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Boosting Resilience in Seedlings and Grafted Vegetable Transplants

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In the last decade, the U.S. semi-arid agricultural regions, including southwest Texas, have faced alarming episodes of heat and drought stresses. These extreme environmental conditions trigger transplant shock and negatively affect crop performance and economic returns. In response, research from our TAMU Veg Lab, along with other various groups, has concentrated on developing pre-transplant management strategies to boost resilience and increase seedling stress tolerance to ensure a successful stand establishment and transplant growth performance. Specifically, we have been focused on gaining a better understanding of how selective strategies regulate or induce key morpho-physiological traits involved in seedling and grafted transplant adaptation. To approach this question, we take advantage of G×E×M^2 (Genetics × Environment × Management × Microbes) factors and their constructive interaction influencing specific or multiple traits. In the second part of this presentation, we will focus on grafting, a unique and widely recognized tool for managing soil-borne diseases and mitigating abiotic stresses, and how plant responses differ between grafted vs. non-grafted plants (emphasis on tomato and pepper) when exposed to different management strategies, environmental stresses, and nitrogen inputs particularly under protected environments and organic systems. We will also highlight key traits that help evaluate a diverse pool of scion and rootstock genotypes, shedding light on the selection process for optimal grafting outcomes.

Keywords: heat stress, drought stress, scion, rootstock, tomato, pepper

ORAL ABSTRACTS

Enhancing Plant Nursery Production with Advanced and Ultra-Density Indoor Farming Systems

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The growing demand for high-quality seedlings, together with the need to reduce the environmental footprint of agricultural processes, is pushing the nursery sector beyond the traditional greenhouse paradigm. In recent years, indoor cultivation systems and vertical farming have attracted attention thanks to their ability to maintain stable environmental conditions, cut water and pesticide use, and ensure continuous year-round productivity. This study aims to provide an integrated overview of the advantages, limitations, and economic implications associated with the potentiality of the nursery industry to produce in ultra-density indoor farming systems, compared to the traditional transplant production. This review examined studies reporting quantitative data on five key dimensions: (i) environmental control—temperature, relative humidity, photosynthetic photon flux density (PPFD), and CO_2 concentration; (ii) resource efficiency—consumption of water, nutrients, electricity, and pesticide use; (iii) space utilisation—yield per unit area and number of cultivation layers; (iv) seedling quality—uniformity, mortality, and plant health status; and (v) economic indicators—investment cost, operating cost, and potential revenue. All values were normalised and summarised using medians and ranges to construct a coherent comparison between indoor systems and traditional nurseries. Across the information analysed, fresh weight yield increases of +30 % to +60 % were reported for indoor systems compared to conventional greenhouses, while seedling mortality decreased on average from 6–8 % to 3–4 %. Water consumption was 90–95 % lower thanks to closed-loop hydroponic circuits, whereas electrical energy intensity was 3 to 6 × higher. Investment costs were 5–10 × greater, yet year-round production cycles and premium quality allow higher sales prices. Full environmental control in indoor farming delivers tangible benefits in nursery productivity and seedling quality, but the energy trade-off remains the main barrier to large-scale adoption. Hybrid models—indoor germination followed by greenhouse finishing—emerge as the most economically and ecologically balanced strategy for nurseries targeting premium quality.

Keywords: nursery production; indoor farming; vertical farming; seedling quality; resource efficiency

Oral session 1

Precision fertigation management for vegetable crops and seedlings with NutriSense DSS

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NutriSense is a Decision Support System (DSS) designed to optimise nutrient management in vegetable crops and seedlings grown in both soil and soilless systems. This innovative tool can assist growers in precisely managing fertigation to meet crop requirements and minimise the nutrient losses. The DSS uses validated algorithms and models to adapt the nutrient supply to the plant species, the developmental stage, the climatic conditions and cropping system aiming to maintain optimal nutrient concentrations in the root environment. Two primary modules are offered through the DSS: the SOILLESS NutriSense and the SOIL NutriSense for soilless and soil-grow crops, respectively. In particular, the SOIL NutriSense version calculates optimal fertigation based on soil and irrigation water analysis data, ensuring nutrient availability while mitigating nutrient losses due to leaching and avoiding over-fertilisation. Fertiliser recommendations can be updated throughout the growing cycle when new soil analyses become available, ensuring that fertilizer applications align with crop needs. The version for soilless crops is used for nutrient solution (NS) composition management, considering the water's mineral composition and the characteristics of the growing system. An important feature of the DSS is its support for nutrient management in closed-loop soilless culture systems where the drainage solution (DS) is recycled. The DSS can adjust the net nutrient input into the system according to the composition of the DS after chemical analysis. Furthermore, special algorithms and models are used to tackle one of the main obstacles in closed-loop system implementation, sodium accumulation, which imposes salinity stress due to increasing electrical conductivity (EC). Another advanced feature integrates ion-selective electrodes (ISE) to monitor nutrient concentrations in the DS on daily basis, enabling automated, precise modifications to the supplied NS to improve nutrient management. Furthermore, the DSS includes special recommendations for the seedling stage to effectively achieve the desired morphological and physiological plant characteristics. During this stage, fertigation management plays an important role as it can be used to apply controlled eustress via the NS EC levels. Overall, as an innovative fertigation management tool, NutriSense DSS represents a significant advancement in precision agriculture, offering a comprehensive solution for efficient and environmentally friendly nutrient management in soil and soilless vegetable production.

Keywords: hydroponics, soilless culture, greenhouse, nitrate pollution, nutrient model

ORAL ABSTRACTS

Harnessing synthetic allotetraploid rootstocks to enhance yield and crop resilience

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We report the development of novel synthetic allotetraploid tomato rootstocks, created by chromosome doubling of interspecific hybrids. These rootstocks exhibit broad compatibility with commercial scions and deliver yield gains of up to 46% per plant. Moreover, by crossing distinct synthetic allotetraploids, we combined four diverse genomes within a single genotype, providing “super-heterosis” and enabling the consolidation of complex polygenic traits. While such genomic combinations might not benefit fruit quality, their deployment as rootstocks allows the benefits of wild relatives to be realized without compromising fruit traits. Field trials have demonstrated that tetraploid hybrid rootstocks outperform their inbred counterparts in both vigor and yield. Our rootstocks deliver substantial yield gains, and their low seed production costs make grafted plants economically viable in many new systems. When combined with robotic grafting, this approach enables a transformative shift in crop production practices. The economic case for the application of these rootstocks, even for relatively low-value crops such as processing tomatoes, is described in the accompanying poster by Lefers et al. This hybrid tetraploid strategy is expected to significantly influence the future development of rootstocks across a wide range of crops.

Keywords: breeding, polyploidy, climate resilience, innovation

Oral session 2

Challenges and trends in the production of grafted watermelon seedlings

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Watermelon (*Citrullus lanatus* L.) is a widely enjoyed and flavorful crop primarily grown in warm subtropical areas across the globe. In 2021, the total export value amounted to EUR 2.02 billion, marking a 24.9% increase compared to 2017 and highlighting a growing trend in global consumption. European countries accounted for nearly half (47.4%) of the total export value (FAOSTAT Database, 2022). The production of grafted watermelon seedlings has gained significant attention in recent years due to its ability to enhance the resilience of watermelon crops against soil-borne diseases, improve overall plant vigor, and increase yield potential. However, the production of grafting watermelon seedlings presents a range of challenges and trends that must be addressed for successful commercial implementation. In 2004, AGRIS began its involvement in the development of grafting watermelon seedlings and is now the largest producer in South-east Europe with a production of about 12 million seedlings. Grafted watermelon seedlings production has three separate stages: growing of scion and rootstock seedlings to be grafted (stage I), grafting and healing of grafted seedlings (stage II), and acclimatization of grafted seedlings (stage III). A major challenge is the environmental conditions, especially the radiation temperature during scion and rootstock cultivation, the climate during the healing process, and the radiation, humidity, and temperature in the hardening stage. Modern trends in grafted watermelon production focus on energy saving and dynamic supplementary lighting, both in the greenhouse and healing chamber.

Keywords: healing; scion; rootstock; acclimatization

ORAL ABSTRACTS

Watermelon grafting - Principles, practices, yield and quality

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Watermelon is one of the most popular vegetables to be grafted, and more than 90% of the plants in Serbia are grafted. One of the reasons why grafting is widely used in watermelon production unlike other vegetables, is the easily available and cheap seeds from the pumpkin family, which mainly serve as a rootstock for successful watermelon grafting. The most successful method for grafting watermelon, among others, is the "head grafting" technique. The most important quality factors for good watermelon fruits are sugar content in the heart of the fruit, texture and overall taste. High marketing yield with the lowest percent of physiological disorders was observed in watermelon 'Top gun F1' fruits grafted on rootstock 'Emphasis F1' – Lagenaria type. Descriptive analysis showed that the dominant features in the sensory profile of watermelon were grafted onto 'Emphasis F1' and Lagenaria siceraria rootstocks: moderately watery, refreshing, crunchy, ripe and sweet. The fruits of plants grafted on the basis of 'Strong tosa F1' (a commercial interspecies hybrid of C. maxima × C. moschata) are characterized by spongy, drier and firmer consistency, with a moderately pronounced feeling of sweetness. Fruits from non-grafted plants have a soft and watery consistency with a sweet taste. A typical pleasant smell characterizes watermelon fruits grafted on the 'Emphasis F1' rootstock, while the remaining grafting combinations, to some extent, encourage the appearance of the smell of cucumber 'Strong tosa F1' or pumpkin (Lagenaria siceraria) with increased acidity. This is a noticeable reduction in quality, so the key is that grafting should not be applied in healthy soils. Grafting is a must in contaminated soils. Based on the results, grafting, using the appropriate rootstock and scion combination, could be beneficial for increasing yield and maintaining quality parameters in fruit and vegetable production, especially in light of climate changes.

Keywords: scion; rootstock; physiological disorders; quality; taste

Oral session 2

Developing Grafting Research Programs to Advance the Long-term Sustainability of Watermelon Production

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As multifaceted tools are being evaluated and developed to address production challenges associated with disease management, nutrient stewardship, and water conservation faced by the watermelon industry, growers' interest in and adoption of grafting technology is also emerging and evolving in the United States. Watermelon grafting research in Florida and California, which represent leading states in watermelon acreage and market value in the U.S., has been largely driven by the critical need for enhancing environmental and economic sustainability. The assessment of rootstocks (Cucurbita moschata, Cucurbita maxima × C. moschata, and Citrullus amarus) for seedless watermelons has focused on Fusarium wilt and root-knot nematode resistance as well as cold tolerance for early planting. In addition, the scion-rootstock synergy to promote crop productivity and rootstock impacts on fruit development have been evaluated. The analysis of fruit sensory and compositional quality across multiple seasons, different cultivation systems, and various rootstock-scion combinations revealed that in general watermelon quality can be maintained or even improved for certain attributes when grafted plants are used. Wider plant spacings with a reduced plant population have been shown to help improve the cost-effectiveness of grafted watermelon production while enhancing crop performance. Moreover, best management practices and integrated strategies have been studied to develop recommendations for optimizing water and nitrogen management programs in grafted watermelon production. For example, the ET-based irrigation and fertilization decision support tool was tested in California watermelon fields and the controlled-release fertilizer was examined in Florida watermelon fields. Building a strong partnership with commercial watermelon producers, seed companies, and grafting nurseries contributes substantially to identifying meaningful and impactful grafting research priorities. The watermelon grafting research network is also expected to promote rootstock breeding, technology transfer, and development of innovative solutions to overcome site-specific production constraints.

Keywords: Grafted watermelon, disease resistance, early planting, plant spacing, fruit quality, best management practices

Watermelon graft union formation regulated by rootstock cotyledon and light

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Grafting is a propagation method extensively utilized in watermelon. Traditional watermelon grafting methods (hole insertion and one-cotyledon splice grafting) require the retention of at least one rootstock cotyledon during the healing period to ensure graft success. However, the mechanisms underlying graft healing as regulated by rootstock cotyledon remain poorly understood. Our results showed that the rootstock auxin and sugar levels decreased after the removal of rootstock cotyledon. The rootstock cotyledons regulate callus formation through *ClPIN1a*-mediated endogenous auxin release, thus facilitating graft union development in watermelon. Transcriptomic analysis revealed that cotyledon removal disrupted sugar metabolism and affected gene expression related to cell division and tissue development, and the rootstock's cotyledon-regulated fructokinase *ClFRK1* contributes to graft union formation in watermelon. When rootstock cotyledons were completely removed, pretreatment of high light intensity (300 $\mu mol \cdot m^{-2} \cdot s^{-1}$) to the rootstock exhibited higher survival rate and displayed high seedling quality, enhanced graft union adhesion, and accelerated vascular reconnection. High light intensity pre grafting enhances the translocation and storage of hormones and sugars in the hypocotyl. The above results suggest potential strategies for enhancing watermelon graft union formation by manipulating rootstock cotyledons and light.

Keywords: Watermelon, Graft healing, Cotyledon, Light, Mechanism

Oral session 2

Swelling and rottenness of squash rootstock in grafted watermelon

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In recent decades, grafting watermelon onto squash rootstock has become a common practice worldwide, primarily to combat soil-borne diseases. In addition, the strong vigor of the squash rootstock was found to have a positive effect on the watermelon yield. However, a new concern has emerged in recent years, rotting of the squash-watermelon grafting tissue. At high infection levels, this issue can significantly reduce the watermelon yield biomass. Moreover, a survey indicates that this phenomenon is more prevalent in areas when the crop is exposed to high relative humidity. Isolations did not detect a specific pathogen that can fully explain the phenomenon. Moreover, the pathogens that were found in the infection area are considered as a secondary pathogens that can only infect a weak tissue. Field trial has shown that the occurrence of the phenomenon is related to the scion-rootstock pairing. Specifically, the rotten grafting was observed only in specific rootstock-scion combinations. When either the rootstock or the scion was replaced with watermelon (rootstock) or other watermelon accession (scion), the phenomenon disappeared. These findings suggest that the root cause of the issue is more likely to be physiological than epidemiological. Future research will focus on understanding the physiological factors that contribute to the formatting of this graft rot.

Keywords: Grafting, Root pressure, Rootstock-scion interaction, Rottenness

Oral session 3

Cutting-edge technological and management innovations in vegetable seedling nurseries

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The use of high-quality planting material in vegetable cultivation has a significant impact on crop yield and quality, harvest time and therefore profitability. The aim of this study is to provide an overview of the recent technological and management innovations in vegetable seedlings and transplants production to improve crop sustainability and quality. Thus, the use of multispectral image analysis using artificial intelligence to evaluate seed germination and seedling growth, thermography for irrigation and pest control, the utilization of robotics and drones to increase the efficiency of agronomic management, and seed enhancement technologies through micro and nano-priming are explored. In addition, the incorporation of peat alternative materials such as wood fibre and composted green waste into growing media to reduce their environmental footprint, which should be assessed using standardized life cycle analysis methodologies to ensure accurate and comprehensive evaluation, is studied. The integration of IoT and Blockchain in vegetable seedlings production is also analysed to enhance plant traceability, ensuring real-time monitoring and regulatory compliance. Furthermore, the utilization of nursery techniques to contribute to the production of alternative leafy vegetable products such as baby leaf, teen-leaf and microgreens is examined. Finally, the use of low-cost tools in nurseries to generate higher returns to the companies, while maintaining the sustainability of the production chain is studied. The main findings of this study show that both industry and researchers have carried out numerous innovations and research schemes to optimize seedling production using advanced and sustainable management technologies.

Keywords: Growing media, priming, thermography, multispectral image analysis, plant traceability

Oral session 3

Effective Seed Treatment for Managing Seedling Damping-off of Pumpkin, Caused by Phytophthora capsica

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Phytophthora blight, caused by *Phytophthora capsici* Leonian, is the most important disease of cucurbits in Illinois, United States of America (USA). Illinois is the leading state in pumpkin production in the USA. *P. capsici* causes pre- and post-emergence seeding damping-off. Seedling death in some pumpkin fields was so severe that growers had to replant the fields for a second and even a third time. This study was conducted to develop effective seed treatments to protect pumpkin plants against *P. capsici* during stand establishment. Mefenoxam (Apron XL LS) and metalaxyl (Allegiance F) were highly inhibitory to growth of mycelium of *P. capsici* in vitro. Effectiveness of the seed-treatments were test on pumpkins 'Dickinson', 'Hybrid-401', and 'Hybrid-698'. The following information was collected on pumpkin 'Dickinson', the most susceptible cultivar to *P. capsici*. Effective dose (ED50) of mefenoxam and metalaxyl for 50% inhibition of mycelial growth, for all five isolates of *P. capsici* tested, was 0.98 and 0.99 µg a.i./ml on culture medium, respectively. In the greenhouse studies, thirty-one days after seeding, at inoculum levels of 0, 90, and 600 CFU/g of soil, the average seedling stands for mefenoxam treatment were 98.4, 93.8, and 88.3%; for metalaxyl, 99.1, 85.3, and 85.8; and for the untreated control, 97.5, 55.2, and 45.7, respectively. In field trials, the average seedling stands 35 days after seeding were 76.7, 74.7, and 44.9% for mefenoxam, metalaxyl, and untreated control, respectively. Seed treatment with mefenoxam or metalaxyl did not have any significant effect on either seed germination or seedling vigor.

Keywords: Phytophthora capsici, seedling death, seed-treatment, mefenoxam, metalaxyl

Real-time seed moisture measurement enables fully automatic seed disinfection and/or priming and intermediate or final drying steps

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Seed treatment and/or priming have become well established methods to secure healty- and fast germination and stand establishment after sowing for transplant or direct drilling. Less available syntetic crop protection products, both seed applied as well as soil/foliar applied create more and more challenges sufficient and rapid stand establishment. Costly and/or very exlusive, mostly propriatary seed enhancement did alow solutions for low volume high value greenhouse crops like solanaceae and cucurbits have been available for some decades now. This is also the case for sugarbeet. Since damatic increase in baby leaf crops as well as relevance in general for all vegetable and arrable crops, methods for cost effective but secure combinations of seed disinfection and priming has become more and more relevant. A key parameter to control all relevant process steps is actual moisture content of the seed during any step in the process. An installation has been developed and practically tested on relevant crops, to secure real moisture content measurment during all steps in the disinfection, priming and drying steps. Because of this constant and real-time moisture control system, complete automation of large scale seed disinfection, priming and relevant intermediate- or final drying steps has been made possible and tested in commercial scale.

Keywords: Disinfection Priming Drying Germination Stand Establishment

Oral session 3

Unleashing the Potential of Tomato Seeds through non-Transgenic Genome Editing of NF-Y Transcription Factors

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Modern tomato breeding increasingly focuses on enhancing fruit quality and nutritional content. In this pursuit, transcription factors (TFs) offer a powerful avenue for manipulating metabolic pathways. This study investigates the role of the heterotrimeric TF NF-Y in tomato seed fatty acid biosynthesis, leveraging the often-discarded by-product of tomato processing. Using Zinc Finger Nucleases (ZFNs), a non-transgenic gene editing technique, we disrupted NF-YB/L1L4 and NF-YA8 genes in tomato. Resulting mutant lines exhibited significant alterations in seed morphologies and germination, alongside notable changes in the seed fatty acid profile, demonstrating the efficacy of ZFN-mediated gene editing for nutritional enhancement. Analysis of tomato seed oil revealed a high proportion of unsaturated fatty acids, particularly oleic and linoleic acid, and significant inter-sample variability, highlighting potential industrial applications. Furthermore, the NF-Y mutant lines displayed altered fruit characteristics, prompting a transcriptomic analysis focusing on genes involved in linoleic acid (LA) and α-linolenic acid (ALA) metabolism. These findings underscore NF-Y's regulatory role and its promise as a target for breeding superior tomato varieties with altered seed oil composition and enhanced fruit quality, utilizing non-transgenic approaches to circumvent regulatory hurdles.

Keywords: ZFNs; Genome editing; tomato seed; NF-Y; fatty acids

ORAL ABSTRACTS

Effect of incubation temperature and gibberellic acid on dormancy breaking and seed germination of the protected plant *Lilium martagon* L.

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Lilium martagon L. is a Eurasiatic attractive bulbous plant that is protected by the Greek Presidential Decree 67/1981. The aim of the present study was to investigate the effect of gibberellic acid treatment and incubation temperature on dormancy breaking and seed germination of *L. martagon*. The seeds were soaked in GA_3 solutions of 500 and 1000 $mg \cdot L^{-1}$ for 24 h. To determine the effect of temperature on seed germination, the GA_3-treated seeds were randomly divided and placed in four temperature-controlled growth chambers (10, 15, 20 and 25ºC) with a 12-h light/12-h dark photoperiod. In addition, the seeds were soaked in distilled water for 24 h (control) and then placed in different temperature-controlled growth chambers to germinate. After ten weeks of incubation at 10, 15, 20 and 25°C, the control seeds were subjected to cold stratification at 5°C for 12 weeks and then placed back at the former incubation temperatures. The control seeds as well as the seeds treated with 500 and 1000 $mg \cdot L^{-1}$ exhibited the highest germination percentage (29, 53 and 49%, respectively) at the incubation temperatures of 15ºC. The treatment of seeds with GA_3 significantly improved the germination at 10 and 15°C. At the incubation temperature of 25°C, seed germination was observed only after cold stratification of the control seeds. However, in the germinated seeds which were planted in pots under greenhouse conditions, a significant delay was observed in the emergence of the cotyledonary leaf. The knowledge of the germination requirements of *L. martagon* seeds will facilitate future conservation efforts as well as the sustainable exploitation of this species as a new native plant of ornamental value.

Keywords: cold stratification, gibberellic acid, incubation temperature, seed dormancy, sexual propagation

Oral session 3

Improvement of okra seed germination and seedling growth rate by static magnetic field

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Okra (Abelmoschus esculentus L. Moench) is a significant vegetable crop with increasing interest worldwide. However, okra seed is characterized by delayed and low germination percentage, which is considered a major problem for producers. The object of this work is to study the effect of static magnetic field on germination parameters of okra seeds as well as seedling characteristics. Certified seeds of okra (cv. Pylaias') were used for the experiment. Seeds were exposed to the static magnetic field of 45, 150 or 300 mT for 30, 60, 90 or 120 min. All treatments were performed under similar environmental conditions (temperature 22.72 ± 1.12 °C; relative humidity (RH) 48.46 ± 8.96%). Four replicates, each with 25 seeds, were sown on moistened filter paper disks in Petri dishes and incubated at 21 °c in an upright position for 7 days in a GRW-500 CMP incubator. Based on the data from the petri dish experiment, we study the effect of the optimal combination on seed germination and growth parameters under common nursery conditions. Therefore, four replicates of 25 untreated and treated seeds were placed in a styrofoam cell tray, irrigated with tap water for 3 weeks. Afterwards, one seedling of each replicate was taken randomly and transplanted into individual pots of 10 L in volume and filled with a 1:1 perlite: peat mixture. After 4 weeks in a heated glass greenhouse, the experiment ended. Exposure of okra seeds to 45 or 300 mT static magnetic field had no effect, but only some individual differences compared to the control. On the hand, about germination percentage and speed of germination, all exposure times at 150 mT had higher values than the control, but only exposure of 60 min was significantly higher. In the second experiment, the data of germination percentage and speed of germination of okra seeds show a significant improvement by the application of a magnetic field at 150 mT for 60 min, with the increase for treated seeds being 42.9% and 107.1% compared to the control. From the above results, it is clear that there is a beneficial effect from the exposure of seeds to a magnetic field of 150 mT for 60 min on the germination of okra seeds and seedling development.

Keywords: seed handling; transplants; Faraday cage

Oral session 4

Smart LED lighting to boost crop performance and energy efficiency in propagation

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The production of seedlings under fixed LED lighting has shown good results in terms of energy savings compared with an HPS lighting system. However, when HPS-LED lighting is retrofitted, the quality of the seedlings can be negatively impacted, and the associated power consumption could be further optimized. Our objectives in this study are to demonstrate the benefits of using dynamic LED spectra on the growth, morphology and energy consumption of tomato seedling production. Tomato seeds (Lycopesicum esculentum) and more specifically, the varieties Xaverius and Brioso, were sown in rockwool plugs for 14 days. Both tomato varieties were grafted on DRO141 rootstock. The plants were then transplanted into 10x10 cm cubes under 3 different light treatments. T1 (Broad spectrum*, 14h), T2 (Broad spectrum 5h + monochromatic red 7h + Broad spectrum 2h) and T3 (Broad spectrum 5h + monochromatic red 7h (+20% intensity) + Broad spectrum 2h). The light spectra were applied for 35 days. Each week, various morphological parameters were measured: stem height (h), stem diameter (d), number of leaves (NF), fresh weight (FW), leaf area (SF) and root area (SR). No significant differences were found between plants in treatments 1 and 2. However, treatment 3 induced significant differences compared with treatments 1 and 2. For example, T3 reduced height by 9.8% and 15.9% (average for both varieties) compared with T1 and T2 respectively. In addition, treatment 3 increased the number of leaves by 12.3% and 12% respectively. Finally, fresh biomass was 17.6% and 11.3% higher for treatment 3 than for treatments 1 and 2. We demonstrated that dynamic lighting with the application of monochromatic red during part of the photoperiod did not diminish the morphological properties of young tomato plants, while reducing power consumption. In addition, by increasing the intensity of monochromatic red, it is possible to improve agronomic performance.

Keywords: tomato, energy saving, dynamic lighting, broad spectrum

Oral session 4

Mechanism of light for the production of grafted watermelon seedlings

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Watermelon is among the most important vegetable crops in terms of economic value. Throughout the world, watermelons are mainly established through grafted seedlings due to a number of factors. The production of grafted seedlings can be grouped in three stages: firstly the cultivation of scion and rootstock seedlings, secondly the healing of grafted seedlings, and thirdly the acclimatization of healed grafted seedlings. All stages take place indoors during winter or early spring when light quantity is insufficient. Our objective was to obtain a cultivation protocol of grafted watermelon seedlings' production for all three stages mentioned above using artificial lighting. In the first stage, seedlings to-be-grafted were grown in a greenhouse under supplemental high-pressure sodium (HPS) lamps or 12% blue/88% red (12B/88R) light-emitting diodes (LEDs) with 18 h photoperiod and 90±10 μmol m-2 s-1. Important morphological (stem diameter, leaf area) and biomass (above- and underground) factors were enhanced under 12B. In the following stage of healing, grafted seedlings were treated with LEDs emitting various red/blue compositions in a chamber with controlled conditions (18 h photoperiod and 85±10 μmol m-2 s-1, 25 °C, 93-99% relative humidity). Initially, blue light promoted vascular reconnection, while afterwards red light enhanced the development and molecular profile of the grafted seedlings. Moreover, internal plant growth regulators participated in a varying signaling cascade depending on the light environment. During acclimatization, the experimental set-up was similar to the first stage. Indeed, 12B promoted physiological attributes and root growth, which is crucial for the subsequent plant growth post-transplantation. Overall, LEDs proved beneficial for the production of seedlings to-be-grafted as well as for acclimatization of grafted seedlings in the greenhouse. In the stage of healing it was shown that even small interplays in the light spectra triggers a significant effect in plant behavior.

Keywords: Citrullus lanatus; transplants; light-emitting diodes; LED; controlled environment agriculture

The LED light quality can influence on seedling quality of cucumber scion before grafting operation

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Cucumber is an essential crop in Iran, and susceptibility to soil-borne diseases is a significant production limiting factor. Vegetable grafting can be used as a tool to overcome this problem. In Iran, finding ways to shorten the production period and ensure seedlings' quality is necessary because of the year-round production of cucumber. The first stage of producing grafted cucumber seedlings is the production of uniform scions and rootstocks. PFALs are a suitable production system for growing seedlings without being affected by weather conditions. Light quality and quantity are environmental factors strongly affecting seedlings in controlled environment agriculture. In this study, cucumber scions were treated with different light treatments to evaluate the morphology and growth of cucumber scions. Treatments included five ratios of red and blue LEDs as R9:B1, R8:B2, R7:B3, R6:B4, and R5:B5 in two photosynthetic photon flux densities, 200 and 300 µmol m^{-2} s^{-1}. The temperature was set at 25/18°C (day/night), and photoperiod was 16 h. After 9 days, seedlings were evaluated. The highest hypocotyl length was observed in the ratio of R9:B1 and intensity of 200 µmol m^{-2} s^{-1} by 108 % increase from the ratio of R5:B5 and intensity of 300. The highest shoot dry weight was observed in the ratio of R9:B1 at a light intensity of 300 µmol m^{-2} s^{-1}, with a 66 % increase from the ratio of R5:B5 at a light intensity of 200. The highest leaf area and hypocotyl diameter were observed in the ratio of R9:B1 at a light intensity of 300 µmol m^{-2} s^{-1}. Our findings suggest that a high percentage of red light and a higher intensity could be beneficial to produce cucumber scion seedlings.

Keywords: Red to blue ratio, light intensity, hypocotyl, Plant factory

Oral session 4

Dynamic lighting for growing watermelon scion seedlings in a PFAL

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Watermelon (Citrullus lanatus L.) is a nutritionally and economically valuable cultivation, established through grafted seedlings. During peak seasons, the high demand for grafted watermelon seedlings adds pressure on nurseries, which often face space constraints due to simultaneous scion and rootstock production. Additionally, maintaining optimal temperatures in greenhouses can be challenging during winter, leading to extended cultivation periods and obstructing production planning. Plant factories with artificial lighting (PFALs) offer a promising alternative in high-quality seedling production, under completely controlled environmental conditions and at higher densities than traditional greenhouses. Within PFALs, dynamic lighting, i.e., altering light parameters during plant development, could enhance seedling quality. This study aimed to investigate the effects of dynamic lighting on the quality of watermelon scion seedlings intended for grafting, produced in a PFAL. Two days after sowing (DAS), trays containing the hybrid "Celine F1" (HM. Clause SA, Portes-Les-Valence, France) were moved to an experimental PFAL under LED lighting (PPFD 100 ± 10 μmol m−2 s −1), 18 h photoperiod, and 24/20°C day/night temperatures. Lighting treatments included combinations of white (W) light with deep-red/36% blue (RB) or deep-red/white/12% blue (RWB). Treatments were structured in two phases: the first spectrum from 2 to 7 DAS and a second from 7 to 12 DAS. These included W-RB, W-RWB, RB-W, and RWB-W, and a constant W as a control. Each treatment had 24 replicate seedlings and statistical analysis was conducted at $\alpha=0.05$ ($p \leq 0.05$). Results showed that shoot and root fresh and dry weights were significantly higher under W-RWB compared to other treatments, with RB-W having similar root fresh weight. Leaf area was also significantly greater in W-RWB and RB-W, and sturdiness quotient was best in RB-W. Dickson's Quality Index was significantly higher in W-RWB and RB-W compared to RWB-W and the control, while W-RB showed no significant differences from the other treatments. The results suggest that appropriate dynamic light combinations during watermelon scion seedling development can significantly affect quality. In particular, the W-RWB and W-RB spectra combinations proved to be promising options for PFAL-grown watermelon seedlings intended for grafting.

Keywords: vertical farming; light-emitting diodes

The effect of photoperiodic and supplementary lighting on tomato seedlings under short-day conditions

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Producing healthy, well-acclimated transplants is critical for greenhouse seedling production, particularly during seasons with limited sunlight. This study examined the influence of light quality and timing on the growth, morphological development, and physiological responses of tomato (Solanum lycopersicum) seedlings under short-day conditions. Two experiments were conducted: in the first, seedlings were subjected to six light treatments—control (no supplementary light), monochromatic blue (B) light, monochromatic red (R) light, and four red-blue spectral combinations (75% R + 25% B, 67% R + 33% B, 50% R + 50% B, 33% R + 67% B)—at a density of 100 µmol $m^{-2}s^{-1}$, supplemented with natural sunlight. In the second experiment, the same light treatments were applied for four hours at the end of the day to assess the effects of photoperiod extension. Growth metrics, including plant height, stem diameter, leaf area, and dry biomass, as well as physiological parameters such as chlorophyll content, and antioxidant enzyme activity, were evaluated. The results indicated that all artificial light treatments led to a reduction in longitudinal growth and an increase in stem diameter compared to the control. The control treatment exhibited the lowest dry matter accumulation. However, supplementary lighting significantly enhanced seedling growth quality and physiological performance relative to the control. Red-blue light combinations were more effective than monochromatic treatments, with the 75% R + 25% B regimen demonstrating optimal outcomes, including increased plant height, leaf area, dry biomass, and photosynthetic efficiency. Furthermore, extending the photoperiod with supplementary lighting at the end of the day further improved seedling quality, highlighting the critical roles of both spectral composition and timing in optimizing growth. These findings underscore the potential of tailored light regimes to enhance tomato seedling production under short-day conditions, providing actionable insights for improving crop performance in controlled agricultural environments.

Keywords: Seedling, light quality, photoperiod extension, red-blue light combination, dry biomass

Oral session 4

Optimizing light intensity and salinity on the establishment growth and quality of *Salicornia europaea* L. and *Crithmum maritimum* L. under controlled environment agriculture

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Halophytes are a group of plant species capable of withstanding extreme salinity and thriving in degraded soils. As the nutritional value of many of these species is high, they can serve as an alternative crop for degraded soils. The effect of salinity and light intensity on Greek native edible halophyte plants, *C. maritimum* L. and *S. europaea* L. was investigated. For both halophytes, 4 light intensities (400, 600, 800,1000 μmol m^{-2} s^{-1}) were selected. As for *C. maritimum* L. and *S.europaea* L. 2 salinity treatments were included (Crithmum: 0, 200mM NaCl, Salicornia: 0, 400mM NaCl). The experiments were set in a controlled environment agriculture (CEA) chamber with constant temperature (23°C) and photoperiod 16:8, (day: night). The effect of salinity was evident, only, in *S. europaea* L. showing an increase in above-ground fresh weight at 800 μmol m^{-2} s^{-1} light intensity ($p < 0.05$) and height within NaCl treatment. Antioxidant activity (FRAP) showed the highest value at 1000 μmol m^{-2} m^{-1} (249.61 μg g^{-1}). In contrast, concerning *C. maritimum* L., 1000 μmol m^{-2} s^{-1} reduced dry matter content (15.05% to 11.5% for 0 NaCl treatment and 14.4 to 11.5% for 200 mM NaCl) and showed the highest FRAP at 600 μmol m^{-2} s^{-1}(564.16 μg g^{-1}). Additionally, the height of 1000 m^{-2} s^{-1} treated plants increased, compared to 400-600 m^{-2} s^{-1} ($p < 0.05$). Therefore, regulation in light intensity will lead to an upgrade in growth and quality of selected halophyte species.

Keywords: degraded soils; dry matter; halophytes; height; antioxidant activity

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Oral session 5

Legal Framework for the marketing of seeds and propagating material other than seeds of vegetable species in the EU

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In this overview is presented the current legal framework for the production with a view for the marketing and the marketingof seeds and propagating material other than seeds of vegetable species. More specifically the two main pillars are presented, namely the registration of varieties, the certification system for seeds and the quality requirements for thepropagating material other than seeds of vegetable species along with the currently applicable plant health rules in the EU. This legal framework covers a list of vegetable species (not all) with the rest of them to be regulated with national rules. In addition, the categories of seeds, the requirements of seeds imported from third countries in EU and a list of derogations are presented. The rationale behind of those rules, is the marketing of high quality seeds and propagating material other than seeds of vegetable species in the EU market. Finally, a reference to the Commission proposal of regulation for the plant reproductive material for the revision of current rules is presented.

Keywords: seedlings; grafting

Oral session 5

Redefining Greece's Vegetable Market: New Trends & Growth Prospects

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Vegetable production in Greece remains an important pillar of the national agricultural production, covering a large percentage of the high per capita consumption of fresh vegetables in the country and exports to other countries. However, the sector is currently facing complex challenges, such as climate change, water resource adequacy, labor shortages and the emergence of new crop pests and diseases. To address new challenges, it is imperative to shift to novel cultivation practices, adopt resistant varieties with enhanced tolerances, and utilize grafted plants. Strategic adjustments are necessary to ensure both producer profitability and meet modern market demands. The emerging opportunities for the sustainable development of vegetable industry in Greece are thoroughly analyzed.

Keywords: consumption; seedlings; supply chain

Oral session 6

Effect of shading on fruit quality of grafted tomato plants grown under salinity stress

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The objective of this work was to assess the effects of shading by color nets on fruit quality from grafted tomato plants grown under moderate saline conditions. Tomato plants 'Paronset F1' grafted onto He-Man rootstock, covered by different color shade nets (pearl, blue and red with 40% shade level), were irrigated with non-salty water (1.7 dS m-1) and with moderate salty water (4 dS m^{-1}). Un-shaded plants irrigated with non-salty water represented control conditions. Salt stress at a moderate salinity level (4 dS m^{-1}) resulted in increase of lycopene and ascorbic acid content and in slight in total phenols content as health-promoting substances in all shading nets (blue, red and pearl), indicating the ability to mitigate the toxicity effect of salinity stress. Sugar and total organic acids content in tomato fruits from grafted plants increased under shading nets in comparison to non-shaded/control but it decreased in comparison to shaded control when moderate salinity water was used for irrigation. These results show that shading of grafting tomato under salinity stress has positive influences on the fruit quality.

Keywords: rootstock; scion; color nets; lycopene; ascorbic acid; sugar

Oral session 6

Onion *(Allium cepa)* inoculation with arbuscular mycorrhizal fungi form sand dunes and desert under salinity

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It is generally acknowledged that mycorrhizal fungal inoculation improves plant growth and performance at varying salinity levels by facilitating the plant's uptake of increasingly challenging-to-access nutrients. Investigating the symbiotic interaction between mycorrhizal fungus from sand dunes and onion (*Allium cepa* L.) plants as well as the uptake of mineral nutrients under varying salinity concentrations was the goal of the current study. The experiment took place in pots where three arbuscular mycorrhizal fungi inoculants from desert soils and sand dunes were used under two different levels of salinity. The study's findings demonstrated the beneficial benefits of mycorrhizal fungus inoculation on potassium uptake in plants grown under salinity. In comparison to the control, mycorrhizal inoculants POT8 from sand dunes and *Septoglomus deserticola* from desert soils demonstrated improved plant uptake of phosphorus as well. Similar behavior was displayed by the mixed mycorrhizal inoculum from Andros' island sand dunes, which had a greater potassium uptake than the control. Despite the modest colonization rate in plant roots, it displayed substantial quantities of nutrients. To learn more about the mechanisms enabling this association, it is imperative to investigate further the symbiotic relationship of mycorrhizal fungi from harsh environments like desert soils and sand dunes both at controlled and field conditions.

Keywords: arbuscular mycocorrhiza inoculum; Allium cepa; soil salinity

Enhancing Tomato Drought Tolerance Through Beneficial *Bacillus megaterium*: An Omics-Based Approach

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Bacillus megaterium is a plant growth-promoting bacterium known for its ability to sustain plant growth, modulate biochemical pathways, and enhance tolerance to abiotic stresses. In this trial, a commercial B. megaterium-based biostimulant (containing 5.109 CFU/g of each of the two strains, MHBM06 and MHBM77, Atens-Agrotecnologias Naturales SL, Tarragona, Spain) was applied on tomato (Solanum lycopersicum L. Pralyna hybrid, Sais Sementi, Italy) under 3 levels of water availability corresponding to 100%, 70%, and 40% of the water holding capacity (WHC). The biostimulant was applied to substrate at 0, 0.25, and 0.5 ml/L during transplantation and 10 days after transplantation (DAT). Plant responses were daily monitored using a high-throughput phenotyping (PlantEye F600, Phenospex, Herleen, Netherlands) platform belong to Arcadia srl; the platform is able to measure morphological traits (digital biomass, 3D leaf area, plant height, plant volume) and plant spectral indices (NDVI, NPCI, PSRI). Plant samplings (leaves and roots) were made at 7, 14, 21 DAT. Water stress had not affected plant growth at the first sampling (7 DAT), but *B. megaterium* at 0.5 ml/L improved all biomass components (roots, leaves, and stems dry weight) as well as root length. At the next sampling (14 DAT), the plants exhibited early water stress symptoms, with an increase in stem biomass under both *B. megaterium* inoculation, without and with moderate water stress (70% WHC). The bacterium's effect was also observed at the root level, with increased biomass and longer roots. At 21 DAT, the biostimulant significantly mitigated the adverse effects of drought stress by enhancing leaf and stem dry weight and improving the Membrane Stability Index (MSI). The phenotyping results on digital biomass confirmed *B. megaterium's* ability to counteract the water stress in tomato. The metabolomic profile of leaves at the end of the trial was notably altered, especially lipidic and organic oxygen compounds, both associated with stress response. The proteomic analysis revealed an up-regulation of proteins involved in DNA repair, stress response, and protection from Reactive Oxygen Species (ROS)-induced damage in the stressed plants, especially at 40% WHC. Nevertheless, at a higher dose of biostimulant, over-expression seems to be less intensified. These findings highlight the efficacy of *Bacillus megaterium*-based biostimulant in improving tomato plants resilience to water stress when applied to the root zone in a limited-irrigated environment (70% of WHC). However, these results were not confirmed at a more severe water stress (40% of WHC). The study underscores the potential of microbial biostimulants as a sustainable solution for mitigating the effects of climate change on horticultural productions.

Keywords: biostimulants, phenotyping, metabolomics, drought resilience, proteomics, root length

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Oral session 6

Grafting to alleviate stress in tomato plants irrigated with treated wastewater; a study at the molecular level

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Climate crisis is imposing critical conditions of water scarcity. Especially around the Mediterranean, the availability of water destined for agricultural use is declining and agricultural production is severely affected. The use of treated wastewater for irrigation is an emerging sustainable solution when the strict standards of this reuse are met. However, the reuse can create serious problems in crops due to high salt concentration in wastewater. The main objective of the PRIMA2021 – "SAFE" project is the development and optimization of solutions for sustainably growing crops using treated wastewater with a high salt content. For this project, a "grape" indeterminate tomato hybrid was cultivated hydroponically in a greenhouse of the Sustainable Agricultural Structures and Renewable Energy Resources Laboratory (SASRER Lab). Since one of the reasons of grafting is the tolerance against abiotic stresses and especially high salinity, "grape" tomato was grafted on a tolerant rootstock. Grafted and non-grafted plants were irrigated with treated wastewater and the effect of the use of biofertilizers i.e. Trichoderma was also tested against salinity. To elucidate the gene pathways that are induced or suspended by treated wastewater-imposed salinity during cultivation, tomato plants' molecular responses were also tested using -omics tools and detailed expression analyses in two different time points. Gene pathways responding to salinity stress like the key enzymatic antioxidants encoding genes, superoxide dismutase, catalase, glutathione synthetase, ascorbate peroxidase as well as genes encoding for non-enzymatic antioxidants, were monitored through real time RT-PCR in grafted and grafted tomatoes plus Trichoderma as well in the controls. We found significant changes in the expression of key genes between different treatments. Identifying the genes responsible for plants' responses sheds light on plants' adaptation which in turn can help towards developing more tolerant varieties through plant breeding. These varieties along with grafting on resistant rootstocks could be the future of indoor agriculture when wastewater reuse is applied.

Keywords: salinity; sustainability; wastewater reuse; gene expression; tomato

Oral session 7

Understanding and enhancing graft formation in plants

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For millennia people have used grafting to improve and propagate plants. Grafting is widely used in horticulture to increase stress tolerance, improve disease resistance and promote yields. However, we have a limited understanding of how two plants successfully fuse tissues and form vascular connections. Here, I will present my group's latest efforts to understand the molecular basis for how plants successfully graft. I will discuss our work using Arabidopsis thaliana grafting to understand the physiology, genes and pathways involved in successful graft formation. I will also present our recent results grafting with diverse species including monocots and conifers. Finally, incompatibility is a major cause of graft failure and I will present our work on understanding and overcoming this phenomenon. Altogether, our research sheds light on the mechanism of graft formation in diverse species and provides clues for improving grafting success rates.

Keywords: plant grafting, regeneration, Arabidopsis thaliana, graft incompatibility

Oral session 7

Tomato rootstock/scion combinations grown in mediterranean greenhouse conditions for improving yield components and soil microbiome

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Grafting in horticultural crops is an agricultural practice used to increase productivity by mitigating biotic and abiotic stresses at the soil level such as nematodes, soil borne diseases and salinity mainly affecting Solanaceae and Cucurbitaceae crops. The increased vigour and tolerance under harsh conditions in grafted plant is mainly controlled by the rootstock in use. In this trial, we evaluated the effectiveness of two commercial hybrid rootstocks for tomato (OptiFort and RS4) with two scions a mid-plum hybrid "101MVS" and a Sicilian landrace "Pizzutello" during the growing season of 2024. We collected and analysed the microbiome of the rhizosphere of each grafting combination, and the two controls: the auto-grafted and un-grafted of each scion. Microbiome DNA extracted was then sequenced by amplifying two specific regions ITS1-1F for Fungus and 16SV34 for bacteria. A relative lateness in fruit maturation was shown in grafted plants independently of the grafting combinations, at the same time a drastic increase in yield was recorded for the cultivar Pizutello grafted on both rootstocks. Thus, OptiFort combinations recorded the highest yield thru the 8 trusses harvested by plant for both scions with a 5% increase in fruit yield compared to RS4 with 101MVS. The primary analysis of the metagenome sequencing of the microbiome in the rhizosphere highlighted the changes in the rhizosphere colonies of both bacterial and fungal categories present and their abundance in the root zone of different grafting combination. The rootstock showed to be the main manipulator of bacterial and fungal abundance although the effect of the scion was also noticed for some microbial species. This study highlighted the positive effect of rootstocks in enhancing vigour and yield and illustrating it as a technique able to alternate rhizosphere microbiomes, mainly influenced by rootstocks used. Thus, Rootstock choice have a fundamental effect on the rhizosphere microbial diversity.

Keywords: *Solanum lycopersicum* L., 16SV34, ITS1-1F, microbiome sequencing, rhizosphere, landraces

Combined effects of allied potential rootstocks and Se biofortication on eggplant fruit yield, nutritional and health-promoting compounds

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Vegetable grafting is counted as an effective technique for safeguarding yield and quality under various growing conditions. In this respect, there is expanding scientific interest in exploiting new species as potential rootstocks for vegetables to upsurge sustainability and resilience of production systems. Concomitantly, selenium (Se) biofortification has been documented as an appropriate approach to enhance the dietary value of vegetables and increase Se daily intake in humans. However, the identification of the key factors involved in the biofortification processes, such as genotype, chemical form, type and method of application, remains the imperative issues. Thus, the current study evaluated the combined effect of allied potential rootstocks and Se biofortication on'Gloria' F1 eggplant growth, yield and fruit quality traits.Selenium at 2.0 μmol L^{-1} enhanced total fruit yield in ungrafted, self-grafted and grafted plants as compared to the control. Marketable yield was positively affected by Se-biofortification and S. torvum rootstock. Selenium at 4.0 μmol L^{-1} gave the highest fruit firmness, whereas plants grafted onto S. torvum or S. aethiopicum rootstocks showed an increase in SSC. Plants supplied with the highest Se dosage had the highest fruit chlorogenic acid and ascorbic acid concentrations. Furthermore, plants grafted onto S. torvum or S. paniculatum rootstocks and supplied with 4.0 μmol Se L^{-1} showed the highest fruit Se concentration. Finally, Se-biofortification at 4.0 μmol L^{-1} and grafting onto S. torvum or S. paniculatum augmented eggplant plant performance, nutritional and functional features.

Keywords: *S. melongena*, greenhouse cultivation, Se-enrichment, herbaceous grafting

Oral session 8

Unveiling the power of vegetables in biodiversity and healthy diet

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Generally, vegetables are widely and all over the world recognized for their value in almost any diet. Nutritional and culinary value is also studied and understood in several groups of vegetables. Vegetables play pivotal role to upgrade any diet to a healthy one, and vegetables inclusion is recommended in modern diet today. What was missed or underestimated is the richness of vegetables and the variation in terms of groups, species, landraces and climate/soil adaptations. This unique enrichment, compounded with its capability to fit in any crop systems, offers new horizons and potential uses. Vegetables offer a unique powerful tool to contribute to biodiversity and to mitigate climate change and confront future food security perils. Vegetables are a match made in heaven with today's agro-food systems.

Keywords: underutilized crop; unexploited species

Exploitation of Wild and Growing Germplasm for the Innovation of Vegetable Production

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he wild and growing germplasm represents a great resource of interest for diversifying vegetable produce and its quality, and for increasing the resilience and the sustainability of the farming systems. The wild and growing germplasm represents a great resource of interest for diversifying vegetable produce and its quality, and for increasing the resilience and the sustainability of the farming systems. The Mediterranean area, besides being of great importance for vegetable growing, represents an origin and diversification center of several cultivated species. In this area ancestors of several crops are widespread and some of them are harvested in the wild and/or occasionally grown in small farms for commercial purposes. Among the centers of origin and diversification of the cultivated plants described by Vavilov, the Mediterranean countries, and in particularly Italy, have an ancient history for vegetable growing and production and it has been expressed during the time by the great diversity in terms of species, types, landraces and cultivars utilized. This great agrobiodiversity supports the great richness of traditional foods which render very famous the Mediterranean cousine. For vegetable crop diversification the potential number of species is theoretically high. The groups of species suitable for the above purpose are: i) wild species; ii) exotic species introduced from other continents; iii) minor species and heirloom cultivars and landraces; iv) cultivars of species widely utilised capable of supplying vegetables with new characteristics. The information on the species' requirements and on their adaptability vary and are often inadequate. For the wild and the exotic species, the varieties available are often insufficient, representing pre-breeding materials, whereas for the other groups of species will be selected specific varieties for different farming systems (e.g. open air, greenhouse, vertical farming). Data concerning the wild species is almost nil and the attention turns to the bio-morphological studies of the plant and the chemical composition of the edible organ, whereas for minor species we can at least find previous references about their growing both in the open air and/or in the greenhouse. In cold greenhouse conditions we need species to grow by selected cultivars resistant against biotic and abiotic stresses providing produce the consumer request, implement the growing techniques for increasing the yield and the quality of the produce. The contribution of the new species could overcome the agronomic issues, such as in the Mediterranean areas the rest periods during summertime and soil-borne pests and diseases. In this frame will be illustrated the work in progress in view to exploit wild and growing Mediterranean germplasm for supporting the innovation of the environmentally friendly vegetable chains for improving the human wellbeing.The contribution of the new species could overcome the agronomic issues, such as in the Mediterranean areas the rest periods during summertime and the biotic and abiotic stresses. In this frame will be illustrated the work in progress in view to exploit wild and growing Mediterranean germplasm for supporting the innovation of the environmentally friendly vegetable chains improving the human wellbeing.

Keywords: vegetable diversification, wild species, landraces, minor crops, heirloom cultivars

Oral session 8

Effects of a microbial biostimulant on growth and eco-physiological responses of young potted olive trees

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A two-year experiment was carried out to evaluate the effects of a microbial biostimulant (represented by a biological community made up of vesciculo-arbuscular mycorrhizae, beneficial rhizosphere bacteria and saprophytic fungi) on the growth and eco-physiological responses of young olive trees, using untreated trees as the control. For the experiment, potted trees of 35-40 cm height were used. At the beginning of the experiment, in spring, the trees were transplanted into larger pots and treated with biostimulants, applied to the soil. At the beginning of the second year, the biostimulant was applied again by dispersing it in water, which was poured into the substrate of each pot. The microbial biostimulant resulted in an increase in trunk diameter and tree height. It also led to increased development of lateral branches and tertiary branching and total biomass of trees. The integration of dendrochronological analysis with intra-seasonal $\delta^{13}C$ profiling in tree rings provided valuable insights into growth dynamics and ecophysiological responses across the two monitored growing seasons. Trees treated with the microbial biostimulant showed a significant increase in stem ring width and basal area increment, indicating enhanced growth performance. Concurrently, the seasonal $\delta^{13}C$ pattern revealed consistently lower values in treated trees, particularly during the second year, suggesting a sustained higher internal to ambient CO_2 ratio. This pattern likely reflects improved stomatal regulation and more efficient carbon assimilation under biostimulant application. The observed findings indicate a potential role of biostimulants in modulating plant responses to climate variability. This enhanced adaptability could be especially valuable in Mediterranean regions, where irregular rainfall and prolonged drought periods are becoming increasingly frequent.

Keywords: Biostimulants, carbon isotope, Ci/Ca ratio, *Olea europaea* L., tree rings, tree growth

Comparison of the effects of root restriction and intermittent low temperature storage on bolting in Delphinium grandiflorum_

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Early bolting is a problem to produce high quality cut flowers under high temperature conditions in Delphinium grandiflorum, which is high temperature and long day plants. Root restriction has been revealed to be effective to inhibit early bolting under high temperature conditions in D. grandiflorum. Intermittent low temperature storage (ILTS), which is the treatment alternating the storage in refrigerators and the growing in greenhouses repeatedly, is also effective to inhibit early bolting in D. grandiflorum. Root restriction takes less time and effort than ILTS because seedlings grow in greenhouses during the entire period. However, the effect varied by cultivars. This experiment compared the effect of root restriction with that of ILTS in the same year to investigate the optimal method for growing the seedlings of two cultivars in D. grandiflorum under high temperature conditions. The ILTS seedlings resulted in 0% early bolting rate in 'F1 Morpho Grand Blue' (early season) and 'F1 Morpho Platinum Blue' (middle season). In contrast, the effect of root restriction differed between cultivars: in 'F1 Morpho Platinum Blue', early bolting of the seedlings in 288 holes (root zone volume of approximately 9 mL) were suppressed (bolting rate 0%) compared to that of the seedlings in 128 holes (approximately 20 mL, bolting rate 10%). However, the early bolting rates in 'F1 Morpho Grand Blue' were not significantly different between 288 holes and 128 holes (62% and 45% respectively). There is no significant difference among treatments in cut flower quality. Effects of root restriction varied by cultivars because root restriction might have been easily influenced by earliness. Meanwhile ILTS may not be affected by earliness because the cooling period reduced plant growth. As results of this study, it was suggested that ILTS is suitable for early season cultivars, and root restriction is suitable for middle season cultivars.

Keywords: cell tray, high temperature, seedling, cut flower quality

Oral session 8

Optimizing Biosolid Compost Application for Sustainable Basil *(Ocimum basilicum)* Cultivation: Impacts on Soil Health and Crop Quality

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Soil amendments are gaining popularity as agricultural production must meet rising demands while combating the devastating effects of soil degradation caused by a growing global population. Investigating sustainable agricultural practices is essential to addressing these challenges. Biosolid compost, derived from treated wastewater and traditionally used for forage crops, is increasingly being utilized to enhance soil properties by improving organic matter content, nutrient availability, and overall soil health. However, further research is necessary to understand its impact on crop quality and transplant establishment. This study evaluates the effects of biosolid compost amendments on the growth, physiology, and transplant establishment of basil (Ocimum basilicum). Basil plants were transplanted into sandy soils amended with varying concentrations of biosolid compost (0%, 5%, 10%, 15%, and 30% v/v) and grown in half-gallon pots. These plants were monitored across three planting trials. Soil properties, including pH, electrical conductivity, and nutrient levels, were evaluated before, during, and after each trial to assess changes over time. Plant physiological attributes, such as chlorophyll content, stomatal conductance, and height, were measured during growth. Post-harvest analyses assessed antioxidant capacity, nitrate content, phenolic properties, and biomass (fresh and dry). Results revealed that moderate compost concentrations improved soil organic matter, stabilized pH, and increased nutrient availability, leading to better transplant establishment, higher yields, and enhanced physiological performance. However, higher concentrations (> 15%) resulted in delayed germination and early seedling vigor reduction, underscoring the importance of optimized application rates. This research provides valuable insights into the role of biosolid compost in sustainable agriculture and transplant establishment for high-value crops like basil, particularly in nutrient-poor sandy soils such as those found in Florida.

Keywords: Biosolid Compost, Basil (Ocimum basilicum), Transplant Establishment, Sustainable Agriculture, Soil Health, Antioxidants

Comparing USDA Energy Content Values for Crops with Adiabatic Calorimetry Measurements

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Energy analysis is a critical method on assessing agricultural systems sustainability. The majority of the studies apply energy indicators from databases and literature to calculate yield as energy output. The aim of this study is to investigate the accuracy of USDA energy values by comparing them with the energy content obtained through experimental measurement. Samples (edible parts) from eighteen vegetable crop species were collected and dried, and their energy content was measured through the adiabatic calorimetry method. Their calculated energy content (EXPV) was compared with the energy values retrieved from the USDA database (USDAV). The comparisons resulted the equation USDAV= 1.0371EXPV + 4994.2. R^2 value was 0.85, presenting a strong correlation between the calculated energy content and the USDA-derived energy values. The results suggesting that the USDA energy values are reliable. However, a slight overestimation of the USDA compared to the experimental measurements is indicated. These findings confirm the applicability of USDA energy values in energy analysis studies.

Keywords: Energy analysis, bomb calorimetry, sustainable agriculture

POSTER ABSTRACTS

Poster session 1

Seed Priming as a promising tool to mitigate drought stress in zucchini seedling (*Cucurbita pepo* L.)

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Seed priming is a pre-sowing technique involving controlled seed hydration to initiate metabolic activity without radicle emergence. Various priming agents such as hydropriming, osmopriming, and hormonal priming have shown promise in enhancing seed performance in horticultural crops. In this study, we evaluated the effects of seven priming agents (plant extracts: moringa and brassica; vitamins: ascorbic acid and nicotinic acid; elicitors: melatonin and salicylic acid; and the plant hormone gibberellic acid) on zucchini germination and seedling development under drought conditions. All primed seeds exhibited more uniform germination than the control, though brassica extract delayed germination (8 DAS) compared to nicotinic and ascorbic acid (4 DAS). Gibberellic acid significantly enhanced hypocotyl elongation (51.54 mm), whereas brassica extract resulted in the shortest (18.72 mm). After two drought cycles, melatonin-primed seedlings maintained the highest chlorophyll content (SPAD 36.6), exceeding that of non-stressed controls (SPAD 34.5). Salicylic acid priming led to the greatest flower production under both stressed and non-stressed conditions (5.6 and 6 flowers/plant, respectively) on the other side, moringa primed seedlings were the most affected by drought and the flower number decrease from 5.4 flower per plant to 1.8 flower in the stressed plant. These results underscore seed priming as a cost-effective strategy for improving zucchini seedling performance under water-limited conditions.

Keywords: water deficit, squash, organic extract, nursery production

Unlocking the potential of wild edible Greek taxa: Seed germination trials at the Balkan Botanic Garden of Kroussia

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For the past two decades, the Balkan Botanic Garden of Kroussia (BBGK) of the Hellenic Agricultural Organization – DIMITRA has maintained approximately 1,500 taxa of the Greek flora under various ex situ conservation regimes. These taxa are preserved primarily in the BBGK Seed Bank, which currently comprises approximately 3,100 seed accessions, each representing genetically and geographically distinct populations. Lately, there is a growing interest in wild edible species due to their high nutritional value, their role in conservation of biodiversity, their connection to traditional knowledge, and their potential for sustainable development. These species are well-adapted to Greece's climate and could be introduced as alternative crops. According to FAO, edible wild plants are plant species that grow naturally in the wild — without human cultivation — and have one or more parts (such as roots, leaves, stems, fruits, seeds, or flowers) that are safe and acceptable for human consumption. In the present study, seed germination trials were conducted on 28 wild edible taxa from the BBGK seed collection. Many of the taxa included in this study had not been previously investigated and found no references in the literature regarding their sexual propagation. Prior to germination, all seed lots were decontaminated and subsequently placed under germination conditions based on their individual requirements.

Keywords: biodiversity, sexual propagation, wild edible taxa, seed bank

The role of temperature in dormancy breaking and seed germination of the threatened Balkan endemic plant *Lilium rhodopaeum* Delip

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Lilium rhodopaeum (Delip.) is a threatened Balkan endemic taxon found in the Rhodopi Mountain (borderline of Greece-Bulgaria). The aim of the present study was to investigate the effect of temperature on seed germination and define the dormancy type of *L. rhodopaeum* seeds. The germination response of the studied species was evaluated using controlled growth chambers at 5, 10, 15, 20 and 25ºC (12h light/12h dark). The results showed that seed germination was affected by incubation temperature, and specifically, the seeds germinated only at the low temperature of 5ºC (67.50%). At the incubation temperature of 5°C, the first germinated seeds of *L. rhodopaeum* were observed on the eleventh week from the beginning of the germination test. The non-germinated seeds that were incubated at 10, 15, 20 and 25°C were transferred to 5°C at the end of tenth week. The percentage and the beginning of their germination were affected by the incubation temperature to which they were subjected during the first ten weeks. The seeds from 10 and 15°C chambers that were transferred to the 5°C chamber germinated at 77.50 and 72.50%, respectively, while those transferred from the 20 and 25°C chambers to that of 5°C showed significantly reduced germination percentages (43.75% and 21.25%, respectively). The mature seeds of *L. rhodopaeum* showed a fully developed embryo. According to the observed germination behavior, the seeds exhibited physiological dormancy, as only their exposure to low temperature (5°C) resulted in the release of dormancy leading to germination. Moreover, in the germinated seeds which were planted in pots under greenhouse conditions, no delay was observed in the emergence of cotyledonary leaf. The knowledge of the germination requirements of *L. rhodopaeum* seeds is expected to support both in situ and ex situ conservation efforts, further allowing the sustainable exploitation of this attractive yellow-flowered species as ornamental plant.

Keywords: ex situ conservation, in situ conservation, incubation temperature, physiological dormancy, sexual propagation, Liliaceae

Effect of temperature on the germination of *Allium nigrum* L. seeds associated with its GIS-derived ecological profile

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Allium nigrum is an attractive Mediterranean bulbous plant of ornamental value mainly due to its long and compact inflorescence. The aim of the present study was to investigate the effect of incubation temperature and cold stratification on dormancy breaking and seed germination of *A. nigrum*. The germination responses of *A. nigrum* seeds were evaluated at four constant temperatures of 10, 15, 20, and 25°C using temperature-controlled growth chambers with a 12-h light/12-h dark photoperiod. Furthermore, the germination response was evaluated at a low (10°C) and a high (20°C) incubation temperature of seeds stratified at 5°C for one month. The Geographic Information Systems (GIS) was used to unveil the domestic ecological requirements of *A. nigrum* based on its distribution in Greece. The results of the study indicated a specific temperature dependence on the germination of A. nigrum seeds. Specifically, *A. nigrum* seeds seem to prefer a low temperature (10°C) for germination. The germination percentage at incubation temperature of 10°C was 93.33%. No seed germinated at incubation temperatures of 15, 20, and 25°C. Furthermore, one-month cold stratification did not result in seed germination over a wide temperature range. The GIS-derived ecological profile provided important information regarding the climate conditions (temperature, precipitation) under which *A. nigrum* populations grow in natural habitats, facilitating the interpretation of the effect of temperature on seed germination, and also informing for the appropriate conditions regarding its use as a new ornamental plant in man-made environments. The knowledge of the germination requirements of *A. nigrum* seeds is expected to support the sustainable exploitation of species as a new native plant of ornamental value.

Keywords: cold stratification, ecological profile, incubation temperature, seed dormancy, sexual propagation, Alliaceae

Poster session 1

Tomato seeds' germination under the effect of *Ascophyllum nodosum* from different extraction methods

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Ascophyllum nodosum is one of the most studied and applied seaweeds as plant-based biostimulants for many years now. Several studies have proven its beneficial effects on many species under stressful abiotic conditions, such as drought, salinity or high temperatures. In the available literature regarding seaweeds as biostimulants, several methods of extraction are mentioned, but there is no comparison of the effects of each method. This research tests two commercial formulations of Ascophyllum nodosum with two different extraction methods (Algit Super – alkaline hydrolysis and Alga Max – cold processing). Tomato seeds were soaked in 2% of both commercial formulations for 15', put in petri dishes (each petri dish contained 20 seeds, and every treatment consisted of 4 replications. All treatments, including the control (seeds soaked in distilled water), were irrigated with 75mM NaCl to determine any effect of the formulations under saline conditions. The seeds in petri dishes germinated in the dark for 8 days. Parameters evaluated were average seedling length, speed and percentage of germination and vigour index I & II. The results indicate a positive effect, significant or not, of both extract methods of Ascophyllum nodosum on every parameter evaluated. However, alkaline hydrolysis had a greater positive effect on all parameters compared to the control and in some cases compared to cold processing as well.

Keywords: biostimulants, seaweeds, salinity

Effect of salinity and light intensity on seed germination of two Salicornia europaea L. Greek native populations

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Salicornia europaea L. is an extreme halophyte species that thrives in degraded coastal soils. The species has high nutritional value and can serve as an alternative crop for degraded soils. However, seed germination remains a challenging issue. In this study, seeds from two native *Salicornia* species were collected from Kalochori and Angelochori, Thessaloniki, Greece—coastal areas where halophytes naturally germinate and grow. The effects of salinity (0 and 1% NaCl) and light intensity (dark, 40, and 80 μmol m^{-2} s^{-1}) on seed germination were investigated using an agar-solidified (0.6% w/v) medium. Seeds were placed in Petri dishes filled with 25 mL of culture medium. Each treatment consisted of five replicates of 25 seeds each. Both salinity and light intensity had significant effects on germination. For Kalochori genotype, the 80 μmol m^{-2} s^{-1} treatment without NaCl resulted in the highest germination speed (109.5%, $p < 0.05$) and germination percentage (74.4%). Similarly, for Angelochori genotype, the 80 and 40 μmol m^{-2} s^{-1} treatments without NaCl led to higher germination speed (127.5% and 126.4%, respectively, $p < 0.05$) and germination percentages (78.4% and 80.8%, respectively, $p < 0.05$). In conclusion, salt stress appears to be an inhibitory factor in the initial stage of S. europaea seed germination, whereas higher light intensity enhances germination during the same stage.

Keywords: halophytes, LED, NaCl, salt stress

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Effect of temperature on the germination of *Sonchus oleraceus* _

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Sonchus oleraceus is a native plant from the Asteraceae family, and although it is considered an underutilized species, its consumption has recently increased, creating potential as a horticultural product. This induced to study this plant, aiming to understand how its germination responds to temperature. To examine this, *Sonchus oleraceus* seeds were subjected to five temperature treatments (0, 5, 10, 15, 20 C) with three replicates per treatment. Twenty-five seeds were placed in petri dishes with filter paper and soaked with distilled water to maintain the appropriate moisture for the initiation of germination. Once the dark conditions for homogenous germination were ensured, the petri dishes were placed in plant growth chambers with a regulated temperature. Germination was defined by the visible radicle emergence and a root length exceeding 2mm. Throughout the experiment, fungicide treatments were applied to avoid contamination, and moisture levels were assessed. Measurements included the final percentage of seed germination, germination rate per day, and seedling growth. Results indicated that temperature affects germination parameters such as germination rate, germination percentage per day, total fresh and dry weight of seedlings, and Vigour Indexes I and II. Germination was completely inhibited at 0 C, whereas 20 C resulted as the optimal temperature for Sonchus oleraceus seed germination.

Keywords: leafy vegetables, seeds, minor crops, underutilized species, Asteraceae family, horticultural species, native plant

Evaluating grafting and plant spacing effects on Florida's watermelon farms

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Florida is a leading producer of watermelons (Citrullus lanatus (Thunb.) Matsum. & Nakai) in the United States. As the third fastest-growing state in population, Florida watermelon producers face challenges due to limited land availability for crop rotations, driven by increasing urban development. This limitation exacerbates soil-borne diseases like Fusarium wilt, a significant threat to the industry. Grafting can reduce or eliminate the risk of infection while potentially enhancing water and nutrient use efficiency. However, many producers remain unaware of this technology, and those who are familiar with it identify high cost as the main barrier to adoption. To address this challenge, our main objective was to evaluate the impact of reducing planting density by changing within-row plant spacing to reduce initial investment in grafted transplants. This research was conducted at two commercial farms in north central Florida, following each farm's standard production practices. The results varied between locations: at one farm, plant spacing had a significant impact on yield while grafting did not. At the other farm, however, grafting significantly increased yield, but plant spacing did not have an effect on yield. Fruit quality parameters, such as fruit firmness, were not affected by the location, grafting, or spacing. Our findings suggest that growers can expect consistent fruit quality and crop yield performance with grafted plants. The difference observed between the two farms in terms of spacing effects on overall yield highlights the importance of selecting optimal plant densities, scion combinations, and appropriate farm practices to reduce grafted transplant investment. Additionally, our collaborative work outlines strategies to increase grafting awareness and adoption among Florida producers, provides insights from growers, and offers an outlook on future adoption and research needs. Despite the increased use of grafted watermelons, commercial growers remain concerned about harvest delays, limited grafted plants suppliers, and costs.

Keywords: vegetables, grower adoption, fruit quality, yield

Case study: stress tolerant tomato rootstock development, semi-commercial field results and business case for grafting adoption in processing tomatoes

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Grafting applied to open-field processing tomatoes offers the potential for a radical step-change in the industry. Key benefits of grafting include increased yield per plant and greater composite plant resistance to abiotic and biotic stress. To assess these benefits, the grafting of processing tomatoes was evaluated at a field trial and semi-commercial scale from 2023-2024 in California. Data collected from this work demonstrated that grafting is a viable and profitable technology for wider adoption in the processing tomato industry. Significant milestones achieved in this work include: 1) the development of superior tomato rootstocks targeted for open-field use, 2) a step-change in grafting speed and volume potential through automated grafting, and 3) an increase in resilience and yield potential that justifies the cost of grafting processing tomatoes. Rootstocks for this work were developed using wild relatives with notable vigor, along with abiotic and biotic stress resistance traits. Grafting was done using the first-ever-deployed custom robotic grafting machine capable of an output of 4,000 seedlings per hour with minimal human oversight. When grafted with industry-preferred processing tomato scions and planted at 56% of standard planting density, the best-performing rootstocks provided an average 2.21x yield increase per plant vs. ungrafted across five fields. Grafted plants also demonstrated increased resistance to heat stress and Fusarium wilt race 3. Considering the higher seedling cost and the observed 24% increase in yield per hectare, using grafted processing tomato seedlings is expected to be more profitable than using ungrafted seedlings where the base historical field yield is higher than 112 metric tons per hectare.

Keywords: breeding, climate, resilience, cross-disciplinary, agtech, innovation

Assessing Growers' Perceptions and Adoption of Vegetable Grafting in the Southeastern United States

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Despite the growing research in vegetable grafting in the past decade, its adoption rate among growers in the U.S. remains relatively low. This study investigated vegetable growers' perceptions and adoption of grafted vegetable transplants, including barriers, through a comprehensive survey conducted in the Southeastern U.S., an important vegetable production region in the U.S. Results revealed significant variability in growers' understanding and acceptance of vegetable grafting. While most respondents recognized potential benefits of grafting, such as increased yield and improved crop disease resistance, concerns about increased transplant costs and uncertainty about crop production performance remained prominent barriers to adoption. Among the factors influencing growers' adoption decisions, the cost of grafted transplants is a more critical factor than potential yield improvements associated with grafting. Growers typically evaluate the cost and benefit of grafting by comparing it to their past experiences with transplant prices and crop yields. The likelihood of adopting vegetable grafting decreases sharply when the gap between the grafted transplant price and the transplant price that growers have paid in recent production seasons becomes larger. Most growers who use grafted plants purchase them from nurseries rather than grafting the plants themselves. In addition, growers are most interested in grafted cucumbers and watermelons, among other crops. By understanding growers' perspectives on vegetable grafting, this study would provide valuable insights into developing targeted extension programs and research initiatives aimed at facilitating the broader adoption of grafting technology among U.S. vegetable growers. The results also suggest that encouraging more nurseries to produce grafted transplants—and therefore increasing the economic scale of grafted transplant production—could help promote the adoption of grafting technology among U.S. vegetable growers.

Keywords: Willingness to adopt, grafted transplants, barriers to adoption

Poster session 1

Monitoring water balance of grafted tomato seedlings

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Unfavourable environmental conditions during the curing period of grafted seedlings can cause water loss, resulting in severe wilting and delayed establishment. Mitigating these challenges requires monitoring the water balance of grafted seedlings, including water transpiration and absorption rates. In this study, the water balance of the grafted seedlings was monitored continually under a photosynthetic photon flux density of 50 μmol m-2 s-1, an air temperature of 25 °C, and relative humidity of c.a. 90%, and a CO2 concentration of 500 μmol mol-1. Forty grafted tomato (Solanum lycopersicum L.) seedlings were placed in a container filled with a nutrient solution. Transpiration and absorption rates were determined for 10 grafted seedlings using a method adapted from Van Leperen and Madery (1994). The percentage of vegetation cover was estimated using a LiDAR camera. The remaining 30 grafted seedlings were subjected to destructive measurements, namely fresh and dry weights, leaf area, and stem length, on days 0, 2, 4, 6, and 8, with microscopic observation of stem cross-sections. The results revealed that the transpiration and absorption rates remained low immediately after grafting but increased with the graft establishment, as confirmed via microscopic observations. The reaction to light and dark periods in terms of transpiration and absorption rates increased after the establishment of the grafted seedlings. During the initial stage, the difference between transpiration and absorption rates was minimal but increased after the establishment of grafted seedlings. Similarly, the percentage of vegetation cover remained stable in the initial stage and increased over time. These trends are consistent with the destructive measurements. In this study, tracking the water balance demonstrated the feasibility of continuous and non-destructive estimation of the establishment progress of grafted seedlings. The proposed method provides valuable insights into the optimisation of environmental conditions to ensure the successful establishment of the grafted seedlings.

Keywords: absorption rate, environmental conditions, microscopic observation, Solanum lycopersicum, transpiration rate

Poster session 2

Effect of genotype on the morphometric parameters of grafted cucumbers

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Grafting cucumbers is becoming one of the most common alternative tools for improving the plant's tolerance against biotic and abiotic stresses and increasing fruit yield, quality, and ripening duration. The efficacy of genotype on the morphometric parameters of grafted cucumbers was investigated at the Lithuanian Research Centre for Agriculture and Forestry in 2024. Five cultivars of different squash species were used as rootstocks, and the studies used cucumber plants of Lithuanian cultivar 'Kaunita' as scions. The tongue graft method was used in the grafting procedure. Plants were grown in the plastic greenhouse before grafting and grafted plants were cultivated as outdoor culture. The compatibility of rootstock and scions was assessed 14 days after the grafting procedure. Plant height and shoot dry weight of grafted and non-grafted control plants were estimated 70 days after the transplanting. It was determined that the highest compatibility was determined when the cucumber was grafted onto Cucurbita maxima and Cucurbita moschata rootstocks. The plant's survival in this combination reached 92% and 88%, respectively. Concerning the plant's vegetative part growth, cucumber grafted onto C. moschata rootstock showed the best capability to form the highest plants. The average plant height of this combination reached up to 98,7 cm and was 25% higher than the non-grafted control. Grafting onto C. moschata showed the highest dry shoot weight value. Obtained results confirm that cucumber onto C. moschata rootstock combination was the most effective compared with other combinations.

Keywords: Cucurbita moschata, compatibility, cucumber, grafting, squash

Poster session 2

Establishing old tomato varieties in a sustainable hydroponic growing system

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Today, soiless cultivation is considered one of the most effective and sustainable cultivation systems in controlled environment agriculture because of the high yields and higher land, water and nutrient use efficiencies achieved. In hydroponics floating systems plants develop on floating trays with their roots submerging in tanks full of nutrient solutions. However, indoor production of vegetables nowadays is heavily relying on existing varieties selected and developed for open field production while the development of new varieties for controlled environments is still limited. There is a great potential in genetic variability and older genetic material to breed for matching the new environments with more desirable characteristics such as faster growth rate and high quality. The scope of this study was to evaluate and compare the performance of two older and well known Greek tomato cultivars, cv. Makedonia and cv. Areti, under protected conventional soil cultivation versus cultivation in a hydroponics floating system. The plants were grown in pots and in hydroponic floating system tanks in a diffusion glass greenhouse of the Sustainable Agricultural Structures and Renewable Energy Resources Laboratory (SASRER Lab). Phenotypic measurements (number of leaves, plant height, number of internodes, stem thickness) were taken and yield, quality (total soluble solids, oBrix) as well as photosynthetic parameters were evaluated. In general, results show that cultivars perform similarly in the two growing systems in terms of yield while in terms of quality, total soluble solids content was higher in the tomato fruits grown in the floating system. These results indicate that there is potential in growing old cultivars in new sustainable growing systems and even better these cultivars can serve as starting material for breeding using modern -omics tools and molecular markers.

Keywords: Tomato; Floating system; Greenhouse; plant breeding

POSTER ABSTRACTS

Evaluating pepper landraces as potential rootstocks for mitigating drought stress

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Drought stress significantly reduces crop yield and quality by impairing physiological processes, nutrient uptake, and water use efficiency, posing a major threat to global food security under changing climatic conditions. The development of drought-tolerant rootstocks is imperative in order to address the impact of climate change, as elevated temperatures and erratic rainfall pose a significant threat to global crop production. Rootstocks capable of withstanding such stress, can enhance plant survival and assist in maintaining yield levels, especially in regions like the Mediterranean basin where water scarcity is intensifying. Pepper plants, among other vegetables, are recognized as being sensitive to abiotic stresses such as drought, which adversely affect yield and fruit quality. However, certain genotypes exhibit remarkable tolerance to harsh environmental conditions, thereby sustaining productivity despite water scarcity. To explore this further, a study was conducted at the Laboratory of Vegetable Production of Agricultural University of Athens, to evaluate the impact of drought on three hydroponically cultivated pepper varieties: the Jordanian landraces 'JO 109' and 'JO 204', and the California variety 'Yolo Wonder'. Plants were subjected to either regular irrigation or reduced irrigation conditions. In the latter case, the water supply was decreased by up to 40% in comparison to the fully irrigated plants. Key parameters measured included yield and nutrient status (K, Na, Ca, and Mg concentrations in leaves and fruits). The findings of this study revealed significant variations in drought tolerance among the pepper varieties. 'JO 109' exhibited remarkable resilience, maintaining stable yield under conditions of reduced irrigation supply. This was attributed to the fact that the K/Na ratio and Ca levels in its fruit remained unaffected by the limited irrigation. The integration of drought-tolerant rootstocks into agricultural practices is of pivotal significance for ensuring the security of food production and enhancing the adaptability of vegetable crops to evolving climate conditions. This approach is imperative for sustainable agriculture in the context of water scarcity and climate change.

Keywords: *Capsicum annum* L., soilless culture, irrigation, varieties, yield

Poster session 2

Agroecological approaches affect the initial growth of pea in an intercropping system

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Agroecological approaches have gained considerable interest in recent year due to the pollution from pesticides and fertilizers in many countries. Agroecology aims to transform agricultural systems by incorporating sustainable practices that leverage natural processes to develop innovative solutions. One of the agroecological approaches that have been used is intercropping that has several significant advantages. By adopting agroecological methods, farmers can reduce or entirely replace chemical inputs like herbicides while maintaining or even improving crop productivity. The objective of the present study to determine how intercropping affects the initial growth of pea in an intercropping system and to evaluate the weed growth. The research was conducted during the 2023–2024 growing season at the experimental farm of Aristotle University of Thessaloniki, located in northern Greece (40°32'07.7"N 22°59'20.5"E). A Randomized Complete Block Design (RCBD) with four replications was employed to assess pea growth and also weed growth in wheat and pea monocultures and their respective intercrops. No pesticides or fertilizers were applied during the growing season. There was differences in weed growth in the different treatments. At harvest, weed biomass was measured for each experimental plot. The results revealed that the wheat-pea intercrop provided better weed suppression compared to wheat monocultures. Furthermore, the field pea monoculture, followed by the wheat-pea intercrop, achieved the highest Leaf Area Index and dry yield among all treatments. In conclusion, selecting appropriate crop species, utilizing intercrops, and optimizing sowing densities can effectively suppress weed growth, reduce dependence on herbicides, and enhance the sustainability of cropping systems.

Keywords: leaf area, dry matter, yield, weeds

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Study of the effect of harvest time on the quality characteristics of two yellow-fleshed kiwifruit cultivars

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Kiwifruit cultivation is a major economic activity worldwide, with its high nutritional value and low caloric content enhancing consumer appeal. The stage of fruit maturity at harvest plays a critical role in determining postharvest performance and quality. This study examined the influence of harvest timing on quality attributes of two yellow-fleshed Actinidia chinensis cultivars: the early-maturing AC497076 ("76") and the late-maturing AC501022 ("22"). Fruits were collected from three orchards in Karitsa and stored at 0 °C (95% RH) for 45 and 70 days (cultivar 76) or 45 and 90 days (cultivar 22), followed by ripening at 20 °C. Harvests were conducted at three maturity stages (early, commercial, late), spaced approximately one week apart for cultivar 76 and ten days for cultivar 22. Cultivar 76 exhibited consistently higher dry matter content (19–22%) and smaller fruit size across harvest stages. Early-harvest fruits of both cultivars showed greater flesh firmness, favoring long-term storage, while fruits from later harvests achieved higher soluble solids content, greater dry matter, and more intense golden flesh color, enhancing eating quality. These findings provide insights into optimizing harvest timing to balance storability and sensory quality in yellow-fleshed kiwifruit.

Keywords: Harvest time, kiwifruit, maturity, ripening, yellow-fleshed cultivars

Poster session 2

Optimizing Intercropping Systems Through Cultivar Selection

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Intercropping is a sustainable agricultural practice that contributes to increased biodi-versity in cropping systems. In contrast, monocultures—due to the extensive use of ferti-lizers and pesticides—lead to biodiversity loss and soil quality degradation. Therefore, there is a pressing need to adopt systems like intercropping that enhance biodiversity and promote ecosystem services, while maintaining high productivity and sustainability. The objective of the present study was to determine the effect of intercropping different cul-tivars of bread wheat with pea on overall productivity. The research was conducted dur-ing the 2023–2024 growing season at the experimental farm of Aristotle University of Thessaloniki, located in northern Greece. A Randomized Complete Block Design (RCBD) with four replications was used to evaluate both pea and wheat growth, utilizing two dif-ferent cultivars from each species. Throughout the growing season, morphological, phys-iological, and agronomic characteristics were measured. The Flamenko–Arvika combina-tion achieved the highest Land Equivalent Ratio (LER), indicating complementary and facilitative interactions between the two cultivars. The results showed that pea varieties grew as well as—and in some cases better than—in monoculture systems, while wheat performed more satisfactorily under monoculture conditions. Certain pea and wheat cul-tivars are better adapted to intercropping systems and can be leveraged by farmers to en-hance productivity. Notably, many intercropping combinations obtained a LER value above 1, demonstrating greater effectiveness than their respective sole crops. Facilitation and niche differentiation between the two species allowed for improved capture of envi-ronmental resources, such as water and nitrogen, leading to enhanced mixture perfor-mance. These findings suggest that selecting appropriate species and cultivars can max-imize yields in the context of sustainable agricultural ecosystem management.

Keywords: grain yield, LER, mixture, biodiversity, sustainability

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Comparing USDA Energy Content Values for Crops with Adiabatic Calorimetry Measurements

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Energy analysis is a critical method on assessing agricultural systems sustainability. The majority of the studies apply energy indicators from databases and literature to calculate yield as energy output. The aim of this study is to investigate the accuracy of USDA energy values by comparing them with the energy content obtained through experimental measurement. Samples (edible parts) from eighteen vegetable crop species were collected and dried, and their energy content was measured through the adiabatic calorimetry method. Their calculated energy content (EXPV) was compared with the energy values retrieved from the USDA database (USDAV). The comparisons resulted the equation USDAV= 1.0371EXPV + 4994.2. R^2 value was 0.85, presenting a strong correlation between the calculated energy content and the USDA-derived energy values. The results suggesting that the USDA energy values are reliable. However, a slight overestimation of the USDA compared to the experimental measurements is indicated. These findings confirm the applicability of USDA energy values in energy analysis studies.

Keywords: Energy analysis, bomb calorimetry, sustainable agriculture

Effect of rootstock and root biostimulants on tomato scion characteristic

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Tomato grafting is a technique used to enhance plant growth and resilience. Rootstock with strong root system provides sufficient inputs for successful growth, even in poor cultivation conditions, such as those found in long-used greenhouses. Root biostimulants are substances that promote the growth and development of a plant's root system and increase their resistance to stressful conditions. The aim of this study was investigate the influence of rootstock and root biostimulants on vegetative growth and yield traits of tomato cultivar. Experiment was establish with Cultivar Agilis was used in experiment as selfgrafted or grafted onto seven selected rootstock: Arnold, DRO141TX, Maxifort, Multifort, Optifort, Emperador and Suzuka. Grafted plants were planted at clay-loam soil, in a two-row system at heated commercial greenhouse on February 27. Biostimulants (Intera and Kendal nem) were applied 60 days after planting, while as control plants were sprayed with water. The biostimulants were applied four times, at two weeks interval. The vegetative parameters (plant height, leaf number and stem diameter) were smaller at selfgrafted plants compared to those grafted onto rootstock. Biostimulants Intera achieved better results for plant height and stem diameter than BS Kendal nem or water. Plants grafted onto Optifort rootstock formed an inflorescence branch earlier (after 7.3 leaves) than plants grafted on selfgrafted, Arnold, DRO141TX and Suzuka. The highest total yield was measured in plants grafted on rootstock Emperador (24.4 t/0.1 ha) and was higher than in plants grafted on rootstocks selfgrafted, and DR (14.3; 21.2 and 22.7 t/0.1 ha respectively). Biostimulator Intera achieved a higher early (44 and 18 %) and total (6 and 7 %) yield than plants treated with water and biostimulant Kendal nem (respectively). Plants grafted onto rootstock and treated with biostimulants archived better vegetative growth as well as early and total yield than selfgrafted plants.

Comparative Phytohormone Profiling of Contrasting Tomato Rootstocks, Scions, and Grafted Plants

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Phytohormones are key regulators of plant growth and development and have been proposed as one of the mechanisms through which rootstocks influence scion vigor. In this study, we analyzed the leaf phytohormone profiles of two contrasting tomato rootstocks 'DR0141TX' (vigorous) and 'SHIELD RZ F1' (low vigor) under open field conditions, as well as when grafted with 'BHN 1022' grape and 'Skyway' beefsteak tomato scions (with nongrafted scion controls) under high tunnel conditions, approximately 10 weeks after transplanting. Although both the high- and low-vigor rootstocks (nongrafted) showed similar total cytokinin levels, the concentration of isopentenyladenosine riboside was higher in the low-vigor rootstock. Differences in trans-zeatin (tZ) and trans-zeatin riboside (tZR) between the two rootstocks were marginally significant, leading to a higher zeatin/zeatin riboside ratio in the low-vigor rootstock. Additionally, the low-vigor rootstock had greater levels of gibberellic acid (GA), abscisic acid (ABA), and brassinolide (BL). In the grafted tomato experiment, no significant rootstock-scion interactions were observed for the majority of phytohormones, except for GA1, which was higher only in the grape tomato grafted with the low-vigor rootstock. Rootstocks did not impact levels of cytokinin, auxin, GA, ABA, or BL. However, the scion genotype significantly influenced the concentrations of tZR, isopentenyladenosine, total cytokinins, and ABA. While nongrafted rootstocks of differing vigor showed distinct leaf phytohormone profiles, in grafted plants, the scion exerted dominant effects on phytohormone status – even for hormones primarily synthesized in the roots, such as cytokinins. Interestingly, indole-3-acetic acid (IAA) was not detected in the leaves of either rootstock (nongrafted). Environmental conditions could have significant impacts on phytohormone levels, suggesting that differences in growing environments may also have contributed to the observed variation. Further research is needed to characterize the functions of key phytohormones, especially their regulatory roles in mediating grafted tomato growth, flowering, and fruit development.

Keywords: Phytohormone analysis, rootstock-scion interaction, Solanum lycopersicum, tomato grafting, vigor

Does high salinity favor an obligate halophyte in the early stages of germination and growth? An in vitro study on two Greek native *Salicornia europaea* L. populations

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Salicornia europaea L. is an annual species of the Chenopodiaceae family. The species has a high nutritional value and can grow under high salinity conditions in degraded soils. However, data on its tolerance to salinity and how it affects its growth in the early stages after germination are insufficient for the success of a systematic cultivation. Studying this stage under *in vitro* conditions could provide valuable information for its cultivation. Two native Greek *S. europaea* genotypes (Kalochori and Angelochori) were grown *in vitro* in two culture media MS + 20 g/L sucrose + 6 g/L agar (GM1) and MS + 20 g/L sucrose + 8,9 μM BA + 5,37 μM NAA + 250 mM NaCl + 6 g/L agar (GM2). After 40 days shoot length, root length, shoot/root ratio and callus formulation (%) were measured and the comparison was made between the two genotypes. Within GM1 medium, Kalochori showed a significantly higher shoot length (1.51 cm), and lower shoot/root ratio (2.67) compared to Angelochori. Both genotypes in GM2 had limited development and formulated callus at the base of the plantlets. Kalochori genotype in GM2 resulted in 9.5% callus formulation callus formulation while Angelochori genotype in 76.9%. Kalochori generally showed a better response in both growing media tested due to reduced callus formulation and enhanced growth compared to Angelochori genotype. The presence of growth regulators and high salt concentrations inhibit shoot growth and root formation in both genotypes, which exhibit differences between them in every treatment. Overall, the results indicate that even though S. *europaea* is a halophyte, low salinity concentrations favor seed germination and seedling growth in early stages.

Keywords: tissue culture, micropropagation, growth regulators, rooting, seedling establishment

This work was funded by the European PRIMA project: “Converting marginal lands of the Mediterranean basin into productive and sustainable agro-ecosystems using low water demanding neglected and underutilized species (acronym: VENUS)”.

Influence of abiotic factors on carrot (*Daucus sativus* Röhl.) seed plants development and seed quality

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Carrot seeds were grown in the LAMMC Institute of Horticulture experimental field and seed production greenhouse covered with double polymer film from 2023-2024. Plants in the field and the greenhouse were planted into soil and vegetative containers filled with peat and natural soil. During the plant cultivation indicators that characterize their reproductive properties were recorded and determined the quantity and quality of seeds. The studies have established that meteorological conditions and cultivation methods influence the morphological characteristics of carrot seeds. It was found that seeds of the same cultivar grown under different conditions ripen seeds of various weights. Seeds grown in a greenhouse were heavier (1000 pcs. weighed 1.3-1.7 g) than in the field conditions (1000 pcs. – 0.9-1.2 g). Results of the studies showed that seeds grown in soil form more umbels than in vegetative containers. It was obtained from 47 to 80 pcs. umbels in soil cultivation, and 39-59 pcs. in vegetative containers. Studies have shown that not all umbels form seeds. After evaluating the seed stalk's productivity in soil and vegetative containers, plants grown in the soil produced significantly more seeds (22.0-49.7 g) than in vegetative containers (8.9-14.7 g).

Keywords: carrot, quality, productivity, reproduction features, seed stalks

GIS-facilitated germination of *Linum arboreum* L. seeds for conservation and sustainable utilization

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In the context of biosourcing from biodiversity for new ornamental crops, the aim of the present study was to investigate the effect of incubation temperature on seed germination of the attractive *Linum arboreum* L. (Linaceae), a Greek native Aegean subendemic subshrub. The germination responses of wild-sourced seeds were evaluated at four constant temperatures of 10, 15, 20, and 25°C using temperature-controlled growth chambers with a 12-h light/12-h dark photoperiod, and the natural species' requirements were explored with Geographic Information Systems (GIS) based on its distribution range. The results of the germination test showed that seed germination was affected by incubation temperature. The seeds incubated at 10, 15 and 20°C germinated at high percentages (89.17, 96.67 and 94.17%, respectively), and no significant differences were observed among them The lowest germination percentage (15.83%) was observed at the high incubation temperature of 25°C. The GIS-derived ecological profile provided important information regarding the climate conditions (temperature, precipitation) under which the studied species grow in its natural habitat, and facilitated the interpretation of the effect of temperature on seed germination, also informing for the appropriate conditions regarding its use as an ornamental plant in man-made environments. The knowledge of the germination requirements of *L. arboreum* seeds will facilitate conservation efforts and may contribute to its sustainable exploitation as a new native crop of ornamental value.

Keywords: ecological profile, germination, incubation temperature, sexual propagation, Linaceae

Unlocking the potential of wild edible Greek taxa: Seed germination trials at the Balkan Botanic Garden of Kroussia

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For the past two decades, the Balkan Botanic Garden of Kroussia (BBGK) of the Hellenic Agricultural Organization – DIMITRA has maintained approximately 1,500 taxa of the Greek flora under various ex situ conservation regimes. These taxa are preserved primarily in the BBGK Seed Bank, which currently comprises approximately 3,100 seed accessions, each representing genetically and geographically distinct populations. Lately, there is a growing interest in wild edible species due to their high nutritional value, their role in conservation of biodiversity, their connection to traditional knowledge, and their potential for sustainable development. These species are well-adapted to Greece's climate and could be introduced as alternative crops. According to FAO, edible wild plants are plant species that grow naturally in the wild — without human cultivation — and have one or more parts (such as roots, leaves, stems, fruits, seeds, or flowers) that are safe and acceptable for human consumption. In the present study, seed germination trials were conducted on 28 wild edible taxa from the BBGK seed collection. Many of the taxa included in this study had not been previously investigated and found no references in the literature regarding their sexual propagation. Prior to germination, all seed lots were decontaminated and subsequently placed under germination conditions based on their individual requirements.

Keywords: biodiversity, sexual propagation, wild edible taxa, seed bank

On farm mycorrhizal inoculum production for conventionally produced fresh spring onion

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Arbuscular mycorrhizal fungal (AMF) inocula application in vegetables may be beneficial in cases of low local inoculum and where increased inoculum results in fast colonization, providing the benefits of mycorrhiza earlier. Such benefits include lower fertilizer inputs, amelioration of losses to pathogens, nematodes, drought and salinity. However, mycorrhizal inocula are costly. Conventionally produced spring onion is characterized by high fertilizer and pesticide inputs, frequent soil disturbance and fallow periods, along with a rather short cultivation period. On the other hand, onion is known for high mycorrhizal responsiveness. On farm AMF inoculum was produced, assessing local and other inocula, different substrates and comparing pit to pot production. The produced inocula were field applied to compare with non inculated onion for yield, nutrients and quality characteristics. The inoculum that was produced had high mycorrhizal root length colonization and average infectivity. A substrate with 1:1 attapulgite:zeolite (by weight) plus vermiculite (~20% of the volume), corn as host plant and initial inoculum from an adjacent wheat field were chosen. The application of the inoculum (powder form) in field grown spring onion, in a soil with 40 mg kg-1 Olsen P, was done with the seeding machine through the fertilizer/pesticide box, and it did not differ in yield with the non-inoculated control. However, inoculated plants did not receive P fertilization. Qualitative results had marginal differences between inoculated and non-inoculated plants. For the second year, the AMF inoculum produced had higher colonization than in the first year, and was applied in a 7.9 mg kg-1 Olsen P field by hand, and was then pushed with the seeding machine. Spring onion yield was lower for the inoculated plants. In both years, root length colonization was initially higher for the non-inoculated plans, showing a competitive local AMF community

Keywords: fresh spring onion, arbuscular mycorrhizae, inoculum

Adaptation of greenhouse tomato plants in treated wastewater irrigation

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The agricultural sector accounts for most of the global water consumption. Combined pressures from a growing population and the escalating climate crisis are expected to intensify water scarcity. In this context, the reuse of treated wastewater (TW) from domestic and industrial sources has emerged as a viable strategy to mitigate freshwater depletion. Nonetheless, the continuous application of TW may lead to salt accumulation and increased abiotic stress in plants. The aim of this study was to evaluate the sustainability, as well as Resources Use Efficiency, of tomato cultivation using TW under high salinity conditions, focusing on yield performance and fruit quality. A hydroponic cultivation system was established using grafted and non-grafted grape tomato plants, irrigated either with TW—without fertilizers—or with a conventional hydroponic nutrient solution (Control). Additionally, Trichoderma harzianum T-22 was applied monthly as a biostimulant. The experiment was conducted in a pilot greenhouse in Thessaloniki, Greece, equipped with automated climate control and monitoring systems. Total yield was recorded, while fruit quality was assessed by measuring total soluble solids (°Brix). The Electrical Conductivity (EC) of the TW averaged 5.5 mS cm^{-1}, primarily due to elevated chloride and sodium ion concentrations. Plant adaptability and resilience were evaluated through physiological measurements. Yield was significantly higher in plants of the Control, regardless of grafting. In contrast, °Brix were affected by the type of water applied, as well as grafting. Non-grafted plants exhibited higher °Brix values under both treatments, with the difference being significant only under the Control treatment. Despite the high-salinity stress, plants of the TW treatment were satisfactorily adapted and remained productive until the end of the experiment using exclusively TW. These findings are highly promising, highlighting the potential of TW reuse in hydroponic cultivation systems and contributing to more sustainable agricultural practices under conditions of increasing water scarcity.

Keywords: protected cultivation, sustainable production, resources use efficiency, abiotic stress, photosynthesis, fruit quality

Poster session 3

Nutritional quality of cherry tomatoes grown under prolonged water deficit since crop establishment

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Tomato is an essential crop, especially on the Greek island of Crete, where the producers prefer greenhouse cultivation. Crete, located in the Mediterranean region near Africa, is already affected by water scarcity, which negatively impacts the productivity and quality of horticultural produce such as tomatoes. These effects are expected to worsen due to the rising temperatures, which further reduce the amount of available water resources. The TOMISAD project aims to optimize water resource management, preserving and enhancing the quality of greenhouse-grown cherry tomatoes. In this experiment, cherry tomato (Lycopersicon esculentum L. var. 'Lobello') seedlings were transplanted into soil in a commercial greenhouse in Tympaki, Crete, Greece, on July 27, 2024. Plants were irrigated via a drip irrigation system that was modified to supply 100%, 75%, and 50% of the standard irrigation scheme followed by the producer. After 110 days, three replications of twelve fruits, randomly harvested from six plants per treatment, were homogenized and analyzed for their lycopene and total phenolic content. Until the sampling day, each plant of 100% (control), 75%, and 50% water volume was irrigated with 182, 137, and 91 liters of irrigation solution in total, respectively. On average, daily mean air temperature, relative humidity, and solar radiation in the greenhouse were 68%, 23°C and 102 W/m2, respectively. The results indicated a statistically significant increase in lycopene content in 50% irrigation compared to 75% irrigation and the control (100%) (Tukey's test, α = 0.05). Additionally, although the total phenolic content tended to increase as irrigation volume decreased, analysis of variance revealed no statistically significant differences among treatments. These findings suggest that irrigation water volume reduction may improve or at least not affect the nutritional quality of greenhouse-produced tomatoes. This is particularly valuable in regions or periods where water availability is already limited or expected to become so. As more research is needed in this area, the TOMISAD project will further investigate the effects of water deficit on other quality parameters, as well as yield and shelf life of commercial cherry tomatoes.

Keywords: drought; lycopene; phenolics

Effect of grafting and irrigation regimes on the yield and fruit quality of tomato grown under greenhouse conditions

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Sustainable production of vegetable crops is mainly focused in the mediterranean Countries on water economy and conservation techniques due to limited access to fresh water for agriculture. Grafting on vegetable crops, such as tomatoes (*Solanum lycopersicum* L.), is likely an interesting technique for tolerating water shortage regimes. In this study, we evaluated the performance of four commercial tomato rootstocks under water stress (WS) conditions, combined with three scions: two Italian landrace "Pizzutello" and a breeding line "101MVS", during the winter production season under cold greenhouse, in a split-plot design with two irrigation regimes: full irrigation (100%) and induced WS of 40% (60 % irrigation). At the physiological level, the water retention in leaves under WS was reduced and leaves showed a reduced capacity of water stocking in both grafted and non-grafted combinations compared to plant under full irrigation regime. A decrease of estimated chlorophyll content (SPAD) was also noted in WS plants independently of the rootstocks/scion combination, except for the "DynaFort" rootstock, which produced a stable SPAD measurement for the three varieties and under both irrigation regimes. "RS4" rootstock showed to induce lateness in fruit maturity under WS compared to other rootstocks. "OptfortF1" allowed to reach the same yield under both irrigation regimes with a marginal earliness for the plants grown under WS. The biochemical analysis of the fruits highlighted the ability each rootstock in response to WS especially with the ratio AsA/DHA, GABA, amadori compounds and proline concentration that were notably different among the rootstock/scion combinations. Findings in this study showed an interesting potential for grafted tomato plants to be used under deficit irrigation regimes by the selection of the adequate rootstock to increase the productivity.

Keywords: Solanum lycopersicum L., Rootstock, water stress, greenhouse production, biochemical analysis, Water use efficiency.

Role of Selected Biostimulants and Organic Amendments on Artichoke and Pepper Seedling Quality

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Transplant shock is a major challenge in vegetable production, particularly in semi-arid regions of the southern U.S., where rapid acclimation and stand establishment are critical for a successful crop performance. This study evaluated a range of biostimulants including organic amendments on transplant quality of artichoke (Cynara cardunculus var. scolymus) and pepper (Capsicum annuum) seedlings. Two artichoke cultivars (17-111' and '17-129') were treated with the following biostimulants: seaweed extract (Kelpak), humic substance (Novihum®), bacterial inoculant (Spectrum), mycorrhizal fungi mix (MycoApply), a combination of bacteria and mycorrhizal fungi (Spectrum + Myco), and an untreated control. In 17-129, Spectrum improved root dry weight by 100% and slightly improved leaf area and shoot fresh weight, while Novihum increased root dry weight, root length, leaf area and shoot fresh weight compared to the untreated control. In 17-111, Spectrum + Myco significantly increased leaf area by 13 % and shoot fresh weight by 30 %, while Kelpak reduced root length by 13 % and root dry weight by 45 %, indicating a cultivar-specific response to biostimulants. In pepper, two cultivars (Tenor' and 'Mama Mia Giallo') were treated with four organic amendments: solid humic acids (Novihum®), Trichoderma (RootShield® PLUS+), liquid humic substances (Huma Pro® 16), and foliar calcium (On-Gard®). Mama Mia Giallo seedlings treated with Novihum were the only ones exhibiting a higher leaf area (14%) and shoot fresh weight (25 %). In a follow up pepper trial with two cultivars (Jimmy Nardello' and 'Mama Mia Giallo') grown under organic management, Spectrum+Myco significantly improved shoot and root traits of Mama Mia Giallo including stem diameter, leaf area, shoot fresh weight and root length compared to untreated. These findings suggest that when choosing biostimulants and/or organic amendments growers need to consider their responses are cultivar as well as management dependent.

Keywords: transplants, seaweed, mycorrhizal fungi, bacterial inoculant, humic acids

Tomato seedlings gas exchange parameters under deficient Mg supply

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The aim of this study was to investigate reaction of tomato cultivars and rootstocks on magnesium (Mg) deficiency at the seedlings phase. Experiment was established which 14 scions-cultivars (Araldino; Big beef; Byelsa; Capuccino; Eyre; Hayet; Matissimo; Mei Shuai; Novero; Rosamei; Rossano; Santiana; Signora and Svth2913) and 10 rootstocks (Auroch; CGT; Enpower; LA1223; LA1777; Optifort; Secure force; Suzuka; TOR 23901 and Vigoterra). Two levels of Mg (standard - 1 mM and deficient- 0.1 mM) were used and plants were grown in half-strenght Hoagland's nutrient solution using floating system. At the end of the experiment (30 days after sowing) measurements of chlorophyll concentration index (CCI) and leaf gas exchange parameters (photosynthesis intensity (A), stomatal conductance (gsw), intercellular CO2 (Ci) and transpiration rate (E)) were done. Scions significantly differed for all measured properties except A. Cultivars grown at standard Mg had higher A (12.6); gsw (0.33) and E (8.51), while seedlings in deficient Mg conditions had higher CCI (39.9) and Ci (289). The influence of both factors were recorded on all cultivar measured properties. Differences between rootstocks were found for all measured properties and significant differences between Mg treatments were noted for gsw, Ci and E. Rootstock seedlings grown with deficient Mg had higher gsw (0.37) and Ci (296), while seedlings in sufficient Mg conditions had higher E (11.9). The influence of both factors were recorded on A, Ci and E properties. The deficient Mg concentration did not significantly decrease most values of the rootstock measured traits, while significantly decreased values for scions/cultivars comparing to higher Mg concentration used.

Keywords: chlorophyll concentration index, conductance, photosynthesis, rootstock, scion, transpiration

Poster session 4

Evaluation of peat-alternative substrates for the production of lettuce seedlings

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Lettuce is an important vegetable in the Region of Murcia, where more than 15,000 ha are grown, normally in open air conditions. Lettuce transplants are produced in specialized nurseries, with peat-based substrates being the main growing medium. Given the European Union's efforts to restrict peat extraction and the critical role of peatland preservation in mitigating climate change, transitioning to peat-free substrates based on renewable and, when possible, locally sourced alternatives is essential. In this study, we investigated the performance of three alternative growing substrates (S1: Posigreen, a substrate based on marine plants and algae residues, 100 % peat-free; S2: a blend prepared by mixing 50% white peat+30% wood fibre+20% husk rice; S3: a blend prepared by mixing 33% white peat +33% coco pith +34% wood fibre), using a commercial peat-based substrate as a control treatment (S0: a blend prepared by mixing 70% white peat+30% brown peat) to produce lettuce var. Alatriste seedlings. The plantlets were cultivated in 220 cell plug trays in a spring growing cycle for 28 days in a nethouse. Germination and emergence rates were measured after sowing. At the transplanting time, plantlets were assessed for various growth parameters. In addition, substrate physicochemical properties were measured on unplanted substrate treatments. The highest height plant, leaf area and fresh weight were obtained in plants grown in S0 and S3, while the lowest number of leaves, root volume and shoot/root ratio were attained in S1. Some S1 physicochemical properties, particularly the high electrical conductivity and high bulk density, limited the aerial growth of transplants, although its balanced shoot/root ratio could favour a successful establishment. In general, the results demonstrate that using alternative peat substrates in seedling production may provide growers with an opportunity to reduce peat consumption in transplant operations.

Keywords: transplants, wood fibre, peat-free, substrate blends, Lactuca sativa, shoot:root ratio

Effects of red-orange light irradiation on the growth of seedlings of spinach, komatsuna, Swiss chard, cucumber and tomato

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In recent years, "wavelength conversion materials" that convert UV and blue light into red-orange light have been attracting attention, with potential uses in agricultural films and other fields. While several studies have reported the effects of light wavelength on plant growth and secondary metabolite content, there are few reports on the impact of red-orange light on plants. This study investigates the effect of red-orange light, which wavelength is converted from UV and blue light, on the growth of some vegetable seedlings. The test plants used in this study were spinach 'Hydro Seven', komatsuna 'Hamami 2', Swiss chard 'Vietra Bianco', cucumber 'Natsu Suzumi', and three tomato varieties of 'Momotaro York', 'Furutika' and 'CF Chika'. The plants were cultivated hydroponically in plant factories with artificial lighting. The seeds were sown on urethane cubes, and after confirming germination and root growth, spinach and komatsuna were grown for 14 days, Swiss chard and cucumber for 22 days, and tomatoes for 18 days. The light treatment conditions included of white LEDs and white + red-orange LEDs. The light intensity was set at 150 μmol m^{-2} s^{-1} for white light and 23 μmol m^{-2} s^{-1} for red-orange light. The parameters measured included shoot fresh weight, plant height, number of leaves, and relative chlorophyll content, as indicated by SPAD values. As a result, the addition of red-orange light to white light increased the shoot fresh weight by 11% in spinach, 6% in Swiss chard, 21% in cucumber, 8% in tomato 'Momotaro York', 17% in 'Furutika' and 28% in 'CF Chika', compared to white light alone. Additionally, the SPAD values for spinach, cucumber, and tomato varieties 'Momotaro York' and 'CF Chika' seedlings were significantly higher. These results demonstrate the effectiveness of red-orange light irradiation in promoting plant growth.

Keywords: hydroponics, light emitting diode (LED), light quality, plant factory, seedling cultivation

Poster session 4

Influence of abiotic factors on the yields of early cultivar rootstock combinations of nectarines (*Prunus persica* var. nucipersica)

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The study was carried out in the spring of 2017 – 2018 in an orchard of the Agricultural Experimental Station – Khan Krum, Shumen region, Bulgaria. The experimental plantation was established in the spring of 2011. The following early nectarines cultivars were studied: Aureliogrand, Sunfree, Bigtop, Gergana (the first selected Bulgarian cultivar), Weinberger, Nectagrand 2, Caldesi 2000 (cultivar with white flesh) and independently engrafted on a seminal rootstock (Elbert) and clonal GF 677, as well as the cold hardy dessert cultivar Redhaven. During the studied period, they established negative temperatures (- 3.6 and – 5.0 0C) which coincided with the phenological phase of full blossoms as a result in the flowers of which frosting occurred in the studied cultivars (76.4 - 100.0 %). A relatively low percentage of frozen blossoms were observed in the cultivars grafted on rootstock GF 677. In 2017, the blossom damage was relatively low and yields were obtained unlike in 2018. Negative spring temperatures had a negative impact on productivity if blossom damage percentage exceeded 80 %.

Keywords: nectarines, cultivars, frost, Prunus persica var. nucipersica, yield

Comparative study of vegetative propagation methods of the medicinal plant *Origanum scabrum* (Boiss. & Heldr.)

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Origanum scabrum (Lamiaceae) is an endemic plant of Greece with aromatic and medicinal properties. Plant propagation with botanical seeds is difficult and asexual propagation, by crown division or micropropagation, is an alternative approach to producing propagating material and preserving genetic material. The differences in the development of plants from crown division derived from mother plants grown in pots and plants derived from micropropagation were studied. Plants from micropropagation were produced from explants grown in modified semi-solid media MS (Murashige and Skoog), with sucrose (30g/L), agar (4g/L) and pH=5.8 and under T=20oC, photoperiod=16 hours, light intensity=40 μmol m^{-2} sec^{-1}. Microplants and plants from crown division were planted in trays with peat/perlite substrate (1/1 v/v), on April 26, 2024. After 24 days, plants were transplanted into 2 L pots with peat/perlite substrate (1/1 v/v). For each propagation method, 4 experimental plots of 20 plants each were used. During the growth of the plants, the percentage (%) of survival/growing plants, the number of shoots per plant, the number of leaves per plant, the height of the largest shoot on each plant and the number of flowering plants were calculated. On the 120th day after transplantation, the fresh and dry weight of the above-ground part of the plant was measured and the dry matter content was calculated. Both methods of propagation achieve a high plant survival rate (greater than 86%) without statistically significant differences. Plants derived from micropropagation have a higher growth rate, as shown by the rate of leaf and shoot emergence and by the height of the largest shoot of the plant. In addition, plants derived from micropropagation have higher fresh and dry weight of the above-ground part of the plant, higher dry matter content (%). However, plants derived from micropropagation flowered 20 days later than plants derived from crown division.

Keywords: aromatic and medicinal plant, crown division, endemic plant, in vitro, Lamiaceae, micropropagation

Poster session 4

Effect of different basal media on micropropagation of the medicinal plant *Origanum scabrum* (Boiss. & Heldr.)

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Micropropagation of the endemic medicinal plant Origanum scabrum (Lamiaceae) is an effective method for producing propagating material and preserving plant genetic material. The effect of the three different basal media, Murashige & Skoog (MS), Woody Plant Medium (WPM), and Gamborgs' medium (B5), as well as their concentrations (full strength and half strength), on the micropropagation of the O. scabrum was studied. Node explants were transferred to Petri dishes with modified semi-solid media MS, ½MS, WPM, ½ WPM, B5 and ½ B5, according to the six experimental treatments. In all treatments, sucrose (30g/L) and agar (4g/L) were added to the media, and the pH was adjusted to 5.8. In vitro cultures were transferred to growth chambers with T=20oC, photoperiod=16 hours, light intensity=40 μmol m-2 sec-1. For each treatment twelve petri dishes, with five explants each, were used. Microplants cultivated in ½ MS basal media have the highest number of shoots, leaves, and nodes per explant, indicating the suitability of this basal media for rapid production of microplants that can be used subcultures. Microplants cultivated in the basal media ½ WPM have the slowest production rate of propagating units (nodes). On the other hand, microplants cultivated in the basal media with ½ WPM or with ½ B5 produced higher number of roots, indicating the suitability of these basal media to produce microplants for transplantation to the field. After acclimatization for 14 days, microplants derived from all media showed high rates of survival during their growth in an unheated greenhouse for 68 days, were the plants derived from the ½ MS media, full-strength MS and full-strength WPM produced higher number of leaves and lateral shoots.

Keywords: aromatic and medicinal plant, endemic plant, full strength, Gamborgs' medium, half strength, in vitro, Lamiaceae, Murashige & Skoog, woody plant medium

Optimizing Salicornia Propagation: A Study on Rooting Enhancers

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Salicornia is a resilient halophyte that naturally thrives in coastal environments and is naturally propagated by seeds. However, propagation by cuttings has not yet been fully explored. For this purpose, 2 species of salicornia genus, one annual (Salicornia europaea L.) and one perennial (Salicornia fruticose L.), were subjected to separate propagation experiments under the same rooting enhancers both conventional (IBA 1000, 2000 ppm, K-IBA 1000,2000 ppm, NAA 500, 1000 ppm) and organic (vitax -organic rooting gel, aloe vera). S europaea exhibited the highest rooting percentages (98%) under both vitax and aloe vera treatments and the highest root number under IBA 2000 ppm and K-IBA 1000 ppm treatments compared to control ($p < 0.05$). As for S. fruticosa, the highest rooting percentages came from aloe vera, NAA 500-1000 ppm and IBA 1000 ppm (98%, respectively). Differences were noted in root number and average root length. In specific, IBA 2000 and 1000 ppm showed a higher root number compared to the other treatments ($p < 0.05$). At the same time, K-IBA 1000 and 2000 ppm resulted in an elevated average root length ($p < 0.05$). Conventional rooting enhancers seem to promote rooting percentage, root number and root length compared to organic ones. In conclusion, S. europaea and S. fruticosa showed a similar response to the rooting enhancers used except for root length. Consequently, propagation with cuttings using conventional rooting enhancers may be proposed as a means to maximize halophyte propagation. Aloe vera and vitax rooting gel may be used as an organic alternative.

Keywords: cuttings; IBA; K-IBA; rooting percentage; root length

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Poster session 4

Nitrogen fertilization strategies for common purslane cultivated under different soilless systems

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Purslane is a widely recognized wild leafy vegetable that has gained significant research attention, especially in agricultural and environmental studies, due to its remarkable resilience and high nutritional value. Incorporating purslane into efficient and responsible cropping systems, such as hydroponics, could strengthen its impact in sustainable agriculture. In hydroponics, balancing ammonium to nitrate nitrogen ratio (Nr) in nutrient solutions comprises the most common fertilization practice in leafy green production to regulate pH in rootzone, increase NUE and suppress nitrates accumulation in fresh produce. The aim of this study was to comparatively assess the impact of soilless cultivation systems and high ammonia fertilization on purslane growth and quality performance. Therefore, purslane grown either in a soilless, using perlite as substrate, or in a floating system, and supplied with a nutrient solution of standard or high Nr. In floating system, purslane exhibited incredibly higher growth rate while the period from transplanting to flowering was almost the half of that of plants grown in soilless system. On the other hand, the plants grown in soilless system recorded higher N assimilation rate. Concerning the applied Nr, high ammonia fertilization restricted yield performance only in plants grown in floating system without contributing to less nitrates accumulation in leaves. In contrast, plants grown in soilless system did not experience any yield constrictions due to high Nr, while nitrate levels in leaves ranged within safe thresholds for human consumption irrespective the different Nr. In both systems, high Nr restricted the N reduced form content in dry plant tissues by approximately 15%. Concluding, high Nr could be considered as an efficient nitrogen fertilization strategy when common purslane is cultivated in soilless systems. However, in hydroponics, high Nr can emerge ammonia toxicity, compromising the yield and quality of common purslane.

Keywords: Portulaca oleracea; hydroponics; plant nutrition

The effects of root zone volume on early bolting in Delphinium and Larkspur

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Early bolting is a big problem to produce high quality cut flowers under high temperature conditions in Delphinium, which are high temperature and long day plants. In D. grandiflorum, it has been revealed that seedlings grown under root restricted conditions are reduced the rate of early bolting, even in summer in Japan. Early bolting under high temperature conditions is also a big issue in D x belladonna and Larkspur (Consolida ajacis) but the effects of root restriction have not been studied. In this study, we investigated the effects of root restriction in D x belladonna and Larkspur by growing seedlings in cell trays with different hole sizes. In D x belladonna, the early bolting rate of seedlings grown in 288 holes (root zone volume of approximately 9 mL) was suppressed more than other root zone volume. There is no significant difference among cell trays in cut flower quality after transplanting. 288 holes cell tray is also effective to suppress early bolting in Larkspur. Early bolting rate in 288 holes is 34.0% in 'Cannes Blue Picotee' and 5.9% in 'DelQIS Deep Blue'. There is also no significant difference among cell trays in cut flower quality after transplanting. Cut flower length is higher than 70 cm in each treatment except for 200 holes (approximately 12 mL) cell tray in 'Cannes Blue Picotee'. It was suggested that early bolting of Delphinium and Larkspur could be controlled by root zone volume, and 288 holes cell tray is the most suitable. We will examine the conditions in detail by changing some conditions that vary with root volume such as root dry weight, amount of fertilizer and so on in the future and reveal the mechanism by which the root restriction affects the early bolting in Delphinium and Larkspur.

Keywords: high temperature, root restriction, cell tray, cut flower quality

Poster session 4

Study on high yields of potato microtubers formed by long-day conditions using temporary light interruption treatment

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Long-day conditions using temporary light interruption treatment (day-break treatment, DB) are a cultivation method in which potatoes Solanum tuberosum L. are grown under long-day conditions to promote tuber formation. This method has been reported to tend to produce higher yields per potato plant than when grown under short-day conditions as well as under long-day conditions. This is due to the fact that under these conditions, tuber formation can be induced under long-day conditions, where tubers do not normally form. Japan's potato supply has been declining year by year. One of the seed potato production methods used in Japan is the hydroponic cultivation technique. Generally, the hydroponic production of mini-tuber seed potatoes produces approximately 30 mini-tubers per plant. A previous study reported that potato cultivation using DB produced 20 microtubers per plant, which was fewer than the number of seed potatoes produced per plant through the standard hydroponic cultivation. Therefore, this study examined the ways to further increase microtuber yields by DB in addition of short-day treatment. In this experiment, four treatments were used: a short-day treatment, a DB, a treatment that switched to a short-day treatment 17 days after the start of the DB, and a treatment that alternate between DB and short-day treatments every other week. The light source was a mixture of red and blue LEDs (5:1). The number of microtubers formed in the DB was 24.4 per plant, whereas the number increased to 58 per plant in the treatment where the DB and short-day treatments were switched every other week. These results indicate that when microtubers are grown in the DB plus short-day treatment, yields are increased when the DB is repeated every other week.

Keywords: Environmental control, LED, photoperiodic tuberization, plant factory with artificial lighting, seed potato

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