EVALUATION OF THE EFFECT OF REGULATED DEFICIT IRRIGATION ON VITIS VINIFERA CABERNET SAUVIGNON PHYSIOLOGICAL TRAITS AND FINAL FRUIT COMPOSITION

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CENTRO DE INVESTIGACIÓN E INNOVACIÓN VIÑA CONCHA Y TORO

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INTRODUCTION

Water availability in agriculture has become a limiting factor, mainly because of constant drought associated with la Niña phenomenon which leads to fewer precipitations in Chile.

Optimal irrigation in grapevines could be accomplished by means of physiological data based programming and final grape and wine chemical and sensory performance. This study aims to understand the impacts of different levels of deficit irrigation on a large amount of chemical markers from aroma to non-volatile compounds, and the final impact on sensory profile.

MATERIALS & METHODS

A regulated deficit irrigation (RDI) experimental trial that was conducted in a commercial vineyard of Cabernet Sauvignon in the Maule valley in central Chile. Four regulated deficit irrigation (RDI regimes were employed in four replicated blocks to replenish different portions of evapotranspiration (ET) from pea-size stadium until harvest. These managements were conceived X0: 100% ET, X1: 70% ET, X2: 50-100% ET (50% ET before veraison and 100% ET afterward) and X3: 25-100% ET (25% ET before veraison and 100% ET afterward). The following parameters were measured: midday stem water potential (Ψstem), stomatal conductance (gs), vine and grapes growth, yield, quality of must. GSMS for norisoprenoid, terpene, C6s compounds and methoxypyrazines concentration and HPLC for anthocyanin and low molecular weight phenols was used.

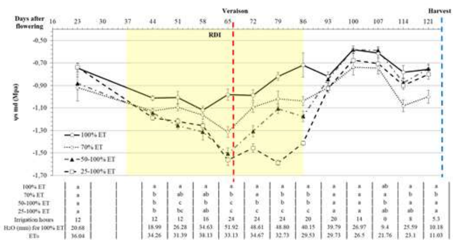

Figure 1. Midday stem water potential of treatments during the season. Different letters in vertical order indicate significant differences p ≤ 0,05.

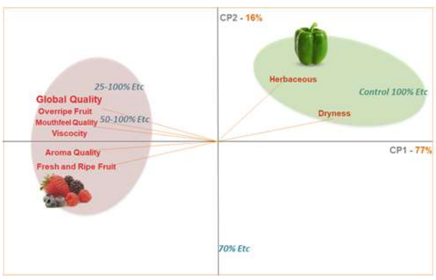

Figure 2. Principal components analysis of sensory attributes of wines of plant of the different treatments.

RESULTS

RDI technique reduces the sources, the foliage in this case expressed as pruning weight but also the Sinks, reducing the total yield of grapes produced, mainly by a lighter clusters with fewer and smaller berries (Table 1). Since sources and sinks are reduced ravaz index is not affected.

Table 1. Yield components by treatment. Different letters in vertical order indicate significant differences p ≤ 0,05.

Treatment	Yield/HA (kg)	Pruned/Plant (kg)	Ravaz index	Berry average weight (g)	Cluster weight (g)	Rachis weight (g)	Berries number
X0	16154^{a}	1.03^{a}	4,41	1.10^{a}	173^{a}	9.82^{a}	147^{a}
X1	15494^{a}	0.86^{b}	5,13	1.00^{b}	146^{b}	8.36^{b}	136^{ab}
X2	13,474^{ab}	0.90^{b}	4,11	0.85^{c}	114^{c}	7.81^{bc}	123^{b}
X3	11,982^{b}	0.90^{b}	3,73	0.82^{c}	105^{c}	6.77^{c}	120^{b}

This stable condition between sources and sinks might be the responsible of not having differences in grape sugar accumulation (Table 2). But in general terms an increase in the concentration of quality associated chemical markers is observed with reduced irrigation, higher concentrations of polyphenols like anthocyanins and some flavonoids, quercetin and miricetins mainly.

Table 2. Non volatile chemical characterization of grapes by treatment. Different letters in vertical order indicate significant differences p ≤ 0,05.

Treatment	Brix	Malic acid (g)	pH	Total acidity	Total anthocyanins (mg/l)	DO280	Flaval-3-oles (mg/l)	Ac. Hidroxi. (mg/l)	Flavonoles (mg/l)	FBPM (mg/l)
X0	24,1	**1.67 a**	3,53	2,91	**707 b**	**78,0 b**	94,39	4,60	**136,9 b**	235,9
X1	24,3	**1.52 ab**	3,53	2,85	**688 b**	**84,7 ab**	68,08	5,73	**142,4 b**	216,2
X2	24,2	**1.28 bc**	3,49	2,92	**755 ab**	**97,1 a**	73,69	8,35	**181,0 a**	263,0
X3	24,1	**1.06 c**	3,53	3,00	**905 a**	**100,2 a**	59,50	8,08	**183,9 a**	251,5

The experiment only shows an increased concentration of anthocyanins (Figure 3), but not effect on the concentration expressed by mg per Berry. So no prove of an effect on the synthesis or degradation of this molecules.

In terms of aromas, grapes from X0 are characterized by higher concentrations of cineoles but lower ethyl acetate, Trans-2 and Trans-3-Hexenol, and 3-isobutyl-2-methoxypyrazine (IBMP) by kilogram of must and by Berry was possible to observe, particular for the 70% Etc treatment (Figure 4). So either a lower degradation or a higher synthesis.

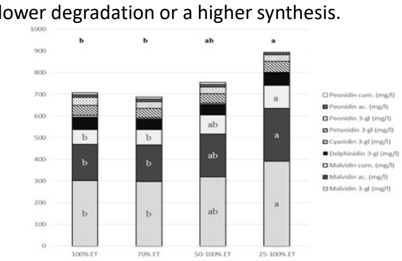

Figure 3. Concentration of different anthocyanins in grape samples. Different letters in horizontal order indicate significant differences, for particular anthocyanin inside a bar, or for the total anthocyanin on the top. p ≤ 0,05.

CONCLUSIONS

Of definite interest were the outcomes from the grapes' evolution monitoring, as we had expectations of an alteration in their development in RDI conditions. Apart from the mere berry size, which showed significant differences between the treatments and control, no other variations have been registered. Surprisingly, the °Brix degrees were very alike, indicating that a reduced water availability does not always imply a faster maturation of the sugars in the grapes, as opposed to previous investigations that shows that a conventional irrigation may imply a delay in sugar accumulation. These circumstances additionally, allowed us to harvest all of the four regimes at the same time, thus providing optimal comparison bases. Significant differences were found in several traits, from lower concentration of malic acid in RDI treatments to higher concentrations of anthocyanin and some specific flavonoids like quercetin and miricetins. In the case of aroma compounds, our partial results indicate a significant effect of the RDI in increasing the concentration of 3-Isobutyl-2-methoxypyrazine and others green aromas, wich does not correlate with later sensory wine analysis. This results might be linked to increased light interception in the RDI treatments, who tend to defoliate early in the season.

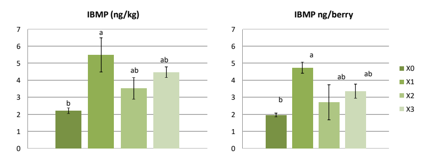

Figure 4. Concentration by litter and by berry of 3-isobutyl-2-methoxypyrazine (IBMP) in grape samples. Different letters in horizontal order indicate significant differences between treatments. p ≤ 0,05.

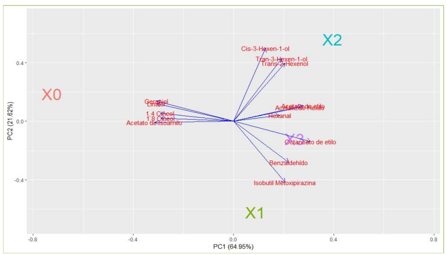

Figure 5. Principal components analysis of the different aroma components of grapes on the different treatments

ACKNOWLEDGMENTS

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