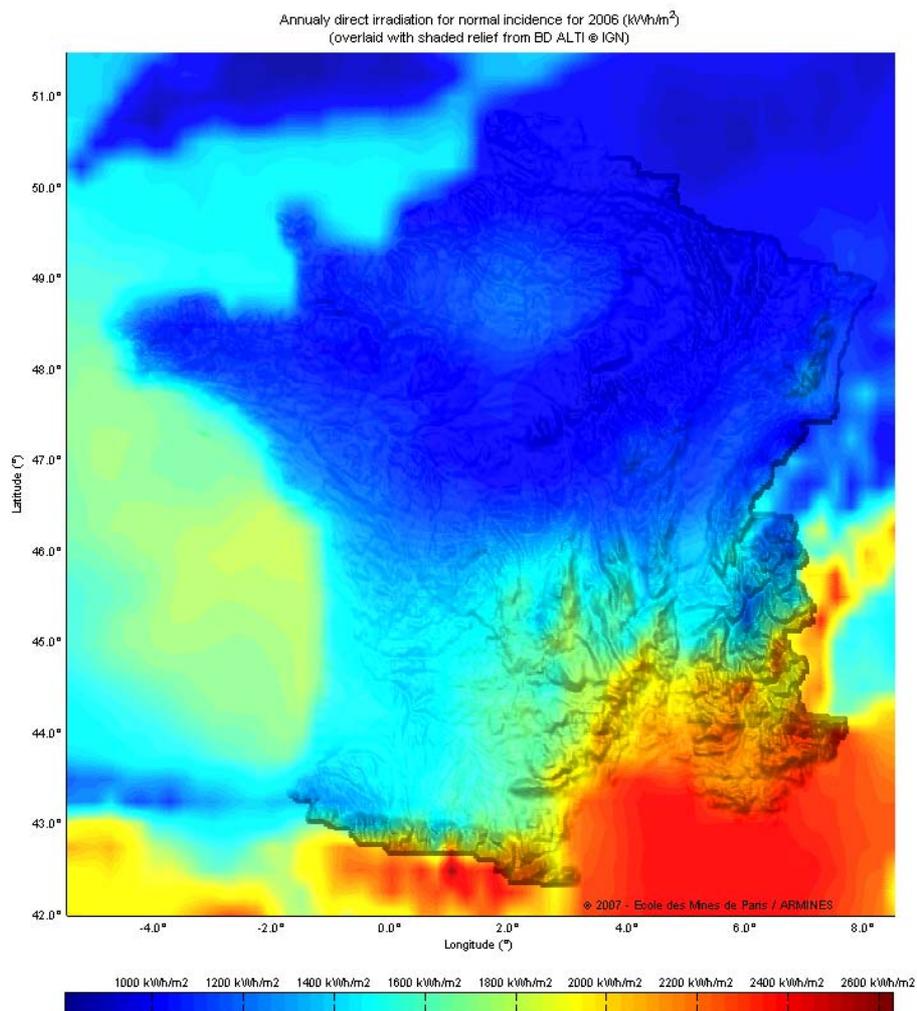


Figure 3. Solar Radiation Map for France.

Source: Ecole des Mines de Paris.

From Figure 3 it can firstly be seen that France has considerable variation. While much of the country experiences levels between 1,000 to 1,400 kWh/m², some of the Mediterranean coastal areas are as high as 2,200, experiencing higher average solar radiation levels as those occurring in Thailand.

The other distinguishing feature is that there is great variation in day length in temperate zones. Typical long summer days mean higher exposure to radiation for vines, for that time of the year, sometimes as much as 15-16 hours. Conversely, when days are short, the vines are usually in dormancy. The closer one gets to the Equator, the less pronounced is this

variance, with the Sun rising at 6 and setting at 6. As one moves further away from the Equator, the more the days vary. Typically, the days become shorter in the cool season in Thailand (November to February). There is no pronounced dormancy period as you would find in temperate zones.

What is interesting from this radiation comparison is to view it from the perspective of cultivars. For example, it is known that Shiraz has proven itself to be the best adapted cultivar for Thailand, favouring the light orange to yellow areas. By examining similar radiation levels in France, basically in a vertical line west of Montpellier, areas well known for quality Shiraz production are featured.

It can thus be concluded that vineyards in tropical countries are not necessarily exposed to higher solar radiation levels and that much of the radiation that vines are exposed to is diffuse. While it has been demonstrated that sunlight or radiation is beneficial to both grapevine and berry growth, as well as berry composition, this approach requires some caution in the tropics as there may be enough variance in the solar axis that certain parts of the vines fall into shade at certain times of the year. Uneven or excessive exposure to radiation can cause considerable variation in berry ripening, even within a single bunch [6].

The other significant difference between temperate and tropical zones is the relatively constant high temperatures due to radiation experienced in the tropics. This has implications for winemaking. Most winemakers in Thailand use air conditioning in their cellars. Not only does this make working more comfortable, it ensures that the product is maintained at constant temperature. Wine will quickly spoil in the tropics if it is not properly stored.

Climate

The Koppen climate classification for the tropics (Figure 4), demonstrates quite clearly how uneven the climate pattern is when viewed as average rainfall. Under this classification, a wet season month is defined as a month where average rainfall is 60mm or more. It can be seen that some areas have very high annual averages, while others are low. This is usually determined by the direction and strength of the annual monsoons. The high rainfall areas are the beneficiary of two monsoon currents, sometimes providing year-round rainfall.

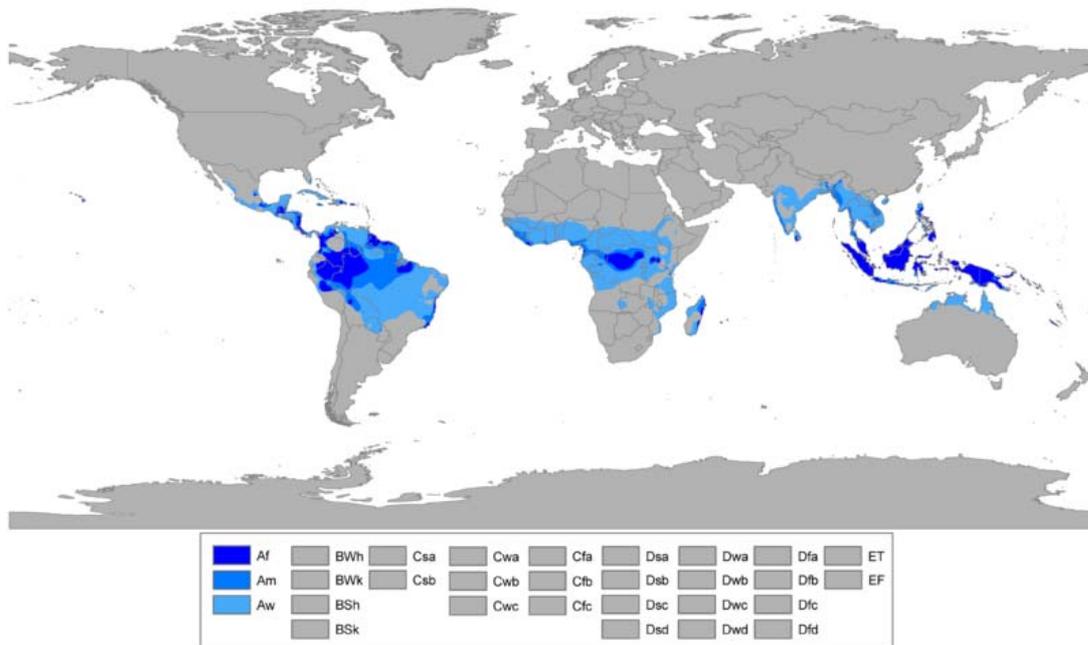


Figure 4. Tropical climate zones where annual average temperatures exceed 18°C.
 Source: Wikimedia Commons.

Other researchers have proposed that multiple criteria are necessary when determining viticultural areas in the world. Tonietto and Carbonneau, for example, suggest a dryness index, a heliothermal index and a cool night index as being the three major indices for classifying viticultural regions worldwide [7].

The climate of Thailand is dominated by the Asian monsoon: the southwest or the summer monsoon and the northeast or the winter monsoon. The southwest monsoon prevails during May to October from the Indian Ocean to the inland of the country. It causes rainfall and cloudy skies over the entire country. This is the wet season in Thailand. The northeast monsoon prevails from Central Asia to Thailand during November to February. This monsoon generally brings a relatively cool and dry air mass to the country, with partly clear sky days. There is great variance in rainfall, temperature and humidity and distinct micro-climates exist in a number of areas, such as Chiang Mai and Chantaburi. Identifying smaller meso-climates with cooler temperatures and lower rainfall can be the first critical step in uncovering suitable wine producing areas.

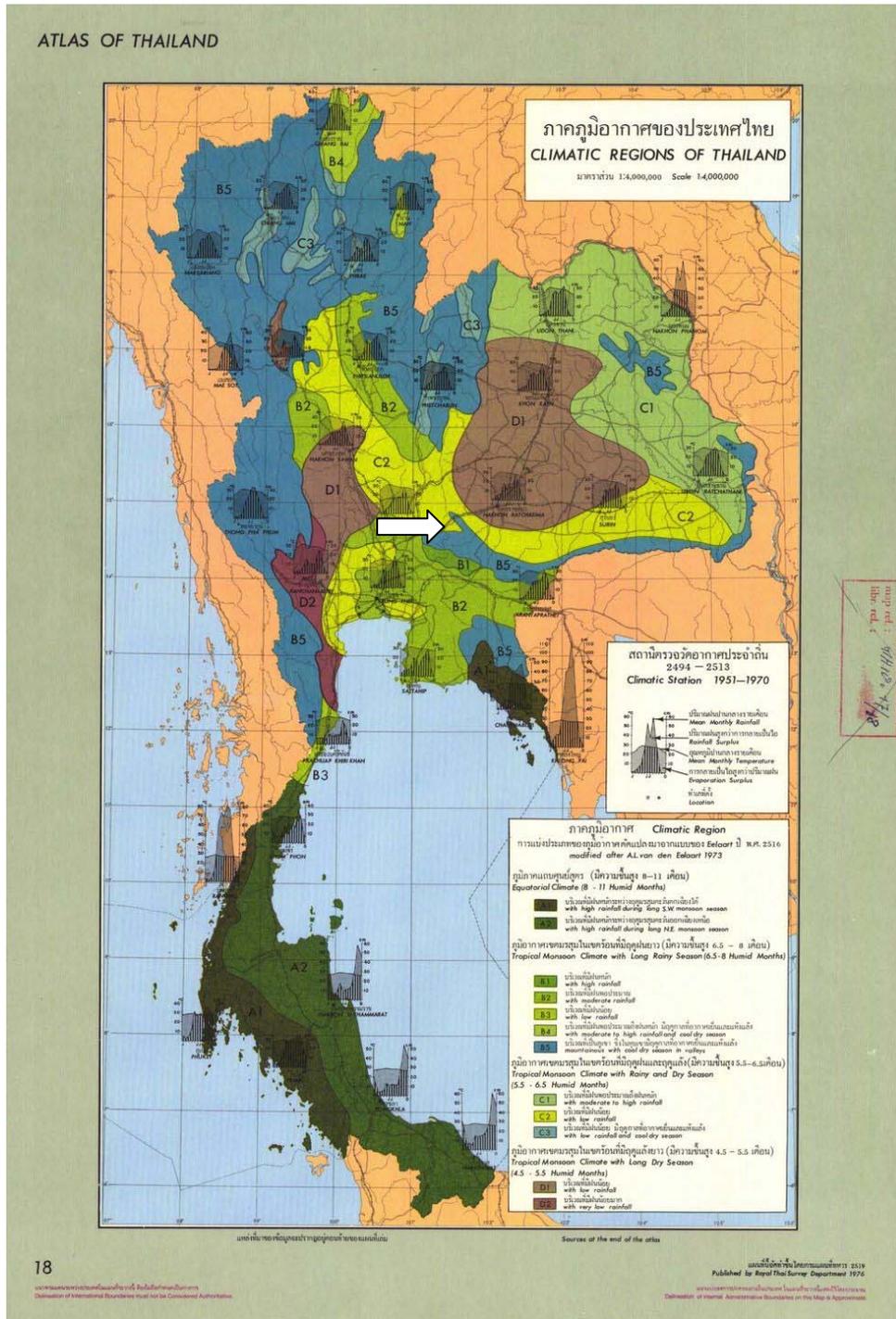


Figure 5. Map Showing the Various Climatic Regions in Thailand.

Source: www.library.wur.nl

From the map in Figure 5 it can be seen that the Khao Yai area borders B5, the dark blue area and C2, the light green area (see arrow). B5 is typified by a cool dry season in the valleys, while C2 usually experiences lower rainfall. Both of these factors would be significant in choosing a vineyard site.

High rainfall, sudden variance in temperature and high humidity are factors that can make life difficult for the tropical viticulturist. All can combine to create conditions for the spread of disease, particularly those that are fungal related, such as powdery mildew. While careful site selection can help to lower this risk, growers are all at times exposed to the vagaries of nature.

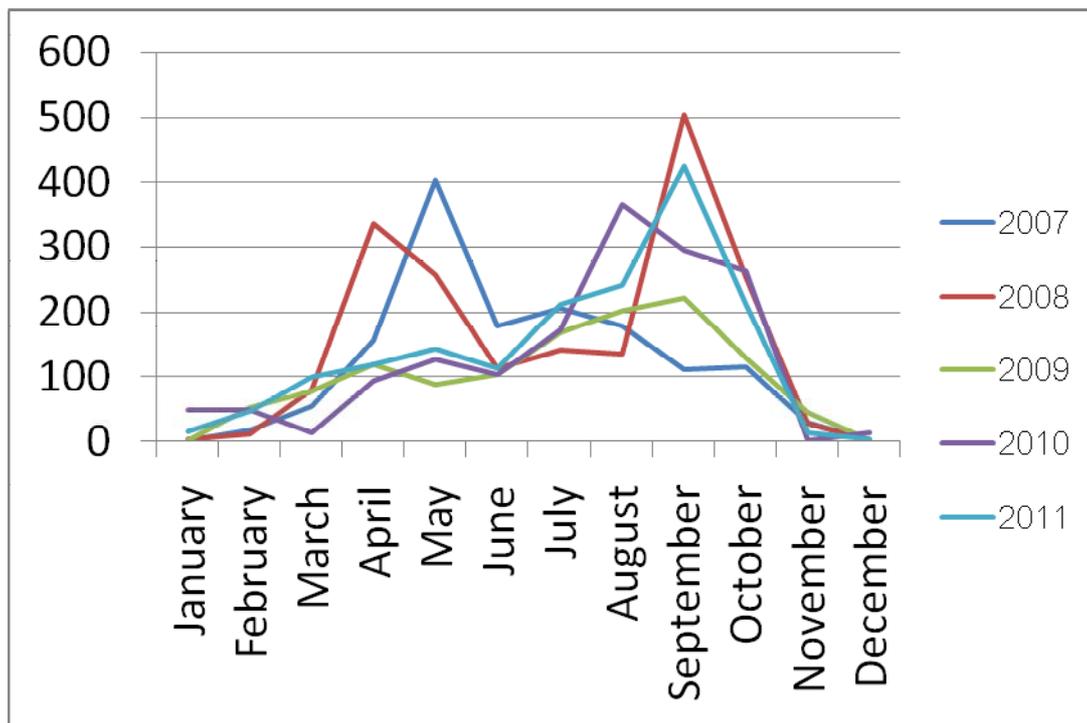


Figure 6. Five-year Rainfall for Khao Yai area.

Data kindly provided by Mr. Prayut Piangbunta, PB Valley.

High rainfall also promotes vigorous growth, so sometimes techniques such as leaf removal are necessary to achieve balance [8]. With this vigorous growth it is possible to achieve two, or sometimes more, crops each year. While this might be of benefit to growers of table grapes, wine producers have quickly realized that the second crop has an effect on overall quality and most have now adopted the practice of double pruning/single cropping [9, 10]. The first pruning for rainy season vegetative growth is undertaken in April/May, corresponding with the early peak in rainfall shown in Fig. 6. This first spur prune is usually

done on old wood, sometimes leaving 1 bud standing. The second pruning for the fruit vegetative cycle is undertaken in September/October, depending on the variety and the weather, but usually corresponding with the second rainfall peak [10]. The second pruning usually leaves from 3-8 new buds on the vine and flowering often commences six weeks later in mid-November, aiming to maximize the availability of cooler weather and to harvest from late January to early March (Fig. 7).

Another climate factor relevant to some areas, particularly at higher elevations, is wind. Strong winds can quickly damage shoots and bunches. Detailed wind maps and related data exist for all of Thailand and, while strong winds are always possible during a tropical storm, the most damaging winds appear to herald in the cool season when rainfall has ceased.

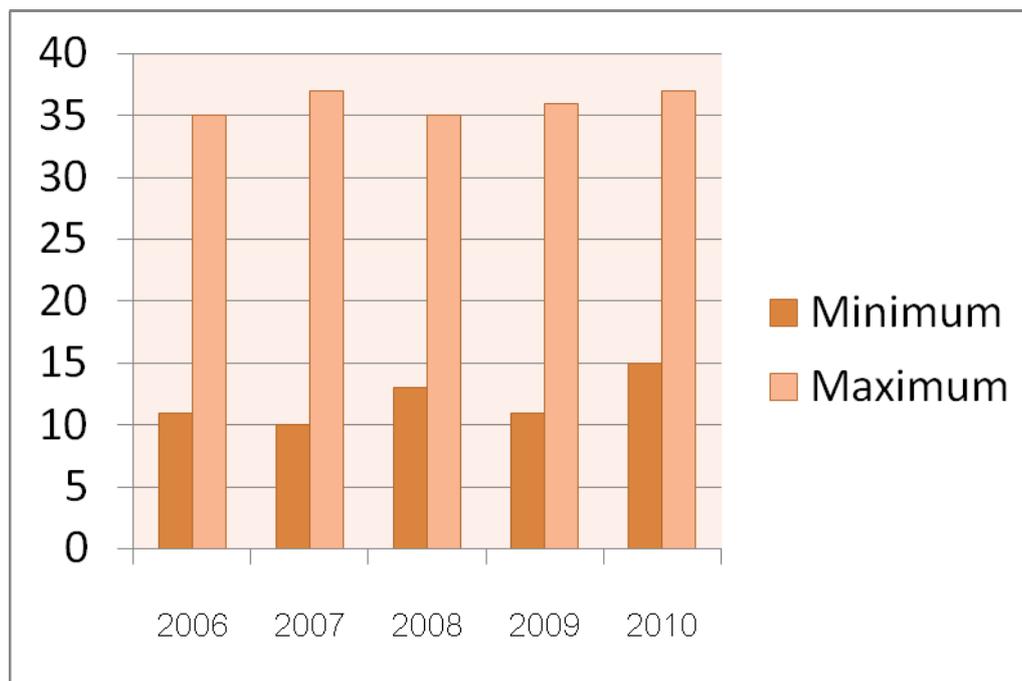


Figure 7. Five-year Minimum/Maximum Temperatures for Khao Yai area (°C).

Data kindly provided by Mr. Prayut Piangbunta, PB Valley.

NB. Minimum temperatures tend to occur in December-January, while maximums occur in March-April.

The Khorat Plateau, where Khao Yai is located, as well as much of the northeast of Thailand, is also prone to freak hail storms in the summer. Although this occurrence is difficult to predict, hailstorms during berry development could cause considerable damage.

Irrigation

Irrigation is perhaps the most controversial issue facing tropical wines, since it is essential for their success. Much of the criticism of irrigation comes from Old World regions where there is a well held belief that this practice goes against the concept of *terroir* and that wines become too uniform and predictable from vintage to vintage [11]. In many areas of Europe irrigation is still banned, although this is slowly changing as the effects of climate change begin to hit home [12]. Obviously, such beliefs are not supported, nor practical, in the tropics.

Experience from the tropics, and elsewhere, has demonstrated that drip irrigation can be a useful tool for water management in the vineyard [13]. A number of growers in the tropics apply water constraints (otherwise known as deficit irrigation) as a technique to induce the vine to channel energy into the developing grape clusters instead of excess foliage. It has been clearly proven that careful management can enhance the quality of the wine [14]. Drip irrigation is also a useful and labour-saving tool for applying fertilizer to the vines in a uniform manner and this technique is known as fertigation [15].

Since most vineyards in Thailand are irrigated, they are reliant to a certain extent on rain to fill storage ponds. However, the vines themselves do not require this rain and, in fact, it probably does more harm than good when you consider soil leaching and disease. Soils typically in Thailand soak up all of the rainfall to a point where they become saturated and then surface water appears and tends to congregate, making for soggy ground. Once the monsoon ends, the soils tend to dry quickly, particularly if there are sub-surface aquifers.



Figure 8. Vines under Drip Irrigation at Khao Yai, Thailand.

Soils

Another important factor for the viticulturist to consider in the tropics is soils. Due to heavy rainfall, it is important to have soils that drain relatively quickly. Roughly two-fifths of Thailand is covered by mountains and hills, the steepness of which generally precludes cultivation. Nevertheless, surveys have shown that as much as 58% of these hills might also be converted to agricultural purposes. Agricultural land occupies about 50% of the total land area. Soils throughout most of the country are of low fertility, largely as a result of leaching by heavy rainfall. Differences between the various soil types are the result of differences in parent rock material, variations in the amount of rainfall, length of wet and dry seasons, type of vegetation cover and other natural factors. In general, stony and shallow soils characterize the hill and mountain terrain of the North.



Figure 9. Soil Map of Upper Thailand.

Source: www.eusoils.jrc.ec.europa.eu

Shallow sandy loams cover a large part of the Khorat Plateau, where Khao Yai is located. Their generally low fertility partly explains the lower economic level of much of the region [16]. Soils along the main rivers are more fertile and alluvial loams of high fertility are found along the Mekong River. Lowland soils covering about a fifth of the Northeast (some 3.5 million hectares) have mostly been converted to rice paddy.

The central plains rice-growing area and the delta of the Chao Phraya River have clayey soils of high to moderate fertility. Low-lying and flat, much of the area is flooded during the rainy season, and this is where Siam Winery's floating vineyards are to be found. Higher areas on the edges of the plain are generally well-drained soils of high to moderate fertility that are suitable for intensive cultivation. These lands are used extensively for maize and sugarcane. Among other highly useful soils are the well-drained clayey and loamy soils in parts of the peninsula where rubber is grown.

Figure 9 shows that Khao Yai (see arrow) straddles two main soil regions, remarkably corresponding with the Climatic Regions map (Fig. 5). The dark brown area is Low-Humic Gley soils on semi-recent and old alluvium and level to undulating. The yellow area is typified by steep land, acid to intermediate rocks with mainly shallow Red-Yellow Podzolic soils. There are also pockets of Red-Brown Earths, known as *terra rossa*, to be found in the area. These are predominately due to the breakdown of limestone.



Figure 10. Terra Rossa Soils of Wang Nam Kheo where Village Farm Winery is located.

Source: Google Earth.

Detailed soil reconnaissance maps are freely available for all regions of Thailand. While ground inspection is vital and having the soil tested in a laboratory desirable, detailed maps provide a good indication of where to look and what to expect. While no ideal soil may exist, aspects such as good drainage are important. Testing the soil for fertility and mineral content will also give a good indication as to the type and amount of inputs that will be required in a vineyard. Prior testing of the soil will also allow for better future environmental monitoring for heavy metal and chemical build-up.

Grapes

It has been the general practice of vineyards in the tropics to adapt 'classic' varieties from Old World vines to the tropics. This has largely been trial and error, however, it has already become apparent that some varieties do better than others in terms of vigor and ultimate wine quality, while some are more delicate, requiring additional care. Some work has been done on crossing with native tropical cultivars [17]. This offers the possibility of better adaptation, perhaps to a wider range of climates, as well as enhanced disease resistance and tolerance. More research needs to be done in this area as it is also of high interest to countries whose wine industries are already feeling the impact of climate change.

Of major concern to grape producers in the tropics is the expected lifetime of vines. It appears that the second crop, in spite of pruning, takes its toll on energy use by the plant. There are reports of as little as 8-12 years for some vines in India, while Ingalls [18], gives an expected lifetime of 15 years. This has significant implications for tropical viticulture. The first is that when the vines are beginning to wane, careful management of lower yield can result in higher quality wine. However, without such careful management, the reverse may also occur. The second factor is that not all cultivars will decrease their output at the same age and variation can be expected due to locality and climatic factors. Nonetheless, it would appear that a rotation system needs to be considered by some vineyards if they are to hold on to their hard earned markets. This implies far greater use of land to maintain output and could become a serious limiting factor in some areas and a drain on investment resources.

Tourism

The importance of tourism to many tropical vineyards cannot be underestimated. Countries such as India, Thailand and Brazil rely heavily on an annual influx of tourists. More recently there has been an emphasis on agricultural tourism in Thailand, enabling tourists to view, and sometimes participate directly in, agricultural activities [19]. The more popular of these activities for vineyards is harvest time. Most wineries in Thailand are either located close to popular tourist areas or they have created attractions such as theme parks and resorts to draw tourists.

An influx of tourists is particularly critical while the vines are still young and it becomes an important source of income to sustain the winery until such times as wines are produced, reputations established and markets gained. Following this, it becomes an attractive source of additional income through cellar door sales and fees for tours and tastings. Most wineries supplement their income by providing restaurant facilities or providing food in some way to enhance the experience for tourists.

Thus tourism becomes a consideration when choosing a site for a vineyard. Apart from all of the climatic and other factors, if the vineyard is close to popular tourist destinations then there is a much better chance of developing a sustainable business.

Land Availability and Price

A further consideration for any prospective vineyard is land prices. It would be easy to assume that land availability and prices in newly developing countries would be cheaper and easier to obtain, however, this is rarely the case.

Most Old World vineyards are settled in designated areas and are usually not under threat of competition from other industries. It is for this reason that some vines still growing today are hundreds of years old. In the tropics, particularly in countries such as Thailand, competition for land and resources is fierce. What may at first appear a tranquil country estate could soon be surrounded by housing developments within ten years, or worse, industrial estates. Zoning barely exists and there is thus a high risk in choice of location.



Figure 11. Popular housing estates are ever encroaching on scarce agricultural land.

A further unforeseen factor from uncontrolled development in the tropics is that land prices could escalate to the point where using the land for growing grapes becomes unsustainable. This is clearly illustrated by the fact that a hectare of land in Khao Yai currently has a higher purchase price than a hectare of land in St. Emilion.

Conclusion

It is apparent that there are some distinct differences between producing wine in the tropics as opposed to temperate regions and these differences require some adaptation of existing practices. For example, cultural practices have to be adapted for the two growth cycles occurring each year.

What is required in considering a vineyard in the tropics is also what defines tropical wine production. The major considerations, and differences, are; solar radiation, rainfall, dry season, temperature, humidity, air, water and soil pollution, storage, micro-climate, disease, irrigation, soils, tourism, land price and availability. Data is readily available covering most of these factors, useful in the search for new land, and profiles could be easily established for existing vineyards.

The major obstacles facing the future growth of the wine industry in Thailand are taxes and security of tenure. To create a wine culture amongst the growing middle class in the country requires a minimum of offering an equivalent product at a cheaper price. This cannot be achieved under the existing government tax regime. History shows that close collaboration will be required between the private-academic-government sectors to effect change.

Security of tenure and associated land prices could mostly be resolved by effective zoning. Unless all of the factors outlined above are documented to define a viticulture area, then zoning cannot be expected. Given the record of uncontrolled development in Thailand, even then it may be difficult to achieve. What may be more realistic is for vineyards to be classified as agro-tourism zones. This might hopefully offer some protection from soaring land prices and being built out.

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