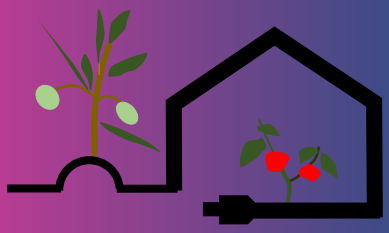
Horchimodel 2023

International Symposium on Models for Plant Growth, Environments, Farm Management in Orchards and Protected Cultivation

PROGRAM



26-28 JUNE 2023
UNIVERSIDAD DE ALMERÍA
ALMERIA-SPAIN

Plant modelling for the adaptation of smart horticulture to climate change

UNIVERSIDAD DE ALMERÍA

Instituto Andaluz de Investigación y Formación Agraria, Pesquera, Alimentaria y de la Producción Ecológica
Consejería de Agricultura, Pesca, Agua y Desarrollo Rural

ISHS
International Society for Horticultural Science

Welcome to Almería, Spain, for the International Symposium on Models for Plant Growth, Environments, Farm Management in Orchards and Protected Cultivation (Horchimodel 2023)

Spanish scientists welcome you to Horchimodel 2023, a great event to promote horticultural sciences and innovation worldwide around crop modelling.

Spain, a horticultural country

Spain is the leading producer of fruit and vegetables in the European Union, with a volume of more than 23 million tons.

Spain has fast become one of the most desired tourist destinations on the planet, being the second most visited country in the world, recording more than 82 million tourists.

Producer of fruit and vegetables in Europe

Tourist destination in the World

Almería, the province of protected crops

Almería is a modern city located in the historical Andalusian region of Spain. It has a long tradition in agriculture, starting during the transition from the Neolithic to the Bronze Age (4000-1800 b.C.) with the development of Los Millares complex, an archaeological site located 20 km northwest of Almeria. Today, the 32,000 ha of plastic greenhouses provide 3.7 million tonnes of fruits and vegetable along the year, allowing Almería to be the first horticultural production area in Spain with more than 100,000 jobs.

Institutions supporting the symposium

University of Almería (UAL) - https://www.ual.es/

Andalusian Institute of Agricultural, Fisheries, Food and Organic Production Research and Training (IFAPA) - https://www.juntadeandalucia.es/agriculturaypesca/ifapa/web/

International Society for Horticultural Science (ISHS) - https://www.ishs.org/

Chairs of the ISHS Divisions

Dr. Evelyne Costes - Physiology and Plant-Environment Interactions of Horticultural Crops in Field Systems.

Dr. In-Bok Lee - Precision Horticulture and Engineering.

Prof. Youssef Rouphael - Protected Cultivation and Soilless Culture.

Chairs of the ISHS Working Groups

Dr. Nadia Bertin - Modelling in Fruit Research and Orchard Management.

Dr. Luo Weihong - Modelling Plant Growth, Environmental Control, Greenhouse Environment.

Conveners

Prf. Dr. Francisco Domingo Molina Aiz – University of Almería - *ISHS Member of Division Precision Horticulture and Engineering and Workgroup Modelling Plant Growth, Environmental Control, Greenhouse Environment.*
fmolina@ual.es

Dr. Lorenzo León Moreno - IFAPA-Córdoba - *ISHS Member of Division Physiology and Plant-Environment Interactions of Horticultural Crops in Field Systems and Workgroup Modelling in Fruit Research and Orchard Management.*
lorenzo.leon@juntadeandalucia.es

Local Organizing Committee

Prf. Dr. Diego Luis Valera Martínez - University of Almería. Director of the Research Group AGR-198 "*Rural Engineering*" of the University of Almería - *ISHS Member of Division Precision Horticulture and Engineering.*
dvalera@ual.es

Prf. Dr. Alejandro López Martínez – University of Almería. Director of the Research Management Secretariat of the University of Almería.
alm212@ual.es

Prf. Dr. María Luisa Gallardo Pino – University of Almería - *ISHS Member of - ISHS Member of Division Physiology and Plant-Environment Interactions of Horticultural Crops in Field Systems and Workgroup Modelling Plant Growth, Environmental Control, Greenhouse Environment and Workgroup Modelling in Fruit Research and Orchard Management.*
mgallard@ual.es

Prf. Dr. Virginia Pinillos Villatoro – University of Almería. *ISHS Member of - ISHS Member of Division Physiology and Plant-Environment Interactions of Horticultural Crops in Field Systems.*
vpinillo@ual.es

Dr. Mirelle Nathalie Honoré – University of Almería. *ISHS Member of - ISHS Member of Division Physiology and Plant-Environment Interactions of Horticultural Crops in Field Systems and Workgroup Modelling Plant Growth, Environmental Control, Greenhouse Environment and Workgroup Modelling in Fruit Research and Orchard Management.*
mh052@inlumine.ual.es

Dr. Salvador Parra Gómez - Territorial Delegation Agriculture, Livestock and Fisheries Almería – Spanish Government.
salvador.parra@juntadeandalucia.es

Dr. Evangelina Medrano Cortés – IFAPA La Mojonera - *ISHS Member of Workgroup Modelling Plant Growth, Environmental Control, Greenhouse Environment.*
evangelina.medrano@juntadeandalucia.es

Plant modelling for the adaptation of smart horticulture to climate change

Spirit of Horchimodel 2023

The HorchiModel 2023 symposium will be held in Almería (Spain) from June 26th to 28th 2023.

The symposium incorporates under the aegis of two ISHS Working Groups "*Modelling in Fruit Research and Orchard Management*" and "*Modelling Plant Growth, Environmental Control, Greenhouse Environment*", respectively:

- *XI International Symposium on Modelling in Fruit Research and Orchard Management*.

- *VI International Symposium on Models for Plant Growth, Environment Control and Farming Management in Protected Cultivation (HortiModel)*

This event will be an opportunity to bring together in the same space and time specialists in the modelling of fruit and vegetable production systems both orchards and greenhouses and to present their research innovations, to share ideas and knowledge and discuss state-of-the-art and future perspectives for the modelling.

Crop models can provide integrated understanding and cross-talk between physiological processes at multiple plant scales, optimizing trait combinations for selecting innovative genotypes, simulate complex greenhouses and orchard designs, anticipating the consequences of environmental fluctuations, soil water restriction or pest attack, for system control and management limiting spread of insects or pathogens.

Plant modelling can help achieve sustainable agriculture by optimizing the use of inputs such as water, nutrients, energy or phytosanitary products. Models also can improve the economic performance of farms by predicting yields, fruit quality or the start of the harvest.

Crop modelling has the potential to enable society to assess the efficacy of manipulating genotype and agronomic management technologies to mitigate and adapt crop production systems to climate change.

Topics

• **Topic 1:** Decision support modelling tools for sustainable horticulture.
- Water, nutrient and energy management.
- Climate control systems.
- Computational Fluid Dynamic (CFD) models.
- Plant status and stress response.
- Plants and sensors.
- Digital twins.

• **Topic 2**: Methodological issues for plant systems modelling.
- Data acquisition and model calibration.
- Multi-scale, integrative approaches.
- Model selection and evaluation.
- Model reduction and simplification strategies.
- Model combination and scale integration.

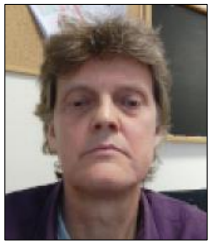
• **Topic 3**: Modelling plant and organ development and physiology.
- Plant/organ growth and development.
- Carbon partitioning.
- Fruit quality.
- Biotic stress control.

• **Topic 4:** Modelling plant architecture.
- Plants 3D reconstruction.
- Plants architecture and production.
- Functional–structural plant modelling.
- Light interception.

• **Topic 5:** Modelling plant adaptation to climate change.
- Crop and climate.
- Plant defence and disease control.
- Phenology.
- Life Cycle Assessment (LCA).

Keynote Speakers

• **Hicham Fatnassi:** "Considering plant activity in greenhouse climate models using Computational Fluid Dynamics: What has been accomplished and what remains to be done."
International Center for Biosaline Agriculture, Dubai - United Arab Emirates.
https://www.biosaline.org/staff/dr-hicham-fatnassi



• **Gerhard Buck-Sorlin:** "Crop Modelling in and for Horticulture: Paradigms, Methods, Workflows and Scales."
Teams ImHorPhen & STRAGENE. Institut Agro, Université d'Angers, INRAE, IRHS, SFR QuaSaV – Angers – France.
https://www6.angers-nantes.inrae.fr/irhs_eng/Contacts-and-Location/Staff-directory/Buck-Sorlin

• **Leo Marcelis:** "Modelling plant and organ development and physiology."
Horticulture and Product Physiology. Wageningen University & Research, Wageningen – Netherlands.
https://www.wur.nl/en/Persons/Leo-prof.dr.ir.-LFM-Leo-Marcelis.htm

• **Katrin Kahlen:** "Modelling plant architecture in vineyards and greenhouses."
Department of Modeling & Systems Analysis. Hochschule Geisenheim University, Geisenheim – Germany.
https://www.hs-geisenheim.de/en/persons/person/170/

• **Ixchel Hernandez Ochoa:** "Exploring climate change impacts and adaptation strategies in crop production by using dynamic crop simulation models: possibilities and limitations."
INRES Crop Science. Universität Bonn, Bonn – Germany.
https://www.lap.uni-bonn.de/en/staff/websites/ixchel-hernandez-ochoa

Scientific Committee

Leo **Marcelis**
Wageningen University & Research (The Netherlands)

Rodney **Thompson**
University of Almería (Spain)

Cecilia **Stanghellini**
Wageningen University & Research (The Netherlands)

Danfeng **Huang**
Shanghai Jiao Tong University (China)

Hicham **Fatnassi**
International Center for Biosaline Agriculture, Dubai (United Arab Emirates)

Oliver **Körner**
Leibniz-Institute of Vegetable and Ornamental Crops (Germany)

Frédéric **Boudon**
Institut Agro, Montpellier (France)

Esteban José **Baeza**
Future Farms Solutions, Almería (Spain)

Silke **Hemming**
Wageningen University & Research (The Netherlands)

Katrin **Kahlen**
Hochschule Geisenheim University (Germany)

Nikolaos **Katsoulas**
University of Thessaly (Greece)

Anne **Elings**
Wageningen University & Research (The Netherlands)

Valentina **Baldazzi**
Université Côte d'Azur (France)

María Victoria **González-Dugo**
Instituto de Agricultura Sostenible (Spain)

Gerhard **Buck-Sorlin**
Institut Agro - Agrocampus Ouest (France)

Luis **Gonzaga Santesteban**
Universidad Pública de Navarra (Spain)

Zhanwu **Dai**
Institute of Botany - Chinese Academy of Sciences (China)

Luigi **Manfrini**
Alma Mater Studiorum Università di Bologna (Italy)

Véronique **Letort - Le Chevalier**
Centrale Supélec MICS, Paris-Saclay (France)

Liqi **Han**
University of Queensland (Australia)

Ixchel **Hernandez Ochoa**
INRES Crop Science, Universität Bonn, Bonn (Germany)

Melba Ruth **Salazar-Gutiérrez**
Horticulture, Auburn University, Auburn (USA)

Theodore **DeJong**
University of California, Davis (USA)

Eike **Luedeling**
INRES Crop Science, Universität Bonn, Bonn (Germany)

Luca **Incrocci**
Università di Pisa, Pisa (Italy)

Ashraf **Tubeileh**
California Polytechnic State University, San Luis Obispo (USA)

SYMPOSIUM SCHEDULE

Time	Monday 26	Tuesday 27	Wednesday 28
8:30-9:00	D Welcome	D Welcome	
9:00-9:30	A ***Opening Ceremony*** Introduction by organizers and welcome	A **Topic 3 - Modelling plant and organ development and physiology** *Keynote speaker:* Leo Marcelis	D Welcome
9:30-10:00	A **Topic 1 - Decision support modelling tools for sustainable horticulture** *Keynote speaker:* Hicham Fatnassi	A ***Oral presentations Topic 3 - Session 1*** 4 Oral presentations of 15 min (12 min+3 min of questions)	A **Topic 5 - Modelling plant adaptation to Climate change** *Keynote speaker:* Ixchel Hernandez Ochoa
10:00-10:30	A ***Oral presentations Topic 1 - Session 1*** 2 Oral presentations of 15 min (12 min+3 min of questions)		A ***Oral presentations Topic 5 - Session 1*** 2 Oral presentations of 15 min (12 min+3 min of questions)
10:30-11:00	D **Coffee Break**	D **Coffee Break**	D **Coffee Break**
11:00-11:30	A ***Oral presentations Topic 1 - Session 2*** 6 Oral presentations of 15 min (12 min+3 min of questions)	A ***Oral presentations Topic 3 - Session 2*** 6 Oral presentations of 15 min (12 min+3 min of questions) / C ***Oral presentations Topic 1 - Session 3*** 6 Oral presentations of 15 min (12 min+3 min of questions)	A ***Oral presentations Topic 5 - Session 2*** 6 Oral presentations of 15 min (12 min+3 min of questions) / C ***Oral presentations Topic 1 - Session 5*** 6 Oral presentations of 15 min (12 min+3 min of questions)
11:30-12:00			
12:00-12:30			
12:30-13:00	B ***Poster presentations – Session 1***	B ***Poster presentations – Session 3***	B ***Poster presentations – Session 4***
13:00-13:30			
13:30-14:00	E **Lunch**	E **Lunch**	E **Lunch**
14:00-14:30			
14:30-15:00			
15:00-15:30	A **Topic 2 - Methodological issues for plant systems modelling** *Keynote speaker:* Gerhard Buck-Sorlin	A **Topic 4 - Modelling plant architecture** *Keynote speaker:* Katrin Kahlen	A ***Farewell Speech*** Closing remarks by the Organizing Committee
15:30-16:00	A ***Oral presentations Topic 2 - Session 1*** 4 Oral presentations of 15 min (12 min+3 min of questions)	A ***Oral presentations Topic 4 - Session 1*** 4 Oral presentations of 15 min (12 min+3 min of questions)	***Technical Tour*** - *Visit to the Experimental Farm UAL-ANECOOP* (https://www.fundacionualanecoop.com/en/) - *Visit to the olive orchards of the Oro del Desierto Company* (https://orodeldesierto.com/en/)
16:00-16:30			
16:30-17:00	D **Coffee Break**	D **Coffee Break**	
17:00-17:30	A ***Oral presentations Topic 2 - Session 2*** 4 Oral presentations of 15 min (12 min+3 min of questions)	A ***Oral presentations Topic 4 - Session 2*** 4 Oral presentations of 15 min (12 min+3 min of questions) / C ***Oral presentations Topic 1 - Session 4*** 4 Oral presentations of 15 min (12 min+3 min of questions)	
17:30-18:00			
18:00-18:30	B ***Poster presentations – Session 2***	A ***ISHS Business Meeting*** - Divisions Precision Horticulture and Engineering. - Division Physiology and Plant-Environment Interactions of Horticultural Crops in Field Systems.	
18:30-19:00			
19:00-19:30	F Practical demonstrations of modelling software and mobile applications		
20:00-20:30	Light snack and drinks in "*La Guajira*"	**Guided visit to the Almería "*Alcazaba*" fortified complex**	
20:30-21:00			
21:00-21:30	**Assistance to Flamenco show in "*La Guajira*"**	Walk from the "*Alcazaba*" to the Nautic Port of Almería	
21:30-22:00			
22:00-22:30		**Gala Dinner in "*Catamaran*" Restaurant in the Almería Nautic Port**	
22:30-23:00			

A **Auditorium** — D **Hall of *Aulario II***
B **Bioclimatic Room** — E **University Restaurant**
C **Conference Room** — F **Technical Classroom 1 & 2**

MAP OF THE UNIVERSITY OF ALMERIA

PROGRAM

MONDAY

26 JUNE

MONDAY 26 JUNE

9:00-9:30	***Opening Ceremony*** **-** Introduction by organizers and welcome	***Auditorium***
	Topic 1 - Decision support modelling tools for sustainable horticulture	***Auditorium***
9:30-10:00	***Keynote 1*** - Considering plant activity in greenhouse climate models using Computational Fluid Dynamics: What has been accomplished and what remains to be done.	*Keynote:* **Dr. Hicham Fatnassi** International Center for Biosaline Agriculture. Dubai (United Arab Emirates)

ORAL PRESENTATIONS		***Auditorium***
	Topic 1 - Session 1: Water, nutrient and energy management Chair: **Rodney Thompson** - Department of Agronomy - University of Almería, Almería (Spain).	
10:00-10:15	**OS1.1** - Adaptation of VegSyst-DSS as a recommendation system for nutrient solution composition in greenhouse fertigated, soil-grown vegetable crops.	Prof. Dr. Marisa Gallardo Depart. Agronomy - University of Almería (Spain)
10:15-10:30	**OS1.2** - VegSyst-DSS Suite software to calculate the nutrient solution composition in greenhouse soil-grown vegetable crops.	Dr. María López Martín Depart. Agronomy - University of Almería (Spain)
	Topic 1 - Session 2: Water, nutrient and energy management Chair: **Rodney Thompson** - Department of Agronomy - University of Almería, Almería (Spain).	
11:00-11:15	**OS1.3** - PRECIMED: a simulation model for nutrient uptake prediction of a hydroponic tomato crop grown in the Mediterranean region.	Prof. Dr. Nikolaos Katsoulas University of Thessaly, Volos (Greece)
11:15-11:30	**OS1.4** - Parameterization of the AquaCrop model for full drip-irrigated young almond trees.	Dr. Francisco Montoya ITAP and FUNDESCAM, Albacete (Spain)
11:30-11:45	**OS1.5** - A stem water potential model to manage irrigation of apple trees.	Dr. Luis González Nieto Cornell University, Geneva (USA)
11:45-12:00	**OS1.6** - Modelling plant growth and nitrogen uptake for optimal nitrogen fertilization of rocket.	Dr. Daniele Massa Council for Agricultural Research and Economics, Pontecagnano Faiano (Italy)
12:00-12:15	**OS1.7** - Assessment of transpiration in different almond production systems with two-source energy balance models using high-resolution aerial imagery.	Mr. Manuel Quintanilla IRTA, Lleida (Spain)

POSTER PRESENTATIONS		
	Poster presentations – Session 1	***Bioclimatic Room***
12:30-13:30	***Topic 1 - Decision support modelling tools for sustainable horticulture*** - Water, nutrient and energy management	
PS1.1	The effect of different phosphorus and irrigation levels on the development and early growth of ginger (*Zingiber officinale* Rosc.) root cuttings	Dr. Khayelihle Ncama North-West University Mafikeng Campus, Mmabatho (South Africa)
PS1.2	The effect of rooting enhancers and growth media on the development and early growth of pomegranate (*Punica granatum* L. cv Wonderful) cuttings.	
PS1.3	Evaluation of different irrigation frequencies in vines with the SIMDUALKC model.	Dr. Carlos Campillo Torres CICYTEX. Area de Agronomía de Cultivos leñosos y horticolas, Finca la Orden - Valdesequera Guadajira (Spain)
PS1.4	Life4Doñana: Development of on-demand decision suport system for irrigation and fertiliser management to improve the efficiency of strawberry crops in the Doñana national park area.	
PS1.5	Evaluation of automated irrigation system "Irri_Desk" for vines to improve water use efficiency and profitability.	
PS1.6	A simplified model for the determination of olive tree irrigation requirements.	Prof. Dr. Angelos Patakas University of Patras, Agrinio (Greece)
PS1.7	The influence of changes in the physical and chemical properties of the soil on the long-term wine harvest.	Assist. Prof. Valerica Tudor UASVM of Bucharest (Romania)
PS1.8	Water and nutrients use efficiency in aquaponics: effects of biostimulant application.	Prof. Dr. Nikolaos Katsoulas University of Thessaly, Volos (Greece)
PS1.9	Effect of pyroligneous acid on greenhouse romaine lettuce fresh and dry weights.	Dr. Ashraf Tubeileh California Polytechnic State University, San Luis Obispo (USA)
PS1.10	Comparison of measured transpiration with transpiration estimated with mathematical models based on climate data.	Prof. Dr. Diego Luis Valera CIAIMBITAL, University of Almería (Spain)
PS1.11	Modelling leaf area index and water requirements as a function of water salinity in a cherry tomato crop grown soilless.	Dr. Daniele Massa CARE, Pontecagnano Faiano (Italy)
PS1.12	Adaptation of the VegSyst model to outdoor conditions for sweet pepper.	Mr. José María Vadillo CICYTEX, Guadajira (Spain)
PS1.13	Calculation of nutrient uptake rate of strawberry grown under aquaponics in a plant factory.	Dr. Seo-A Yoon Korea National Open University, Seoul (Republic of Korea)

Topic 2 - Methodologies for plant systems modelling		*Auditorium*
15:00-15:30	***Keynote 2*** - Crop Modelling in and for Horticulture: Paradigms, Methods, Workflows and Scales.	*Keynote:* **Prof. Dr. Gerhard Buck-Sorlin** Teams ImHorPhen & STRAGENE - IRHS Agrocampus Ouest. Angers (France).

ORAL PRESENTATIONS		*Auditorium*
Topic 2 - Session 1: - Data acquisition and model calibration - Multi-scale, integrative approaches - Model reduction and simplification strategies. Chair: **Frederic Boudon** - CIRAD, UMR AGAP Institut, Montpellier (France)		
15:30-15:45	**OS2.1** - Thirty years of fruit tree modeling: what was done and was it worth it?	Prof. Dr. Ted M. DeJong Department of Plant Sciences, UC Davis (USA)
15:45-16:00	**OS2.2** - Odace: A tool for evaluation and dialogue between stakeholders and researchers, to support the design of plant protection solutions.	Dr. Mohamed Memah INRAE, Avignon (France)
16:00-16:15	**OS2.3** - Crop weight estimation from climate sensing.	Sjoerd Boersma Groeneweg, Rhenen (Netherlands)
16:15-16:30	**OS2.4** - Plant performance in precision horticulture: visualizing optimal control strategy under stochastic uncertainty.	Simon van Mourik Wageningen University (Netherlands)
Topic 2 - Session 2: - Model selection and evaluation. - Model combination and scale integration. Chair: **Anne Elings** - Wageningen UR Greenhouse Horticulture, Wageningen (Netherlands)		
17:00-17:15	**OS2.5** - Comparison among four different simplified models for the estimation of tomato crop evapotranspiration in Mediterranean soilless greenhouses.	Dr. Luca Incrocci University of Pisa (Italy)
17:15-17:30	**OS2.6** - Validation of a simulation model of tomato photosynthetic activity in greenhouses.	Prof. Dr. Mª de los Ángeles Moreno Teruel Universidade de Évora (Portugal)
17:30-17:45	**OS2.7** - Process based greenhouse climate models: should we continue with a closed science culture?	David Katzin Wageningen Research, Greenhouse Horticulture and Flower Bulbs (Netherlands)
17:45-18:00	**OS2.8** - Combining yield dissection models with quantitative genetics: a case study in greenhouse-grown tomato in a Mediterranean climate.	Dr. Ep Heuvelink Horticulture and Product Physiology, Wageningen University Research (Netherlands)

POSTER PRESENTATIONS		
Poster presentations – Session 2		***Bioclimatic Room***
18:00-19:00	***Topic 2 - Methodological issues for plant systems modelling***	
PS2.1	Determination of parameters for a photosynthetic model in *Cannabis sativa* L. in greenhouse.	Dr. Juan José Martínez-Quesada Phytoplant Research, Parque Científico Tecnológico, Córdoba (Spain)
18:00-19:00	***Topic 1 - Decision support modelling tools for sustainable horticulture*** - Climate control systems	
PS1.14	Fan jet air circulators vs natural ventilation: a new approach for greenhouse microclimate management.	Ms. Silvia Locatelli Università di Padova (Italy)
PS1.15	Optimization of operation conditions for the adsorption of CO_2 in activated carbons.	Mr. Rubén López Pastor University of Almería (Spain)
PS1.16	Development of crop-local CO_2 enrichment to improve fuel use efficiency supported with an analysis of CO_2 environment using CFD model in protected cultivation of strawberries.	Dr. Kota Hidaka Kyushu Okinawa Agricultural Research Center, NARO, Fukuoka (Japan)
PS1.17	Optical and climatic evaluation of a cool film cover greenhouse in the coastal region of Ecuador.	María Teresa Lao Arenas University of Almería (Spain)
PS1.18	Modelling the interaction of white marble gravel mulch and the tomato plant energy balance inside a Mediterranean naturally ventilated greenhouse.	Prof. Dr. Francisco Domingo Molina Aiz CIAIMBITAL, University of Almería (Spain)
PS1.19	Correlation analysis between sap flow and climatic factors in the smart farm of United Arab Emirates by model equations using SAS software.	Ms. Jeong YoungAe Korea National Open University (Republic of Korea)
PS1.20	Comparison of single shading and sealed cooling greenhouse for productivity improvement of paprika.	Mr. Hyeong Seok Lee Horticultureal Research Institute, Naju-si, Jeollanam-do (Republic of Korea)

PRACTICAL DEMONSTRATIONS		*Technical Classroom 1 & 2*
19:00-19:30	***Practical demonstrations of modelling software and mobile applications.***	

PROGRAM

TUESDAY

27 JUNE

TUESDAY 27 JUNE

Topic 3 - Modelling plant and organ development and physiology		*Auditorium*
9:00-9:30	***Keynote 3*** - Modelling plant and organ development and physiology.	*Keynote speaker:* **Leo Marcelis** Group Horticulture and Product Physiology - Wageningen University & Research, Wageningen (Netherlands)

ORAL PRESENTATIONS		*Auditorium*
Topic 3 - Session 1: Fruit quality. Chair: **Ep Heuvelink** - Department of Plant Sciences - Wageningen University, Wageningen (The Netherlands).		
9:30-9:45	**OS3.1** - Modeling the plasticity of anthocyanin compositions in response to diverse environments in grapevine.	Prof. Dr. Zhanwu Dai Institute of Botany, CAS, Haidian, Beijing (China)
9:45-10:00	**OS3.2** - Modelling the division-expansion processes of tomato fruit cells with the population balance equation.	Dr. Leonardo Miele INRAe, Avignon (France)
10:00-10:15	**OS3.3** - Dynamic modeling for fruit size and yield estimation in kiwifruit cultivars under potential scenarios of temperature changes.	Assist. Prof. Catalina Pinto Universidad de O'Higgins, San Fernando (Chile)
Topic 3 - Session 2: - Plant/organ growth and development & Carbon partitioning. Chair: **Zhanwu Dai** - Laboratory of Grape Sciences and Enology - Chinese Academy of Sciences (China).		
11:00-11:15	**OS3.5** - Modelling leaf photosynthesis and stomatal conductance responses to drought and nitrogen stress combinations in lilium grown in Chinese solar greenhouses.	Dr. Ningyi Zhang Nanjing Agricultural University, Nanjing (China)
11:15-11:30	**OS3.6** - Process-based modeling of growth and development of cannabidiol-rich hemp (*Cannabis sativa* L.) cultivars grown in controlled environments.	Paul Daiber Köln (Germany)
11:30-11:45	**OS3.7** - Correlation between pollen carbohydrate content and viability in Italian hazelnut cultivars and a wild type: preliminary data and perspectives.	Dr. Claudio Brandoli University of Modena and Reggio Emilia (Italy)
11:45-12:00	**OS3.8** - Modelling soluble sugars and starch dynamics in vegetative plants.	Ana Cristina Zepeda Wageningen University & Research (Netherlands)
12:00-12:15	**OS3.9** - Modeling olive tree yields as a function of soil fertility and depth in rainfed Mediterranean environments.	Dr. Ashraf Tubeileh California Polytechnic State University San Luis Obispo (USA)
12:15-12:30	**OS3.10** - Machine learning based almond yield prediction from tree to orchard level.	Prof. Yufang Jin University of California, Davis (USA)

ORAL PRESENTATIONS		*Conference Room*
Topic 1 - Session 3: Climate control systems. Chair: **Esteban José Baeza Romero** - Future Farms Solutions, Almería (Spain).		
11:00-11:15	**OS1.9** - Computational Fluid Dynamics analysis of the effect of the interaction between the airflow of two naturally ventilated neighbouring greenhouses on plant transpiration and photosynthesis.	Dr. Mireille Nathalie Honoré CIAIMBITAL, University of Almería (Spain)
11:15-11:30	**OS1.10** - Optimised humidity control in indoor-farms guided by cultivar specific evapotranspiration models.	Tundra Ramírez Leibniz-Institute of Vegetable and Ornamental Crops (IGZ), Grossbeeren (Germany)
11:30-11:45	**OS1.11** - Modelling the energy transport through greenhouse screen materials.	Dr. Silke Hemming Business Unit Greenhouse Horticulture, Wageningen University & Research (Netherlands)
11:45-12:00	**OS1.12** - Learning from the physics around crop transpiration.	Feije De Zwart Business Unit Greenhouse Horticulture, Wageningen University & Research (Netherlands)
12:00-12:15	**OS1.13** - Development of strategies for model-based control of CO_2 supplement in greenhouse.	Ms. Suhyun Choi Korea National Open University Seoul (Republic of Korea)
12:15-12:30	**OS1.14** - Model equations for estimating carbon dioxide consumption for multi-leaf lettuce cultivar in a closed plant factory module.	Ms. Jeong YoungAe Korea National Open University (Republic of Korea)

POSTER PRESENTATIONS

Poster presentations – Session 3 — *Bioclimatic Room*

12:30-13:30 — ***Topic 3: Modelling plant and organ development and physiology***
- Fruit quality & - Plant/organ growth and development.

PS3.1	Modelling and optimization of different drying days and storage conditions of macadamia nuts for improved colour retention.	Ms. Noluthando Aruwajoye University of KwaZulu-Natal, Pietermaritzburg (South Africa)
PS3.2	Early prediction of strawberry fruit enlargement by pre-determination of maximum fruit volume correlated to pedicel width.	Mr. Shintaro Ono Kyushu University, Fukuoka (Japan)
PS3.3	A simple model of alternate bearing in olive trees.	Marina Jurado-Ortega Instituto de Agricultura Sostenible Córdoba (Spain)
PS3.4	Considering the function of photosynthate storage organ in crop growth model improves dynamic estimation of leaf growth in Chinese chive cultivation.	Assoc. Prof. Daisuke Yasutake Kyushu University, Fukuoka (Japan)
PS3.5	Leaf lettuce growth model based on estimation of photosynthetic rate per plant under community conditions.	Yuki Sago Yamaguchi University (Japan)
PS3.6	CO_2 uptake patterns of *Schlumbergera truncata* 'Pink Dew' phylloclades at greenhouse and growth chamber.	Assoc. Prof. Yoon Jin Kim Seoul Women's University Seoul (Republic of Korea)
PS3.7	Non-invasive 11C-imaging combined with hierarchical cluster analysis revealed the spatiotemporal variability in carbon partitioning to strawberry fruits depending on leaf position.	Yuta Miyoshi Takasakiryoshioyo Research Institute Takasaki (Japan)
PS3.8	Soil fumigation combined with copper to synergistically promote soil health and increase ginger yield.	Dr. Lirui Ren Haidian, Beijing (China)
PS3.9	The allelopathic effect of selected plant extracts on the germination of the underutilized fruit species, *Strychnos spinosa* Lam.	Dr. Nomali Z. Ngobese University of Johannesburg, Botany and Plant Biotechnology (South Africa)

TUESDAY 27 JUNE

Topic 4 - Modelling plant architecture		Auditorium
15:00-15:30	***Keynote 4*** - Modelling plant architecture in vineyards and greenhouses.	*Keynote speaker:* **Katrin Kahlen** Department of Modeling & Systems Analysis - Hochschule Geisenheim University. Geisenheim - (Germany)

ORAL PRESENTATIONS		Auditorium
Topic 4 - Session 1: - Plants 3D reconstruction - Plants architecture and production. Chair: **Luca Incrocci** - Dep. of Agriculture, Food and Environment, University of Pisa, Pisa (Italy)		
15:30-15:45	**OS4.1** - Using UAV LiDAR for comparing tree development of four olive cultivars under hedgerow planting system: irrigated vs rainfed conditions.	Dr. Lorenzo León IFAPA Centro "Alameda del Obispo", Córdoba (Spain)
15:45-16:00	**OS4.2** - Measuring, analyzing, and predicting interactions between plant canopy structure and water-use efficiency.	Dr. Brian Bailey University of California, Davis (USA)
16:00-16:15	**OS4.3** - Increasing Cannabis productivity by using plants proceeding from tissue culture.	Verónica Codesido Sampedro MIFCO Biosciences, Antequera (Spain)
Topic 4 - Session 2: - Functional–structural plant modelling. - Light interception. Chair: **Ashraf Tubeileh** - California Polytechnic State University, San Luis Obispo (USA)		
17:00-17:15	**OS4.5** - Toward a phenotyping pipeline of architectural and functional traits from multiple sensors on an apple tree collection.	Mr. Nathan Guillot INRAE UMR AGAP, Montpellier (France)
17:15-17:30	**OS4.6** - Estimating solar light accumulation using peak sunshine and photoperiod.	Dr. Paul Fisher Environmental Horticulture Dept., University of Florida, Gainesville (USA)
17:30-17:45	**OS4.7** - The effect of cultivation light intensity on postharvest quality of *Perilla frutescens*.	Ieva Gudzinskaite Lithuanian Research Centre for Agriculture and Forestry, Babtai (Lithuania)
17:45-18:00	**OS4.8** - Modeling plant light usage efficiency in Controlled Environment Agriculture (CEA).	Gediminas Kudirka Lithuanian Research Centre for Agriculture and Forestry, Babtai (Lithuania)

ORAL PRESENTATIONS		Conference Room
Topic 1 - Session 4: Water, nutrient and energy management Chair: **Nikolaos Katsoulas** - University of Thessaly, Volos (Greece)		
17:00-17:15	**OS1.15** - Predictive model of transpiration and ion concentration in recirculating nutrient solution for closed hydroponic vertical farming on greenhouse crop.	Assist. Prof. Manuel Felipe López Mora Universidad Autónoma de San Luis Potosí (Mexico)
17:15-17:30	**OS1.16** - Recalibration and validation of VegSyst model for soil-grown greenhouse tomato cultivated in Uruguay.	Dr. Cecilia Berrueta INIA Cno. Al Terrible, Salto (Uruguay)
17:30-17:45	**OS1.17** - Model-based control of salinity in closed-loop soilless crops and first results from its application in a tomato crop using the DSS NUTRISENSE.	Dr. Dimitrios Savvas Agricultural University of Athens, Laboratory of Vegetable Production, Athens (Greece)
17:45-18:00	**OS1.18** - Simulation model for watering consumption in tomato crop grown in a soilless system.	Dr. Álvaro Morelos-Moreno Universidad Autónoma Antonio Navarro, Saltillo, Coahuila, (Mexico)

BUSINESS MEETING		Auditorium
18:00-19:30	***ISHS Business Meeting*** - Division Precision Horticulture and Engineering. - Division Physiology and Plant-Environment Interactions of Horticultural Crops in Field Systems.	

PROGRAM

WEDNESDAY

28 JUNE

WEDNESDAY 28 JUNE

Topic 5 - Modelling plant adaptation to Climate Change		*Auditorium*
9:30-10:00	***Keynote 5*** - Exploring Climate Change impacts and adaptation strategies in crop production by using dynamic crop simulation models: possibilities and limitations.	*Keynote speaker:* **Ixchel Hernandez Ochoa** Institute of Crop Science and Resource Conservation (INRES) - Universität Bonn (Germany)

ORAL PRESENTATIONS		*Auditorium*
Topic 5 - Session 1: - Phenology. Chair: **Ted M. DeJong** - Department of Plant Sciences, UC Davis, Davis (United States of America)		
10:00-10:15	**OS5.1** - Toward the prediction of flowering date of apple trees from Unmanned Aerial Vehicle (UAV) imagery.	Dr. Frederic Boudon CIRAD, UMR AGAP Institut, Montpellier (France)
10:15-10:30	**OS5.2** - Modeling the flower and fruit phenology of strawberries.	Bernardo Chaves Cordoba Auburn University (USA)
Topic 5 - Session 2: - Phenology. - Plant defense and disease control. - Life Cycle Assessment (LCA). Chair: **Ted M. DeJong** - Department of Plant Sciences, UC Davis, Davis (United States of America)		
11:00-11:15	**OS5.3** - Flowering phenology of olive cultivars in two climates with contrasting winter temperatures (Subtropical and Mediterranean).	Dr. Lorenzo León IFAPA, Córdoba (Spain)
11:15-11:30	**OS5.4** - Modeling dormancy release and flower progression in peaches	Dr. Melba Salazar-Gutiérrez Auburn University (USA)
11:30-11:45	**OS5.5** - Phenology modelling of faba bean (*Vicia faba* L.) cv. Reina Mora inside a Mediterranean naturally ventilated solar greenhouse.	Prf. Dr. Francisco Domingo Molina Aiz CIAIMBITAL, University of Almería (Spain)
11:45-12:00	**OS5.6** - The carbon footprint of training system selection in apple production.	Mr. Lars Zimmermann University of Bonn (Germany)
12:00-12:15	**OS5.7** - Comparing canopy-level and weather-station sensor placement effects on anthracnose and botrytis disease model predictions, for precision timing of fungicide applications in strawberry production.	Prof. Dr. John Derek Lea-Cox Dept. of Plant Science and Landscape University of Maryland (USA)
12:15-12:30	**OS5.8** - Carbon and Nitrogen cycles carrying by microbials: a case study of organic aquaponics.	Assoc. Prof. Sayuri Teramoto Tottori University, Nara (Japan)

ORAL PRESENTATIONS		*Conference Room*
Topic 1 - Session 5: - Plant status and stress response - Plants and robotic. - Digital twins. - Decision Support Systems. Chair: **Silke Hemming** - Wageningen University & Research, Wageningen (Netherlands)		
11:00-11:15	**OS1.19** - Fossil free strawberry cultivation.	Dr. Anne Elings Wageningen UR Greenhouse Horticulture (Netherlands)
11:15-11:30	**OS1.20** - Decision support for selecting suitable frost protection methods for apricot orchards in Germany.	Ms. Christine Schmitz University of Bonn (Germany)
11:30-11:45	**OS1.21** - Robotic precision thinning in apple production - using optimization and Bayesian modeling to assess potentials of automation in horticulture.	Johannes Kopton Bonn University, INRES Horticultural Science, Bonn (Germany)
11:45-12:00	**OS1.22** - Reinforcement learning with attention to future outdoor climate uncertainties in autonomous greenhouse control.	Xiaohan Zhou Horticulture and Product Physiology Group, Wageningen (Netherlands)
12:00-12:15	**OS1.23** - Modeling of the harvesting process as a subsection of an information and controlling system for horticultural production.	Mr. Luis Müller Centre for Business Management in Horticulture, Hannover (Germany)
12:15-12:30	**OS1.24** - Towards optimization of tomato cultivation using a digital twin.	Katarina Smolenova Wageningen Plant Research (Netherlands)

POSTER PRESENTATIONS		
Poster presentations – Session 4		*Bioclimatic Room*
12:30-13:30	***Topic 4 - Modelling plant architecture*** - Plants architecture and production. - Light interception.	
PS4.1	Determination of specific leaf and plant growth parameters for developing a leaf area estimation model of cucumber.	Ms. Ha Rang Shin Kyungpook National University, Buk-gu, (Republic of Korea)
PS4.2	Chamomile flowers from different height of plants and their essential oil content and sesquiterpene composition.	Prof. Dr. Ivan Salamon University of Presov (Slovak Republic)
PS4.3	Estimation of solar irradiance from heliophany as a tool to use in the agricultural technification of the coastal region of Ecuador.	María Teresa Lao Arenas University of Almería (Spain)
PS4.4	Blue LED irradiation regulates ABA signaling and sugar translocation in grapes.	Prof. Dr. Satoru Kondo Chiba University (Japan)

POSTER PRESENTATIONS		
	Poster presentations – Session 4	***Bioclimatic Room***
12:30-13:30	***Topic 5 - Modelling plant adaptation to Climate change:*** Phenology.	
PS5.1	Ensemble-based prediction of first flowering days after transplanting in June-bearing strawberry cultivars using the primary temperature factors.	Ms. Tae Yeon Lee Kyungpook National University Daegu (Republic of Korea)
PS5.2	Use of the AgroNIT smart farming IoT platform to assess the impact of climate variability and change on peach phenology and evapotranspiration in northern Greece.	Mr. Ioannis Moutsinas University of Thessaly, Volos (Greece)
12:30-13:30	***Topic 1 - Decision support modelling tools for sustainable horticulture*** - Plant status and stress response. - Plants and sensors. - Digital twins. - Decission Support Systems.	
PS1.21	Exogenous phytohormones regulates the development and metabolism of different growth strategy crops.	Martynas Urbutis Lithuanian Research Centre for Agriculture and Forestry, Babtai (Lithuania)
PS1.22	Impact of NaCl-salinity on growth, yield and K+ uptake of tomato crops grown in a split-root system using Rb+ as tracer.	Dr. Ioannis LyKoskoufis Department of Agriculture, University of Peloponnese, Kalamata, (Greece)
PS1.23	An IoT service of temperature setpoints for tomato crop control in greenhouses.	Mr. Manuel Muñoz Rodríguez University of Almería (Spain)
PS1.24	A study on the development and accuracy verification of automatic growth measuring devices for horticultural crops.	Mr. Sooho Jung Horticultural Research Institute, Naju-si, Jeollanam-do (Republic of Korea)
PS1.25	Development of a digital twin of a Mediterranean naturally ventilated solar greenhouse – AGROTWIN.	Prof. Dr. Francisco Domingo Molina Aiz CIAIMBITAL, University of Almería (Spain)
PS1.26	Towards a decision support system for sustainable olive cultivation.	Dr. Alvaro Lopez Bernal Departamento de Agronomía, Universidad de Córdoba (Spain)

BUSINESS MEETING	***Auditorium***
15:00-16:00	***Farewell Speech*** Closing remarks by the Organizing Committee

TECHNICAL TOURS	
16:00-19:30	- Visit to the UAL-ANECOOP Experimental Farm of the University of Almería. - Visit to the olive orchard of the *Oro del Desierto* Company.

AUDITORIUM - *Oral presentations*

Activities

Time	Monday 26	Tuesday 27	Wednesday 28
9:00-9:30	***Opening Ceremony***	**Topic 3** - *Keynote speaker*	
9:30-10:00	**Topic 1** - *Keynote speaker*	***Oral presentations Topic 3 - Session 1***	**Topic 5** - *Keynote speaker*
10:00-10:30	***Oral presentations Topic 1 - Session 1***		***Oral presentations Topic 4 - Session 1***
11:00-12:30	***Oral presentations Topic 1 - Session 2***	***Oral presentations Topic 3 - Session 2***	***Oral presentations Topic 4 - Session 2***
15:00-15:30	**Topic 2** - *Keynote speaker*	**Topic 4** - *Keynote speaker*	***Farewell Speech***
15:30-16:30	***Oral presentations Topic 2 - Session 1***	***Oral presentations Topic 4 - Session 1***	
17:00-18:00	***Oral presentations Topic 2 - Session 2***	***Oral presentations Topic 4 - Session 2***	

CONFERENCE ROOM - *Oral presentations*

(*Edificio Ciencias Económicas y Empresariales*)

Activities

Time	Tuesday 27	Wednesday 28
11:00-12:30	*Oral presentations Topic 1 - Session 3*	*Oral presentations Topic 1 - Session 5*
17:00-18:00	*Oral presentations Topic 1 - Session 4*	

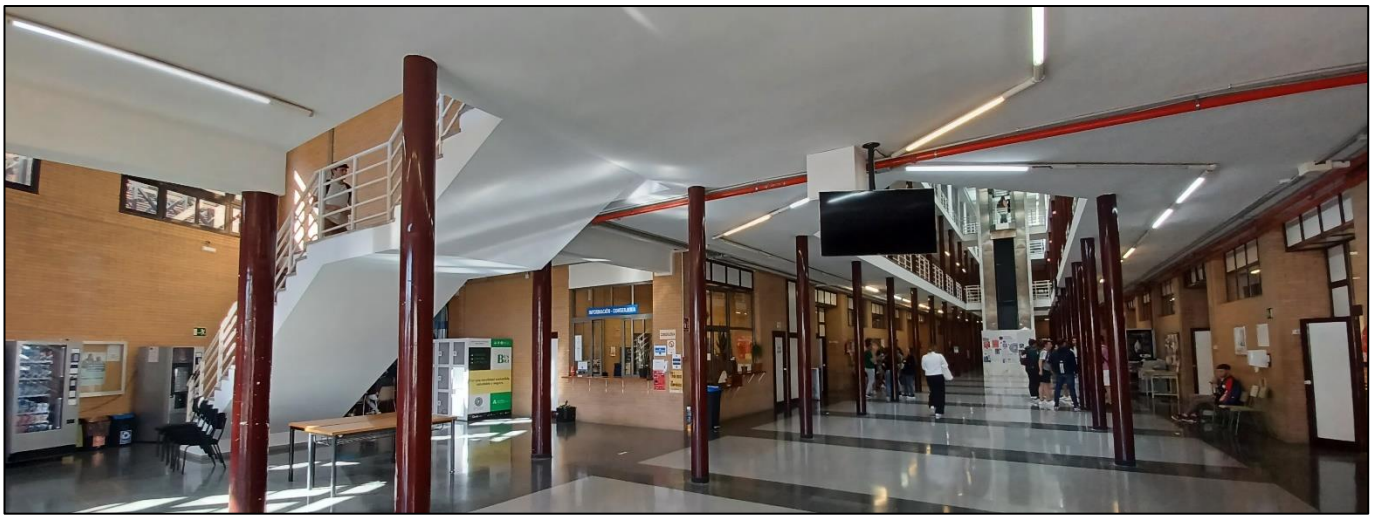
BIOCLIMATIC ROOM- *Poster presentations*

(*Edif. Departamental de Humanidades y Ciencias de la Educación 1*)

Activities

Time	Monday 26	Tuesday 27	Wednesday 28
12:00-13:00	***Poster presentations – Session 1***	***Poster presentations – Session 3***	***Poster presentations – Session 4***
17:30-18:30	***Poster presentations – Session 2***		
18:30-19:30	**Practical demonstrations**		

Hall of Aulario II - *Welcome – Coffee Break – Sponsor stands*

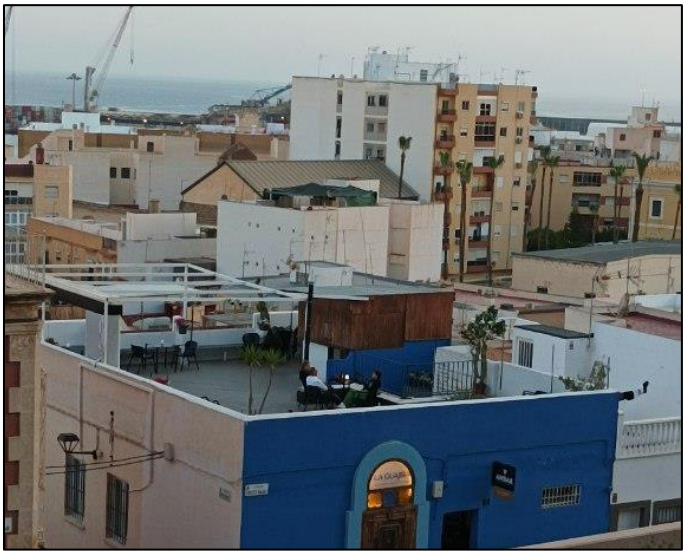


University Restaurant - *Lunchs*

FLAMENCO SHOW

On Monday, June 26 at 20:00 h, all Horchimodel2023 participants are invited to see a flamenco show for free and a previous cocktail at the socio-cultural association "***La Guajira***" located at the foot of the "Alcazaba" in the neighbourhood of La Almedina (Almería).

La Guajira
C/ Cruces Bajas, 1
04002 Almería



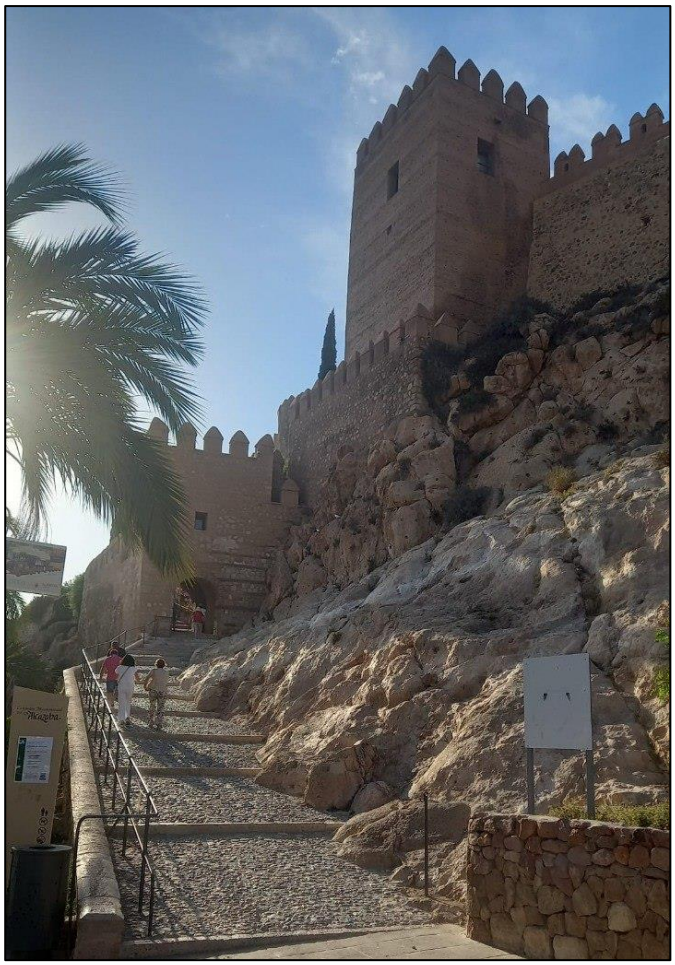
GUIDED VISIT TO THE ALMERÍA ALCAZABA

On Tuesday June 27 at 20:00 h, all *Horchimodel2023* participants are invited to visit the fortified complex of the Alcazaba of Almería.

The organization of the symposium will make available to all participants a bus service that will take us from the University of Almería to the Alcazaba.

The first line of walls is a wide enclosure corresponding to the first Muslim military camp, used as shelter for the population in case of siege. For this task it was provided with large cisterns.

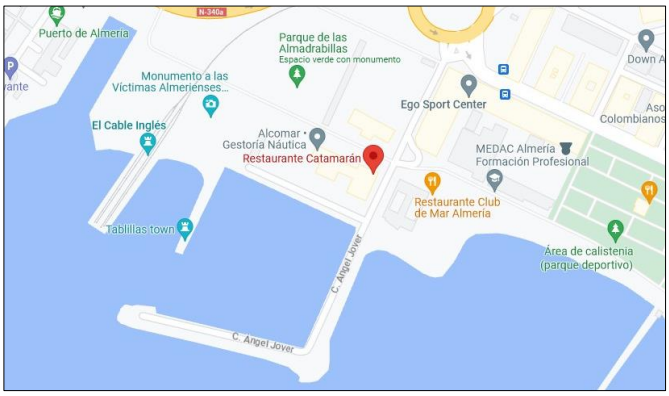
The first enclosure is separated by the second one by the so-called *Muro de la Vela* ("Wall of the Sail"), taking its name from a bell that warned the population in case of events such as the arrival of a ship in the port, danger, fires etc. This wall was built by King Charles III of Spain.



GALA DINNER

On Tuesday June 27 at 22:00 h, participants registered for the Gala Dinner will be able to attend a dinner at the "*Catamaran*" restaurant next to the Almería Marina. Dinner will include a live flamenco music accompaniment.

Restaurante Catamarán
Playa de las Almadravillas, s/n
04007 Almería



TECHNICAL TOUR

Oro del Desierto

(In Google Maps: Oro del desierto, N-340a, 04200 Tabernas, Almería)

Oro del Desierto is a family-owned and operated business placed in Tabernas (Almería). They combines the climate conditions, with more than 3000 sunshine hours/year and without extreme thermal changes and the extra care they take in the whole process: cold extraction within maximum eight hours after harvesting the fruit, the result is a 100% Organic Extra Virgin Olive Oil with all its delicate characteristics and nuances of flavour (https://orodeldesierto.com/en/empresa/).

Experimental Farm Foundation Experimental Ual-Anecoop

(In Google Maps: Fundación Finca Experimental Ual-Anecoop, Paraje Los Goterones s/n, Polígono, 24, parcela 281, 04131 Almería)

The UAL - ANECOOP Foundation was established on June 11, 2003 and started operating in 2004, to coordinate the research and experimentation activities, in a common project, of the second grade Agricultural Cooperative ANECOOP and the University of Almeria.

The UAL Experimental Farm - ANECOOP has a surface area of 11 hectares, of which 5 ha are occupied by greenhouses for experimentation and research. It also has two water ponds and three warehouses of 400, 360 and 100 m^2 that house the irrigation head, laboratories, refrigerated chambers, culture chambers, workshop y offices.