

Effects of different irrigation levels on the quality of Trincadeira grapes – Mediterranean conditions

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Abstract

This work reports the research on Trincadeira grape vine subject to three increasing levels of irrigation: i) non irrigation, ii) farmer irrigation or iii) full irrigation. During grape's maturation, berry size and quality parameters were analyzed. Only in September all analysed parameters were significantly different: non-irrigated plants had smaller berries and lower brix, anthocyanins and polyphenols than irrigated ones.

Keywords: irrigation, grapes, brix, anthocyanins, polyphenols.

Introduction

Irrigation is a useful tool for vineyards of the Mediterranean region, but the availability of water, which can be positive to ensure the plant metabolism and production, can also have negative effects on the quality of grapes by dilution of soluble solids in the berries (Girona *et al.*, 2006; Santesteban and Royo, 2006). Controlled irrigation has positive effects on the synthesis and concentration of phenolic compounds, soluble solids and anthocyanins promoting improvements in the quality of wines in color, aroma and flavor, due to the increased ratio skin/pulp of the berries (Acevedo-Opazo *et al.*, 2010). The development of appropriate irrigation strategies proves to be very important, both to ensure productivity and a good management of water resources. This work aims to contribute to the study of the effects of irrigation on the main quality characteristics of grapes.

Methodology

This research was performed on a vineyard located in Alto Alentejo region (lat: +38,551017°; long: -7,882821°), Portugal, in plants of Trincadeira variety. A trial was established with three irrigation treatments: i) rain-fed (21 mm), ii) farmer irrigation (83

mm) or iii) full irrigation (108 mm), mm of watering being total allocation from July to September, including precipitation.

In July, August and September, fifty berries were randomly harvested from the 13 plants of each treatment. They were weighed (fresh weight) and dried (dry weight) at 48°C for 15 days. Samples were collected in August, at stage II and in September, at stage III for analysis of the most used parameters to directly assess the quality of the fruit: brix, anthocyanins and polyphenols. Brix was determined by a manual refractometer (ALLA, France). The determination of total anthocyanins followed Ribéreau-Gayon and Stonestreet (1965) method, and phenolic compounds were dosed according to Curvelo-Garcia (1988), using a spectrophotometer Perkin Elmer, model Lambda 25 UV/Vis (Shelton, USA).

IBM SPSS Statistics 22 was used for statistical analysis.

Results

Average berry size and water content was determined from July to beginning of September. Berry water percentage was not affected by irrigation throughout the experimental period. Mean dry weight in July was 0,15g/berry and there were no differences between irrigations. In August there were also no differences but in early September non-irrigated plants had 12% significantly smaller berries than irrigated ones (Table 1).

Table 1. Grape dry weight (n = 50) and quality parameters (n = 6 or 8) of berries from the plants subject to the three levels of irrigation. For each parameter, different letters indicate significant statistical differences ($p < 0,05$).

	August			September		
	Non irrigation	Farmer irrigation	Full irrigation	Non irrigation	Farmer irrigation	Full irrigation
Dry weight to 50 berries (g)	0,59 ± 0,1	0,59 ± 0,1	0,70 ± 0,1	0,62 ± 0,1 ^b	0,70 ± 0,1 ^{ab}	0,71 ± 0,1 ^a
Brix (°Bx)	12,3 ± 1,5	12,0 ± 1,9	12,0 ± 1,5	14,7 ± 0,2 ^c	15,0 ± 0,1 ^b	15,3 ± 0,2 ^a
Anthocyanins (mg/L)	100 ± 48	109 ± 58	115 ± 54	178 ± 8 ^b	176 ± 2 ^b	209 ± 6 ^a
Polyphenols (abs)	8,07 ± 1,0	7,88 ± 0,6	7,84 ± 0,8	9,36 ± 0,9 ^b	9,09 ± 0,2 ^b	10,43 ± 0,1 ^a

Brix, anthocyanin and polyphenols were also assessed (Table 1). In August, different applied irrigations had no significant effects on these parameters, but in September there

were marked differences between irrigations. All these quality parameters were significantly higher in fully-irrigated plants and lower on non-irrigated ones.

Discussion

Three levels of irrigation, the farmer irrigation, below it (rain-fed) and above (full irrigation), were applied to a Trincadeira vineyard.

Except for water percentage, plants subject to full irrigation (above farmer irrigation) showed higher values in all parameters considered (berry weight, brix, anthocyanins and polyphenols), as compared to the farmer irrigated or rain-fed plants in the month of September.

The smaller berry size on rain-fed vines, possibly due to decrease in turgor (Matthews *et al.* 1987), indicates that, on this particular year, water was a limiting factor for berry growth.

Brix of rainfed plants was significantly lower than that of farmer-irrigated or fully-irrigated plants. This may be due to the fact that lower water endowments influenced stomatal opening and therefore the process of photosynthesis.

The content of anthocyanins and polyphenols was significantly higher in fully-watered fruits as compared to other irrigations.

Contradicting these results, several authors (e.g. Acevodo-Opazo *et al.*, 2010; Van Leeuwen *et al.*, 2004; Dry *et al.* 2001) report that the imposition of a period of water stress favor the accumulation of anthocyanins. Other authors also say that grapes which receive less water have higher quality because they have a higher skin/pulp ratio, favoring the accumulation of phenolic compounds (e.g. Koundouras *et al.*, 2006; Santesteban and Royo, 2006).

Given the results, it appears that water was a limiting factor at least at the farmer irrigation level; plants would therefore be under some degree of water stress which resulted in lower values for these quality parameters.

Conclusions

This research shows that the quality of the grapes from plants subject to farmer-defined irrigation proved worse than the ones from fully-irrigated plants. Farmer is therefore recommended to increase water allocation.

The apparently contradictory results may suggest that even fully-irrigated plants were still in water stress, i.e., the photosynthetic activity and thus sugar content was limited due to water shortage. These results need farther investigation.

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