VINE RESPONSES TO TWO IRRIGATION SYSTEMS IN THE REGION OF VINHOS VERDES

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Abstract

In this work we try to know the influence of two irrigation systems (Drip and Micro - jet) with the same levels of water applied in an experimental vineyard in the region of Felgueiras.

At present we must say that there are not significant differences between the modalities in 1996, when we refer the yield and the pruning weight by vine. In 1998, we modified slightly the trial because there were troubles with some vines of one treatment. In 1999, we verified large significant differences among the modalities relatively to the pruning weight by vine but there were not significant differences at the yield/vine.

At the moment we do not have enough results about the relations quality of wine and amounts of water applied to the soil and their form of administration. So, we cannot conclude definitively about these two systems of irrigation and their levels of water applied. However, we can say that the treatment «Drip 100% Etm» did not show good results up to now.

Introduction

In the demarcated region of Vinhos Verdes, in the last twenty years, vineyards are being planted in the slopes and in these conditions we did not have experience concerning the relations soil water plant.

To know these relations an experiment was carried out in Fridão - Amarante (North of Portugal) (in press). Furthermore, from the most common irrigation systems applied to vineyards, we do not know which is most suitable to our region. So, we carried out a trial to determine the influence of the drip and the micro jet irrigation system in the yield and quality of the vines.

The references about this matter describe several experiments with different irrigation systems in vineyards, (Peacock *et al 1977,;* Calame 1984 ; Boubals *et al* 1984 ; Van Zyl 1988 ; Garcia-*Escudero et al* 1994 ; Almela *et al* 1997 ; and Lopes *et al* 1999).

These researchers tried to know the amount of water that is necessary to apply to a vineyard and the best way to administrate it to the plants. Peacock *et al(1977)* verified that the drip system was the most efficient method to irrigate vineyards but they verified higher soil salt levels in this system than the sprinkler and

flood irrigation. The amount of water applied in this experiment with the drip system was, during 1972, 73 and 74 respectively 13,1, 15,7 and 30,2 cm by hectare.

Boubals *et al* (1984) in a trial that was carried out near Nîmes, France, refer the best results with drip system but they advised a moderate irrigation of 16mm/ha/day and it is applied during half Jun or half July to near harvest. They verified to their environment that the moderate irrigation generally origin good red wines.

Van Zyl (1988) in his experiment refer that the micro jet system consumes less water than the trickler or drip system. Furthermore, the first irrigation system revealed a more homogeneous root distribution either vertically or horizontally.

Garcia Escudero *et al(*1994*)* verified in a vineyard trial carried out in the region Rioja Alta, during 1990 and 1991, the positive influence of the located irrigation in the yield and in the pruning weight by vine. The sugar content in the grapes is only clearly influenced by the irrigation in the driest year, 1990. The level of anthocyanins is lower in the modalities more irrigated. Also in Spain, Almela *et al(*1997*)* verified that the drip irrigation with 300mm or 3000m3/ha of water was better to the quality of wine than to apply 400mm or 4000m3/ha in the soil of Bullas, Murcia, Spain.

Calame (1984) refer in his work that the vines non irrigated as long as the time goes on they shows performances that approximate from the others one irrigated.

Lopes *et al* (1999) are studying in a experimental vineyard placed at Alentejo, south Portugal, the effect of the drip system in the physiology of the vines.

Material and Methods

The experiment took place near Felgueiras, in the experimental farm of Sergude, since 1996 until 1999. Two different irrigation's systems, drip and micro jet, were analyzed. Each irrigation system has the same three levels of applying water: 100% ETm, 50% ETm and 25% ETm.

The treatment 100% ETm had water content in the soil during the experiment very near or in the ´field capacity` . The reference treatment was not irrigated. Each experimental plot had six vines replicated three times . The space of the vine was two meters in row and three meters inter row. The vine was conducted in single cordon with high canopy. The permanent cordon was 1,20 meters high. The vine was ´Loureiro` grafted on 196/17 in 1990. The average number of buds per modality was the same. The field is at an altitude about 350 meters.

The volume of water applied was 88 liters by vine and irrigation to the treatment 100%Etm and the others treatments had an half (50% Etm) and a quarter of the first volume(25% Etm). An equal volume of water was applied in both systems. The interval of irrigation it was a function of the weather and was controlled by a tensiometer and the TDR probe. So, it there were seven treatments and one of them without water. In 1998, we only retired the «Micro jet 100%Etm» treatment and replaced their plots whose vines were with troubles by new ones with vines of the same age.

In 1999, we selected three vines per plot to calculate the shoot rate growth and the evolution of ripeness. We also selected four vines in each plot to evaluate the yield and pruning weight by vine.

The soil is an antrosoil with a deeper layer of mixture of horizons Ap and C.

The mother rock is a schist .The most spread texture in the profile is the loam. This soil has a good available water content because its field capacity is about 30% v/v and has a relative high level of organic material (1-3%).

The climate of this region is temperate, but it is hot in Summer.

Results and Discussion

The results are related with the years of 1996 and 1999; we can not refer the years 1997 and 1998 because in May of 1997, the wind broken a important part of the shoots and in 98, it rained very much during bloom.

Either the index of budbursting or the index of fruitfulness of the treatments did not show significant differences among them at the level 5%.

1- Data from the average air temperature and precipitation during the vegetative season of 1999

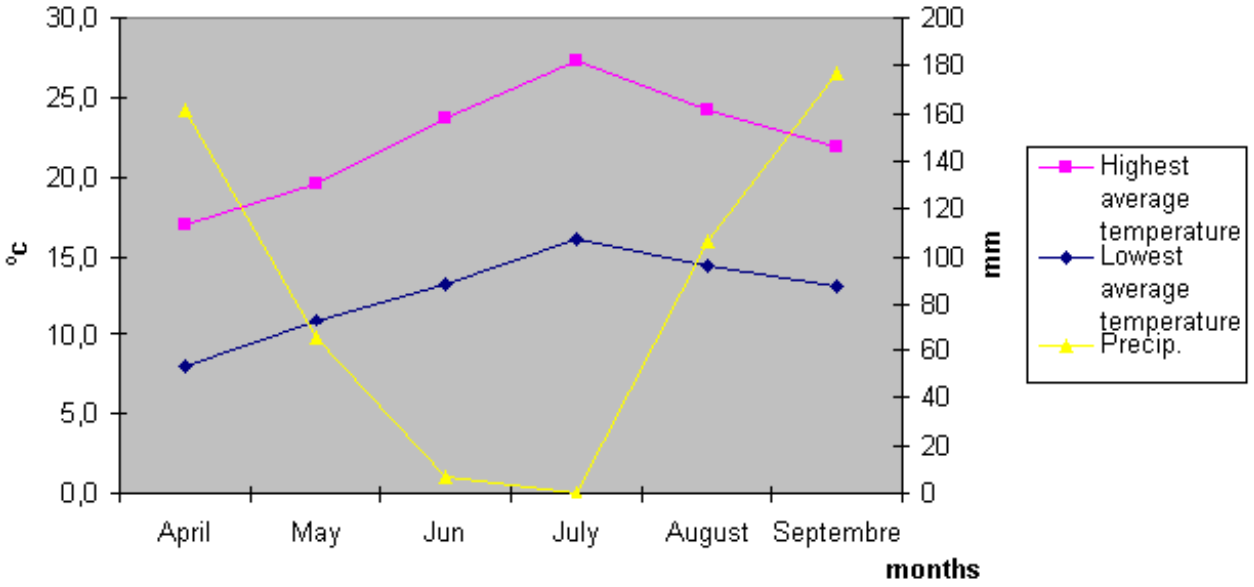

Figure 1 - Highest and lowest average temperature of the air and Precipitation from April to September

2-Relations between the water content in the soil and the shoot rate growth,

2.1 - Water content in the soil obtained with the TDR (TRIME- FM)

The probe used to measure the water content in the soil, a TRIME- FM, it was not able to show , in the surface and sub surface layers, the differences between «Drip 100% Etm» and «Drip 50%» Etm treatments as we can see in figure 2.

Figure 3 presents a important fact related with this type of irrigation: in the layer 74- 92cm of depth, the water content in the soil is generally higher at the treatments with more volume of water supplied as we can see in this figure and this fact suggest us that the roots did not need to absorb water in this layer, because they have it in the superficial layer. The other treatments as the «Drip 25%Etm» and the «Non irrigated» show a lower water content in this layer, and this happens probably because its roots certainly

are deeper than those of the most irrigated treatments. An other important fact in this layer is the level of water content in the treatment «non irrigated» which reveals us a considerable water content.

Figure 4 shows us that the maximum shoot rate growth was obtained on 14th or 15th July, and why does this happen? Figure 5 reveals us that the highest average air temperature of July, was near 10. Figure 4 also presents the effect of the water in the growth of the shoots because on 12th and 14th July, there were two irrigations, and as we think that the growth of the shoots reacts to the air temperature and humidity of the soil , one day or more later, so, we think that the days of measuring the length of the shoots were in conditions to show the effect of the highest air temperature and water content in the soil.

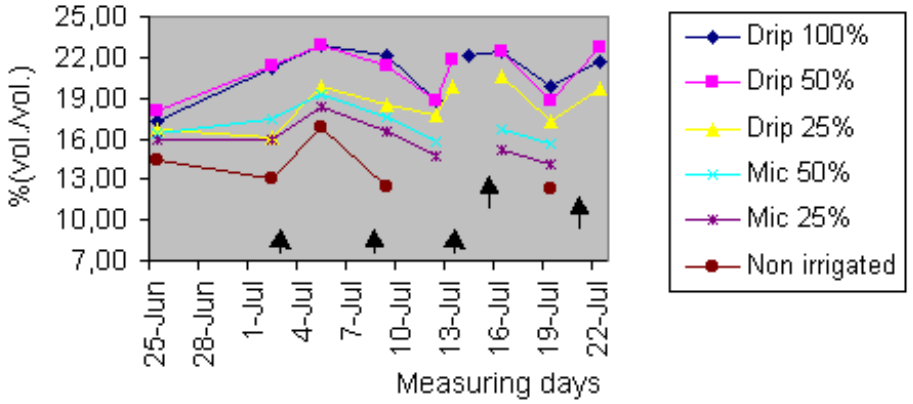

Figure 2- Average water content in the soil layer 2- 20 cm of depth
The arrows indicate the days of irrigation

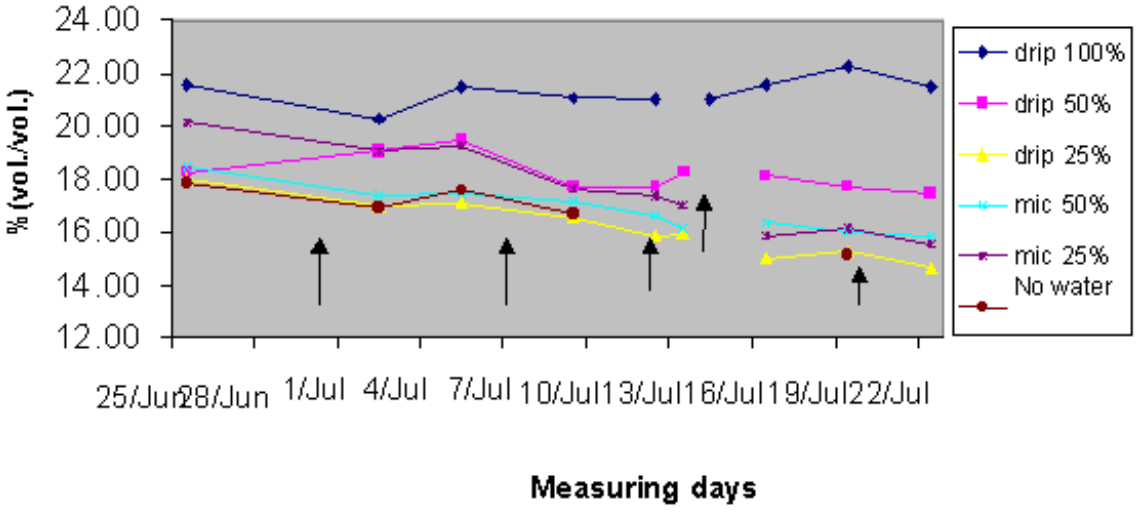

Figure 3- Average humidity of the soil layer since 74-92cm;
The arrows indicate the days of irrigation.

2.2 Shoot Rate Growth in 1999

2.2.1 The main phenological stages of the vines

Table 1 - The main phenological stages of the vines in the season of 1999.

Bloom	Berry set	Pea size	«Grape closed»	Véraison
25/5	17/6	7/7	1/8	16/8

We made an analysis of variance with the data of the shoot rate growth and we verified a significantdifference among the treatments. Figure 4 shows these differences and we can see that the more irrigated «Drip 100% Etm» treatment is depressed by the excess of water applied on 13/7 and 15/7. We can not explain why the «Micro-jet 50%» treatment is more depressed by the water in those days, perhaps the differences were in the vigour of the vines of this treatment? If we observe, in figure 4, the curves of the treatments «Drip 50%» and «Drip 25%», we see that the first curve is always below the second but the difference between these two curves is not so big as it happens on 22/7 and 23/7. The cause of this large difference is probably in the volume of water really applied to the soil of the «Drip 50%» as we could verify measuring the leaves water potential of all treatments and whose results are in table 2. This study reveals that we must give a special attention to the selection of the vines and shoots when we want to know better the influence of the irrigation systems in the vines. The vines selected must be similar in respect to the vigour.

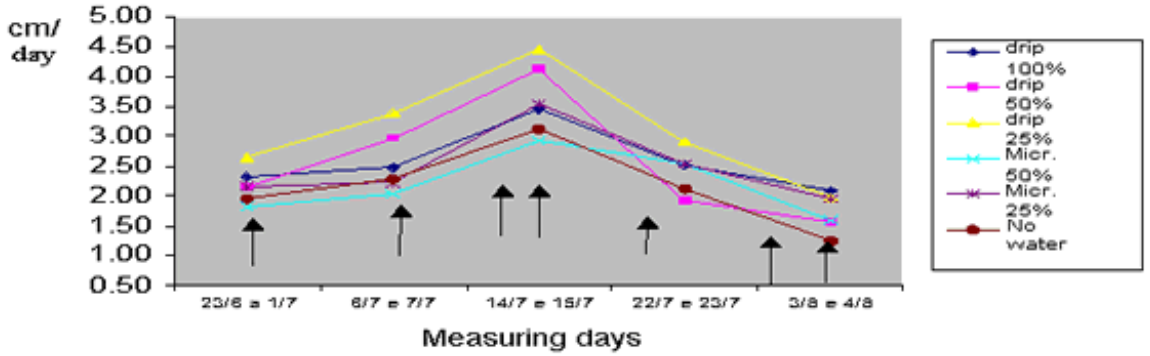

Figure 4 - Average shoot rate growth by modality. The rows indicate the days of irrigation

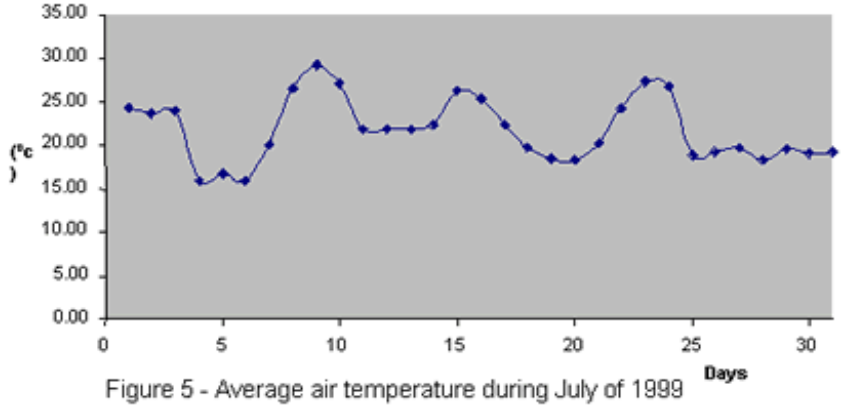

Figure 5 - Average air temperature during July of 1999

3-Relations between the water content in the soil and water potential in the leaves

Table 2 - Leaves water potential(Ψ) or predawn obtained in 30/7/1999

Modalities	Ψ (bares)
Drip 100%	0,51
« 50%	1,05
« 25%	0,73
Micro. 50%	0,75
« 25%	0,95
Non irrigated	0,95

In general the values of table 2 are correct with an exception of «Drip 50%». This method of estimating the binding energy of the water content in the leaves of the vines has the advantage of control the water supplied to the vines during an experiment like this one. With the values of table 2, we corrected the water supplied to «Drip 50% Etm» treatment.

The value obtained for the «Non irrigated »treatment means that there is in the soil, available water in such a way, that it is enough for the vines to complete their vegetative season. If we compare these values with the values of figure 6 for the «non irrigated» treatment we saw that there were water in the soil even in the deeper layers (data not published).

4-Relations between the water content in the soil and the canopy area.

4.1 - Canopy area in Véraison

The canopy area was obtained using a simplification of the Lopes method.

The values in table 3 generally presents the effect of water in the growth of the vines. As one can expect the more irrigated treatments show a greater canopy area, however, Drip 25% Etm has an area smaller than the «non irrigated» one.

Why did this happen ? We think that this happened because there was a plot or replication in a locale with not so vigorous vines. The water in the soil was enough to allow the Non irrigated treatment to obtain an average area of foliage equal or similar to the treatments Micro 50% and Micro 25%.

Table 3 - Average canopy area (m^2) obtained by replication and treatments in Véraison of 1999.

Drip 100%	Drip 50%	Drip 25%	Micro 50%	Micro 25%	No Water
115.5341	74.1035	83.996	90.9178	125.121	114.4815
126.2417	137.4914	110.929224	118.8055	102.128	125.6071
139.0404	136.1287	118.7729	118.2029	102.4552	87.9402

Table 4 reveals that there are not significant differences among the treatments in relation to the average yield by vine. The greater differences of yield between the treatment «Non irrigated» and «Drip 50%» in 1996, and «Micro 50%» in 1999, in percentage, were respectively 2,9 and 21,6.This last value agrees with those obtained in the south of France by Boubals *et al*(1984).

Relatively to the pruning weight of 1996, there were no significant differences among the treatments, but in 1999, there was a highly significant difference among the treatments

Table 5 shows the effect of the microclimate of each treatment in the development of grape rot. The treatments such as «Drip 100%», «Drip 50%» and «Non irrigated» showed a high level of grape rot. How to explain the 4,033kg of grape rot of the «Non irrigated»treatment? This fact is nonsense because

the canopy area of this last treatment is near to that obtained by the «Drip 25%» whose grape rot was only 1,9kg.

Why did this happen?

These results present the dangerous effect of the canopy developed by treatments 100%Etm and 50%Etm of the drip system.

In figure 6, we saw the evolution of the soluble solids in grapes. It rained for all treatments and replications since 17/9 to 20/9.

The analysis of variance of the evolution of the soluble solids in grape composition in 1999, revealed

significant differences among the treatments. The group of treatments with more sugar content are «Drip 50%», the «Non irrigated» and «Micro - jet 25%».

In relation to the titratable acidity there are also significant differences between the treatments. The treatment that shows the greater acidity is «Drip 100%».

5- Relations between the water content in the soil and the weight of pruning, yield and composition of the grapes

Table 4 - Average Yield(Kg) and Pruning Weight(Kg) by vine and treatment of the years 1996 and 1999

	Yield		Pruning	
	1996	1999	**1996**	**1999**
Micro 50%	9,605	11,275	1,825	3,908
Micro 25%	10,7522	8,992	1,758	3,641
Drip 100%	9,6361	9,325	2,535	4,491
Drip 50%	11,2661	9,683	2,086	4,958
Drip 25%	9,9217	9,958	1,883	3,475
Non irrigated	10,9472	9,275	2,101	4,433

Table 5 - Average weight of the grapes with rot and without rot in the year of 1999

	Grapes Rot (Kg)	**Grapes without rot** (Kg)
Micro 50%	2,975	8,300
Micro 25%	2,767	6,225
Gota 100%	4,392	4,933
Gota 50%	4,117	5,567
Gota 25%	1,900	8,058
Non irrigatec	4,033	5,242

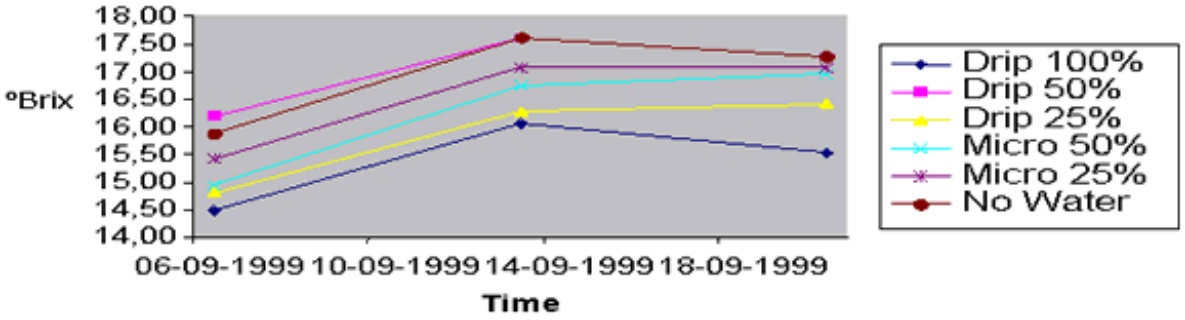

Figure 6- Evolution of soluble solids in grape composition in 1999

6- Relations between the irrigation systems and the quality of the wine

At the moment and in relation to the alcohol content of the wines of each treatment we have only the results from 1996, which show us that there are not significant differences among them. However, the treatments which showed more alcohol content were «Micro-jet 50%» and «Drip 50%».

7-Conclusions

The available results make us to think, at the moment, that the more irrigated treatment, the «Drip 100%Etm » did not contribute to the quality of the wine.

Treatment «Micro jet 50%» presents, in 1999, an interesting relation yield/sugar content.

In accordance with the available results, the trial must go on with the aim of obtaining more consistent results.

Acknowledgement

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