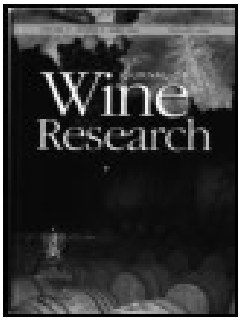

Journal of Wine Research

Routledge
Taylor & Francis Group

ISSN: 0957-1264 (Print) 1469-9672 (Online) Journal homepage: http://www.tandfonline.com/loi/cjwr20

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To cite this article: J. M. Barroso, L. Pombeiro & A. E. Rato (2016): Impacts of crop level, soil and irrigation management in grape berries of cv 'Trincadeira' (Vitis vinifera L.), Journal of Wine Research, DOI: 10.1080/09571264.2016.1238350

To link to this article: http://dx.doi.org/10.1080/09571264.2016.1238350


Published online: 12 Oct 2016.


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JOURNAL OF WINE RESEARCH, 2016
http://dx.doi.org/10.1080/09571264.2016.1238350

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Impacts of crop level, soil and irrigation management in grape berries of cv 'Trincadeira' (*Vitis vinifera* L.)

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ABSTRACT

Berry size and crop yield are widely recognized as important factors that contribute to wine quality. The final berry size indirectly affects the phenolic concentration of the wine due to skin surface-to-berry volume ratio. The effects of different irrigation levels, soil management and plant crop level on growth of 'Trincadeira' berries were studied. In order to test the influence of different irrigation levels (rainfed, pre-veraison and post-veraison), different soil management (tillage and natural cover crops) and different plant crop levels (8 and 16 clusters per vine), leaf water potential, skin anthocyanin, polyphenols, berry skin and seed fresh weight were measured in fruits. The segregation of berries into three different berry classes: small, medium and large, allowed to identify different levels of contribution of soil management and irrigation level into berry, skin and seeds ratios. As expected, higher water availability due to irrigation and soil tillage management during berry development induced an increase in berry flesh weight and this was more evident in larger berries; however, berry skin and seed fresh weight remained unchanged. Also, anthocyanins did not show significant differences.

ARTICLE HISTORY
Received 26 November 2015
Accepted 15 September 2016

KEYWORDS
Berry size; berry skin; irrigation; cover crops; crop level; Portugal

Introduction

It is commonly accepted that berry size is a decisive factor in wine grape quality, being the result of different viticultural practices, mainly the water use during the berry growth and maturation period. Water deficit alters the proportion of berry surface area to volume of mesocarp tissue by restricting berry growth (Ojeda, Andary, Kraeva, Carbonneau, & Deloire, 2002; Roby, Harbertson, Adams, & Mattews, 2004). The contribution of different berry sizes to wine quality requires innovative approaches. The classical postulate of viticulture supports the theory that smaller berries produce the best red wines due to a higher surface:volume ratio. However, and according to Mathews and Nuzzo (2007), no size-dependent change in the concentration of skin solutes in musts is expected because the amount of skin tissue increased proportionally with berry size. In fact, it is difficult to separate and identify the different viticultural practices that affect the berry size in a cluster.

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In spite of other important viticultural practices influence, water availability is the main factor responsible for final berry size. However, compared with other shoot organs, berry growth is the least sensitive to water deficit (Mathews & Nuzzo, 2007). Cultural practices such as the regulated deficit irrigation or soil cover crops are implemented in order to reduce berry size and to promote wine quality by increasing the proportion of skin surface to berry volume. Ojeda et al. (2002) confirmed in Shiraz the importance of moderate water deficit during the anthesis to veraison period to increase phenolic concentration, by reducing berry size. Also, the same authors confirmed that moderate water deficit after veraison increased the biosynthesis of anthocyanins; however, strong water deficit applied before veraison can also reduce this biosynthesis. These assumptions confirmed the difficulty to assess how much yield or berry size affects phenolic composition and consequently wine quality. Moreover, within *Vitis vinifera* L., the vine response to water supply is very different among wine grape cultivars (Souza et al., 2005) and according to practical evidences, among Portuguese regional grape varieties, 'Trincadeira' exhibits a very high level of tolerance to water stress during maturation period.

Alentejo is a particular region for grape growing because it provides high water availability during the first period of fruit growth, and this is more evident in deeper soils. In this region, the high water availability period is followed by an increase in crop evapotranspiration (ET) due to a rapid temperature increase. In these conditions, soil water availability is rapidly exhausted which causes the subsequent grape maturation period extremely difficult to manage in dry land vineyards.

Fruit growth is more influenced when water restrictions are imposed after flowering, than after veraison (Ojeda et al., 2002). In fact, the influence of environmental conditions and agricultural practices during early stages of berry development are crucial to determine further growth. Any kind of limitation imposed to plant assimilation, at this early stage, necessarily affects fruit development by reducing cell number and size. According to this, Kliewer (1977) has reported that temperatures above to 32°C during bloom or in early stages of berry growth significantly reduced the grape berry size.

Traditionally in Alentejo region, tillage between rows is a widely used practice to control weeds in vineyards and also to increase water availability in the critical period between fruit set and veraison. The use of vineyard cover crops is not a new practice and its benefits have long been recognized. In recent years, cover crop use as a sustainable practice has increased due to a multitude of reasons, which include the control of soil erosion, the enhancement of soil structure and the reduction of grapevine vigor (Celette, Wery, Chantelot, Celette, & Gary, 2005; Tesic, Keller, & Hutton, 2007). Also, berry composition can be improved through an effective control of grapevine vigor during pre-veraison period (Monteiro & Lopes, 2007). However, there is not much information about the practices to reduce water availability in the soil before veraison, which is essential in Alentejo conditions. Centinari, Poni, Intrigliolo, Dragoni, and Lakso (2012) stated that cover crops in the inter-row added 0.6–2.6 mm/day to the total vineyard *ET* depending on the training system and on the climatic conditions. Irrigation and cover crops use in Alentejo climatic conditions may be both interesting and complementary practices to improve water management in vineyards.

The number of clusters per plant (crop level) is an essential concern in some regions, because of its impact on wine quality. Cluster thinning before veraison is a common practice that is being used independently of the negative effects of berry growth on surface: