Tempranillo in semi-arid tropical climate (Pernambuco-Brazil). Adaptation of some clones and their affinity to different rootstocks.

Tempranillo dans le climat semi-aride tropical (Pernambuco-Brésil). Adaptation des différents clones et leur affinité aux divers porte-greffes

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Abstract

The variety *Aragonez* (sin. *Tempranillo*), recently introduced in the San Francisco Valley (9º02' S; 40º11' W) has revealed an excellent adaptation, with high potential of quality and yield, even without clonal material.
With the objective of maximizing the behaviour of this variety in this *terroir*, it was installed in Vinibrasil – Vinhos do Brasil, SA a trial field to compare the relations "variety x rootstock", with 10 clones (5 of *Aragonez* – Portuguese origin and 5 of *Tempranillo* – Spanish origin), combined with 6 rootstocks (IAC313, IAC572, 1103P, 420A, 101-14 e SO4).
The first results show greater yield on the rootstocks 101-14 and IAC 313 in both varieties, while in grape composition only few differences were found.
The most interesting combinations are:
- *Aragonez*: cl. Ar-110-JBP/101-14, cl. Ar-60-EAN/101-14, cl. Ar-110-JBP/IAC313, cl. Ar-60-EAN/IAC313, cl. Ar-Embrapa/IAC313 e cl. Ar-Embrapa/SO4.
- *Tempranillo*: cl. Tp-770/101-14, cl. Tp-E24/101-14, cl. Tp-Embrapa/101-14, cl. Tp-770/IAC313, cl. Tp-E24/IAC313, cl. Tp-Embrapa/IAC313 e cl. Tp-Embrapa/SO4.
The introduction of the variety *Aragonez* (*sin. Tempranillo*) in Vinibrasil is contributing to obtain world class wines.

Key-words: semi-arid tropical climate, *Aragonez* (*sin. Tempranillo*), grape composition, clones and rootstocks.

Introduction

The vitiviniculture of the São Francisco Valley region - northeast of Brazil, is relatively recent (Albuquerque *et al.*, 1987). This region, is characterised by a BSwh' climate, according to the Köppen classification, which corresponds to an arid climate. In the annual course of the hydric regimen, the water deficiency that occurs during the summer months is the most serious limitante factor of this region climate (Teixeira & Silva, 1999).
In this region, where the average annual temperature rounds the 26ºC, the vine behaves as perenifollium specie and the winter inactivity, typical of tempered regions, doesn't occur. So, the vegetative cycle is controlled through cultural practices as pruning and irrigation. The beginning of vegetative cycle is defined by the pruning date and the irrigation beginning. The inactivity period, between harvest and pruning, varies from 1 to 2 months and is maintained by the non-irrigation (Cruz *et al.*, 2007). In this climate allows observing different vineyards in diverse phenological stages, during all year.

In this *terroir*, the behaviour of many vine varieties and the most interesting rootstocks for each one of them are yet unknown. The aim of this work is to understand the performance of different 10 clones of the red vine variety Tempranillo (*sin.* Aragonez), grafted onto 6 rootstocks.

Material and methods

The experimental trial was installed on a vineyard belonging to a private company (Vinibrasil-Vinhos do Brasil) a partnership between the Portuguese Dão Sul, Soc. Vitivinícola S.A. and the Brazilian Expand. The farm is located at Lagoa Grande-Petrolina - Brazil (9º 2'S, 40º 11' W). The climate of this region is a BSwh' by the Köppen classification and the majority of soils are podzols. The vineyard is trained in vertical shoot positioning and pruning system is a unilateral royat cordon. The density of plantation is 3333 vines/ha (3 m between rows and 1 m in row) and row orientation is North-South.
For this study, 10 clones of the Iberian variety Tempranillo (*sin.* Aragonez) were chosen, 5 from Spanish origin and 5 from Portuguese origin. The Portuguese clones are: Ar-110-JBP, Ar-54-EAN, Ar-57-EAN, Ar-60-EAN, Ar-Embrapa; and the Spanish ones are: Tp-770, Tp-776, Tp-E24, Tp-E51, Tp-Embrapa. All of them were grafted onto 6 different rootstocks: 101-14, 1103P, 420 A, SO4, IAC313 and IAC572, being the last 2 from Brazilian obtaining on the Instituto Agronómico de Campinas (IAC). In total we have 60 different plots, represented each one by 30 vines.
At harvest, number and cluster weight of each plant from each combination were collected. We also collected berry samples for must composition characterization.

Results and discussion

Climate characterization

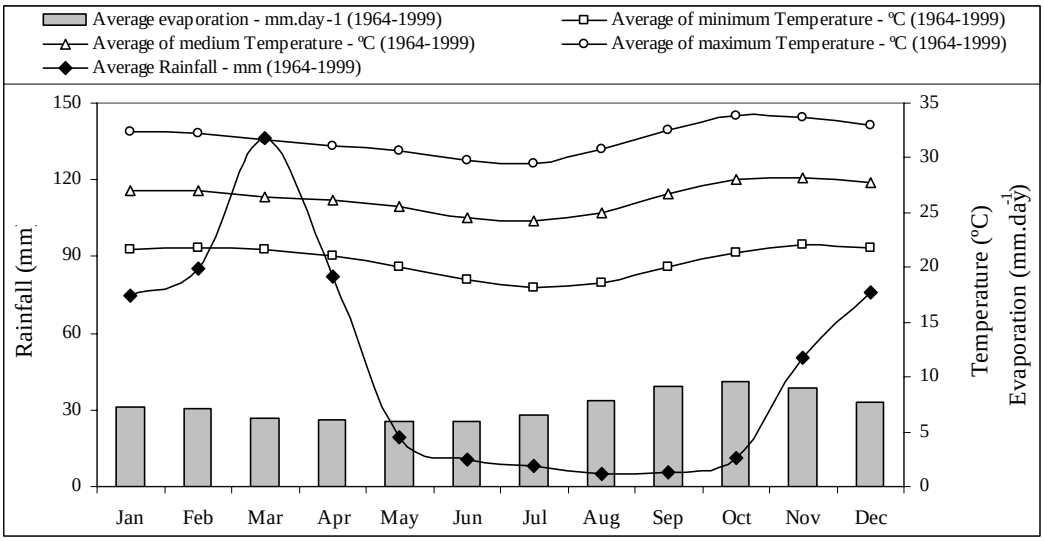

Figure 1 Average of 36 years (1964-1999) of minimum, medium and maximum temperature, daily evaporation and monthly rainfall. Pernambuco, Northeast of Brazil.

In figure 1, we can observe the climatic conditions for a large period of years (1964-1999) in northeast of Brazil. The medium temperature reach high values during all year, and the annual average is around 26 ºC. The hottest period is from September to December, when the evaporation rate is higher. The annual rainfall rounds the 570mm and is concentrated in the period from December to April. During this period the irrigation needed for wine production is minimal. From May to November the rainfall occurrence is extremely low and the vines survival is only possible with irrigation.

'Aragonez' variety results

Rootstock	Clusters/Vine	Yield (Kg/vine)	Cluster weight (g)	Yield (t/ha)
101-14	8,2 a	2,9 a	357,3 a	9,5 a
1103P	6,7 b	2,2 b	332,8 ab	7,4 b
420A	5,2 c	1,5 c	283,1 b	4,9 c
IAC313	8,3 a	2,8 a	340,1 a	9,4 a
IAC572	6,6 bc	1,2 c	183,1 c	4,0 c
SO4	7,5 ab	2,3 b	306,2 ab	7,5 b
Sig.	*	*	*	*

Table 1 Influence of rootstock on yield parameters of the Aragonez variety at northeast of Brazil, October 2007, Pernambuco. Average of 5 clones.
Note: Sig. – Significance level; n.s. – non significant at 5% level by F test; significant at 5% level (*), by Tukey HSD test. Values followed by equal letters don't differ significantly, at 5% by Tukey HSD test.

In table 1, we can observe that at yield parameters, the rootstocks 101-14 and IAC313 have been the most productive, with higher clusters number and weight. On the opposite, the rootstocks 420A and IAC572, after this first harvest, seem to have low interest. It's important to refer that the lower cluster weight in IAC572 is associated to heavier berries, which is caused by some coulure, provoked by its higher vigour (table 2). SO4 shows for all parameters an intermediate behaviour.

Rootstock	Berry weight (g)	PAC (% v/v)	Titrable Acidity (g tar. ac./l)	pH
101-14	1,67 bc	12,1	6,4 b	3,28 c
1103P	1,59 c	12,7	6,0 b	3,37 ab
420A	1,84 ab	13,1	6,0 b	3,40 a
IAC313	1,83 a	12,5	7,5 a	3,32 ab
IAC572	1,98 a	13,1	6,1 b	3,30 bc
SO4	1,66 bc	12,8	5,9 b	3,28 c
Sig.	*	*ns*	*	*

Table 2 Influence of rootstock on grape composition at harvest, of the Aragonez variety at northeast of Brazil, October of 2007, Pernambuco. Average of 5 clones.
Note: Sig. – Significance level; n.s. – non significant at 5% level by F test; significant at 5% level (*) by Tukey HSD test. Values followed by equal letters don't differ significantly, at 5% by Tukey HSD test.

In qualitative terms, no differences were found, on PAC, between different rootstocks, whereas in what concerns titrable acidity, IAC313 was the one that reached a higher value, what, in this hot climate, it's very important. The rootstocks 101-14 and IAC313, are those that present, at the same time, higher yield and lower pH (table 2).
In what respects to clones, differences in cluster weight and yield per vine were found. Clones Ar-54-EAN and Ar-Embrapa are the ones that originated heavier clusters and consequently presented a greater production per plant (table 3).
At grape composition, we only found differences in PAC, being Ar-54-EAN the least alcoholic clone (table 4).

Clone	Clusters/Vine	Yield (Kg/vine)	Cluster weight (g)	Yield (t/ha)
Ar-110-JBP	6,6	1,9 b	275,7 c	6,2 b
Ar-54-EAN	6,9	2,4 a	348,0 a	7,9 a
Ar-57-EAN	6,7	1,8 b	263,7 c	6,0 b
Ar-60-EAN	7,4	2,2 ab	294,0 bc	7,2 ab
Ar-Embrapa	7,9	2,5 a	322,0 ab	8,4 a
Sig.	*ns*	*	*	*

Table 3 Yield parameters of the clones of the Aragonez variety at northeast of Brazil, October of 2007, Pernambuco. Average of 6 rootstocks.
Note: Sig. – Significance level; n.s. – non significant at 5% level by F test; significant at 5% level (*) by Tukey HSD test. Values followed by equal letters don't differ significantly, at 5% by Tukey HSD test.

Clone	Berry weight (g)	PAC (% v/v)	Titrable Acidity (g tar. ac./l)	pH
Ar-110-JBP	1,71	13,0 a	6,3	3,31
Ar-54-EAN	1,76	11,8 b	7,1	3,29
Ar-57-EAN	1,72	13,1 a	6,1	3,33
Ar-60-EAN	1,75	12,9 a	6,1	3,35
Ar-Embrapa	1,86	12,7 a	5,9	3,37
Sig.	*ns*	*	*ns*	*ns*

Table 4 Grape composition at harvest of the clones of the Aragonez variety at northeast of Brazil, October of 2007, Pernambuco. Average of 6 rootstocks.
Note: Sig. – Significance level; n.s. – non significant at 5% level by F test; significant at 5% level (*) by Tukey HSD test. Values followed by equal letters don't differ significantly, at 5% by Tukey HSD test.

From the conjugation of yield and quality results, from the 'Aragonez' clones, the most promising combinations are: Ar-110-JBP/101-14, Ar-60-EAN/101-14, Ar-110-JBP/IAC313, Ar-60-EAN/IAC313, Ar-Embrapa/IAC313 e Ar-Embrapa/SO4.

'Tempranillo' variety results

In 'Tempranillo' (Spanish origin), are also the rootstocks 101-14 and IAC313 those that originated greater number and weight of clusters, and consequently a bigger production. Although IAC572 has originated the highest number of clusters, due to their lower weight they present an intermediate behaviour, as the SO4 (table 5).

Rootstock	Clusters/Vine	Yield (Kg/vine)	Cluster weight (g)	Yield (t/ha)
101-14	7,7 ab	2,6 ab	333,9 ab	8,5 ab
1103P	5,6 c	1,6 c	284,0 bc	5,3 c
420A	5,9 c	1,8 c	315,9 b	6,0 c
IAC313	6,9 abc	2,7 a	384,1 a	8,9 a
IAC572	8,3 a	2,0 bc	236,3 c	6,6 bc
SO4	6,3 bc	2,0 bc	316,0 b	6,7 bc
Sig.	*	*	**	*

Table 5 Influence of rootstock on yield parameters of the Tempranillo variety at northeast of Brazil, October 2007, Pernambuco. Average of 5 clones.
Note: Sig. – Significance level; n.s. – non significant at 5% level by F test; significant at 5% level (*), 1%(**) e 0,1%(***), by Tukey HSD test. Values followed by equal letters don't differ significantly, at 5% by Tukey HSD test. na – not applicable.

Rootstock	Berry weight (g)	PAC (% v/v)	Titrable Acidity (g tar. ac./l)	pH
101-14	1,85 b	12,9	6,0	3,46 c
1103P	1,58 b	13,0	5,8	3,58 a
420A	1,65 b	13,0	5,9	3,49 bc
IAC313	2,08 ab	12,7	6,0	3,53 ab
IAC572	2,23 a	13,0	5,8	3,57 a
SO4	1,98 ab	13,1	6,2	3,51 abc
Sig.	*	*ns*	*ns*	*

Table 6 Influence of rootstock on grape composition at harvest, of the Tempranillo variety at northeast of Brazil, October of 2007, Pernambuco. Average of 5 clones.
Note: Sig. – Significance level; n.s. – non significant at 5% level by F test; significant at 5% level (*) and 1%(**) by Tukey HSD test. Values followed by equal letters don't differ significantly, at 5% by Tukey HSD test.

Clone	Clusters/Vine	Yield (Kg/vine)	Cluster weight (g)	Yield (t/ha)
Tp-770	7,0 ab	2,2 ab	321,6	7,4 ab
Tp-776	6,2 b	1,9 b	300,5	6,3 b
Tp-E24	6,2b	2,0 ab	328,5	6,8 ab
Tp-E51	6,6 ab	1,9 b	288,7	6,3 b
Tp-Embrapa	7,9 a	2,5 a	319,0	8,4 a
Sig.	**	**	*ns*	**

Table 7 Yield parameters of the clones of the Tempranillo variety at northeast of Brazil, October of 2007, Pernambuco. Average of 6 rootstocks.
Note: Sig. – Significance level; n.s. – non significant at 5% level by F test; significant at 5% level (*) and 1%(**) by Tukey HSD test. Values followed by equal letters don't differ significantly, at 5% by Tukey HSD test.

IAC 572, as verified in clones of 'Aragonez', induced heavier berries in 'Tempranillo', however, the clusters were lighter due to the lower berries number per cluster, provoked by the excess of vigour that conduced to some coulure (table 6).
In terms of quality, we can verify, in table 6, that differences between rootstocks are found only at pH level.
From all of 'Tempranillo' clones, Tp-770 and Tp-Embrapa are those that tend to produce higher clusters number and consequently higher yields. The clones Tp-E51 and Tp-776 are, after this first harvest, those that seem to be less promissory (table 7).
At grape composition, only were found differences on titrable acidity. On this parameter, the clones Tp-770 and Tp-Embrapa are those that tend to present higher values (table 8).
In terms of clone x rootstock combinations, for Tempranillo clones, the most interesting combinations were: Tp-770/101-14, Tp-E24/101-14, Tp-Embrapa/101-14, Tp-770/IAC313, Tp-E24/IAC313, Tp-Embrapa/IAC313 and Tp-Embrapa/SO4.

Clone	Berry weight (g)	PAC (% v/v)	Titrable Acidity (g tar. ac./l)	pH
Tp-770	1,89	12,9	6,2 a	3,49
Tp-776	2,07	12,8	5,8 ab	3,53
Tp-E24	1,77	12,9	5,6 b	3,54
Tp-E51	1,91	13,3	5,8 ab	3,54
Tp-Embrapa	1,82	12,7	6,3 a	3,50
Sig.	*ns*	*ns*	**	*ns*

Table 8 Grape composition at harvest of the clones of the Tempranillo variety at northeast of Brazil, October of 2007, Pernambuco. Average of 6 rootstocks.
Note: Sig. – Significance level; n.s. – non significant at 5% level by F test; significant at 1%(**) by Tukey HSD test. Values followed by equal letters don't differ significantly, at 5% by Tukey HSD test.

'Tempranillo' and 'Aragonez' comparison

Variety	Clusters/Vine	Yield (Kg/vine)	Cluster weight (g)	Yield (t/ha)
Aragonez	7,1	2,14	300	7,1
Tempranillo	6,8	2,10	312	7,0
Sig.	*ns*	*ns*	*ns*	*ns*

Table 9 Yield parameters of the of the Aragonez and Tempranillo varieties at harvest northeast of Brazil, October of 2007, Pernambuco. Average of 6 rootstocks x 5 clones.
Note: Sig. – Significance level; n.s. – non significant at 5% level by F test.

Variety	Clone	PAC (% v/v)	Titrable Acidity (g tar. ac./l)	pH
Aragonez	**Ag-110-JBP**	13,0 a	6,3 b	3,31 b
	Ag-54-EAN	11,8 b	7,1 a	3,29 b
	Ag-57-EAN	13,1 a	6,2 b	3,33 b
	Ag-60-EAN	12,9 a	6,1 b	3,35 b
	Ag-Embrapa	12,7 a	5,9 b	3,37 b
Tempranillo	**Tp-770**	12,9 a	6,2 b	3,49 a
	Tp-776	12,8 a	5,9 b	3,53 a
	Tp-E24	12,9 a	5,6 b	3,54 a
	Tp-E51	13,3 a	5,8 b	3,54 a
	Tp-Embrapa	12,7 a	6,3 b	3,50a
	Sig.	*	*	**
Aragonez	all clones	12,7	6,3	3,33
Tempranillo	all clones	13,0	5,9	3,52
	Sig.	*ns*	*	***

Table 10 Grape composition at harvest of the clones of the Aragonez and Tempranillo varieties at northeast of Brazil, October of 2007, Pernambuco. Average of 6 rootstocks.
Note: Sig. – Significance level; n.s. – non significant at 5% level by F test; significant at 5% level (*) and 0,1%(***), by Tukey HSD test. Values followed by equal letters don't differ significantly, at 5% by Tukey HSD test.

When we compare the clones of Spanish origin (Tempranillo) with the ones from Portuguese origin (Aragonez), we verify that on yield components any significant differences were found (table 9).
Comparing the grape composition parameters of clones from the two origins, we verify that clone Ar-54-EAN is the one that presents minor PAC, but greater titrable acidity. All of the Portuguese clones present significantly lower pH than the Spanish ones (table 10).

Conclusions

In a semi-arid tropical climate, where the behaviour of different vine varieties and their clones and rootstocks isn't well known, this kind of studies are essential for the choice of the most adjusted combinations. And it has a special relevance in a region where the production of grapes for wine is relatively recent.
In a general way we are able to say that the yield was more influenced by the rootstock than by the clone. Independently of the origin of clones (Portugal or Spain), the rootstocks 101-14 and IAC313 were those that originated greater yield (clusters number and weight), whereas the grape composition, only few differences were found among all the rootstocks.
We've already found some combinations clone x rootstock, from both origins, that seems to be more interesting, at yield and grape composition parameters.

In a general way, the Portuguese clones, for the same yield levels, present lower pH, which can be decisive in future vineyards. The next harvests will permit to validate these results and indicate the best combinations for this *terroir*.

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