Firsts approaches in the development of phenological models and zonification for walnut (*Juglans regia*) production in Argentina

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INTRODUCTION

In the last decades, walnut consumption has increased worldwide thanks to their nutritional properties[1]. Following this trend, walnut cultivated area has expanded in Argentina (mainly in Catamarca, Mendoza and La Rioja) reaching 18235 ha in 2021[2]. The expansion of walnut production in Argentina has reached areas with little or no previous experience, specially in the high-density orchards. Walnut quality is determined by nut and kernel size, kernel color, oil content, and kernel-to-nut weight ratio (KNR). These features depend on the variety, but environmental conditions, management and their interactions play a key role[3]. Temperature is the main driver of plant phenology and determines the occurrence of reproductive stages that impact on production. As temperature increases are expected in Argentina[4], walnut production and quality may be threatened in the future.

OBJECTIVE

To assess fruit quality in walnut orchards, covering a latitudinal-altitudinal gradient along western Argentina.

MATERIALS AND METHODS

Experimental sites

- Walnut orchards cv Chandler grafted on Paradox, trained to central leader (Figure 4)
- Seven sampling locations in Mendoza (5 sites) and La Rioja (2 sites)

Fruit measurements at harvest

- Nut size and dry weight
- Kernel dry weight (dw)
- Kernel to nut ratio (KNR, calculated as kernel-whole nut weight ratio)

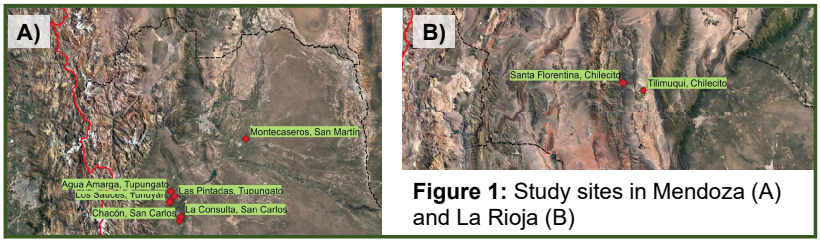

Figure 1: Study sites in Mendoza (A) and La Rioja (B)

Table 1: Average maximum, mean and minimum temperature (ºC) during december 2022 – april 2023, and altitude of the seven sites of study.

Temperature (ºC)	Agua Amarga	La Consulta	Los Sauces	Montecaseros	Santa Florentina	Tilimuqui
Maximum	29.0	29.7	30.6	32.0	32.9	33.5
Mean	20.8	20.2	21.2	23.9	21.0	23.9
Minimum	12.9	11.1	12.9	15.7	9.1	14.3
Altitude (masl)	1039	927	1005	620	1997	928

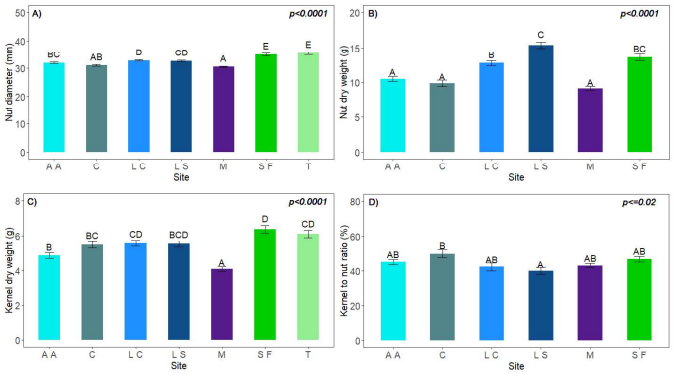

Figure 2: Nut diameter (A) and dry weight (B), kernel dry weight (C) and kernel to nut ratio (D) in the seven sites of study, (AA Agua Amarga, C Chacón, LC La Consulta, LS Los Sauces, M Montecaseros, SF Santa Florentina, T Tilimuqui)

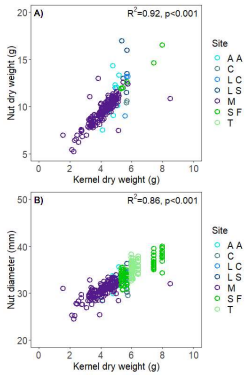

Figure 3: Correlations between kernel dry weight and nut dry weight (A) and nut diammeter (B) for all the sites of study.

Figure 4: Walnut orchard at harvest in Agua Amarga, Mendoza, March 2023.

RESULTS AND DISCUSSION

Sites differed around 4.5 ºC in maximum and minimum temperatures and 3.7 ºC in mean temperature (Table 1). The warmest sites were Tilimuqui and Montecaseros, while the coldest was La Consulta. Specially, higher autumn temperatures were registered in Montecaseros, which was site with the lowest kernel dw (Figure 2, C). However, kernel dw was the highest in Tilimuqui. It is known that either water deficit or high temperatures occurences during the first half of the growing season, could affect the size and quantity of nuts[5]. In that regard, high temperatures may had affected kernel fill in Montecaseros but not in Tilimuqui or Santa Florentina, where a summer rainfall regime could alleviate crop water demand[6]. Despite differences in kernel and nut dw, the KNR was the most stable yield component between sites (Figure 2, D), as previously reported[6]. Strong correlations between kernel dw and nut dw (Figure 3, A) and size (Figure 3, B) were found for all sites. This could be related to a strong genetic effect in fruit characteristics[7].

FUTURE PERSPECTIVES

Other walnut features, such as phenology, fruit quality and kernel oil concentration remained to be evaluated. Sampling in the same and other sites will continue. This study is a first approach to reach a better understanding of environment and genotype interactions in walnut. We sight to contribute to walnut phenological models and zonification in Argentina.

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