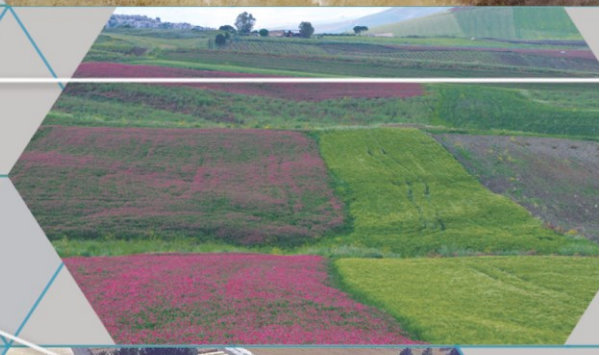
ISPAMED 2023

International Conference
Palermo 12 - 13 July 2023



International Conference

Innovations for Sustainable Crop Production in the Mediterranean Region

Palermo 12 - 13 July 2023

Book of abstract

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INTESA

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International conference Innovations for Sustainable Crop Production in the Mediterranean Region

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Foreword

Agriculture is an economic sector of the utmost importance, as it can meet the food needs of a growing world population and generate income. However, the application of high-input agricultural techniques in recent decades has led to a decline in soil fertility, an increase in desertification, excessive pressure on water resources, an increase in greenhouse gas emissions, unsustainable use of non-renewable energy resources and a loss of biodiversity. Agriculture thus contributes to climate change but is also itself vulnerable to its effects. Therefore, innovations in production methods are needed to increase the sustainability of agricultural production. The goal of the conference is to define the state of the art in terms of environmental impacts in agriculture and to promote possible innovations to increase the sustainability of agricultural products. The event will be focused on tree fruits, crops, protected horticulture and plant protection.

The programme is divided into five thematic sessions:

- Climate Change, Biodiversity and Mediterranean Production.
- Enhancement of Water Resources and Food Safety.
- Economic aspects, sustainable crop production and Consumption Models.
- Advances in plant diseases and arthropod pests management in a context of climatic change.
- Sustainable greenhouse production systems for vegetable crops.

In particular, the results of the INTESA project (Italy-Tunisia 2014-2020) “Innovation in technologies to support the sustainable development of agribusiness” will be presented in the 5th session.

The Scientific Committee is chaired by Prof. Tiziano Caruso, assisted by national and international scientists. Each session will be introduced by an invited keynote speaker.

We look forward to seeing you in Palermo!!

Tiziano Caruso
Chair of the Scientific Committee

Giuseppe Di Miceli
Chair of the Organizational Committee

Conference programme

Wednesday, 12 July 2023

8:30 Registration

9:30 Welcome, Opening and Addresses

Prof Tiziano Caruso, Scientific Committee Chairman
Prof Massimo Midiri, Rector University of Palermo
Dr Dario Cartabellotta, Director of Sicilian Regional Department of Agriculture
Dr Luca Sammartino, Vice President of Sicilian Regional Government

10:00 **SESSION 1** – *Climate Change, Biodiversity and Mediterranean Production*

Chair: **Prof Tiziano CARUSO**, Department of Agricultural, Food and Forest Sciences – University of Palermo, Italy

Keynote lecture

New fruit species adapted to a changing climate
Prof Florin STANICA, Faculty of Horticulture, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania

Invited speaker

Tomato cultivation in Sicily: from tradition to innovation
Dr Rosario Paolo MAURO, Department of Agriculture, Food and Environment, University of Catania, Italy

Algae-based biostimulant positively affects germination and seedling vigour in durum wheat under salt stress conditions
***Dr Angelo ROSSINI**, Department of Agricultural and Forest Sciences, University of Tuscia, Italy*

Agronomic response and leaf gas exchange of old Sicilian wheat populations
Dr Sebastiano Andrea CORINZIA, Department of Agriculture, Food and Environment, University of Catania, Italy

Bringing value to Albanian biodiversity: the case of MAPs challenges for the future.
Dr Alban IBRALIU, Department of Crop Production, Agricultural University of Tirana, Albania

Exploitation of durum wheat agrobiodiversity: yield performance and quality of the grain and flour of Sicilian landraces
Dr Silvia ZINGALE, Department of Agriculture, Food and Environment, University of Catania, Italy

13.00 Light lunch

14.30 **SESSION 2** – *Enhancement of water resources and food safety*

Chair: **Prof Maurizio BORIN**, Department of Agronomy, Food, Natural Resources, Animals and the Environment, University of Padova, Italy

Keynote lecture

Sustainable water resources management to enhance food security: innovation and strategies
Dr Federica CARUCCI, Department of Agricultural and Forest Sciences, University of Tuscia, Italy

Invited speaker

Treated wastewater irrigation of oregano crop in a Mediterranean environment: effects on growth, yield and essential oil compounds

Dr Mario LICATA, Department of Agricultural, Food and Forest Sciences, University of Palermo, Italy
Sustainable mitigation strategies to enhance tomato performance under nitrogen and water deficit: the role of silicon and plant breeding
Prof Susana CARVALHO, Faculty of Sciences, University of Porto, Vairão, Portugal
Low-cost systems for precise and sustainable orchard irrigation management: combining proximal and remote approaches
Dr Roberto MASSENTI, Department of Agricultural, Food and Forest Sciences, University of Palermo, Italy *and* **Dr Mariana MARTINES**, Graniot, Spain.
Identification of Putative Biomarkers Involved in Defense Response to Spilocea oleagina *in olive by using a RNAseq approach*
Dr Annalisa MARCHESE, Department of Agricultural, Food and Forest Sciences, University of Palermo, Italy
Farmers' perceptions and attitudes in using treated wastewater and desalinated water for irrigation: Yuck factor vs sustainability
Prof Sandra RICART, Department of Electronics, Information and Bioengineering – Politecnico di Milano, Italy

17.00 Short presentation
Chair: **Prof. Youssef ROUPHAEL**, Department of Agricultural Sciences, University of Napoli, Italy

Ecklonia maxima-derivate seaweed extract supply as mitigation strategy to alleviate drought stress in chicory plants
Dr Beppe Benedetto CONSENTINO, Department of Agricultural, Food and Forest Sciences, University of Palermo, Italy

Life Cycle Assessment of Tomatoes Cultivated in an Innovative Soilless System: A Case Study in Sicily, Italy
Dr Simona PRESTIGIACOMO, Department of Agricultural, Food and Forest Sciences, University of Palermo, Italy

Synergistic Effect of a Plant-Derived Protein Hydrolysate and Arbuscular Mycorrhizal Fungi on Eggplant Grown in Open Fields: A Two-Year Study
Dr Lorena VULTAGGIO, Department of Agricultural, Food and Forest Sciences, University of Palermo, Italy

Exploring factors affecting Medicago intertexta L. seed yield in the Mediterranean Environment: an evaluation
Dr Lucia DINOLFO, Department of Agricultural, Food and Forest Sciences, University of Palermo, Italy

Using native Mediterranean plants to mitigate anthropogenic impacts in urban areas
Dr Simona APRILE, Research Centre for Plant Protection and Certification, Italy

Preliminary studies on somatic embryogenesis from floral explants of Sulla coronaria L.
Dr Monica AUTERI, Department of Agricultural, Food and Forest Sciences, University of Palermo, Italy

Estimating leaf and plant water status with phylloclip, a new low-cost sensor to estimate leaf vapor condensation
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Vegetable protein hydrolysates and mycorrhizae inoculation to cope water stress effects on nursery potted Corylus avellana L. young plants

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Growing Genovese basil in a Mediterranean environment: influence of multiple pre-harvest factors on production and functional and sensory quality
Dr Michele CIRIELLO, Department of Agricultural Sciences, University of Naples Federico II, Portici, Italy

Wine to Power: production of synthetic methane exploiting the C02 produced during wine fermentation
Dr Mario RAGUSA, Istituto Regionale Vini e Oli di Sicilia – IRVO

20:30 **CONFERENCE DINNER**, "*Viridarium trecentesco*" del Complesso Monumentale dello Steri, Piazza Marina, 60, 90133 Palermo PA

Thursday, 13 July 2023

9:00 **SESSION 3** – *Sustainable Production and Consumption Models*
Chair: **Prof Pietro COLUMBA**, Department of Agricultural, Food and Forest Sciences, University of Palermo, Italy

Keynote lecture
Credence Goods and the Formulation of an African Commodities Sustainable Strategy
Prof Vincenzo PROVENZANO, *Dipartimento di Scienze Economiche, Aziendali e Statistiche*, University of Palermo

Invited speaker
Environmental sustainability and economic viability in Mediterranean agriculture
Prof Gioacchino PAPPALARDO, Department of Agriculture, Food and Environment, University of Catania, Italy.
Enzymatic activity like a crucial indicator of the soil health
Prof Geanina BIREESCU, Institute of Biological Research, Romania
Consumer preferences and attitudes toward Mediterranean production: Arancia Rossa di Sicilia PGI
Dr Carla ZARBÀ, Department of Agriculture, Food and Environment, University of Catania*, Italy*
Consumption patterns and supply of food markets in the Mediterranean
Prof Francesc FUSTÈ-FORNÈ, University of Girona, Spain.

11:30 **SESSION 4** – *Advances in plant diseases and arthropod pests management in a context of climate change*
Chair: **Prof Salvatore Walter DAVINO**, Department of Agricultural, Food and Forest Sciences, University of Palermo, Italy

Keynote lecture
Can global warming accelerate virus evolution and emergence of resistance-breaking isolates
Prof Luis RUBIO, Instituto Valenciano de Investigaciones Agrarias, Valencia, Spain

Invited speaker
Application of innovative techniques for the detection of plant pathogens
Dr Slavica MATIC, Institute for Sustainable Plant Protection, CNR, Italy

Tomato brown rugose fruit virus outbreak in Sicily: the evolution of its management after its first introduction in 2018
Dr Andrea G. CARUSO, Department of Agricultural, Food and Forest Sciences, University of Palermo, Italy
Effects of abiotic stresses and climate change on plant-fungi symbiosis
Dr Livio TORTA, Department of Agricultural, Food and Forest Sciences, University of Palermo, Italy
Climate change and insects in agroecosystems
Prof Gabriella LO VERDE, Department of Agricultural, Food and Forest Sciences, University of Palermo, Italy
14:00 Light Lunch

15:00 **SESSION 5** – *Sustainable horticultural crops for greenhouse production: presentation of INTESA project results*
Chair: **Prof Leo SABATINO,** Department of Agricultural, Food and Forest Sciences, University of Palermo, Italy

Keynote lecture
Redefinition of sustainable vegetable production through the exploration of cutting-edge cultivation management practices and DSS application
Prof Georgia NTATSI, Department of Crop Science, Agricultural University of Athens, Greece

Invited speaker
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Prof Zied DRISS, Ecole Nationale d'Ingénieurs de Sfax, Tunisia
Agriponic: a sustainable cultivation model for soilless tomato production
Dr Giovanni GUGLIUZZA, Research Centre for Plant Protection and Certification, Italy
Sustainable Approaches of Protected Vegetables Cultivation in Indian Arid and Semi-arid Regions
Dr Pradeep KUMAR, Central Arid Zone Research Institute of Jodhpur, India
Climatic change and development of new horticulture models in Tunisia
Dr Slim ZOUARÌ, Union tunisienne de l'agriculture et de la pêche, Tunisia

17.00 Short presentation
Chair: **Prof Riccardo LO BIANCO**, Department of Agricultural, Food and Forest Sciences, University of Palermo, Italy
Tuta absoluta potential vector of the emerging Tomato Brown Rugose Fruit Virus
Dr Roberto RIZZO, Research Centre for Plant Protection and Certification, Italy
Use of solar seawater distiller to provide clean water for irrigating tomato-cultivated greenhouses
Dr Ridha BOUDHIAF, Laboratory of Electro-Mechanic Systems (LASEM), National School of Engineers of Sfax, University of Sfax, Tunisia
Consumer preferences regarding beef consumption: an analysis in the Mediterranean area
Dr Federico MODICA, Department of Agricultural, Food and Forest Sciences, University of Palermo, Italy
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Dr María José LÓPEZ-SERRANO, Department of Economics, Business and Statistics, University of Palermo, Italy

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Dr Ana BATLLES-DELAFUENTE, Department of Economics and Business, University of Almería, Spain
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Manlio GRUTTADAURIA, Netafim Italia S.r.l.
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Dr Evgenia SARAKATSANI, Department of Agricultural, Food and Forest Sciences, University of Palermo, Italy
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Dr Giuseppe GRECO, Ente di Sviluppo Agricolo della Regione Siciliana
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Theme 1
Climate Change, Biodiversity and Mediterranean Production

New fruit species adapted to a changing climate

Stănică F.

Faculty of Horticulture University of Agronomic Sciences and Veterinary Medicine of Bucharest Romania florin.stanica@usamv.ro

Abstract

Recently, fruit production in Europe faces many challenges that we need to understand and find solutions for. Due to its position, the Mediterranean Region seams to be even more affected. Climate change, energy crises, war, market fluidity, competition, labour force scarcity, new pests and diseases, pollution, lost of biodiversity etc. are only few threats in front of agriculture production in general and fruit industry in special. The introduction of new fruit species can offer some competitive advantage for the daring farmers: production of fruits with high nutraceutical value, reduction of irrigation water use, no important pests and diseases, low cost crop maintenance, etc. Asimina (*Asimina triloba* Dunal.), sea buckthorn (*Hippophae rhamnoides* L.) and jujube (*Ziziphus jujuba* Mill.) are three new fruit species that could be taken in consideration to be tested and then, planted on large areas in the Mediterranean Region. Some information about the origin, cultivars, cultivation technology, fruit composition and uses are presented based on the Romanian experience.

Tomato cultivation in Sicily: from tradition to innovation

Mauro R. P.; Giordano M.; Cannata C.; Basile F.; Leonardi C.
Dipartimento di Agricoltura, Alimentazione e Ambiente (Di3A) – Università degli Studi di Catania, Via S. Sofia, 100 – 95123 Catania Italy

Abstract

Tomato cultivation for fresh consumption has been a significant part of Sicilian agriculture since the19th century. From its early days of cultivation to the present, tomato cultivation in Sicily has undergone an evolutionary process that is unparalleled among other vegetables, resulting in a unique agricultural configuration today. This evolution has unfolded along three main directions, which have involved (i) improvements in protective structures (mainly greenhouses), (ii) advancements in agronomic techniques, and (iii) innovation in product typologies and cultivars. The cumulative effects of these innovations have shaped a highly specialized sector with distinct strengths, weaknesses, and general traits compared to protected tomato cultivations in Central and Northern Europe. In the immediate future, the irreplaceable economic and social role played by tomato in Sicily must be supported by achieving specific objectives, including (i) enhancing the sensory and nutraceutical qualities of the local product, (ii) developing technical strategies for increased productivity, quality, and sustainability of the crop, and (iii) devising more suitable communication and marketing strategies for Sicilian products.

Algae-based biostimulant positively affects germination and seedling vigour in durum wheat under salt stress conditions

Rossini A.; Ruggeri R*.; Mzid N.; Rossini F.
*Department of Agriculture and Forest Sciences, University of Tuscia, Viterbo, Italy, *r.ruggeri@unitus.it*

Abstract

Soil salinization is a critical environmental problem in arid and semiarid regions of the world. It seriously hinders plant growth and, consequently, agricultural production. Maintaining crop yield in such unfavourable environments is a continuous challenge for the sustainable development of semiarid regions. The response to this abiotic stress varies not only among plant species and varieties, but also depending on the phenological stages, including germination and seedling establishment. One possible strategy to improve seed germination in saline soils is to prime the seeds with biostimulants. The aim of the present study was to evaluate the effect of an algae biostimulant on germination and seedling biomass in durum wheat (Triticum durum Desf.), under different saline conditions. The experiment was carried out combining different salinity and algae concentrations. Two saline water treatments (100 and 200 mM NaCl) were applied and compared with the untreated control. Seeds were sprayed with a solution containing a combination of 20% fungicides and different concentrations of macroalga Codium fragile (Suringar) Hariot (0%, 10%, 20%, and 30%). Subsequently, the seeds were placed in Petri dishes containing three filter papers soaked with different saline water treatment. Each treatment combination was applied to 100 seeds (experimental unit, one Petri dish) and replicated 4 times. All experimental units were placed in a germinator at 20 ± 1 °C. The effect of the algae on seed germination and seedling biomass under salinity stress was evaluated over a period of 8 days. Besides the determination of the germination curves, data were recorded for the following traits: median germination time (T50), root length, root number, epicotyl length, epicotyl biomass. Results from the present study revealed that the best performances, for the investigated traits, were obtained by additional application of the algae biostimulant under both control and salinity treatments. Epicotyl length and biomass as well as root length were found to be significantly and positively affected by the application of different biostimulant doses as compared to the control treatment (0% algae). As for germination traits, remarkable are the results obtained under the most severe saline condition (200 mM NaCl). Indeed, seeds treated with algae biostimulant showed a significantly higher final germination (from 83% to 87%) as compared to that observed in control treatment (61%). Regarding the germination speed, T50 values ranged from 1.6 days for control treatment (no salinity) with 10% of algae application to 4.6 days for 200 mM salinity treatment without additional application of algae. The findings indicate that the appropriate dose of biostimulant can markedly improve the germination and the seedlings vigour of durum wheat seeds under saline conditions.

Agronomic response and leaf gas exchange of old Sicilian wheat populations

Corinzia S. A.; Testa G.; Caruso P.; Cosentino S L*
*Department of Agriculture, Food and Environment (Di3A), University of Catania, via Valdisavoia 5, 95123 Catania, Italy. *cosentin@unict.it*

Abstract

Ancient Sicilian wheat populations, preserved by scientific institutions and by local farmers, despite their lower productivity if compared to modern varieties, possess relevant agronomic traits that lead to a higher level of tolerance or resistance to biotics (pathogens and weeds) and abiotic stresses. Some of these traits are the higher plant height, which increase the competitiveness against weeds, and the low susceptibility to drought, due to the extensive root system or to the low water consumption. The interest on these wheat population is also related to their appreciable technological features, sensory and nutraceutical properties such as high fiber content, antioxidants, vitamin and mineral. The aim of the present work was the agronomic comparison among ancient Sicilian populations of durum (Triticum durum) and bread wheat (T. aestivum) compared to two commercial varieties of durum and bread wheat, under irrigated and rainfed conditions. The field trial was carried out at the experimental farm of the University of Catania (37° 24' N., 15° 03' E., 10 m a.s.l.), in a representative area of Sicilian cereal farming, in a typical Xerofluvents soil with a preponderantly clayey texture. The experimental design was a split-plot design with three replicates. The irrigation was the experimental factor assigned to the main plots and had two levels: 100% of maximum crop evapotranspiration (ETm) restoration and rainfed. The sub-plot factor was the genotype, with seventeen categories: thirteen ancient Sicilian populations of durum wheat (“Bidì”, “Castiglione Glabro”, “Giustalisa”, “Margherito”, “Perciasacchi”, “Realforte”, “Ruscia”, “Russello – Priziusa”, “Russello Ibleo”, “Timilia”, “Tripolino” e “Urria”), one ancient Sicilian populations of bread wheat (“Maiorca”), one old variety of durum wheat (“Senatore Cappelli”), one commercial variety of durum wheat (“Mongibello”) and one commercial variety of soft wheat (“Bologna”). Irrigation was provided by a sprinkler irrigation system. Daily ETm was calculated according to: ETm = ET0 × Kc; where ET0 is reference evapotranspiration (mm) and Kc is the crop coefficient for wheat according to. Sowing was carried out on January 8, 2020 with a target sowing density of 400 plants m-2. The trial followed organic management. The fertilisation has been performed before sowing and just before stem elongation phase applying in total 80 kg ha-1 of N as organic fertiliser in pellet with 7% of N and 13% of P2O5. Harvesting was carried out on July 6, 2021. Physiological measurements have been carried out weekly from flowering until full ripening using the LCi-SD Portable Photosynthesis system (ADC BioScientific Ltd.), which measures net photosynthesis rate (µmol C02 m-2 s-1), transpiration rate (mmol H20 m-2 s-1) and stomatal conductance (mol H20 m-2 s-1) on the basis of C02 and H20 gas exchange. Instant water use efficiency (iWUE) has been calculated as the ratio of net photosynthesis and transpiration. Wheat responded to the different levels of water availability in the soil, showing a lower stomatal conductance in rainfed condition, as a consequence of the reduced water availability. The reduction of the stomatal conductance limited the transpiration and therefore the water consumption of the crop, but also led a reduction of the photosynthetic rate. Ancient wheat population showed similar or, in some cases, higher net photosynthesis rate and lower rate of transpiration, suggesting their suitability for Mediterranean drought-prone areas.

Bringing value to Albanian Biodiversity: the case of MAPs Challenges for the Future.

Ibraliu A.
Department of Agronomy Sciences, Faculty of Agriculture and Environment, Agricultural University of Tirana, Kodër Kamëz Tirana, Albania albanibraliu@ubt.edu.al

Abstract

Albania is located in Mediterranean region in the Balkan Peninsula: Climate conditions are characterized by costal subtropical towards inland continental climate. It is one of the European countries with richest flora identifies about 3629 plant species which count to about 30 % of Europeanflora, of those 30 are endemic and about 180 sub-endemic species and more than 400 species that are identified and used as medicinal and aromatic plants (MAPs). A number of which are recognised in the National Red Data Book as endemic species (40 species). MAPs are very important commodity and plays a significant role in Albania economy and many people consumes phyto- medicine, herbal teas, ethno-medical, cooking and flavours and in industrial use as raw drug or extracted essential oils. MAPs are a major agro-forestry business in Albania, especially in terms of international trade. They are the most important line item in Albania's export, which is generated domestically, currently estimated to account for 50 million Euro annually. The exports, mainly to the EU and US, have increased over the years, Germany is the most important importer of Albanian MAPs in EU. Some of these challenges are related to the cultivation and post-harvest technology and GAP practices and quality standards and traceability. Addressing these issues should be a priority for policy-makers and private sector actors, in order to improve the sector's competitiveness and sustainability.

Exploitation of durum wheat agrobiodiversity: yield performance and quality of the grain and flour of Sicilian landraces

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Abstract

Durum wheat is a key crop in the Mediterranean agroecosystems, being well suited to semiarid environments with limited and irregular rainfall and high temperatures. The leading role of Italy in durum wheat production is essentially attributable to the pasta sector, which has prompted the intense breeding activity carried out in this country since the beginning of the 20th century. In Sicily, a few tens of improved durum wheat varieties are currently cropped, but recently also an increasing number of landraces were rediscovered and exploited mainly in marginal growing conditions. Within this context, the present study aims at evaluating the main bio- agronomic and quality traits of forty-seven durum wheat genotypes, including forty-five landraces and two improved varieties. Such genotypes were grown during the 2013/2014 and 2014/2015 cropping seasons at the experimental farm of 'Stazione Consorziale Sperimentale di Granicoltura per la Sicilia' located in 'Santo Pietro' (Caltagirone, CT), adopting a randomized blocks design in with three replicates. Bio-agronomic traits and quality of the grain and wholemeal flour of the studied genotypes were assessed. The data were submitted to two-way ANOVA and the means were compared with the Tukey test ($p \leq 0,05$). Overall, the main effect of the genotype (G) was significant for all the traits, with wide variability among the genotypes, whereas the year (Y) factor and the Y x G interaction were not significant, probably due to the time course of weather conditions, which were similar during the two cropping seasons. The grain yield among the genotypes was equal to 2 t ha-1, on average, although some landraces, such as 'Vallelunga glabra', 'Farro lungo' and 'Russello 01' reached greater productive levels (>2.4 t ha-1, combined with increased thousand kernels weights (>57.3 g). Different landraces, including 'Bidì' and 'Russello 01' were identified, which contemporarily evidenced appreciable productive performances associated with suitable attitudes to bread or pasta-making processes. The results stressed the need for maintaining and exploring the available germplasm as a source of novel variability to improve the adaptability and grain quality of the crop, mainly in order to sustain the local and traditional durum wheat supply chains. In particular, the development of Evolutionary Populations (EP) by screening and inter-crossing the landraces having interesting traits was suggested as a way to contribute to the environmental, economic and social sustainability in internal marginal areas of Sicily.

Theme 2
Enhancement of water resources and food safety

Sustainable water resources management to enhance food security: innovation and strategies

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Abstract
The current state of the global food system is not sustainable, with nearly a third of the world's population experiencing moderate to severe food insecurity and 12% suffering from severe food insecurity [1]. The security of the food supply is threatened by climate change and non-climatic stressors. Indeed, climate change is causing a decrease in crop yields (e.g., maize and wheat) in many lower-latitude regions, leading to an increase in food prices by as much as 29% [2]. The Mediterranean Basin is among the most vulnerable areas to the impacts of climate change, as rising temperatures and decreasing rainfall are harming agricultural production [2]. On the other hand, the global population is expected to reach 9.7 billion by 2050, resulting in a 70% increase in food production to meet the growing demand [3]. This rapid population growth has also led to an increased demand for water supplies, with irrigation remaining the primary method for food production and the most prominent water use. Agriculture faces a significant challenge in implementing interventions to efficiently utilize water to increase productivity while minimizing environmental harm. A useful indicator for measuring the efficient utilisation of water in the agricultural sector is Water Use Efficiency (WUE), which represents the relationship between plant productivity and water usage [4]. Studies suggest that improving WUE in response to climate change can be accomplished through various methods, such as implementing efficient water management solutions. The use of modern irrigation technologies is an important possibility to achieve water savings and food security. Different solutions are available, including the application of deficit irrigation techniques, the use of irrigation decision support systems, the application of precision irrigation techniques, but also the use of unconventional water for irrigation. This improvement of irrigation techniques must include a process of transferring innovation on a farm scale. It is therefore essential that agronomic innovations become common agricultural practices.

Treated wastewater irrigation of oregano (Origanum vulgare spp. hirtum (Link) letswaart) crop in a Mediterranean environment: effects on growth, yield and essential oil compounds

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Abstract

In arid and semi-arid regions, irrigation with treated wastewater (TWW) provides benefits for crop in terms of water and nutrient supply [1]. Medicinal and aromatic plants can exploit the use of TWW during their growth stages and obtain an appreciable productivity [2]. The effect of TWW irrigation on essential oil (EO) can vary both in qualitative and quantitative characteristics [3]. The aims of this study were to assess the effect of TWW irrigation compared to freshwater (FW) on crop yield, EO yield and composition of oregano (Origanum vulgare spp. hirtum (Link) letswaart) and soil characteristics. Tests were carried out in Sicily (Italy) during the growing seasons 2016-2018. TWW was obtained from a pilot-scale constructed wetland system. An experimental field of oregano was set up close to the system. The experimental design was a split-plot design for a two factor-experiment. Urban TWW was used for the tests. Morphological and productive parameters of oregano plants were determined and EOs were isolated, analysed and the components were identified. The main soil characteristics were also determined. During two-year tests, TWW irrigation allowed to increase crop and EO yield but, despite the difference in water quality between the two sources of irrigation water, no significant variations were found in EO content and composition in the FW- and TWW-irrigated plants. Regarding soil, the two study factors did not produce relevant differences in all soil characteristics. Our results demonstrate that oregano is suitable as industrial crop for biomass and essential oil production under TWW irrigation, however the EO content and composition are not significantly affected in the short-term.

Sustainable mitigation strategies to enhance tomato performance under nitrogen and water deficit: the role of silicon and plant breeding

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Abstract

Despite nitrogen (N) and water (W) deficit being two of the most important factors limiting plant growth, only a few studies have addressed the interactions between both abiotic stresses, and new insights are required to improve their use efficiency [1]. Silicon (Si) has been reported as a beneficial metalloid for plants since it alleviates several stresses [2]. However, its role in mitigating the negative impact of N deficit alone, or when combined with W deficit, is not well studied. Plant breeding is a powerfull tool for inducing tolerance, but only few studies have analysed tomato phenotypic variability in response to these abiotic stresses. The main aim of the current study was to explore these two sustainable mitigation strategies that could help tomato plants to cope with N+W stresses. To that end two independent experiments were carried out. In Exp. 1, it was found that applying sodium silicate (2 mM) to the nutrient solution of tomato seedlings could only alleviate stress caused by the N+W deficit, resulting in a higher root dry weight (by 28%), total dry weight (by 23%), and root length (by 37%). Additionally, plants supplied with Si showed an increased antioxidant (AOX) enzymatic activity at root level (with APX and CAT being enhanced by 48% and by 263%, respectively), which might partly explain their better performance. In Exp. 2, a phenotypic evaluation and analysis of the growth traits of 40 tomato genotypes (mostly focusing on old cultivars) grown under combined N and water deficit was performed. This allowed to conclude that tomato plants have a considerably high variability in their response to the combined deficit, and that old accessions might represent a valuable gene pool for plant breeding when targeting tolerance to these combined abiotic stresses. Taken together, these findings also highlight that tomato grown under combined stresses employ specific response mechanisms that cannot be deduced from the responses obtained when both stressors are individually applied.

Low-cost systems for precise and sustainable orchard irrigation management: combining proximal and remote approaches

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Abstract
Climate change, especially in the Mediterranean basin, forces and encourages us to use proximal and remote sensors for continuous and non-destructive tree monitoring, in order to study their adaptive capacity and to determine a precise and sustainable orchard management. It is very important to recognize and develop the relations between water and tree in terms of canopy vigor, for this reason the combined use of remote and proximal sensors on plants could provide accurate and economical information of their water and nutritional status, photosynthetic efficiency, and evapotranspiration process. The main aim of our recent and future work is to investigate the use of innovative, non-destructive, and low-cost systems in horticulture, with particular attention to the combined use of proximal and remote sensing technology for more precise and sustainable management of orchards and assessment of their water and nutrient status. Among the most useful, reliable, and interesting sensors that allow monitoring of fruit tree water status, we have been testing sap flow meters to measure tree xylem sap flow and water consumption nondestructively and continuously; fruit gauges, low-cost sensors to monitor fruit diameter growth dynamics and their absolute and relative growth rates; and leaf patch clamp pressure probes used to noninvasively and continuously monitor leaf turgor pressure. The use of satellite imagery is one of the most cost- effective remote sensing methods. Satellite monitoring provides quick, reliable, and essential answers on plant development using vegetation indices such as NDVI, NDMI, NDRE, MSAVI and others, which can be useful for monitoring trees and their precise and sustainable irrigation and fertilization management. It is also possible to find problem areas in the field, identify crops and predict yields. The use of proximal sensing allows to obtain punctual information; in contrast, the addition of remote sensing technologies will be able to provide faster, less expensive and more comprehensive, large-scale responses. Through the combined use of the two approaches, the data obtained will cover large areas with time and cost savings. Our future challenges will be to integrate eco-physiological observations in combination with remote sensing measurements, to test innovative services and decision support systems to farmers for optimizing orchard management.

Identification of putative biomarkers involved in defence response to Spilocea oleagina in olive by using a RNAseq approach and possible application for early detection.

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Abstract
Appreciated for its fruits and oil, the evergreen long-lived olive tree (Olea europaea L.) is considered a rustic species quite resilient to both biotic and abiotic stresses. However, in favorable climatic conditions, it can be attacked by a variety of bacterial and fungal infections, which can result in considerable production losses. Spilocaea oleagina (Castagne) Hughes, formerly known as Venturia oleaginea (Castagne), is one of the fungal infections that affect olive trees, causing Peacock's eye or leaf spot infection feared in the Mediterranean countries, as it can lead to a serious yield loss. An important goal for the economy of the crop, especially in organic farms, is the sanitary defense of the olive grove since any damage to the plants reduces vegetative activity and may jeopardize the fruits, which has a negative impact on the final product's quality and the cost of production. In the present work, a comparative transcriptomic analysis (RNA-seq) was carried in leaf tissues, chosen at two different stages (T0 = healthy; T1 = infected), of a low susceptible cultivar Koroneiki and a high susceptible cultivar Nocellara del Belice, aiming to shed light on defense mechanism and to discover putative genes and biomarkers involved in low susceptibility. It was remarkable that in Koroneiki there were uniquely expressed genes involved in signaling, cell-wall remodeling and defense responses against Spilocea, as well as specific transcription factors (TS), while 'Nocellara del Belice' showed a very weak and non-specific system of defense, expressing genes that overlap with wounding responses, and revealed genes of susceptibility. Target genes and biomarkers for developing innovative techniques of early detection of the disease by using a portable instrument, the bCUBE, marketed by Hyris, Ltd. Preliminary results are promising. Furthermore, markers and resistance genes were discovered which can be useful for assisted screening and breeding resistant olive genotypes.

Farmers' perceptions and attitudes in using treated wastewater and desalinated water for irrigation: Yuck factor vs sustainability

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Abstract

Water scarcity and water pollution are both worldwide phenomena and two of humankind's most significant challenges today in a climate change scenario [1]. Alternative water resources (e.g., treated wastewater and desalinated water), are intended to close the gap between both challenges. Many regions worldwide are exploring how alternative water resources can be promoted to face emerging water scarcity, current and future water shortages, or growing pressure on global water resources [2]. Although water schemes are shaped by complex interrelationships between technological, economic, and socio-political factors, research has been prioritized on the technical aspects, while social concerns, such as end users' perceptions and predisposition to use, have not been assessed or considered seriously enough, even being disregarded. Interestingly, empirical research demonstrated that alternative water resources' main challenges to more effective water management are largely social rather than technical [3]. Agricultural systems, the most vulnerable economic sector to climate and natural conditions, are adversely influenced by water scarcity and pollution through increased water stress, change in run-off patterns, seasonality fluctuation, and temperature variations [4]. Farmers' attitudes regarding using treated wastewater and desalinated water as an adaptation measure highlighted benefits and constraints. For the treated wastewater, benefits include no seasonal supply affection, less over-exploitation or fertigation, while desalinated water is valued due to its consideration as an almost inexhaustible source. However, both alternative water resources must address key constraints: environmental and health risks in the first case, energy cost and electrical conductivity in the second [5]. Likewise, the yuck factor increasingly determines the acceptance to use them [6]. Starting from a global analysis and moving to close specific case studies, this lecture aims to deepen on which factors are influencing farmers and irrigation districts when accepting and deciding to use or refuse alternative water resources, and which social learnings can be highlighted to face water scarcity and water pollution in semi-arid regions.

Theme 3
Sustainable Production and Consumption Models

Economic aspects, sustainable crop production and Consumption Models Côte D'Ivoire and The European Union Sustainable Cocoa Initiative

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Abstract
The United Nations 2030 Agenda and its 17 Sustainable Development Goals aim to bring nations together to address global challenges to sustainable development. Therefore, bilateral, and multilateral development projects and programs in sub-Saharan Africa to address the Sustainable Development Goals (SDGs) are crucial. In 2022, the European Union, Ivory Coast, and Ghana jointly approved e Sustainable Cocoa Alliance, an ambitious roadmap to improve cocoa production and its economic, social, and environmental sustainability. Cocoa is a fundamental commodity, a primary source of income for African countries, especially the Ivory Coast. The Ivorian economy depends mainly on cultivating cocoa, representing the African country with the highest production and export. The paper analyzes how sustainable cocoa production represents the main medium-term outcome for the African Country's balanced and sustainable development.

Consumption patterns and supply of food markets in the Mediterranean

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Abstract
This presentation examines the consumption patterns and supply dynamics of food markets in the Mediterranean region. With a focus on the interplay between consumer demand and market availability, the study analyzes the factors shaping the region's food consumption habits and the corresponding supply chain dynamics, with special attention to the role of fish. It explores the cultural, socioeconomic, and environmental influences on the Mediterranean diet and their implications for local and global food systems. By considering the complexities of this unique region, the presentation sheds light on the challenges and opportunities for sustainable and resilient food supply chains in the Mediterranean, contributing to the understanding of the relationships between production and consumption in food markets.

Quantification of the soil health through the enzymatic profile and the Soil Health Card

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Abstract
Soil is a crucial natural resource and the heart of a healthy environment. As a target objective of the Horizon Europe Program on the EU agenda for the period 2021-2027, the new research on soil health was considered of crucial importance. Consequently, the concept of Soil Health has been proposed to understand the importance of soil for stakeholders and decision makers [1] (Bonfante, Basile and Bouma, 2020). As FAO [2] mentions, the natural resources for agriculture are increasingly scarce, so, the key- question in the actual context is: will agriculture be able to meet the needs of a global population that is projected to reach over 9 billion by mid-century? According to research carried out by US Department of Agriculture (USDA) [3] and National Soil Health Institute [4] and to evaluate the anthropogenic impact of agricultural technologies on the soil in the context of climate changes, we propose a new and original model for Romania, the Soil Health Card in traditional agroecosystems from North-Eastern Romania. The main stages of this gradual work refer to the analysis of the main soil health indicators, as follows: (i) morphological, physical and chemical soil properties; (ii) soil enzymatic profile, according to the activities of enzymes involved in the bio-geo-chemical cycles of the main elements, to have a comprehensive biochemical characterization of the soil; (iii) soil vulnerability to the impact of chemicals used in agriculture (fertilizers, pesticides, heavy metals); (iv) quantification of the main soil health indicators that were analyzed, using the Soil Health Card, on the basis of which the farmers can get know about the actually status of the agricultural land, in order to take measures to prevent and limit negative environmental effects through scientific and sustainable management. Thus, the Soil Health Card offers the farmer a quick and practical way to assess the current state of the health of the agricultural land, highlights the main factors of soil disturbance (soil pollution, soil erosion, soil acidification, soil salinization, soil compaction) in this way monitoring the subsequent evolution of agroecosystems.

Consumer preferences and attitudes toward Mediterranean production: Arancia Rossa di Sicilia PGI

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Abstract

The research paper highlights the strategic role of the “Protected Geographical Indication - PGI” label to influence consumers’ attitude. In particular, by conducting 3 focus group in different Italian cities, we explored Italian consumers’ knowledge and perception about Arancia Rossa di Sicilia PGI. In particular, from this research have emerged that need to be that consumers appreciate Arancia Rossa di Sicilia PGI and are willing to pay more for them because they perceive them as a high-quality product compared to other blood oranges. However not all consumers are familiar with the logo of the consortium that certifies PGI as scheme of quality and that suggest the undertaking of communication actions.

Theme 4
Advances in plant diseases and arthropod pests management in a context of climate change

Can global warming accelerate virus evolution and the emergence of resistance- breaking isolates?

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Abstract
Global warming is predicted to impact negatively on Mediterranean agriculture favouring the emergence of new pathogens and pests. Viruses account for about 50 % of emerging plant diseases worldwide and cause considerable economical losses by reducing the yield and quality of crop products [1]. Presently, disease control is mainly based on preventing virus dispersion and the introgression of resistance genes by plant breeding [2]. Global warming also affects disease management since some resistances can be inefficient at high temperatures. Furthermore, it has been speculated that temperature fluctuations between day and night can create the conditions for adaptative evolution and the emergence of resistance-breaking isolates able to infect resistant plants at any temperature. Tomato spotted wilt virus (TSWV) is one of the most destructive plant viruses [3] and only two single dominant resistance genes, Sw-5b for tomato and Tsw for pepper, are commercially available. However, in the last two decades, resistance-breaking isolates of TSWV for tomato and pepper have been reported in several countries [4]. Evaluation of the factors and genetic determinants involved in resistance breakdown can facilitate the obtention of efficient and durable resistance. Tsw resistance is temperature sensitive and fails at temperatures higher than 30 °C. An evolutionary experiment was performed to test the influence of temperature on the emergence of Tsw resistance-breaking isolates of TSWV. Three wild-type TSWV isolates were inoculated in pepper plants with the resistance gene Tsw and were maintained in a growth room with controlled temperature, half at 25 °C and the other half alternating at 35 and 25 °C. Few plants at 25 °C and most at 35/25 °C were infected showing systemic necrosis (necrotic or chlorotic spots in non- inoculated leaves). Extracts of these symptomatic plants were used to inoculate transgenic plants of Nicotiana benthamina with the resistance gene Tsw and were grown at 25 °C. Only extracts from three pepper plants grown at 35/25 °C (one per each TSWV isolate) were able to infect the transgenic N. benthamiana plants showing severe symptoms (stunting, curling and chlorotic mosaic in leaves). Nucleotide sequencing revealed that resistance breakdown can be produced by only one nucleotide substitution in the gene NSs of TSWV producing an amino acid replacement in the protein, which was different for each TSWV isolate inoculated. This experiment supports that high temperatures favour the rapid evolution and emergence of TSWV resistance-breaking isolates.

Application of innovative techniques for the detection of plant pathogens

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Abstract
Despite advancements in research and technology, yield losses from various pathogens and pests at the worldwide level of agricultural production now account for around 30%. These losses are higher in underdeveloped areas where there is a greater need for food and a higher risk of hunger. Because of this, the FAO started a number of initiatives to raise global awareness regarding how protecting plant health may assist to fight hunger and poverty and preserve the environment. Early detection of plant pathogens is the first step to maintain plants healthy, and the application of cutting-edge diagnostic techniques may contribute to this task. We studied the efficiency of three innovative diagnostic techniques, i.e. Loop-Mediated Isothermal Amplification (LAMP), Raman spectroscopy (RS) and Electronic nose (E-nose) in pathogen detection in asymptomatic samples and monitoring the pathogen infection progress in important agricultural and forest cultures. LAMP, a quick and point-of-care diagnostic technique, can amplify isothermally the pathogen sequence without the need of extracting nucleic acids. It was successfully applied to detect the harmful Flavescence Dorée phytoplasma (FDp) and the recently discovered Olea europaea geminivirus (OEGV) in asymptomatic infected plants directly in the field, within half an hour. RS, a cheap and non-destructive pathogen detection method produces a chemical fingerprint of a sample. It successfully differentiated the RS metabolic profiles of virus-infected asymptomatic and healthy plants with 70-100% precision when applied to dangerous plant viruses such as tomato yellow leaf curl Sardinia virus (TYLCSV), tomato spotted wilt virus (TSWV), grapevine fan leaf virus (GFLV) and grapevine rupestris stem pitting-associated virus (GRSPaV). E-nose, a quick and non-destructive sensor technology, analyses volatile organic compounds (VOCs) produced by plant pathogens. E-nose successfully differentiated VOCs produced by pathogenic fungi of different important forest plant pathogens grown in pure cultures, such a Phytophthora plurivora vs. Pythium intermedium, Fusarium oxysporum vs. Rhizoctonia solani, but also showed the ability to distinguish between samples of the same pathogen species. i.e. Ciboria batschiana. All three described innovative techniques represent promising tools for further improvement of plant health and for more efficient and sustainable management of plant diseases.

Tomato brown rugose fruit virus outbreak in Sicily: the evolution of its management four years after its introductio

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Abstract

Plant viruses are the most dangerous pathogens for horticultural crops, due to their rapid diffusion and production losses, such as Tomato brown rugose fruit virus (ToBRFV) (family Virgaviridae), a positive-sense single-stranded RNA (ssRNA+) (~6,400 nucleotides) virus with a typical tobamovirus organization. It was detected for the first time in April 2015 on tomato plants in the Jordan Valley, and subsequently reported in many other countries. ToBRFV causes several symptoms on tomato and pepper plants; in severe cases, the product is unmarketable or the whole plant can even collapse and die. Its dispersion and spread are mainly mechanical, but it can also be carried for long distances, via contaminated seeds (seed-borne) and berries, facilitating the invasion of new areas. In Sicily (Italy), it was crucial to immediately implement strict containment rules when ToBRFV appeared during late 2018 on tomato crops, operating in a context of surveillance, early diagnosis and epidemiological studies to deal with this virus. Results obtained four years after its introduction have highlighted several aspects of its dispersion in protected tomato crops, and the necessity to produce ToBRFV-free propagation material (seeds and plantlets). Regarding tomato seeds monitoring, ToBRFV-positive samples went from a percentage of infected lots of about 30% in the first months of investigation (end of year 2018) to approximately 0% for the last surveys; the same scenario occurred in nurseries, where a significant decrease of infected plantlets was reported. The situation appears less encouraging regarding greenhouse production; although there has been a percentage decrease of ToBRFV dispersion, it still appears to be present in Sicily, representing a serious threat for other Sicilian or Italian production areas. Strong and appropriate measures (e.g. seed disinfection procedures before sale), implementation of efficient phytosanitary practices (e.g., use of gloves, disposable gowns, hand sanitizers), restrictive cultivation practices, reliable diagnosis, soil solarization etc. allowed to drop the percentage of infected farms; despite this, ToBRFV is still present, even if minimally, in the production process, from seed to greenhouses. The epidemiology evaluation in experimental conditions conducted in the last four years confirmed that even if it is present in very low percentages, it can spread very quickly, damaging the entire crop in a short time.

To date, an effective mitigation of ToBRFV impact and dispersion on production was achieved in Sicily, thanks to a well-organized phytosanitary regulation, the availability of different serological/molecular diagnostic methods and the development of a diagnostic network for its monitoring. In conclusion, a suitable integrated disease management approach requires different strategies, such as the potential secondary hosts monitoring, hygiene and prophylactic measures application, infected plants removal, continuous monitoring of cultural practices, and resistance genes identification in tomato lines and hybrids, bringing new hope for the future.

Effects of abiotic stresses and climate change on plant-fungi symbiosis

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Abstract
Plants are naturally colonized by numerous fungal entities which establish different symbiotic relationships with the hosts. Mycorrhizal or pathogenic associations are generally characterized by mutualistic and antagonistic symbiosis, respectively. Endophytic fungi, on the other hand, vary their relationship with the host according to its vegetative state.
These complex and delicate balances can be altered by environmental disturbance agents, capable of inducing acute or chronic stresses on the host plants. In particular, climate change, causing vegetational and physiological alterations, can be directly or indirectly related to variations in the symbiotic relationship between fungi and plants. Furthermore, the introduction of new species of fungal microorganisms or the recrudescence of fungal infections have already been reported as a consequence of global warming.
In the light of these new emergencies, it is appropriate to define innovative strategies aimed, on the one hand, at restoring the best vegetative state of the plants and, on the other, at containing new infections.

Climate change and insects in agroecosystems

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Abstract
Climate influences individual plants and animals, populations, communities and entire ecosystems. Global patterns of the main climatic parameters, i.e. temperature, relative humidity, rainfall, winds, have an essential role in setting the physiological limits determining which insect species can establish their populations in certain habitats. Changes in climate are expected to influence the geographic distribution and abundance of many species, thus indirectly increasing the risk of insect vector borne disease transmission, to increase the biological invasions by exotic species and, in some cases, to lead to species extinction. The effects of climate change on insect pest populations can be direct, through impacts on their physiology and behavior (survival rate, growth rate, diapause, voltinism), or indirect, through biotic interactions (food resources, competitors, enemies and mutualists). Insect pests are a group for which information on actual or potential range expansion is beginning to accumulate, as their impact on managed ecosystems often require applying management strategies (eradication, integrated pest management). Moreover, as life-history and phenology adaptation can be expected in many pest species, some attempts have been made to build forecasting models, to evaluate the probability of changes in the insect phenology, and the need of different management strategies also in regions in which a pest is already present. In some species, demographic modelling approaches based on their physiology can describe the biological responses to weather, but in most cases, the information available on both the insect biology (all instars) and long-term population fluctuations, is not sufficient to build reliable demographic models.

Theme 5
Sustainable horticultural crops for greenhouse production: presentation of INTESA project results

Assessing Salinity Tolerance and Fruit Quality of Pepper Landraces

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Abstract

Soil salinity, exacerbated by climate change, is a major global problem, particularly prominent in the Mediterranean basin. Most commercially cultivated varieties of horticultural species, including pepper, are considered salt sensitive. However, certain genotypes that are not widely cultivated exhibit adaptability to adverse environmental conditions while maintaining stable yields. This study aimed to investigate the effects of salinity stress on yield, nutrition, and fruit quality of four pepper landraces: VCP-02 (Capsicum annum var. grossum), VCP-05 (Capsicum annum var. grossum), VCP-07 (Capsicum annum var. grossum), and VCP-11 or 'Florinis'. The California cultivar 'Yolo Wonder' and the commercial hybrid 'Sammy RZ (F1-Hybrid)' were used as controls. The experiment was conducted in the greenhouse facilities of the Laboratory of Vegetable Production at the Agricultural University of Athens. Half of the plants were exposed to a nutrient solution containing 30 mM NaCl (salt-treated plants), while the remaining plants were irrigated with a nutrient solution containing 0.5 mM NaCl (control plants). Yield, nutrition, and organoleptic characteristics such as dry matter content, fruit diameter, fruit height, firmness, titratable acidity (TA), total soluble solids content (TSSC), and color were evaluated. The results revealed that the landraces were more tolerant to salinity than the commercial varieties 'Yolo Wonder' and 'Sammy RZ'. Moreover, subjecting pepper plants to increased salinity levels resulted in improved fruit quality, as evidenced by a 20% increase in dry matter content. These findings underscore the suitability of the landraces VCP-05 (Capsicum annum var. grossum), VCP-02 (Capsicum annum var. grossum), and VCP-07 (Capsicum annum var. grossum), for cultivation in saline environments and highlight the potential of their genetic traits for developing new or enhanced pepper varieties with improved resistance to salinity stress.

Basil Growth Optimization: A Comprehensive Study of Performance Indicators in Hydroponics

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Abstract:
Climate change-induced abiotic stresses, including salinity, drought, metal toxicity, and nutritional deficiencies, pose escalating threats to cultivated plants, leading to significant reductions in crop yield. In response to these challenges, our comprehensive study explores the potential of hydroponics, an innovative solution that cultivates plants in nutrient-rich water, superseding traditional soil-based methods. Our research focused on identifying the optimal conditions for hydroponic cultivation of basil to maximize yield and physiological performance. Basil specimens thrived in hydroponic conditions, demonstrating healthy and vigorous growth with an average stem length of 60 cm and a stem diameter exceeding 1.2 cm. The plants also exhibited an excellent count of stems, nodes, and leaves, affirming their robust development. Further evidence of high yield was observed through significant fresh biomass production. Both the aerial parts and the whole plant showcased high outputs, indicative of the plant's health and successful cultivation, thereby endorsing the effectiveness of hydroponics. Fresh biomass yields were impressive, with an average of 242 g for aerial parts and 348 g for the whole plant. Physiological indicators substantiated the benefits of hydroponics, with total chlorophyll concentrations, internal CO2 concentration, maximal yield of photosystem II (PSII) photochemistry (Fv/Fm), and yield of photosystem I (PSI) and PSII photochemistry falling within optimal ranges. Moreover, basil plants showed efficient photosynthetic energy utilization, evidenced by lower non- regulated non-photochemical energy dissipation in PSII (Y(NO)) than regulated non-photochemical energy dissipation (Y(NPQ)). A favorable trend was observed in the PSI oxidation state (P700ox) values, indicating successful plant adaptation to the culture conditions. These results confirm healthy photosynthetic activity and a strong capacity for carbon assimilation, providing critical evaluation measures for plant growth and potential for carbon sequestration – a boon for environmental sustainability. Finally, complex correlation analyses concluded our research, revealing interconnections between studied parameters and illuminating the physiological dynamics of basil plants in hydroponic settings. Our results compellingly advocate for hydroponics as a sustainable, efficient cultivation method, backed by robust basil growth and high yield.
In conclusion, this study reinforces the potential of hydroponics in agricultural advancement, fostering robust plant growth, optimized photosynthesis, and sustainability. The research underscores the socio-economic impacts of hydroponics, including increased agricultural productivity, job creation, and environmental sustainability. Considering these findings, promoting innovation and widespread adoption of hydroponics is crucial to address mounting global food demands amidst changing environmental conditions.

Use of the solar energy for sustainable environmental solutions

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Abstract:
Nowadays, renewable energy solutions have become a necessity to enhance the economies of ountries. In fact, these technologies do not produce polluted waste or emissions. They participate in the struggle against the greenhouse effect and the CO2 emissions in the atmosphere. Many researchers have noted that solar energy is an appealing field of investment. Particularly, the solar system are attractive techniques because of its simplicity of work. The mainly function is to convert the solar energy into heat and electrical energy. In this work, we have studied the aerodynamic and thermal characteristics of the solar systems. As a first step, we have used adequate instrumentation to measure the velocity and the temperature in different directions placed in the system. As a second step, we have developed numerical simulations to study different parameters like the solar radiation, the inlet velocity, and the event effect. Globally, it has been observed that all these parameters have a direct effect on the local results. However, solar radiation provides an increase in the temperature and it has no effect on the velocity. The inlet velocity of the air has a huge effect on the considered solar systems. The velocity, the turbulent kinetic energy, the dissipation rate of the turbulent kinetic energy, and the turbulent viscosity have been increased due to the inlet value of the velocity. The good agreements obtained by the comparison of the numerical results with the experimental data confirm the validity of the numerical method.

Agriponic: a sustainable cultivation model for soilless tomato production

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Abstract
Southern coast of Sicily is the second European area (9,000 Ha) for greenhouse horticultural productions. First crop, in terms of importance, grown in greenhouses is tomato. Its cultivation is characterized by soil cultivation or soilless cultivation utilizing various types of substrates. On the contrary, other methods that do not require a substrate, like aeroponic, nutrient film technique (NFT), acquaponic and floating are not quite widespread nowadays. Therefore, this study aims to evaluate tomato plant performances in an innovative cultivation system based on aeroponic and NFT techniques. A new production model for tomato cherry called “Agriponic” was proposed. This is a combination of aeroponic and NFT technique inside a greenhouse.
Closed polystyrene channels (40 X 40 cm) were allocated at a distance of 1.6 m. On the upper part, at a distance of 28 cm, holes were realized for plant allocation to achieve a planting density of 1,5 plants per square metre. Tomato roots were partially suspended and sprayed with a nutrient-rich, highly aerated fertigation solution and partially laid on the base of the channel where a thin film of leaching solution passed through. Then, leaching solution was collected in a tank for reuse (closed-loop). Greenhouse air temperature and humidity, air temperature inside channels and irrigation water temperature were registered and water and nutrients inputs were monitored. First observations wereconducted on plant growth, phenology, photosynthetic activity. Agriponic system increased plantgrowth especially in terms of roots biomass this behaviour was confirmed by higher photosynthetic values. Moreover, an advance in flowering has been observed. First observation on Agriponic systems evidenced good tomato plants performance and low input request allowing higher environmental sustainability. Further studies are underway on the quantitative and qualitative aspects of production, socio-economic sustainability and Life Cycle Assessment of the model.

Sustainable Approaches of Protected Vegetables Cultivation in Indian Arid and Semi-arid Regions

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Abstract
Protected cultivation is a fast growing sector across the world, including Indian hot arid and semi-arid regions where open field cultivation of vegetables is challenging and risky due to a number of biotic and abiotic factors. Protected cultivation of vegetable in (semi)arid regions started a decade ago has now picked up momentum because of its potential to providing protection from external crop limiting factors, besides modifying microclimate that favors crop growth and production with enabling high resource use efficiency. However, as compared to other regions, the output is somewhat limited in semi(arid) regions due to harsh climate and limited possibility to modify inside microclimate in most common low-tech protected cultivation structures i.e., natuarlly ventilated polyhouse (plastic greenhouse). Furthermore, prevailing soil based cultivation requires extra care and management to deal with recurring issues due to successive cropping e.g., buildup of soil-borne pathogens and rootzone salinity, and disturbance of other soil properties, thus affecting the sustainability of the system. Considerable efforts have been made to providing region-specific solutions to make protected cultivation technology as a profitable and sustainable venture particularly in semi(arid) regions. These include effective management and use of rain water from greenhouse roof-top, proper irrigation scheduling, vegetable grafting, micro-climate management and use of bio- inoculants. Efficient water and energy use: Arid region is highly deficient in water, both in terms of availability and quality. The high quality rain water can be a valuable resource in these scarce regions. So, the efforts devoted to effectively manage in harvesting of rain water and its judicious utilization through appropriate irrigation scheduling particularly in protected cultivation. Greenhouse roof-top rain water harvested and channelized to store in plastic lined open pond, and its use directly in soilless cultivation, which require high quality water, or in mixing with marginal ground water to apply in soil-based cultivation. For preventing the loss of stored rain water in open pond, application of two sizes polypropylene balls (8mm + 4mm) as floating cover on the surface of water bodies is found effective to minimizing evaporative losses by up to 70%. Likewise, the abundantly available free solar energy is harvested through solar PV system and used in various operations including irrigation pumps and other greenhouse equipments (drip, fogger, fans, etc.). For saving water loss through soil evaporation, mulching is useful technology. Plastic mulch (white on black) is useful in winter and rainy season, while in warm season, reflective soil cover (mulch) from abundantly available silica based minerals has been found useful to moderating hydrothermal properties of greenhouse soils during hotter period. Micro-climate and irrigation management: Judicious use of irrigation water is essential in water scarce semi(arid)regions. For harvesting good yield, maintaining adequate moisture in soil is essential. Irrigation at reduced rate even at 20% deficit of normal rate cause significant yield reduction in normal cucumber and tomato. However, grafted plants on selected rootstocks under same deficit level could provide equivalent yield to that of normal plants grown under normal water supply, thus saving significant amount of water (about 19%). Further, irrigation at higher frequency (twice a day) was found better for higher yield and water productivity in both grafted and non-grafted cucumber as compared to those irrigated at alternate day. Intermittent use of roof-top micro-sprinklers with inside thermal screen movement could effectively manage summer heat in naturally ventilated polyhouse. Intermittent use of foggers (2-5 sec per cycle) at different intervals during initial growth stage is useful to manage heat stress.

Further, a customized low-cost protected cultivation structure (double layer-net house) has been found for small farmers getting regular income. Integrated agronomic intervention: Due to successive cropping in soil-based protected cultivation some growing issues arises such as buildup of soil-borne pathogens and disturbed soil properties, with erratic soil and aerial temperatures which impact crop yields. Vegetable grafting- a sustainable tool has shown immense potential to mitigate the impact such recurring issues. For instance, grafting greenhouse cucumber on interspecific *Cucurbita* hybrid rootstock (NS-55) has increased plants tolerance to water deficit, salinity and heat stress in greenhouse cucumber in different growing conditions. Cucumber growth is halted during winter under non-heated greenhouse, but grafting on cold tolerant local fig-leaf gourd (*Cucurbita ficifolia*) of Ooty region has been beneficial to enhance low temperature tolerance in cucumber, and provided 42% higher yield with 15 days early harvest. A considerable water saving was attained with the use of grafting. Similarly, grafted tomato on a wild tomato (*Solanum pimpinellifolium* line IIHR 1939) rootstock genotype has produced promising results under both normal as well as moderate water deficit (-20% of normal). Another rootstock i.e., Arka Vikas was useful to sustain yield under sever water deficit conditions (-40%) with providing high water productivity. Double leader training system has increased tomato yield by up to 42%, which further supported by the grafting onto vigorous rootstocks like RF-4A and Arka Vikas. Using integrated effects of grafting, plant lowering, mulching enabled to harvest tomato yield during September to May up to 35kg m^{-2} in a customized low-cost double layer nethouse protected structure. Furthermore, grafting has significantly reduced product water use from 44L to 36L in tomato and 35L to 26L in cucumber compared to non-grafted plants. Planting method also influenced crop performance in different seasons. Rootzone application of certain beneficial microorganisms like *Trichoderma*, *Pseudomonas* and *Mycorrhiza* alone or in combination proved to be useful in increasing plant establishment and overall crop production in lose textured arid soils, besides providing wider adoptability to plants against fluctuating environments. Overall, integration of different innovative techniques can be an effective way to manage the complexity of recurring soil-water and environment issues in protected cultivation in (semi)arid regions for establishing it as a profitable and sustainable venture.

SHORT PRESENTATION

Ecklonia maxima-derivate seaweed extract supply as mitigation strategy to alleviate drought stress in chicory plants

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Abstract
Severe climatic conditions, such as drought, have critical repercussions on agriculture and on food disposal. Thus, ecological means to overcome drought are important to improve agroecosystems sustainability and resilience. In this study, the use of an Ecklonia maxima-derivate seaweed extract (SwE) as a tool to mitigate drought constrain in chicory plants grown in greenhouse was evaluated. Plants were cultivated in plastic pots filled with peat and subjected to drought stress by retaining moisture range at 90–100% of water holding capacity (WHC) [well-watered (WW)], 60–70% WHC [moderate drought stress (MDS)] or 30–40% WHC [severe drought stress (SDS)]. Drought stress decreased plant growth yield, however, in plants supplied with SwE, head fresh mass was 7.6% higher than control. Water constrains reduced relative water content (RWC), whereas, SwE improved RWC when plants were exposed to drought. Moreover, water use efficiency (WUE) increased with the increase of drought intensity and plants exposed to drought significantly improved WUE when supplied with SwE. Drought stress intensity linearly reduced nitrogen use efficiency (NUE) in plants exposed to MDS and SDS, compared with WW plants. SwE application enhanced NUE by 7.7% compared with control plants. Chlorophyll was reduced by drought, while SwE supply increased its concentration. Water constrain enhanced malondialdehyde, especially in SwE non-treated plants. Drought stress improved proline and total polyphenols in plants supplied with SwE. Biostimulated plants grown under WW or MDS conditions showed higher ascorbic acid level than those exposed to SDS and non-biostimulated. The study proved that SwE application is a useful practice to mitigate drought in chicory plants, safeguarding yield and quality features.

Life Cycle Assessment of Tomatoes Cultivated in an Innovative Soilless System: A Case Study on Tomato Production in Sicily, Italy

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Abstract
The increasing global population and the resulting demand for food pose significant challenges for sustainable agriculture. Among vital agricultural crops, tomatoes hold great significance, cultivated over approximately 5.16 million hectares, yielding an estimated production of 189.1 million tons in 2021. Tomatoes are grown in open fields and greenhouses. For fresh consumption, much of the production takes place inside greenhouses. To explore innovative approaches in greenhouse tomato production, a case study was conducted in Sicily, Italy, on a commercial farm. The study focused on a specific soilless closed-loop production system known as “agriponic” that combined two advanced techniques, aeroponics and Nutrient Film Technique (NFT). The closed-loop nature of the agriponic system implies that the nutrient-rich mist and the water used are recycled within the greenhouse allowing a precise control of fertigation. The goal of the study was to assess the mass and energy balances of each operation involved in the production process from cradle to gate of tomato in order to evaluate the life cycle assessment (LCA) and to verify the potential of agriponic soilless cultivation for precise and efficient horticultural production. The software SimaPro 9.3.0.3 and the Ecoinvent database were used to quantify the environmental impact of tomato cultivation. The study considered five phases, from seedling purchase and planting to the harvest, using a functional unit of 1 ton of cherry tomatoes produced. Five impact categories were calculated: Global Warming Potential (GWP), Ozone Layer Depletion Potential (ODP), Photochemical Oxidation Potential (POCP), Acidification Potential (PA) and Eutrophication Potential (EP). The results showed that agriponic production has a carbon footprint per unit of product, of 562,287 kg CO2-eq per ton of tomatoes produced. The plant growth phase had the greatest environmental impact, particularly in the Ozone Depletion Potential (ODP) and Photochemical Oxidation (POCP) categories mainly due to the use of fertilizers, pesticides, and electricity for pump operation. The greenhouse climate management phase also contributed significantly to the overall environmental footprint, specifically to Potential Acidification (PA) impact category, also presented significant impacts. Conversely, the phases of aeroponic plant transplanting, harvesting and crop disposal had negligible impacts. Areas of improvement and recommendations to enhance sustainability in tomato cultivation are identified, such as minimizing plastic use, exploring sustainable heating alternatives, adopting eco-friendly transportation, and utilizing renewable energy sources. In conclusion, this case study suggested that agriponic production can offer several environmental advantages. The concept of nutrient cycling within a circular economy framework is a crucial component of the future sustainable food systems. By minimizing the resource wastage and conserving water and nutrients, the closed-loop of aeroponic cultivation demonstrate impressive potential as a successful application of precision agriculture in horticultural production, contributing to enhanced sustainability.

Synergistic Effect of a Plant-Derived Protein Hydrolysate and buscular Mycorrhizal Fungi on Eggplant Grown in Open Fields: A Two-Year Study

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Abstract
Plant biostimulants, such as plant protein hydrolysates (PHs) and arbuscular mycorrhizal fungi (AM), are natural products capable of increasing the yield and quality of crops and decreasing the ecological impact of plant growing cycles. However, there is little research on the mutual application of different categories of biostimulants (microbial and non-microbial). The current study was conducted to examine the effects of “Trainer” PH application (0 or 3 mL L-1) and AM (R. irregularis) inoculation on yield, quality and nitrogen indices of ”Birgah” F1 eggplant cultivated for two years (2020 and 2021). Results revealed that the combined application of PH and AM significantly enhanced total and marketable yields and average marketable fruit weight compared to non-treated plants (control). Moreover, biostimulants increased the soluble solids content (SSC), chlorogenic acid and total anthocyanins compared to control plants. Interestingly, the mutual application of PH and AM improved fruit quality by reducing the glycoalkaloid concentration. Furthermore, both biostimulants exerted a synergistic action, enhancing nitrogen use efficiency. On the other hand, productive and fruit-quality features were significantly influenced by the year due to remarkable differences in terms of maximum temperature between the first and second cultivation cycles. Overall, our research underlined that PH and AM can positively interact to improve the performance of eggplant cultivated in open fields.

Exploring factors affecting Medicago intertexta L. seed yield in the Mediterranean Environment: an evaluation

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Abstract
Medicago intertexta L. (Mill.) [1,2] is an annual self-seeding legume species, widely distributed in the Mediterranean basin and well known among local farmers for its palatability, biomass productivity and nutritive value as forage crop for pasture improvement [3]. However, one notable morphological featureis the presence of a long and thin peduncle, which causes the pods to drop rapidly upon drying, making the harvesting process challenging for seed production. The lack of knowledge regarding the agronomicaspects of this species, represents a limiting element for the introduction and the spread of this crop in forage cropping systems. Consequently, the aim of this work is the evaluation of patterns of change in seed yield with different seeding rates in Medicago intertexta in a semi-arid Mediterranean environment. The trial was carried out during the 2021/22 growing season in a semi-arid, hilly area of Sicily with a typical semi-arid environment. Treatments consisted of two seed rates densities: 20 germinable seeds/m2 (T1) and 160 germinable seeds/m2 (T2). The treatments were arranged in a completel randomized block design with three replications. At maturity, plant height was measured, successively stands were manually cut and shed pods were gathered. Then, dry matter yield (kg ha-1), harvest index (%), 1000-seed weight, pods/plant, seeds/pod, seeds/plant, seed yield (kg ha-1), germination (%), hard seeds (%) were evaluated. All treatments recorded a moderate productive response, reaching dry matter yields at the end of the season of 4,260 kg ha-1 and 4,967kg ha-1 respectively for T1 and T2. At the first treatment, the seeds of pods had the lowest 1000-seed weight, indicating that reserve accumulation was still in progress. Germination percentage and hard seed percentage of M. intertexta seeds were not significantly affected by the sowing rate. All treatments produced seed which had a germination percentage of over 80%. For all plant densities germination tests showed very high incidence of hard seeds (65% and 77% respectively for T1 and T2). The high seed yield of T1 is justified by an increased plant development due to a lack of intraspecific competition because of the low seeding density. In fact, the number of pods/plant and seed/pod as well as seed/plant are significantly higher than in T2. Nevertheless, the seed yield is higher in T2 due to the increased amount of plants per m^2. These preliminary outcomes could offer potential guidance for optimizing seed production in this species. It should be noted that the high percentage of hard seeds could regenerate a pasture stand in the subsequent growing seasons. Further research is necessary to explore alternative harvesting methods for maximizing commercial seed production, as well as to investigate additional factors like environmental conditions and agronomic practices that can affect seed quality and yield.

Using native Mediterranean plants to mitigate anthropogenic impacts in urban areas

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Abstract
In recent decades, heavy human activity and urbanisation have caused a series of environmental changes that affect climate and human health. In the cities, various green technologies (green roofs and walls, permeable pavements, vegetated swales, green ways) can play a strategic role in mitigating these effects, contributing to climate regulation, water cycle, air purification and the reduction of CO2 emissions into the atmosphere, etc. Extensive green roofs, thanks to their insulating capacity, have over time acquired a high ecological value in Mediterranean cities, where they can contribute to a significant reduction in the energy consumption of buildings, especially in the summer season. To perform this function, the vegetation cover must remain continuous and homogeneous over time, which is a critical aspect in Mediterranean climates where water is a limiting factor. Thus, resistance to drought, dry substrates and high levels of solar radiation become key factors in the choice of plant species under these conditions. Therefore, with the aim to define suitable plant models for extensive green roofs in the Mediterranean area, the following species were compared Sedum sediforme Jacq., Sedum ochroleucum Chaix, *Drosanthemum floribundum* (Haw.) Schwantes, *Pallenis maritima* (L.) Greuter and Helichrysum panormitanum Tineo ex Guss, in order to evaluate their agronomic performance. The test was carried out in Bagheria, near Palermo (Italy), at the CREA experimental farm, in extensive green roof simulation structures. A randomised block experimental scheme with three repetitions was adopted. During one year of observations, the following were recorded: plant height, growth index, ground cover percentages, flowering time and duration and, at the end of the trial, the percentage of plant survival. All data were subjected to analysis of variance (ANOVA). The results obtained showed the suitability of all the species studied for use in green roofs in the Mediterranean environment, and made it possible to define some specific characteristics. In particular, H. panormitanum stood out for the highest values of the growth index (20), *D. floribundum* for the highest ground cover percentages (93%), while *P. maritima* for the longest flowering period, more than 10 months.

Preliminary studies on somatic embryogenesis from floral explants of *Sulla coronaria* L.

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Abstract
Sulla coronaria L. is a short-lived perennial herb native to the central-western Mediterranean area: it is a forage legume widely used in Italy with approximately 97,000 ha, mostly in Sicily. It is mainly known thanks to its excellent drought tolerance and good quality forage: in particular, the condensed tannin content in the leaves can reduce methane emissions and improve the life quality of grazing animals. Furthermore, *S.coronaria* has a positive influence on soil protection, landscape architecture, and honey production. *S.coronaria* is an allogamous species and, for this reason, it is very hard to get new varieties with the desired forage characteristics. Somatic embryogenesis could be a significant solution to regenerate genotypes of interest starting from a small quantity of plant material and without seasonal dependence. Moreover, a successful protocol preludes to the production of synthetic seeds. This work aims to investigate the possibility to induce somatic embryogenesis starting from flower explants of *S.coronaria.* Samplings were carried out in March and April 2023. Twenty sites with both cultivated and wild plants were identified in Sicily. Only unopened flowers were selected for in vitro culture. After surface sterilization, 5 different explants (anther/filament, ovary, style/stigma, petals, whole immature flower) were dissected under sterile conditions and plated under three different hormonal combinations: MS medium supplemented with 5 µM N-(2-chloro-4-pyridyl)-N′- phenylurea (4-CPPU) + 5 µM 2,4-dichlorophenoxyacetic acid (2,4-D) (4); 8.8 µM 6- banzylaminopurine (BA) + 1.07 µM 1-Naphthaleneacetic acid (NAA) (7); 10 µM naphthoxyacetic acid (NOA) + 4.4 µM 6-banzylaminopurine (BA) (16). All explants were incubated at 26°C and to test light influence, half of the plates were incubated in the dark. Preliminary results indicate that almost all explants produced green or brown calli under all conditions in approximately 10-30 days after culture initiation. As regards regeneration events, new individuals were obtained from anthers, ovaries, and petals incubated on medium 16 in the light. As regards dark conditions, regeneration was achieved only with petals on medium 7. Based on preliminary results, further investigations are underway to identify the best combination of “explant-medium-light condition” in terms of new individuals regenerated. Moreover, based on the observation of obtained callus, successful somatic embryogenesis is expected. Finally, the regenerates will be analyzed to evaluate their ploidy and genetic stability.

Estimating leaf and plant water status with phylloclip, a new low-cost sensor to estimate leaf vapor condensation

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Abstract
The current trial discusses a low-cost leaf proximal sensor, knows as 'Phylloclip', which detects the condensing water vapor resulting from the leaf transpiration process. The sensor takes advantage of a passive temperature gradient between the sunlit leaf and the sensor plate below and simultaneously monitoring incident solar radiation. This simple and inexpensive device enables an approximate evaluation of the plant water status by comparing the daily patterns of leaf transpiration and solar radiation. In theory, when the plant is well-hydrated, there is likely to be a strong correlation between condensation and sunlight. However, deviations from these patterns are indicative of a potential drop in the plant hydration level. It is important to note that the sensor still requires validation with established parameters for estimating plant water status. In this study, the relationship between the sensor outputs and the climatic mechanism that drives leaf transpiration, known as Vapor Pressure Deficit (VPD) are presented. These preliminary results may serve as a starting point for developing models and algorithms to estimate plant water status by correlating 'Phylloclip' output data with common indicators of plant hydration status (Sap Flow Rate, Stem and Leaf Water Potential, Leaf Turgor Pressure, and more). Moreover, this sensor may potentially represent an affordable component of a Decision Support System (DSS) for efficient and sustainable irrigation management.

Vegetable protein hydrolysates and mycorrhizae inoculation to cope water stress effects on nursery potted Corylus avellana L. young plants

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Abstract
In the current climate change scenario, it is essential to define multiple strategies to increase crop resilience and mitigate the negative consequences on crop production. Hazelnut (Corylus avellana L.) is one of the most important nut tree crops grown in several countries all over the world and mainly in the Mediterranean Basin area, where Italy is the second largest producer, after Turkey [1]. Hazelnut has historically been grown in hilly areas, and recently, thanks to the increasing interest in this species, new orchards are planted in fertile plains, with completely different climates and precipitations compared to the traditional cultivation areas. Hazelnut is well known as a very sensitive species to both water stress and high temperatures [2]. This study aims to evaluate: i) the growth performances and morpho-physiological adaptive responses to prolonged water stress in potted young hazelnut plants and ii) the effect of biostimulant treatments in mitigating the effects of water and heat stresses were evaluated. The research was conducted in a cold polycarbonate greenhouse, on one-year-old micro- propagated plants of cv “Tonda di Giffoni” at the Department of Agricultural Sciences of the University of Naples “Federico II” during two consecutive growing seasons (2021-2022). Three irrigation levels (i.e., 100, 80, and 60% of the Daily Water Requirement, DWR) were applied in combination with none or two different biostimulants applied by robot drenching. Protein hydrolysates were applied every two weeks with a dosage of 2.5 ml/l according to the chemical characteristics of the product, during the whole growing season, while the mycorrhizal inoculum was applied at a single-dose of 15 g per plant at the beginning of each growing season. During the two seasons, growth rate (i.e., basal diameter, branch length, leaf number, leaf area, and buds), eco-physiological behaviour (i.e., gas exchanges measurements, Chlorophyll a fluorescence emission, SPAD index, and leaf water potential), and leaf functional traits were investigated. Results showed interaction effects between the water deficit level and the type of biostimulant applied. The mycorrhizae positively influenced the physiological and growth behaviour of plants grown under 80% DWR, while protein hydrolysates were more effective in combination with 60% DWR. To conclude, the use of biostimulants helps to counteract the negative effects of the deficit irrigation level and improve plant quality. However, further studies are needed to understand the interaction effects among the type of biostimulants, their dosage and the deficit water level.

Wine to Power Synthetic Methane production utilizing CO2 from wine fermentation First concrete example of Circular Economy applied to agriculture.

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Abstract
With a view to satisfying the principles of the circular economy and the challenges of environmental sustainability in agricultural production, the project that we have studied and developed consists in producing CO2-neutral renewable synthetic methane ("Green-Methane") to replace the normal diesel petroleum origin used by current tractors for the cultivation of vineyards. Synthetic methane is produced by a special Methanization Plant, a reactor in which carbon dioxide and hydrogen combine to produce methane. The production of the hydrogen required for the methanation reaction takes place through the electrolysis, process to split water into hydrogen and oxygen, made by an Electrolyzer, utilizing the electricity in surplus produced by wind or photovoltaic plants, both non-programmable energy sources, that are a factor of instability for the electricity grid. The source of the carbon used in the reaction, in this case is the CO2 coming from the fermentation of the grape musts, in fact about 90 g are produced for each liter of fermenting grape must. Only in Province of Trapani (Sicily), one of the largest territories with vineyards in Europe, each year are produced around 2 million hectoliters. The plant to produce "Green-Methane" basically is made up of two sections: first one for the separation and storage of CO2 deriving from the fermentation of the grape, second one section to produce synthetic methane composed by an "Electrolyser" for hydrogen production, and a "Reactor" for the process of methanation. The "waste" of all reaction is pure electrolytic OXYGEN, very useful in many sectors. To test the system in the field, a CO2 capture and storage system was installed in a winery in the province of Trapani. The synthetic methane produced by the reaction will be stored at high pressure and will be used, among other things, as fuel for tractors and other agricultural vehicles for the cultivation of vineyards.

Tuta absoluta potential vector of the emerging Tomato Brown Rugose Fruit Virus

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Abstract

Tomato (Solanum lycopersicum L., Solanaceae) is one of the most important and widespread crops worldwide and it is constantly threatened by numerous pathogens, including Tomato brown rugose fruit virus (ToBRFV). ToBRFV was characterized in 2014 and currently it is one of the most significant challenges for the tomato production worldwide. It is an extremely infectious tobamovirus whose transmission mainly occurs through plant-to-plant contact or infected sap by adherence to different surfaces and tools. Moreover, it has been recently demonstrated the ToBRFV transmission due to the mechanical action of Bombus terrestris L. (Hymenoptera: Apidae), the only arthropod vector known to date. In this context, the potential role of other insects as vectors of this pathogen was investigated testing one of the main tomato pests, the South American tomato pinworm Tuta absoluta (Meyrick) (Lepidoptera: Gelechiidae). Laboratory tests were carried out using tomato seedlings and T. absoluta reared under laboratory conditions within insect-proof cages. Sap extract of ToBRFV ToB-SIC01/19 isolate was mechanically inoculated into healthy tomato plants through foliar micro-lesions that facilitate the virions' entry. RT-qPCR analysis were carried out to confirm the ToBRFV infection on the inoculated plants; subsequently, uninfected adults of T. absoluta were released and left ovipositing on infected plants. The obtained pest progeny resulted positive to ToBRFV presence in the emerging adults. In a second test, T. absoluta ToBRFV-infected adults were released on healthy plants, in order to evaluate their ability to transmit the virus. The latter hypothesis was confirmed. Finally, pupae obtained from larvae fed on infected plants have been disinfected and compared with not disinfected pupae. Similarly, adults obtained from disinfected and not disinfected pupae were analysed and compared. The results confirmed the ToBRFV presence in both adults and pupae of disinfected and not disinfected T. absoluta, showing that the ToBRFV is located within the insect body. In conclusion, this study demonstrated for the first time that T. absoluta is able to acquire and transmit ToBRFV, thus having a key role on the disease epidemiology. Further tests will be needed to verify the ToBRFV virions localization in the insect vector body.

Use of solar seawater distiller to provide clean water for irrigating tomato-cultivated greenhouses

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Abstract
Since the demand of clean water increases gravely in most regions of the world due to important rising of people and the necessity of clean water for agriculture, solar seawater distillation presents a better source of clean water. Currently, this process was well tested to provide clean water for irrigating tomato-cultivated greenhouses in Mediterranean Regions. The idea of this work is to modify the structure of absorber inside a solar distiller to augment the production of this device. To understand this idea, three triangular solar sea water distillers were fabricated and tested under the same climate of Sfax region central-eastern Tunisia, namely, Triangular Solar Sea Water Distiller with Rectangular Absorber (TSSWDRA), Triangular Solar Sea Water Distiller with Trapezoidal Absorber (TSSWDTA) and Triangular Solar Sea Water Distiller with Concave Absorber (TSSWDCA). Experimental results show that the concave and trapezoidal structures of absorber increase the distillate yield of triangular solar sea water distiller by, respectively, 25.38% and 12.67% as compared to the rectangular one. Also, the distillate yield of TSSWDCA increases by 11.30% higher than that of the TSSWDTA. The values of pH, electrical conductivity, TDS (Total Dissolved Solids) and salinity show that the quality of clean water after solar distillation is very well during the day of experience.

Consumer preferences regarding beef consumption: an analysis in the Mediterranean area

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Abstract
In current events, consumers are subject to various stimuli (advertising campaigns, popular magazines, social) that affect their marginal consumption propensity. However, as Economic Theory teaches us, themarginal propensity to consume does not necessarily translate into consumer spending. This is strongly affected by consumers' eating habits and other variables that determine where the consumption phenomenon occurs. The study aims to analyses post-modern consumer behavior toward beef consumption. To achieve this goal, an online questionnaire was administered to 535 partecipants. Statistical analyses were performed by R statistical software, using two-tailed P-values, and setting statistical significance at $P \leq 0.05$. The results show that consumption choices are influenced by the impact of beef can have on health. In addition, consumers consider the origin and certifications of the raw material to be extremely crucial.

The Correlation between the Economic Development of Agriculture and Tourism: the Case Study in Southern Sicily.

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Abstract
The tourism sector in the European Union is undeniably of great economic importance. With substantial contributions in terms of economic value, direct and indirect employment, and trade balance, the sector plays a vital role in driving economic growth, supporting livelihoods, and promoting overall development. When considering indirect and induced impacts, the total contribution reached an impressive €1.5 trillion, equivalent to 10.3% of the EU's GDP. Furthermore, tourism is a major employment provider in the EU. In 2019, the sector directlyemployed 13.5 million people, accounting for 5.8% of total employment in the EU. When considering indirect and induced impacts, the tourism sector supported 27.2 million jobs, which is equivalent to 11.7% of total employment. Moreover, the tourism sector encompasses a wide range of industries that directly or indirectly support tourism activities. Collectively, these industries employed 26.8 million people in 2019, highlighting the diverse employment opportunities available within the sector.
Conversely, the agricultural sector in the European Union has been facing challenges in recent years, including decreasing profit margins due to the entrance of other countries where developing agriculture is cheaper or insufficient, polluted, or expensive water resources. The EU's common agricultural policy (CAP) was launched in 1962 to safeguard European Union farmers to make a reasonable living, help tackle climate change and the sustainable management of natural resources, maintain rural areas and landscapes across the EU, and keep the rural economy alive by promoting jobs in farming, agri-food industries, and associated sectors. Nevertheless, one of the significant challenges faced by the agricultural sector in the EU, where the inflation rate is notably increasing the cost of inputs, is the entry of countries where agricultural production costs are lower. This competition has led to decreasing profit margins for EU farmers. In this context, the study aims to examine the consequences of tourism's economic development at the expense of agriculture and analyze whether there is a negative correlation between different key variables in both sectors. Additionally, changes perceived by satellite imagery in recent years have been measured, clearly indicating the shift from agricultural areas, previously dedicated to vine cultivation, to houses with pools now oriented towards tourism. Furthermore, based on the detected geospatial changes, a projection has been made considering the continuity of the analyzed trends. To study the negative correlation between different variables, a correlation matrix will be used. This analytical tool provides a systematic and comprehensive approach to assess the relationships between variables, uncovering the presence and magnitude of negative correlations. By utilizing a correlation matrix, it will be identified and quantified the strength of inverse associations, thereby enhancing the understanding of complex interrelationships and patterns within the dataset. This research aims to conclude the importance of fostering agriculture in European countries since it is of paramount importance for several reasons.

Biodesinfection in Spanish horticultural crops as a profitable and efficient alternative: a step towards circular economy

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Abstract
Intensive agriculture has led to a myriad of environmental impacts that significantly affect ecosystems. One notable consequence is the decline in water quality, including detrimental effects on marine environments, caused by the extensive use of conventional fertilizers. In response, institutions have devised diverse strategies grounded in the principles of the circular economy and the bioeconomy. These approaches aim to curtail excessive fertilization practices and mitigate the negative externalities they entail. In our research, we present a comprehensive field trial that evaluates the complete elimination of conventional inorganic fertilizers. Instead, we implement a production methodology centered on the utilization of recycled plant residues in conjunction with other organic compounds. To illustrate the efficacy of this approach, we focus on a tomato crop and meticulously analyze the profitability of this alternative technique relative to conventional vegetable production methods. The findings of our trial underscore the remarkable sustainability and financial viability of farms that embrace these innovative strategies from a circular perspective. Not only do they effectively reduce environmental impact, but they also demonstrate enhanced economic returns. By adopting this ecologically sound approach, agricultural practices can be aligned with the principles of the circular economy, paving the way for a more sustainable future.

Tunisian immigrants in Sicily: is it a contribution to sustainable agriculture?

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Abstract
Tunisian immigration in Italy has 110,000 immigrants, 20% of whom in Sicily correspond to 23,000 in a regular situation with residence and long-term work permits. It began in the 1960s and 1970s. It is primarily an economic immigration of rural origin. Western Sicily was a destination for Tunisian immigration due to a rural exodus to the north of Italy and a need for restocking. Today 16% of these Tunisian immigrants work in fishing in Sicilian coastal towns. Tunisian immigration to Italy increased after 1980 due to an employment crisis and diplomatic incident with Libya. From the 2000s, family reunification feminized this immigration through marriage and then higher education. Some are agricultural workers at the beginning then gradually leased land in the south of Sicily, province of Ragusa in particular, to make vegetable crops. Over the past decade, land has been acquired and new farms have been created. This contribution provides an overview of these new agricultural entrepreneurs in Sicily.

Nectar-inhabiting bacteria: Effects on egg parasitoids of invasive stink bugs

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Abstract

Pests and diseases account for 40% of the food crop losses worldwide. In the era of climate change and global trade, pest occurrence is projected to rise, subsequently increasing the losses in crop production. In this gloomy scenario, it is more than ever crucial to reinforce the resilience of our agroecosystems. Increasing plant diversity in the agricultural landscape leads to a rise in the diversity and abundance of natural enemies of pests, such as predators and parasitoids, which are involved in biological control of insect pests. However, the increased occurrence of these natural enemies does not necessarily translate into reductions in pest occurrence. There may be various factors behind this discrepancy. Flowering plants are assumed to improve parasitoid performance by providing food resources, such as nectar, which is a sugar-rich solution on which adult parasitoids rely for their energetic and nutritional needs. However, we still do not understand how floral provisioning contributes to the efficiency of pest suppression by parasitoids. A hidden component may be the colonisation of nectar by microbes, which alter its quality. In this study, the performance of the following three parasitoids was observed: Trissolcus basalis, Ooencyrtus telenomicida and Anastatus bifasciatus. These parasitoids are important in terms of pest control since they attack the eggs of the invasive stink bugs, which have gained a global importance as plant health threats. Nectar was provided ad libitum to female adult parasitoids that remained in vials. The nectar provided was either fermented by different microbes or non-fermented nectar (control). All microbes were bacteria, which had been previously isolated from the nectar of Fagopyrum esculentum, and belonged to the phyla Firmicutes, Proteobacteria and Actinobacteria. The parasitoids performance was assessed in terms of the number of days during which the insects remained alive. Moreover, the attraction of parasitoids to the bacteria- fermented nectar versus non-fermented nectar was studied by using a four-chamber static olfactometer. The olfactometer consisted of an arena for the insect to walk on and, below the arena, it was divided equally into four chambers, in which the nectar solution was kept on a filter paper. The parasitoids attraction was assessed in terms of their residence time on top of the chambers. Overall, this work highlights the importance of considering the role of nectar-inhabiting microbes in shaping the interactions between parasitoids and their food resources. There results will be discussed in terms of biological control.

Biological control strategy in Sicily: the Biofactory of Ramacca (Catania, Italy)

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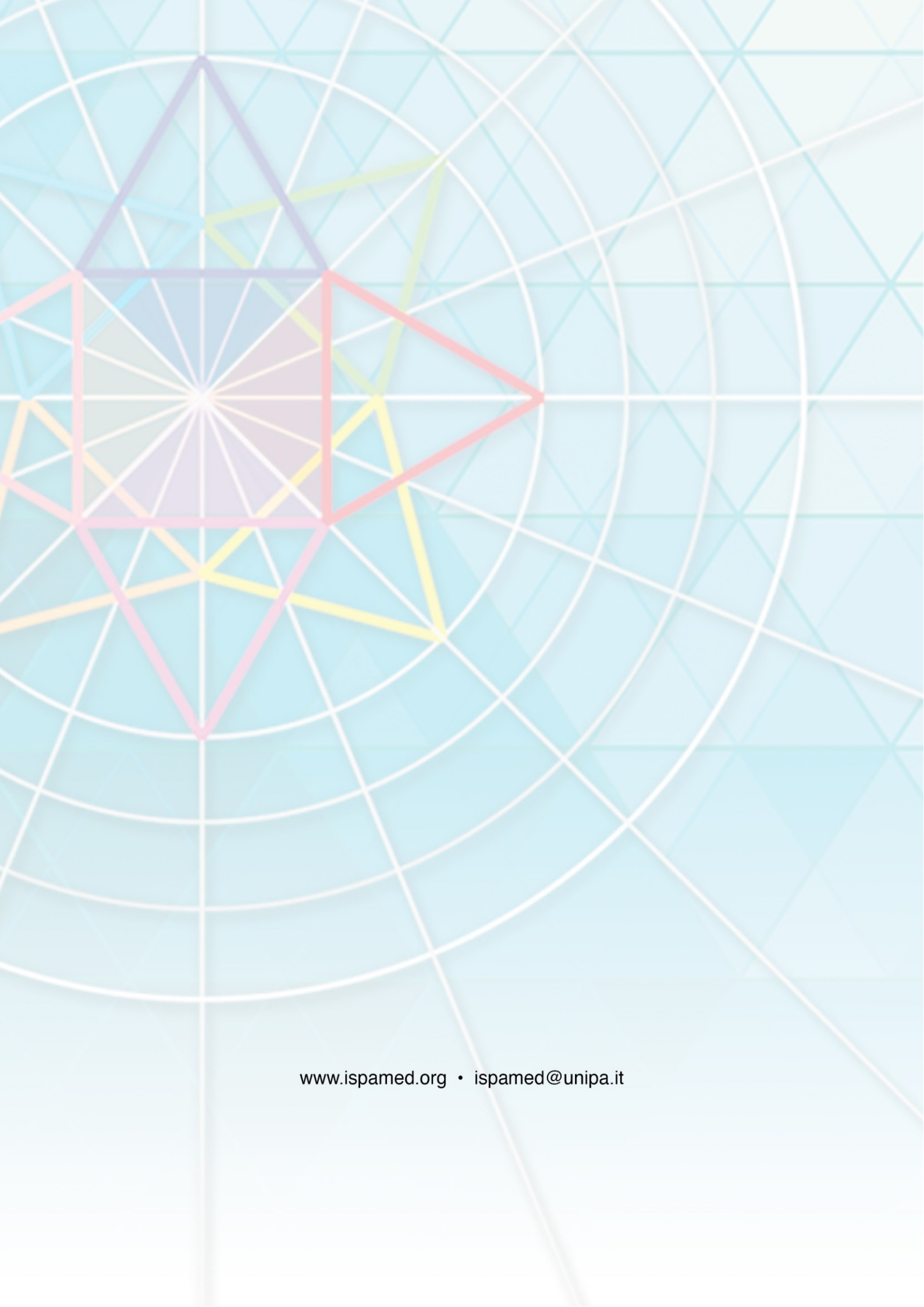
Abstract
Since 2007, in Sicily, plant health protection against citrus and vine mealybugs is taking place through the Biofactory of Ramacca, in the Plain of Catania, a property of the Ente per lo Sviluppo Agricolo of the Sicilian Region, E.S.A., recently enlarged to Thrips and Greenhouse Whiteflies. The Biofactory is unique being aimed to produce industrial quantities of auxiliary insects and is a center of European interest because it is fully organized to provide means of biological fight imposed by the Directive 28/2009/EC (in Italy Legislative Decree 14 August 2012, n. 150), which requires, from 1 January 2014, farms to comply with the application of general principles of integrated pest management. In this report we examine structural features of the Biofactory, breeding techniques empoyed and results obtained in the period 2007–2022, which allowed many companies, from 200 to 360 (i.e. 20% –35% of the regional surface operating in organic citrus production) to be able to employ biological weapons against pest insects. We analyze dynamics and results of production deriving from the approval and adoption, by the owner (E.S.A.), of a new "discipline" which governs the assignment of insects to Sicilian farmers but also to distribution companies for large quantities to balance E.S.A.'s purposes, which are both to ensure adequate performance in order to pursue institutional support to agriculture and that of the economic sustainability of the service. The continuity of the project is assured by the ongoing program for the period 2021–2028 with an enlargement of the array of entomological production aimed at intercepting the needs of new productions (i.e. greenhouse horticulture, vines, ornamental and fruit trees).



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