

Viniculture in the Semi-Arid Tropical Region of Brazil

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Summary: In the semi-arid tropics viticulture was successful according to technologies developed by Hungarian expertise

Introduction

The AGROINVEST Rt. has been present in the northeastern region Brazilian Tropics already for two decades. In the beginning, it was involved in fisheries and fish breeding and since 1986, in viticulture as well. In terms of the latter one, AGROINVEST Rt. works as a consultant in Cupertino with CODEVASF (a state owned company for the development of the region of the Sao Francisco river) and within the framework of technological and technical co-operation of the two governments.

The co-operation in viticulture was first embodied by one Hungarian consultant and due to the good results of the initial period, five horticulturists perform consultant roles in the practically new wine-growing region of the Sao Francisco valley since 1992.

According to our expectations, this activity will grow in the near future and we plan to raise the number of Hungarian viticulturist experts working in this region from 8–10 persons.

General description

The tropical-growing region where this work takes place is the northeastern region of Brazil. Petrolina City of Pernambuco State lies in the centre of this region (the capital of the state, Recife is situated 9000 kilometres to the northeast). Its geographical position: southern latitude 9.23 and eastern longitude 30 degrees, and it is 376 meters above sea level. Our target area, however, largely exceeds this city considered as cultural and trade centre of the region. Thus the region moving southward from the above mentioned central state down in the valley of the Sao Francisco river through

Bahia and then Minas Gerais states until Pirapoa also belongs here, which – as we will see later – is a different tropical zone and hence growing conditions also differ from those of the centre since this area is already at latitude 17 degrees.

On the other hand, north to the centre, leaving behind the Sao Francisco river providing the so important irrigation water of the region, we work even up to latitude 4 degrees in Rio Grande do Norte and Ceara states, in the vicinity of Fortaleza harbour around Mossoro.

As the technological or ecological conditions are decisively influencing the production, it can be helpful to refer to other geographical characteristics of the region as well, for example to the availability of water. The Sao Francisco River running from the south to the east is the main water supply. Its length is 3198 kilometres and its estuary to the Atlantic Ocean at Breio Grande in Sergipe State. Because of its origin and Minas section the climate is rather humid, the river has a large water flow, furthermore some reservoirs increase its capacity.

Thus in case of our central semi-arid climate, there is a large artificial reservoir, the Sobrandinho lake near Petrolina which can hold some 50 billion cubic meters of water and this amount provides enough water to irrigate even 150 thousand hectares only in the centre (Petrolina-Juazeiro) of the region. Nevertheless electricity production of the power station, the dam of the reservoir has a significant influence on the area too.

Characteristics of the tropical region

In general, zone on the northern hemisphere between the equator and latitude 23.27 degrees bordered by the Tropic of Cancer and zones on the southern hemisphere between the

equator and latitude 23.27 degrees bordered by the Tropic of Capricorn are called tropical zones.

Hence the whole target area of our operation belongs to the tropical zone, however, differently from the temperate climate, precipitation has a more important role because of the high temperatures. Consequently we have to differentiate between the zones according to the amount of precipitation.

The classification of Köppen (Klimalehre 1906) is widely accepted all around the world. Based on this, the following zones can be separated in the tropics:

arid tropics	less than	250 mm/year	BWh
semi-arid tropics	from 240 to	600 mm/year	Bsh
slightly wet tropics	from 600 to	900 mm/year	Cwapp
semi-wet tropics	from 900 to	1200 mm/year	Awpp
wet tropics	more than	1200 mm/year	Amp

Cardinal meteorological data of the centre of the region – belonging to the semiarid-arid tropical zone – are the following (CPATSA-EMBRAPA-MANDACARU station 1966-88):

Monthly and annual averages:

Month	Temperature			Rel. air humidity %	Precipitation mm	Evaporation mm	Sunny hours hr/day
	mean	max	min				
January	27.6	32.2	21.5	58	52.0	206	7.6
February	27.3	31.7	21.4	62	78.0	179	7.2
March	27.4	31.2	21.3	61	92.0	180	7.0
April	26.6	30.6	21.0	65	43.0	150	7.4
May	25.9	29.9	20.2	63	7.0	145	6.5
June	25.2	29.4	19.0	61	4.0	138	6.8
July	24.9	29.2	18.2	58	2.0	138	7.1
August	25.6	30.4	18.4	51	2.0	156	8.4
September	27.1	32.0	20.1	48	3.0	174	8.4
October	28.6	33.2	21.4	55	9.0	201	8.5
November	28.6	33.2	22.2	50	45.0	209	8.0
December	27.8	32.4	21.7	56	64.0	206	7.0
Annual average	26.9			57	401.0	2080	7.5

Before discussing consequences of climatic circumstances and our experiences, those conditions should be noted which are to be considered as tropical based on the latitude, but they do not have characteristic matchings with common views about tropics in terms of plant production, especially wine growing.

Obviously only those can be listed here from where we have experience or information.

One of them is a typical South-American experience. We had the task to examine wine growing possibilities in Peru. We encountered a type of climatic effects which differs from the characteristics of the tropical zone. Arriving to the north of Chile into Peruvian areas, being far the Tropic of Capricorn, the Pacific Ocean still conveys cold water close to the capital, so the temperature at Lima is notably lower than in the north-eastern Brazilian areas of the same latitude. Therefore possibilities for more than one harvest annually do not exist here. Getting even closer to the equator, in the vicinity of Trujillo it is already at the latitude of 8 degrees. If the growing area is further away from this so called littoral climatic effect and affected by the continental climate, more than two harvests are possible in vineyards annually.

The other condition which has an effect also in our target area for consultancy is the elevation above sea level.

450 kilometres south from Petrolina, in the first mountains of Chapada da Diamantina at Morro do Chapéu the elevation is 1000 m above sea level.

Later on we discuss the problems of growing seedless table grapes along with the advantages of micro regions higher than 1000 meters above sea level with variable climates due to the varied landscape. Thus the issue of temperature decreasing with elevation will be discussed. These facts results in longer growing periods – with a higher amount of sunlight than plain areas is a more favourable circumstance for varieties of higher sunlight demand.

First of all, it is important to look at specialities of the semi-arid growing area when discussing its characteristics, especially if we are to diversify the production for some reason. On the other hand, these climatic differences will have an important role in the case of wine production, particularly for white wine varieties. Actually, the role of all

of these factors cannot be clearly seen when considering future's viticultural possibilities. For example, we started to test one of the table grape varieties regarded important by us this year, since varieties of this category do not adapt appropriately on central areas of the region due to the average temperatures.

Ecological aspects

When discussing ecological conditions, first of all that condition should be emphasised which – looking from Europe – is a crucial one, namely that our target area is in South America on the Southern Hemisphere. This fact in itself results in opportunities since the vegetation and dormant periods are in opposing calendar periods than on the Northern Hemisphere. It is also important to see that a growing area inducing real tropical effects can control the vegetation in a way, which does not exist in other regions. Obviously, advantages of plant production of the Southern Hemisphere cannot be disregarded, for example in the case of producing for the European market. But opportunities for

production are much different in areas where growers can significantly free their technology from the decisive effects of the climate and growing seasons.

This thought leads us to the statement that the essence of experiences in case of tropical zones – if stable high temperatures make it possible – grow our plant whole year around instead of being limited by the precipitation its amount and distribution. Many examples support the following allegation for viniculture: plenty of precipitation – if the grower cannot have an influence on its distribution – makes the production impossible. Therefore based on these experiences we can get to the arid or semi-arid tropics, where precipitation does not come from rain and its amount is insignificant, but there is abundant amount of water for the irrigation of the plant. A decisive element of such conditions is that the water can be supplied in amounts and distribution matching the needs of plants. By conditions provided by this type of tropical growing regions, we can conclude that we face a “greenhouse climate” in this case.

Finally, which are the important elements of this growing region?

- Vegetation is possible all around the year so the growers can decide how to control it. Thus various annual crops can be sown and harvested whenever it is made possible by the technology. In case of woody plants, therefore in case of vine too, the vegetation period can be started by running or intensive irrigation. The homogeneity of bud burst can be supported by chemicals and the harvest can start 90–120 days from the beginning depending on the variety. In central location (Petrolina-Juazeiro) 2.5 harvests are typical but 3 harvests annually are also common.
- There is no winter season or complete dormant period, as we believe no complete dormancy exists. At least this plant physiological category cannot be explained by science here. As a matter of fact, leaves do not fall after the harvest, those have to be taken off from the stock during pruning, but according to external symptoms, shoots and buds are well formed.
- Our experience shows that some inactive periods should be left depending on the variety and nutrient supply. Some irrigation is needed in this period too.
- Ample nutrient supply is possible and also needed in the whole vegetation period and due to applied irrigation conditions, irrigation with nutrient solution (fertigation) is possible in some cases.
- The need for irrigation is unavoidable in the whole year around except for rainy periods when the amount of precipitation should be taken into account. Due to the climate, sensitivity of some varieties and producing extra quality for some market demands, irrigation of the leaves (spray) is essential to control their temperature.
- The role of pest control and plant protection is significant because of the irrigation, rains, intensive cultivation and the permanently high temperatures. Most of the pests and pathogens have a higher reproduction rate than under temperate climates, and the fact of the complete lack of frost improves living conditions of pests as well. Partially due to the above-mentioned factors, also the soil needs intensive tillage.
- As a result of closeness to the equator, days are short and the presented meteorological data also approve the low amount of sunny hours because of the cloud cover, so grape varieties with high demand for sunlight can be adapted with difficulties.
- Early table grape varieties can be adapted also with difficulties due to the high temperatures and other (possibly genetic) factors not known in details yet.
- In consequence of the semi-arid climate, natural woody vegetation could not develop, only shrubby plant associations could and can be found on uncultivated areas. Hence the organic content of soils is very low (0.10-0.20%). Besides these mostly sandy soils are poor in minerals, in addition to these there are 2.5 harvests annually as an average, but 3 crops are not rare either in the intensive cultivation. All of these lead to the need of notable amounts organic and chemical fertiliser in order to achieve high yields and quality.
- One of the environmental elements important for us is the wind. Firstly it ensures quick drying in rainy periods; secondly strong winds drift sand in sandy areas in the heat periods so that installation of wind shelters is necessary to prevent damages.
- There are no hails generally.
- Viniculture has a history of 25 years in the region, and its intensive form roots only 15 years, i.e. there are no traditions of wine growing.
- Since more of the components of production are controlled by growers, limits of yield quality and quantity are not yet known.
- Although semi-arid type of tropical climate is dominant in the valley of Sao Francisco where we operate, some thoughts should be mentioned in advance about the fact that 2 harvests can be realised in case of the constellation of many conditions under the “slightly wet tropics” type as well, but neither 2.5 nor 3 cycles can be completed.
- *Vitis vinifera* cannot be grown with profits in the “wet tropics” zone. Actually except for the last category, there are large wine growing areas in the other zones, but we anticipate that it is advisable to invest larger amounts of capital only in the first two – arid and semi-arid – zones. However, further experiences should be processed, since only lot factors can prove this statement.

Comparison with temperate climate

We believe the above discussed ecological characteristics mean such conditions in these regions which cannot be found under temperate climate neither on the northern nor on the southern hemisphere, as well as under warmer temperate climates. Thus the climate offers considerable opportunities for modern viticulture.

The growing areas are decreasing while the amount of production increases in the world. Transportation costs are falling at the same time. Tropical vine growing areas do not reach 40 thousand hectares all around the world and this shows that the share of vineyards from the world's 7.8 million hectares is very low. Yet we believe that according to the facts presented above, tropical viticulture has great potential.

This production was last discussed by J. L. Cabriol, professor at Toulouse in the bulletin of O.I.V. in 1988. The region's viticulture has undergone a development since then and we trust that we can contribute to the knowledge related to the sector by publishing our recent experiences.

In connection with ecological aspects, changes in the table grape production in the world in the last 30–40 years show the development of an important tendency, although which cannot be accounted for tropical grape production yet, but inevitably signals those alterations which already start to modify the production's world map.

One of them leads to the complete disappearance of a growing region's production potential. Greenhouse table grape production in Belgium near to Brussels was prosperous and an outstanding value of the world's production after World War II. Table grape was produced at high standards in 30 thousand greenhouses in the region of Hoeillaart, Overjise and LaHulpe by the end of 40s. We had the chance to visit these places after graduation in 1947–48, but due to political changes this visit could not be published in our country. Later by the end of 60s, another visit was made to the still flourishing areas with colleagues of the Balatonboglár State Farm. Actually, experience from Belgium has been used partially for the experimental production of early table grape varieties under plastic cover of Balatonboglár. Further experience was gained in Montpellier at the farm of the president of I.T.V., Mr. Charles Daussant, where we could explore the table grape production under plastic cover.

Later, heated greenhouse table grape production had to face a crisis in 70s and 80s, since new producers of the southern hemisphere, such as South-Africa or Chile from South-America have already flooded West-Europe with cheaper grape of quite a good quality. Obviously, two effects were present. On one hand, greenhouse table grape production of the winter period on the northern hemisphere could not compete with the low costs of open-air production.

On the other hand, transportation companies have started to operate their large capacity vessels which could have been suited with cooled containers or chambers and could relatively quickly and cheaply transport table grape, produced on the southern hemisphere in normal vegetation period into Europe.

But further changes of the competition between leading table grape producer countries can be observed due to similar cost-price connections.

Italy has been the leading country in the world's table grape production for a very long period. However, according to the latest report of O.I.V. (Situation e Statistiques du Secteur Vitivinicole Mondial en 1997), the production had a dynamic development in China (310%), South Africa (128%), Chile (84%), Brazil (70%), while the development was only 5% in Italy. Changes of table grape export are even more interesting. The previous leader Italy has fallen to the second place, Chile has overtaken the leading position both in absolute amount of export and 10 years' development, 519 thousand tons and 58% respectively. The same figures for Italy are 418 thousand tons and –0.4%.

If we try projecting these facts into the future, then the Brazilian table grape to be introduced by us provides grate perspectives for world's production both in ecological and economic aspects.

The main reason for this opinion is the impact of production conditions, since harvest can be adjusted to match needs of the word market, and it can even support any changes annually, since conditions make it possible. We will explain detailed possibilities to satisfy such annually varying market needs in the section describing our experience with quality production. Even the needs for the shape or size of a bunch of grape can be satisfied with technologies available there.

If we strive to demonstrate the advantages deriving from the ecological conditions of tropical viticulture, it is advisable to refer to the fact that the increased, management of plants has disadvantages as well. This occurs in the above mentioned growing region as a significantly shorter life span of vineyards than under temperate climate meaning less intensive cultivation. Our experiences until today show that it is not worth maintaining a plantation for more than 25 years. We have some experiences with 20-year-old and with a couple of even older plantations as well, but the yield of stocks is far below than the 15 years old or younger ones. Due to this, growers with more financial resources replant vineyards older than this. Since the new plantation can give an acceptable yield (4–10 tons/hectares) in the second half of the second year, i.e. in the third vegetation period after planting in this growing region, we esteem that there are no problems with the return of the money invested into this plantation with relatively shorter life span.