



Opinion

Volume 28 Issue 1 - January 2024
DOI: 10.19080/ARTOAJ.2024.28.556395

Agri Res & Tech: Open Access J

Copyright © All rights are reserved by Luis Carlos Moro González

Double Wave Model & Digital Twins: Technological Strategies against Water Stress in Woody Crops at Meseta Central of the Iberian Peninsula



Luis Carlos Moro González*

President of Bodegas Familiares Matarromera, Spain

Submission: December 21, 2023; **Published:** January 03, 2024

***Corresponding author:** Luis Carlos Moro González, Bodega Emina Ribera. Carretera de San Bernardo s/n Valbuena de Duero 47359 Valladolid, Castilla y León, Spain

Abstract

The increase in temperatures and intensive agriculture are accelerating the desertification of the Spanish agricultural sector: almost half of the territory is at risk of desertification and the forecast for the year 2050 is for this percentage to reach 67%. The south region, Mediterranean Coast and Inner Plateau of Iberian Peninsula has the highest water stress index in Europe being the agricultural sector the mayor water consumer. Bodegas Familiares Matarromera has developed a strategy on agro-technology approaching to optimize irrigation conditions. The projects under development show that sensor-controlled irrigation allows quality grape crops to be obtained and that it is necessary to keep learning to use current and emerging technology in continuous development to optimize the use of water resources. The current actions should be framed into the so called Sustainable Matarromera on Planet Earth Plan which main efforts address the saving and optimization of natural resources.

Keywords: Inner Subplateau; Meseta Central; Woody crops; Sensor-controlled fertigation; Double Wave Model; Digital Twins; Matarromera

Introduction

According with Continental Mediterranean climates, the most of Iberian Peninsula is characterized by a high interannual variability. Drought is the main natural challenge in Iberian Peninsula concerning economic and environmental issues [1]. Most studies on climate change point out to the Iberian Peninsula, as a critically vulnerable territory. The combination of uncertain seasonal patterns, reduction of rainfalls and increase in average temperatures causes water scarcity with reduced soil humidity leading to desertification [2]. Water management is a global challenge to be addressed by society. Matarromera owns more than 1200 hectares vineyards as well as olive, almonds and pistachio plots, localized at the Inner Plateau. Before the droughts damages could be arise in coming years SM Vicente-Serrano [3], an effort should be done. A sustainable philosophy supported by agro-technology Ramírez [4] is the chosen option to face the upcoming challenges [5].

Facing the lack of water challenge in Agriculture “Double wave model” and Digital Twins

The Meseta Central (Inner Plateau) consists of a large plateau of about 400 000 Km² covering a large part of inner Iberian Peninsula with an average height of 650 m above sea level. The northern Subplateau with heights ranging 700 to 800 m is drained by the great hydrographic basin of Duero River. The climate of the whole extension is framed within semi-arid continental mediterranean with a remarkable annual thermal amplitude being temperatures very extreme. Summers are hot and dry (19 to 22°C) and winters are dry and freezing (3 to 6 °C) with the coldest minimum temperatures in the whole peninsula even below -20 °C. Rainfalls-300-600 mm per year- are irregular, more frequent in spring and autumn and scarce in summer. For this reason, in Meseta Central the distribution of rainfall is increasingly heterogeneous and with longer periods of drought. Agriculture accounts for 70% of the country's fresh water consumption.

In the middle of the last decade, Bodegas Familiares Matarromera began an ambitious plan to reduce the use of irrigation water in woody crops through R&D projects and investments in precision agriculture and associated infrastructure framed into the Sustainable Matarromera on Planet Earth Plan. The combination of knowledge generated in R&D projects, the use of technological tools, and investments in precision agricultural infrastructure, has placed Bodega Matarromera as a benchmark in the area of water management for irrigation. In 2008, the CENIT DEMETER consortium project allowed us to obtain important conclusions regarding the effect of irrigation as a tool for manipulating the metabolism of the vine in the field. To this end, an ambitious study was carried out for 5 years in an experimental vineyard of the Verdejo wine vineyard located in Villalba de Adaja (Valladolid). Verdejo vineyards are the most representative variety of the D.O. Rueda, where EMINA Verdejo wines are produced. Evaluating evapotranspiration, effective precipitation and crop coefficient (Kc), it is concluded that, the vineyard where rational irrigation was applied under the study conditions a greater physiological efficiency is achieved, as well as a balance between yield and vegetative development.

The experience and results generated in the CENIT DEMETER project served as a platform to begin an ambitious line of work aimed at providing controlled irrigation in woody crops (olive plots, vineyards, almond and pistachio plantations) owned by Bodegas Familiares Matarromera distributed in different regions of the Central Inner Plateau.

The irrigation strategy focuses on optimizing water resources through the use of digital tools for sustainable production. To achieve this, the strategy is double and sequential; on the one hand, it seeks to obtain information on the water status and humidity of the soil, roots and plant as well as climate conditions through a weather station placed within the plots. Once the information is obtained, irrigation is provided in those places and times necessary.

The water and nutrients supply are performed through a controlled drip fertigation system. While fertigation is being carried out, real-time information on the state of the plant and soil humidity levels is collected by sensors. The whole process concludes once the humidity values detected fulfilled water requirements. To carry out controlled fertigation and monitor the water and nutrients status of the plant and crop soil in real time, a system is used based on the information generated by two types of sensors that provide complementary information that feeds each other and allows fertigation control. It is a system that we called the "Double Wave Model".

The first type of sensors controls the state of the crop by continuously monitoring soil conditions and plant homeostasis. These are the sensors responsible for reporting the state of the plant and surrounding soil at all times and provides the first wave

of information that feeds the system. An associated alert system warns when stressful situations that require intervention are detected. In such scenario, a remote-controlled watering system provides water and nutrients to the crop and plants.

The second type of sensors is closely associated with fertigation, and it is this second set of sensors that report in real time on the evolution of fertigation, providing information on the amount of water that reaches the plant at different depths and in different parts of the roots. This second wave of information allows real-time regulation of fertigation time and flow, and is based on the experience of Matarromera staff that helps to make decisions regarding the amount and time of irrigation required to cover the plant's water needs. The entire fertigation control system is powered by solar energy.

Next Step: Digital Twins

Bodegas Familiares Matarromera faces new challenges aiming to gain insight the advantages that new technologies could offer to improve irrigation in terms of optimization for water resource. The project SMARTCROPS 5.1 aims to adapt crops to climate change including efficiency in the consumption of resources and their optimization thanks to digitalization; reducing the water footprint through smart irrigation; a reduction in the use of phytosanitary products, which will lead to a reduction in pollution; the use of Big Data / AI / Cloud / Edge Computing. The objective is to develop Digital twins that serve as a platform to generate models of fertigation, and study the behavior of the crops under different conditions. The Digital twin tool generated will help us to optimize the Double Wave Model of fertigation to improve efficiency and reduce water use.

Conclusion

While in the recent past the use of water in agriculture for irrigation was not properly managed, the desertification and lack of this pivotal resource has pushed to optimize the irrigation conditions and the development of technology surrounding it. The preliminary results allow us to be optimistic and highlight the necessity of still improving. Bodegas Familiares Matarromera are in the forefront of the use of agro-technology innovation and contribute to further develop new protocols and fertigation strategies against water stress in woody crops from the heart of the northern Inner Subplateau at Meseta Central of the Iberian Peninsula according to the Sustainable Matarromera on Planet Earth Plan.

Acknowledgment

We would like to thanks to Smartcrops 5.1 Consortium co-funded UE and by CDTi Innovation through FEDER funds. Additionally, we would like to express our thanks to the Ministry of Science and Innovation for their invaluable support.

References

1. Serrano SMV, Burguera MT, Begueria S, Reig F, Latorre B, et al. (2017) A high resolution dataset of drought indices for Spain. *Data* 2(3): 22.
2. EA (2017) Climate change, impacts and vulnerability in Europe 2016: An indicator-based report. European Environmental Agency, Copenhagen.
3. Vicente SM, Moreno JIL, Drumond A, Gimeno L (2011). Effects of warming processes on droughts and water resources in the NW Iberian-Peninsula (1930–2006). *Climate Research* 48(2-3): 203-212.
4. Ramírez JLC (2021) Experiencias realizadas en Logroño para obtener las necesidades de riego a partir de imágenes satélite y medidores de humedad. *PARJAR*, p. 16-23.
5. Villanueva S, Baeza P, Pedrosa R, Moro C, Lisarrague JR (2022) Efecto de diferentes estrategias de riego deficitario en cv. Verdejo, como medidas de adaptación al cambio climático: respuesta morfológica, fisiológica y cualitativa del . *Sociedad Española de Ciencias hortícolas*, pp. 509-5014.



This work is licensed under Creative Commons Attribution 4.0 License
DOI: [10.19080/ARTOAJ.2023.28.556365](https://doi.org/10.19080/ARTOAJ.2023.28.556365)

Your next submission with Juniper Publishers will reach you the below assets

- Quality Editorial service
- Swift Peer Review
- Reprints availability
- E-prints Service
- Manuscript Podcast for convenient understanding
- Global attainment for your research
- Manuscript accessibility in different formats
(Pdf, E-pub, Full Text, Audio)
- Unceasing customer service

Track the below URL for one-step submission
<https://juniperpublishers.com/online-submission.php>