LUH 2021 – The role of science in reconciling ecology and technology in Landscape and Urban Horticulture

December 15-17, 2021

Book of Abstracts & Program

On line symposium
15-17 December 2021

LUH 2021
VIII International Conference on
Landscape and Urban Horticulture

ISHS

Dipartimento di Agricoltura Alimentazione e Ambiente

CNR IRET

The role of science in reconciling ecology and technology in Landscape and Urban Horticulture

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WELCOME

Dear colleague,
Welcome to the VIII International Conference on Landscape and Urban Horticulture, hosted by the CNR, University of Catania and the International Society for Horticultural Science (ISHS). Unfortunately, due to the covid-19 pandemic, the symposium is taking place online.

A major share of the world population inhabits cities; scientific efforts are needed in order to improve the comfort and livability of urban areas. Ecology and technology must synergistically interact to overtake issues associated with the coexistence in limited spaces of biological organisms and man-made artefacts. While urban gardens of any scale greatly contributed in past times to people's wellbeing, today's challenge is to make the urban green areas work as an ecosystem. Thanks to the contribution of experts in agricultural sciences, ecology, botany, landscape design, social science, zoology, and geography, in the symposium we share and discuss the most recent advances in urban green infrastructure and horticulture toward more sustainable and livable cities.

The symposium will allow researchers, young scientists, and graduate students to present their work and exchange ideas. Our symposium attracted participants from 26 different countries, who submitted 87 abstracts.

The symposium program has been organized into oral and poster presentation sessions, related to six different topics regarding landscape and urban horticulture.
Day 17 December the Symposium will host some workshops organized by colleagues from the University of Bologna.

We hope that all the presentations, invited speakers and oral or poster presenters, will provide you useful information about the current critical state of things.

The accepted full papers for the oral and poster presentations will be published in a book series of Acta Horticulturae on behalf of the ISHS.
Enjoy the symposium!

The conveners
Daniela Romano, Francesca Bretzel and Stefania Toscano

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Symposium Program of LUH 2021 – The role of science in reconciling ecology and technology in Landscape and Urban Horticulture

December 15-17, 2021

Day 1 - December 15, 2021 (CET, Central European Time)	
08.30-08.50	***Opening Ceremony - Welcome*** *Carlo Calfapietra* (CNR IRET Head) *Agatino Russo* (Di3A Head)
08.50-09.00	ISHS Report by *Silvana Nicola*
09.00-9.20	***Plenary lecture 1*** ***Horticulture, Design and Ecology How to Deal with the Urban Environment*** *Angeliki Paraskevopoulou - University of Athens (Greece)*
9.20-9.40	***Plenary lecture 2*** ***Can Cities Provide Food in the XXI Century?*** *Francesco Orsini -University of Bologna (Italy)*
Section I: Urban horticulture benefits for people	
Chairperson: *Angeliki Paraskevopoulou (University of Athens, Greece)*	
10.00-10.20	***Invited speaker*** ***Sensory Experience in Nature for Supporting Human Health*** *Anna Maria Palsdottir - Swedish University (Sweden)*
Oral presentations	
10.30-10.40	***Urban Horticulture Can Contribute to the Construction of Comfortable Lives for Diverse People*** *Michiko Takagaki*, Hitoshi Ohara, Hitoshi Watanabe, Satoru Tsukagoshi, Katsuji Noda*
10.40-10.50	**Current Status of Prohibition and Reluctance Pertaining to the Use of Indoor Plants at Hospitals in Chiba Prefecture, Japan** *Shizuka Tanaka*, Satoshi Yamaguchi, Ayako Nagase*
Poster presentations	
11.10-11.30	**Nature Goes to School: Wildflower Meadows in the School Garden** *Francesca Bretzel*, Beatrice Pezzarossa, Francesca Vannucchi, Roberto Pini*
	Urban Gardening as a Tool to Improve the Self-Confidence and Integration in Young Disabled People: The Case of Ortopiù in Naples *Chiara Cirillo*, Giuseppe Carlo Modarelli, Youssef Rouphael, Stefania De Pascale*
	From Suburb to 'Glocal' Innovation Hub: Troisi Park, as Agro-Social Plaza Intensifies the Renewal Value of East Naples District *Chiara Cirillo*, Giuseppe Carlo Modarelli, Teresa Bastia, Youssef Rouphael, Stefania De Pascale*
	Urban Horticulture: A Case Study of a Soilless Urban Garden in Turin (Italy) *Andrea Ertani, Roberta Bulgari, Federica Larcher, Marco Devecchi, Silvana Nicola**
	The Innofarming Project: Innovative Urban Farming Applications for Future Urban Farmers *Giuseppina Pennisi*, Elisa Appolloni, Emanuele Durante, Mustafa Ginesar, Matthieu Guary, Laetitia Maison, Pilar Oñate, Rafael Pagán, Sara Remón, Francesco Orsini*
	The Edible Ornamental Plants: A Resource for Urban Horticulture *Daniela Romano*, Stefania Toscano*

	Middle School Educators' Description of Outdoor Learning Environments Design *April Hausle, Julieta Sherk**
11.30 - Coffee break	
Section II: Historical landscape in urban areas	
Chairperson: *Giulia Caneva (University of Roma3, Italy)*	
11:50	***Invited speaker*** **Traditional Water Management in Anthropic Landscapes** *Pietro Laureano*
Oral presentations	
12:15-12:25	**Resilience and Resistance of Viticultural Biodiversity in the Urban Ecosystem: The Case of the Grapevine Collection of the Botanical Garden of Rome** *Rita Biasi*, Elena Brunori, Federico Moresi, Mauro Maesano, Fabrizio Cipriani, Sergio Carpentieri, Lapo Rossetti, Fabio Attorre*
12:25-12:35	**The Landscape of Bucolics. The Identification of Coniferae in Vergil's Eclogues** *Maciej Helbig*
12:35-12:45	**Agriculture and Natural Resources for Valorizing Peri-Urban Historical Landscapes: The Case Study of Stupinigi Royal Natural Park (Metropolitan City of Turin, Italy)** *Enrico Pomatto*, Marco Devecchi, Federica Larcher, Paola Gullino*
12:45-12.55	**Traditional Vegetables in a Semi Urban Landscape with Various Health Benefits: A Case Study in South Afric** *Kara - Lee Prinsloo*, Riana Kleynhans, Ray Jansen*
13:00 Lunch	
Section II: Historical landscape in urban areas	
Chairperson: *Chiara Cirillo (University of Napoli, Italy)*	
Oral presentations	
14:10-14:20	**Household Knowledge of Growing Practices and Perception of Fruit Tree Diversity in Trinidad and Tobago** *Oral Daley*, Wendy-Ann Isaac, Afiya John, Aliyah Baggoo*
14:20-14:30	**Historic Gardens Restoration. Preliminary Outcomes from a Synergistic Application of Visual Assessment and Geomatic Techniques to Optimize the Management of Arboreal Heritages** *Alberto Minelli*, Enrico Felice, Michaela De Giglio, Marco Dubbini, Valeria Vignoli*
14:30-14:40	**Patchwork Quilt: A Methodology Proposed for the Study of Historic Gardens** *Patrícia Paiva*, Rafael de Brito Sousa, Schirley Cavalcante Alves*
14:40:14:50	**Protecting Monuments and Plant Biodiversity in Archaeological Sites: The Case of the Etruscan Necropolis of `Monterozzi´ (Tarquinia, Central Italy)** *Giulio Zangari*, Emanuela Cicinelli, Flavia Bartoli, Daniela Isola, Fernando Lucchese, Giulia Caneva*
14:50-15:00	**Composition of Flower Visiting Hymenoptera in Flowerbeds and Grasslands in Chiba City, Japan** *Tomomi Kakeya*, Hisatomo Taki, Ayako Nagase*

Poster presentations	
15:15-15:30	**The Flora of Old Rauma, a Unesco World Heritage Site** *Leena Lindén*
	Agricultural Landscape and Historical Urban Landscape: Notes on the Case Study of Bologna (Italy) *Giuseppina Pennisi*, Francesco Casadei, Giovanni Bazzocchi*
	Afuá: Autonomy and Appreciation of Riverside Landscapes in the Amazon *Pedro Mergulhão, Claudia Petry**
	The Biodiversity of Traditional Sicilian Green Areas Stefania Toscano, Alessandro Tribulato, Daniela Romano*
Section III: Urban ecosystem and environmental engineering	
Chairperson: *Elisa Appolloni (University of Bologna, Italy)*	
15:40	***Invited speakers*** **Trace Element Contents, Microbial Communities and Enzymatic Activities of Urban Soils. A Case Study from the City of Marrakech, Morocco** *Ali Boularbah*, Leila Benidire, Naylo Naylo, Sofia Pereira, Hicham El Khalil, Stéphanie Ouvrard, Christophe Schwartz, Paula Castro*
Oral presentations	
16:00-16:10	**Consumer Attitudes to Vertical Farming in the United Kingdom and Germany** *Birgit Ha*, Christina Roigard, Sok Leang Chheang, Grace Ryan, David Jin, Duncan Hedderley, Sara Jaeger*
16:10-16:20	**Constructed Wetlands as Nature-Based Solution for Sustainable Wastewater Management in Urban Areas: A Critical Assessment by Experimental Studies and Literature** *Mario Licata*, Giuseppe Virga, Nicolò Iacuzzi, Davide Farruggia, Yuri Bellone, Maria Cristina Gennaro*
16:20-16:30	**Supplemental Daily Light Integral by Led Light to Improve the Growth of Leafy Vegetables in Aquaponic Systems** *Giuseppe Carlo Modarelli*, Lucia Vanacore, Antonio Luca Langellotti, Paolo Masi, Chiara Cirillo, Stefania De Pascale, Youssef Rouphael*
16:30-16:40	**Plants & Polyester: Suitable Plants for a Textile-Based Living Wall System** *Maren Stollberg*, Alexander von Birgelen*
16:40-16:50	**Impact of Shade Produced by *Prosopis glandulosa* (Honey Mesquite) on Surface Temperatures of Asphalt and *Cynodon dactylon* (Bermudagrass) in Palm Springs, California** *Janet Hartin*
16:50-17:00	**Sub-Alpine Wildflower Meadows as a Template for Water-Conserving Landscape Design in the Western United States** *Phil Allen*, Alyssa Brown*
17:00-17:10	***Northeast Ohio urban farms pivot and thrive in 2020*** *Jacqueline A Kowalski*, Eric Barrett, Amanda Osborne*
Coffee break	

Poster presentations	
17:30-18:00	**Evaluation of Different Plant Species Arranged in Panels for Indoor Vertical Gardens** *Noelia López López*, Isabel Iglesias-Díaz, Santiago Lamosa-Quinteiro, Adolfo López-Fabal, Martín Cortizas-Suárez*
	Urban Trees Felling and Failures: Preliminary Results from an Investigation on an Urban Green Infrastructure. Locating The Most Sensible Species and Optimizing their Management *Alberto Minelli*, Enrico Felice, Valeria Vignoli*
	Recirculating Aquaponic Systems: The New Era of Food Production Hyping the Nutrients Loop *Giuseppe Carlo Modarelli*, Chiara Cirillo, Lucia Vanacore, Antonio Luca Langellotti, Paolo Masi, Stefania De Pascale, Youssef Rouphael*
	Beyond Vegetables: Effects of Led Light on Secondary Metabolites in Medicinal and Aromatic Plants, Edible Flowers and Microgreens *Elisa Appolloni, Giuseppina Pennisi, Laura Carotti, Ilaria Zauli, Dario Migliorini, Ivan Paucek, Stefania Quaini, Francesco Orsini*, Giorgio Gianquinto*
	Sustainability at the Edge: Reviewing Opportunities and Risks for Vertical Farming in Africa *Ivan Paucek, Emanuele Durante, Elisa Appolloni, Giuseppina Pennisi, Nicolo Golinucci, Giacomo Falchetta, Nicolo Stevanato, Federica Inzoli, Stefania Quaini, Francesco Orsini*, Giorgio Gianquinto*
	Effective Microorganisms Collected from Urban Gardens Favors Native Lawn Growth *Claudia Petry*, Vitória Miranda, Lucas Hermes Weber, Aniéli Altmeier Hermann-Bandera, Cristhian Teixeira, Fabiana Tonial, Edson C. Bortoluzzi*
	Characterisation of the Etna Volcanic Ash to Explore its Suitability as Growing Media *Francesca Bretzel, Irene Rosellini, Stefania Toscano*, Daniela Romano*
18:00 - First day symposium closure	
Day 2 - December 16, 2021 (CET, Central European Time)	
Section IV: Planning, Design and Policies in Cities	
Chairperson: *Federica Larcher (University of Turin, Italy)*	
8:30	***Invited speaker*** **Policies for Food Production in Cities: from Ignorance to Cooperation and Strategic Support** *Runrid Fox-Kämper*
Oral presentations	
9:00-9:10	**Evaluation of Horticultural Activity from the Perspective of Administrators and Participants at Facilities Supporting Higher Brain Dysfunction** *Katsuji Noda*, Keitaro Tada, Hiroko Imaizumi, Fmio Terauchi, Naoko Katakura*
9:10-9:20	**Mediterranean Green Buildings: Vegetation Cover and Runoff Water Quality Assessment in a Green Roof System** *Fabrizio Cinelli*, Giovanni Santi, Andrea Scartazza, Martina Pratesi*
9:20-9:30	**Wildflowers: Opportunities for Urban Landscapes** *Davide Farruggia*, Nicolò Iacuzzi, Mario Licata, Salvatore La Bella, Teresa Tuttolomondo, Giuseppe Virga*

9:30-9:40	**A Framework for Selecting Fruitful and Nutritious Crops for Urban Cultivation Systems** *Isabella Righini*, Luuk Graamans, Silke Hemming, Cecilia Stanghellini, Leo F.M. Marcelis*
9:40-9:50	**The Dilemma and Countermeasures of Flower-Themed Tourist Attraction Development in China** *Yuanyuan Xu*, Zhicheng Zhou, Wuzhong Zhou*
9.50 Coffee break	
10:20-10:40	***Invited speaker*** **Urban Gardens: A New Oasis** *Sarah Eberle*
Poster presentations	
10:50-11:20	**Phytosociological Approach to Implement a Sedum-Dominated Plant Community in Extensive Mediterranean Green Roofs** *Francesca Bretzel*, Francesca Vannucchi, Alice Buoncristiano, Giulia Caneva*
	Exploring Latin America's Urban Green Status and Research Gaps *Sofia Flores*, Koenraad Van Meerbeek, Carmen Van Mechelen, José Palacios*
	Towards an Energy Alternative Solution through Open Cast Lignite Mine Reclamation *Aikaterini Gkoltsiou, Angeliki Paraskevopoulou**
	Current Status and Global Distribution of Commercial Vertical Farms *Giuseppina Pennisi*, Francesco Orsini, Stefania Quaini, Giorgio Gianquinto*
	Green Roof Strategies for Substrate-Based Food Production in Urban Areas *Julieta Sherk*, Mikayla Roth*
	Landscapes within Urban Environment *Ilze Stokmane*
Section V: Impact of the Anthropic Activities: Interaction and Synergies	
Chairperson: *Ayako Nagase (Chiba University, Japan)*	
11:30-11:50	***Invited speaker*** **Air Pollution and Urban Green Infrastructure** *Elena Paoletti*
Oral presentations	
11:50-12:00	**Evaluation of Soil Organic Carbon Stocks Within Urban Soils According to Different Land Use Types** *Ali Boularbah*, Meriyem Beroigui, Stéphanie Ouvrard, Leila Benidire, Christophe Schwartz*
12:00-12:10	**Spontaneous Urban Weeds: A Resource against Environmental Pollution** *Nicolò Iacuzzi*, Davide Farruggia, Mario Licata, Salvatore La Bella, Teresa Tuttolomondo, Giuseppe Virga*
12:10-12:20	**Investigation of *Apis mellifera* L. Foraging Behaviour to Promote Pollinator-Friendly Urban Cities in Japan** *Ayako Nagase*, Lise Pouilloux, Frédéric Francis, Noel Grégoire*

Poster presentations	
12:30-12:40	**Screening and Selection Heavy Metal Tolerant Ornamental Plants for Urban or Peri-Urban Areas** *Alessandra Francini, Stefania Toscano, Antonio Ferrante*, Daniela Romano*
	Alien Herbaceous Ornamental Plants as a Risk of Biodiversity Degradation in Habitats of Urban Areas *Inese Naburga*
	Risk Assessment for Heavy Metals in Urban Gardens of Teresina, Brazil *Vito Aurelio Cerasola, Gilmo Vianello, Nicola Michelon, Giuseppina Pennisi, Francesco Orsini*, Giorgio Gianquinto*
	Cadmium (Cd) and Nickel (Ni) Accumulation in Different Organs of Basil Plants *Maria Zografou*, Martha Kazi, Christos Lykas*
13.00 Lunch	
Section VI: Plant functionality and stress in urban ecosystem	
Chairperson: *Antonio Ferrante (University of Milano, Italy)*	
14:00-14:20	***Invited speakers*** **Benefits of Applying Deficit Irrigation Strategies in Ornamental Plants** *Sara Alvarez*, Maria Jesús Sánchez-Blanco*
Oral presentations	
14:20-14:30	**Simulating the Impact of Nature-Based Solutions on Runoff Control by Using I-Tree Hydro+: A Case Study in Padova (Italy)** *Lucia Bortolini*, Valentina Brasola*
14:30-14:40	**A First Approach for Evaluation, Breeding and Promotion of Native to Greece Sage Species for Use as Landscape Plants** *Maria Papafotiou*, Aekaterini N. Martini, Konstantinos F Bertsouklis, Georgia Vlachou, Elektra Kanellou, Eleftherios G. Stylias, Anastasios Kalantzis, Lamprini Tassoula, Eleftherios Dariotis*
Poster presentations	
15:00-16:00	**The Effect of Alternating Irrigation with Fresh and Saline Water on the Growth and Water Relations of Hibiscus Plants** *Sara Alvarez*, Pedro Nortes, Jose Ramon Acosta-Motos, María Jesús Sánchez-Blanco*
	An Appraisal on Adaptation to Xeric Environments of Tree and Shrub Species through Wood Anatomical and Chemical Traits *Veronica De Micco, Chiara Amitrano*, Chiara Cirillo*
	Evaluation of New Promising Hybrids of Greek Sage (Salvia Sp.) Species in Relation to their Growth *Konstantinos Bertsouklis*, Eleftherios Stylias, Anastasios Kalantzis, Aekaterini N Martini, Maria Papafotiou*
	Effect of Cutting Type and Indole Butyric Acid on Propagation of *Salvia fruticosa* with Cuttings *Konstantinos Bertsouklis*, Aekaterini N Martini, Maria Papafotiou*
	Adopting Nature-Based Solutions to Cope with Flooding Phenomena: The Participatory Approach of the Life Beware Project *Francesco Bettella, Lucia Bortolini*, Vincenzo D'Agostino*

	The Suitability of De-Inked Paper Sludge as Growing Media Amendment for Ornamental Potting Plants *Francesca Bretzel*, Francesca Vannucchi, Andrea Scartazza, Eliana Tassi, Irene Rosellini*
	Impact of Mulch on Tree Caliper and Root Characteristics of Four Species of Drought- Resistant Landscape Trees *Janet Hartin*, John Bushoven*
	Growth of Aromatic and Ornamental Species in Sods for Different Gardening Uses *Noelia López López*, Adolfo López-Fabal, Isabel Iglesias-Díaz, Santiago Lamosa-Quinteiro*
	Establishment of Five New Hybrids of Mediterranean Sage Species (*Salvia* sp.) on an Urban Green Roof, as Affected by Irrigation Frequency *Aikaterini Martini*, Lamprini Tassoula, Maria Papafotiou, Anastasios Kalantzis, Eleftherios Stylias, Eleftherios Dariotis*
	Interspecific Crossability as a Mean to Improve Mediterranean Sage Species with Ornamental Value *Aikaterini Martini*, Eleftherios Stylias, Maria Papafotiou, Anastasios Kalantzis, Konstantinos Bertsouklis*
	Evaluation of Giant Granadilla Accessions in a Pergola System *J. Pablo Morales-Payan*
	Avocado Tree Growth and Fruit Yield in Response to Nitrogen Fertilization Regimens in Urban Ecosystem *J. Pablo Morales-Payan*
	Seed Germination of Five Sage Species (*Salvia* sp.) of Native to Greece Populations *Elektra Kanellou, Konstantinos F. Bertsouklis, Maria Papafotiou*, Aikaterini N. Martini, Georgia Vlachou*
	Breeding of New Tulipa Cultivar through Interspecific Hybridization between Tulip Variety 'Bolroyal Dream' and *Tulipa altaica* *Guimei Xing, Yanqiu Zhang, Huihua Zhang, Tianyu Wu, Jiaojiao Lu, Lianwei Qu**
	Ll002 Treatments Delayed Drought Stress Symptoms in Turf: From Pot to Plot *Cristina Sudiro*, Matteo Corniglia, Federico Guglielmi, Adriano Altissimo*
	Can be Used Pedoclimatic Needs as a Marker for Ornamental Plant Selection in Mediterranean Area? *Stefania Toscano*, Antonio Ferrante, Daniela Romano*
Oral presentations	
16:00-16:10	**An Assessment of Mechanical Pest Control Methods in an Urban Landscape** *Derald Harp*, Michaela Bledsoe, Beatriz Ruiz, Taryn Bazhaw, Martin Mendietta, Canaan Sutton, Pedro Castillo*
16:10-16:20	**Commonplace or Commonly Replaced? Presence and Population Distribution of *Balsamorhiza hookeri* var. *hispidata* in Utah Compared to Historic Records** *Alyssa Brown*, Phil Allen*
16:30-17:00 - Business Session by Francesco Orsini	
17:00 - Awards and Symposium closure	

Day 3 - December 17, 2021 (CET, Central European Time)	
International student competition Urbanfarm Registration here is mandatory to access the section	
Chairpersons: *Francesco Orsini & Giuseppina Pennisi (University of Bologna, Italy)*	
9:00-9:15	***Opening speech*** **The International Student Competition Urbanfarm: Results from Three Years of the Challenge** *Giuseppina Pennisi*, Emanuele Durante, Roberta D'Ercole, Laura Carotti, Giorgio Gianquinto, Francesco Orsini*
Project presentations	
9:15-9:25	**From Siapa to Siepe: Urban Farming as a Social and Environmental Sustainability Tool for the Vacant Industrial Land of Galliera, Bologna** *Emanuele Durante*, Francesco Orsini, Brando Di Giovanni, Yasmina Ragab, Mohamed Shahwan, Sherifa Elhaggan, Luca Gialli, Michele Lapomarda, Laura Gabrielli, Patricia Mariscal*
9:25-9:35	**Participating in International Student Competitions and Opening a Tartup Firm: The Case of Aquaponic Design** *Luca Settanni, Gian Marco Tamborra, Francesco Lombardo, Francesco Orsini**
9:35-9:45	**Nurturing the Soul at the Urban Garden: A Project for Salus Space, Bologna, Italy** *Mirette Aziz*, Salma Abdelkader, Beatrice Bellini, Giacomo Buldrini, Marco Coluccia, Aurora Cravino, Mostafa El Kady, Marco Monticelli, Loay Radwan, Licia Signoroni, Francesco Orsini*
9:45-9:55	**AGRiS: Agriculture, Growth and Regeneration Inspired by Sustainability** *Chiara Amitrano*, Marco Rossitti, Shantz Building, Rebekah Waller, Maurizio Iovane, Giuseppe Carlo Modarelli, Giuseppina Pennisi, Francesco Orsini, Chiara Cirillo*
9:55-10:00 – Concluding remarks	
Workshop: Urban agriculture for circular cities **Space and logistic opportunities** **Are municipalities ready to support commercial urban farming?** Registration here[1] is mandatory to access zoom platform.	
10:30-10:40	**Opening of the workshop and introduction of aims and finalities** *Jacopo Monzini (FAO)*
10:40-10:45	**Instructions for activities in the virtual rooms** *Francesco Orsini, University of Bologna, ISHS Landscape and Urban Horticulture Division*
10:45-11:45	**Virtual room 1: Rooftop Agriculture** *Xavier Gabarrell (Universitat Autonoma de Barcelona)*
10:45-11:45	**Virtual room 2: Social Urban and Periurban Agriculture** *Antonella Samoggia (University of Bologna)*
10:45-11:45	**Virtual room 3: Agricultural Parks** *Runrid Fox-Kaemper (ILS)*

[1] Participants must register at the FAO link to receive the password to access the workshop and select the virtual session they wish to follow.

10:45-11:45	**Virtual room 4: Vertical farming** *Matteo Vittuari (University of Bologna)*
11:45-12:00 Coffee break	
12:00-12:40	**Restitution of main outcomes of VR discussion** *Moderators and notekeepers from each virtual room*
12:40-13:00	**Closure of the meeting and future steps** *Jacopo Monzini*
13:00 Lunch	
The bright side of Vertical Farming: the first experimental experience at AlmaVFarm (16:35-18:20) Registration here is mandatory to access the workshop	
Chairperson: *Alessandro Pistillo*	
16:35-16:45	**Opening** *Laura Carotti*
16:45-17:55	**Students presentations**
18:05-18:10	**Award ceremony** *Alessandro Pistillo*
18:10-18:20	**Closure of the workshop** *Francesco Orsini*

Plenary lectures

Horticulture, Design and Ecology How to Deal with the Urban Environment

Angeliki Paraskevopoulou

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Abstract

At present over half of the world's population resides in urban areas and over 30% of the world's landscape has been subjected to some type of development. In many cases worldwide, rapid urbanisation has resulted in transforming people's way of life, environment, and transport. In parallel, the effects of urbanisation have led to the abandonment of rural areas/practices with negative effects on the environment. Overall, urban settlements are characterised by high building density, limited in number and size green spaces, and large impervious paved areas that have contributed to creating adverse environmental conditions within the urban settings. Today urban areas concentrate many environmental risks to health that include air pollution, social isolation, and violence. Together, the triptych horticulture, design, and ecology could offer health, environmental and societal benefits. The importance of horticulture in urban areas generated "urban horticulture" adding a further dimension to "traditional" horticulture. Design is often overseen in horticulture. The various interrelated components of urban settings (e.g. buildings, planting, transport, lighting, electricity, social, cultural) require a multiscale and multidisciplinary design approach. On the other hand, ecology has evolved and identifies the impact of humans on ecosystem dynamics that also needs to be considered. Selected studies on the use of green spaces, people's perceptions towards plants/green spaces, and the use of native plants to enhance the local landscape character are presented with emphasis on urban settings and introducing concepts on how to deal with the urban environment.

Keywords*: Perceptions, native species, urban trees, school grounds, cultural heritage*

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The role of science in reconciling ecology and technology in Landscape and Urban Horticulture

15-17 December,
online Symposium

Can Cities Provide Food in the XXI Century? A Review on the ROLE of Building-Integrated Agriculture

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Abstract

Agricultural food production will face important challenges in the coming decades, mainly associated with climate change and the growing scarcity of resources. The growing population rates and the expansion of urban areas require alternative solutions to ensure food security and social stability. Intensive cultivation techniques are often associated with environmental impacts related to the indiscriminate use of plant protection products, with effects both in the eutrophication and acidification of water bodies and toward the release of greenhouse gases with elevating global warming potential. In this context, the study of innovative production techniques resilient to climate change, and featuring efficient use of resources and adaptability to densely populated contexts assume considerable relevance. Urban agriculture initiatives are blooming worldwide, also thanks to the evolution of building integrated technologies, that allow to move from more traditional farming systems (e.g., community and allotment gardens) toward the colonization of the built landscape, including both indoor vertical farming systems and rooftop farms. Indoor vertical farming uses cultivation systems with high technological content. It takes place in climatic cells isolated from the external environment, opaque to sunlight, and using artificial lighting. If, on one hand, the potential of these systems is often associated with the considerable saving of water and mineral resources, the possibility of reducing phytosanitary interventions or the reduced land use for agriculture, major issues to be addressed mainly concern the high installation costs as well as the elevate energy requirements and environmental impacts associated with lighting. On the other hand, building- integrated agriculture systems have developed on a more diversified degree of technology. While simplified hydroponics is commonly adopted in residential buildings where open-air rooftop gardens are cultivated, commercial rooftop greenhouses often integrate state-of-the- art building engineering and agricultural technologies toward the optimization of the whole building metabolism and a wise use of resources. To address the need for validating urban farming technologies in experimental conditions, both in terms of the potential production of a wide range of crops and in the quantification and valorization of resources uses and saving, the European project H2020 862663 "Food Systems in European Cities (www.foode.eu)" targets the sustainability assessment of City/Region Food Systems initiatives, with a key eye on urban farming systems. This research will elaborate on strengths and weaknesses, as well as potentialities and risks associated with alternative urban agriculture systems, toward the definition of their role on city food security in the coming years.

Keywords: *Urban farming, allotment gardens, vertical farms, rooftop agriculture, food systems*

Section I: Urban horticulture benefits for people

Invited speaker

Sensory Experience in Nature for Supporting Human Health

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Abstract

We sense our surrounding through sensory modalities. These are commonly divided into five modalities based on visible sense organs. There is seeing, hearing, touch, smell, and taste. Also, based on non-visible sense organs, there are further four sensory modalities: the sense of body position, the sense of balance, the sense of body motion and the sense of pain. There is growing evidence that sensory experience of natural elements can have a positive impact on human health; this includes both natural and urban settings. Natural elements (nature) have been used for the promotion, prevention and improvement of human health. In 2002, the Swedish University of Agricultural Sciences (SLU) established a living laboratory, Alnarp Rehabilitation Garden, for studying in a real-life context nature-based rehabilitation for clients suffering from stress-related mental illnesses. Since then additional two target groups have received NBR as a part of their rehabilitation program i.e. persons suffering from post-stroke fatigue and refugees in need of vocational rehabilitation. The concept of Doing (active engagement) and Being (passive engagement) is used in nature-based health intervention to support recovery through sensory experience. The rehabilitation programs all included sensory stimulation through active and passive sensory exposure in the garden as well as horticulture activities. This lecture illuminates the client´s perceived sensory experience that supported their recovery process during their stay in the NBR programs and how these were implemented into their everyday life.

Keywords: *Restorative environment, nature-based solutions, urban nature, health gardens*

Section I: Urban horticulture benefits for people - Oral

Urban Horticulture Can Contribute to the Construction of Comfortable Lives for Diverse People

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Abstract

The Center for Environment, Health and Field Sciences, Chiba University, was established in 2003 as an interdisciplinary education and research center related to the environment and health, where we have conducted various research projects under the keywords "environment, health, and food," aiming at creating a sustainable society through the power of plants. By strengthening this concept, the Center has just set up a program to develop human resources who can plan, implement, and manage various "agriculture-welfare integrating projects" that solve by the power of plants the high-stress and high-tension problem that has been increasingly prevalent in modern urban cities. The target human resources here are those who can handle various horticultural and gardening projects implemented in a wide range of institutions, such as educational institutions from nursery schools to universities, companies in general, and support facilities for the elderly and disabled persons, the projects of which contribute to improving the quality of life for the people concerned. In the introductory course, a curriculum that combines lectures, exercises, and on-site learning, altogether aiming at acquiring basic knowledge and practical skills, is implemented, and in the applied course, a program, in which cultivation training is practiced, in addition to more specialized lectures and exercises, is offered. Here, we will introduce this program, the basic objective of which is to expand the range of horticultural activities in the city as wide as possible and discuss its prospects.

Keywords: *Senior citizen, various disabled people, child, stress reduction, welfare, therapy*

Current Status of Prohibition and Reluctance Pertaining to the Use of Indoor Plants at Hospitals in Chiba Prefecture, Japan

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Abstract

Although previous studies have suggested that plants have positive effects on patients, they are increasingly being prohibited in hospitals in Japan. The aim of this study was to reveal the current situation and the reason for the prohibition and reluctance of installing indoor plants in hospitals. We investigated both cut flowers (brought in by visitors) and set plants (cut flowers and potted plants placed by landscapers, staff, or volunteers). We conducted a questionnaire survey of 288 hospitals in Chiba Prefecture, Japan. We examined the following five categories: (1) prohibition and installation of plants, (2) locations where plants are prohibited or installed, (3) the reason for prohibiting or not installing plants, (4) problems caused by permitting or installing plants, and (5) requests for bringing in or installing plants. Our findings indicated that 36 % of the studied hospitals prohibited bringing in cut flowers and 22 % did not install set plants. Although 90 % of respondents answered that the reason for prohibiting or not installing plants was to prevent infection, no cases of infection caused by permitting or installing plants were reported. We also found that 59 % of hospitals permitted cut flowers and that 76 % installed set plants to improve the mood of patients and staff. Our study addressed the importance of making the hospital environment more comfortable by utilising the positive effects of plants to improve the satisfaction of patients and staff.

Keywords: *Hospital plant environments, people-plant interaction, indoor plants, human well-being*

Section I: Urban horticulture benefits for people - Poster

Nature Goes to School: Wildflower Meadows in the School Garden

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Abstract

Planting mixtures of wildflowers in towns and cities is an effective way to improve urban biodiversity and to involve people in the management of urban green areas. As a dissemination part of a research project dating 2003, we involved schoolteachers in planting a wildflower meadow in the gardens of two schools in Livorno (Italy). Students were engaged in the observation and study of plants, insects, soil and biodiversity, and training lessons were provided to the teaching staff. The school kids, aging from 5- to 12-year-old, participated in all the practical activities, i.e., soil tillage, sowing and seed harvest, little experiments, and produced art and scientific works, such as drawings, poems, photos, diaries, with the help of the teachers. The wildflower meadow, composed by annual plant species from Mediterranean climate, needs to be sown in autumn, just at the beginning of the school year. Flowering starts in March and continues till May, and at the end of the school year, i.e., the beginning of June, the seeds start ripening and can be collected to sow the following year. The 2003 experience has been repeated in the following years in other schools located in various towns. From these experiences a booklet has been produced, containing the guidelines to create a wildflower meadow in the school garden and many suggestions of activities to carry on at school. After the worldwide sanitary emergency, the advantages of open-air activity have been evident: besides the beneficiary effects of exercise and sunshine, the lower risk of contamination pushed teachers to give open-air lessons, in the school garden, rather than in the classroom.

Keywords: *Annual wildflowers, urban biodiversity, school, urban soil*

Urban Gardening as a Tool to Improve the Self-Confidence and Integration in Young Disabled People: The Case of Ortopiù in Naples

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Abstract

Young people with disabilities can sometimes struggle with self-confidence and autonomy. Urban horticulture has been widely recognised as a tool to improve physical activity, social skills, and engagement for people with mental and physical diseases Taking care of plants helps to build up their self-confidence and increase enthusiasm towards horticultural activities. Within the H2020 FoodE project activities we aimed to develop, in collaboration with specialized therapists, a methodological framework to improve self-confidence and integration in young disabled people through horticultural activities in an urban garden "Orto Più (by Si può dare di più Onlus)" in Posillipo neighbourhood, in the city of Naples. Results cover a period of 10 months, from 2020 to 2021, of weekly appointments, during the Sars-Covid 19 pandemic. Gardening helped to improve their self-confidence and capacity to socialise. Carry out repeated actions like digging, watering, sowing and others improved their motoric coordination and equilibrium. Their autonomy on garden management advanced exponentially, thanks also to the practical and theoretical skills acquired during vegetables growth. Furthermore, the adopted framework had several benefits and helped also to cope with all the restriction caused by the Sars-Covid 19 pandemic.

Keywords*: Social inclusion, sustainable development, physical and mental well-being*

From Suburb to 'Glocal' Innovation Hub: Troisi Park, as Agro-Social Plaza Intensifies the Renewal Value of East Naples District

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Abstract

Urban agriculture can play a key role in achieving environmental, social and economic well-being of neighbourhoods, by activating direct and indirect services and opportunities for citizens, so as to contribute to the requalification of neglected suburban areas of big cities. Troisi Park is one of the larger urban park of the east area of the Metropolitan City of Naples: accomplished in the 80s on a parcelled out post- industrial area, nowadays the park is experiencing a decline period. In the framework of the H2020 FoodE project, aiming to create sustainable and resilient City/Region Food Systems, the municipality of Naples in collaboration with the Department of Agricultural Sciences of the University of Naples Federico II will bring new life and essence to this park and in turn to the surrounding area. In the co-design and planning activities already under way, Troisi Park will become a global but local agro-biodiversity hub. Knowledge, nature and culture altogether will be able to create job opportunities for disadvantages-people, beside a space for youths, families and people willing to have a healthy lifestyle, being concurrently part of a sustainable inclusive food system, from food production to consumption. Furthermore, the core area of the park will host a greenhouse cluster for horticultural crop production as well as small allotments to be rented to locals and for educational purposes. Thanks to an active and inclusive collaboration between local schools, associations, municipality and university it will be possible to create a new sustainable future in the district.

Keywords: *Urban agriculture, requalification, social impact, circular economy*

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Urban Horticulture: A Case Study of a Soilless Urban Garden in Turin (Italy)

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Abstract

Urban gardening is becoming more important in recent years, not only due to the increase of urbanization but also to the increase in demand for cultural-social activities. Recreational associations are an important aggregation of the community in any neighborhood. In addition to sharing different cultures, enhancing awareness of environmental issues can take place. The objective of the study was to plan, design and implement an urban garden introducing soilless and vertical systems and recycled material. The soilless urban garden was to be included in a concrete courtyard used by a cultural and social association, located in a post- industrial area, near to a brand new University Campus of the city of Turin. The association is offering a restaurant service to the members, buying groceries at a local street market and cooking fresh meals. To fulfill the needs for easily available fresh vegetables and herbs and for embellishing the grey and ugly yard, the urban garden would provide super fresh vegetables and herbs. In addition, the project aimed to create a youth social inclusion with a critical and multicultural neighborhood. Three technical solutions have been considered in the feasibility study, taking into account the sustainability but also the easy availability of containers and substrates: 1) stacked piled boxes; 2) vertical growing surface; 3) mixed system. Species chosen were: *Lactuca sativa* L. (for fresh leafy salads); *Cucurbita moschata* Duchesne ex Lam. (for the immature long fruits and for the edible flowers); *Fragaria x ananassa* Duch. (for the aggregated fruits); *Eruca sativa* Mill. (for the tender and pungent fresh leaves); *Ocimum basilicum* L., *Mentha viridis* L., *Salvia officinalis* L. and *Origanum vulgare* L. (for the culinary leaves); *Capsicum annuum* L. (spicy cultivar, for the spicy fruits); *Lavandula officinalis* L. (for the adorning and scenting inflorescences); *Trachelospermum jasminoides* Lindl. (for climbing and covering a grey wall, offering white and scenting flowers). In studying the three technical solutions, the construction materials were mainly considered in wood with some support in metal. Pallets, woody shelves and boxes were considered and obtained from local artisans, possibly from recycled material. A feasibility analysis was conducted, considering costs, and the mixed system was adopted due to its versatile and adaptability to the different conditions of the courtyard. As planned, the fresh produce served the purpose of supplying the restaurant and rewarding the members of the association who actively got involved in maintaining the garden. Educational activities were established with kids of a nearby primary school, transferring the value of knowing and growing herbs and vegetables and enhancing awareness of environmental issues. The project allowed also the creation of social interaction between the hosts of the recreational association and the neighborhood. Parallel activities were born, such as the creation of a buying group. In conclusion, the project was a success allowing the production of fresh produce, ready to be used in the restaurant, but with many social implications too. Ultimately, establishing urban gardens is effective for the regeneration and requalification of degraded urban areas.

Keywords: *Kitchen garden, fresh produce, local food, social inclusion*

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The Innofarming Project: Innovative Urban Farming Applications for Future Urban Farmers

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Abstract

Urban Agriculture (UA) is spreading around the world thanks to its capability to bring together the current knowledge and advances from rural agricultural sector with a set of new skills, innovations and technologies, enabling to pursue a large set of ecosystem services within the cities (e.g., provisioning services, regulating services, habitat services and cultural services). In the coming years, thousands of new-incomers in the UA sector are expected, including not only agricultural students or professional farmers but also unemployed youth, social and educational bodies, environmental actors, general public, each of them requiring specific technical competences in UA. The European project INNOFARMING, founded in the framework of Erasmus+ program, have implemented innovative methodology and online training tools to foster the acquisition of key competences in the interdisciplinary context of UA. In the present work, the main outcomes of INNOFARMING project will be illustrated, in order to provide an interdisciplinary framework to strengthen the role of UA for the target groups of the project, which are professional actors (e.g., teachers/trainers on agro-food VET schools, agricultural consultants & academics), agro-food students in formal education and professional farmers, new-incomers (e.g., new project leaders in UA, employees in redevelopment, unemployed youth), supporting organisations for incomers (e.g., incubators, cooperatives or any supporting organisation involved in UA), local administrations as they need to understand better the development stakes of UA and the supporting tools proposed, citizens organisation (e.g., local NGO's, neighbourhood associations, consumer associations).

Keywords: *Education, urban agriculture, teaching tools, innovation*

The Edible Ornamental Plants: A Resource for Urban Horticulture

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Abstract

In recent years, the need to identify "new" food crops has grown, also to oppose the food consumption homologation. Agrobiodiversity is an important element of sustainability, so identifying new edible plants is one of the most effective strategies for food security. Edible and ornamental plants, which combine the aesthetic aspect with the food one, can be a resource especially in urban horticulture and in small cottage gardens because they do not have to be placed in separate areas and allow to obtain great benefits to growing them side by side. Placing food plants, especially fruit trees, in ornamental gardens, is a rather widespread tradition in the Mediterranean area and in particular in Sicily. The species that are both edible and ornamental are very numerous and not always known. To individuate the ornamental and edible plants of possible utilization in Mediterranean gardening, a specific survey was carried out through the analysis of different references about edible plants and flora of Sicilian traditional gardens. Quite 8000 taxa of edible plants, belonging to more than 280 botanical families were surveyed. Comparing this list with a previous survey on the species present in historical and/or traditional Sicilian gardens, rich of 1188 taxa, belonging to 559 genera and 141 botanical families (Toscano et al., 2018), we found that 487 species of these, belonging to 119 botanical families, are edible. For the other 87 taxa, congeneric species are edible. Different plant organs for the same species are edible: fruits are edible for 38.9% of recorded species, flowers for 43.9%, leaves for 42.2%, and hypogeal organs for 19.9%. The data shows that it is possible to easily design edible ornamental gardens in the Mediterranean environment.

Keywords: *Agrobiodiversity, sustainability, edible landscaping, urban horticulture*

Middle School Educators' Description of Outdoor Learning Environments Design

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Abstract

Outdoor learning environments (OLEs) are defined as any outdoor spaces within schools or informal educational settings where lessons occur. Examples of OLEs include, but are not limited to, gardens and outdoor classrooms. Regular outdoor lessons have been shown to improve learning outcomes for middle school students (ages 11-14), as well as contribute to their mental, physical and emotional wellbeing. Although there is a large body of evidence to support the countless benefits of outdoor learning for adolescents, there is little research examining the design of OLEs in middle school settings. In the context of improving the design quality of OLEs, 28 formal and informal middle school educators in the Southeast United States were surveyed to determine their views on which specific design elements are most effective for demonstrating NC Essential Science Standards and other scientific concepts to their students. This study also compared and contrasted OLEs in formal versus informal educational settings, as well as examined educators' attitudes toward teaching outdoors, and perceived barriers to regularly utilizing OLEs during the school day. Results suggest that educators consider gathering spaces to be the most important design elements. Time constraints were found to be the largest barriers to regular outdoor lessons, yet educators feel that their students have improved learning outcomes after utilizing OLE's.

Keywords: *Outdoor learning environments, design, education, middle school*

Section II: Historical landscape in urban areas

Invited speaker

Traditional Water Management in Anthropic Landscapes

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Abstract

Climate change, ecosystem collapse, cataclysms, the end of civilizations are conditions that humanity has had to face numerous times. People have had to deal with the unpredictability of the environment and the variability of the climate. The conditions of climate variability, ecosystem degradation and natural disasters imposed a deep insight in managing resources and the invention of cheap technologies and processes that were not destructive. In several climates and environments, incredibly tenacious cultures were able to use locally available materials and renewable resources. They applied the principles of nature: sun, wind, water to start positive interactive processes and amplify useful dynamics. These very conditions forged locally adapted knowledge capable of responding to adversity with appropriate techniques for water harvesting and distribution, soil protection, recycling and optimal energy use. Such techniques constitute a huge reservoir of biological and cultural diversity and of sustainable knowledge, shows how to intervene in perfect agreement with the environment, highlighting its potential without exhausting it. Today, when climate change occurs due to anthropogenic causes and we are forced to deal with the collapse of ecosystems, the speech shows the value of water traditional knowledge in the field of design and rural and urban management. The significance of the practical and cultural dimensions of this knowledge based on a systemic vision of the human-nature interactions taking into account the environmental, economic and socio-cultural aspects of landscapes is underlined. An emphasis is placed on the water management traditional techniques and local knowledge considered as part of cultural history. Special attention is given to the oasis effect applicable to all those traditional experiences of amplification of local resources. The Oasis Model, interpreted as an appropriate ecosystem management, is proposed as an example for the realizations of sustainable projects all round the world and create a new advanced technology based on naturalistic engineering and traditional knowledge. Using traditional Knowledge does not mean directly reapplying the techniques from the past but understanding the logical reasoning underlying the knowledge system and reapplying it in a creative way: today's appropriate innovations constitute tomorrow's traditional knowledge.

Keywords: *Climate change, biodiversity, sustainability, water resource*

Section II: Historical landscape in urban areas - Oral

Resilience and Resistance of Viticultural Biodiversity in the Urban Ecosystem: The Case of the Grapevine Collection of the Botanical Garden of Rome

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Abstract

Urban viticulture, a globally growing phenomenon, is gaining interest as a strategic multifunctional land use for sustainable cities. In the urban ecosystem, vineyards may represent: i) an economic system that supports short supply chains, ii) a land use that provides essential ecosystem services for well-being and quality of life, like carbon storage, biodiversity maintenance, soil health, food education, social integration; iii) a place of cultural significance, iv) a landscape of appreciated aesthetic value. The knowledge of plant-environment relations becomes essential to ensure resilience, productivity and ecosystem functions of the agricultural systems in urban contexts. The city of Rome together with its peri-urban Roman ager is one of the largest European agricultural municipalities. Inside the Botanical Garden of Rome there is the 'Italian vineyard', a core collection of 149 Italian and international grapevine cultivars, managed according to the principles of organic agriculture. This urban vineyard has been subject to eco-physiological assessments to understand the response of the viticultural biodiversity to the physical extreme characteristics of the urban environment, especially in relation to the thermal and radiative regime. The analyses conducted on the collection during the 2020-2021 season involved: i) the characterization of the vineyard microclimate through bioclimatic indices; ii) the vegetative-productive response to the urban environment of a set of genotypes; iii) the measure of gas exchange efficiency and response to radiative stress. The climatic study highlighted the increase in the occurrence of extreme thermal events. The physiological determinations allowed to group the grapevine cultivars based on the stomatal response and the evolution of leaf senescence, and therefore on the basis of resistance to the urban environment. The preliminary results provide indications for a sustainable use of genetic resources in urban viticulture and strategies to increase the resilience and resistance of *Vitis vinifera* in the urban ecosystem.

Keywords: *Agro-biodiversity, photosistemic function, urban viticulture, abiotic stress, Vitis vinifera sativa*

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The Landscape of Bucolics. The Identification of Coniferae in Vergil's Eclogues

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Abstract

The main aim of this paper is to present the identification of Latin traditional names of Conifers used by Vergil in costruction of the reality of his Eclogues. This paper will present the results of the identification of the names of conifers that Virgil incorporated into the represented world of his bucolic poems. The collection includes a total of six names of conifers, i.e. pinus, iuniperus, taeda, abies, cupressus, taxus, which the author has included in six out of ten eclogs, i.e. in Ecl. 1, 4, 7-10. Most times Virgil mentions pinus (6 times), then iuniperus (2 times), the other names abies, taeda, cupressus and taxus appear only once. The poem most abundant in conifers is the seventh idyll, in text of which the author weaves in four of them (pinus, taeda, iuniperus, abies). Conifers of the Mediterranean area, although not so numerous in Virgil's bucolic work, however, exhibit several characteristic features. They show greater genetic diversity within the population as compared to coniferous other regions, among them we can also distinguish monophyletic types, i.e. covering all descendants of a common ancestor, which include, among others types of Abies - fir, Cupressus - cypress, or Pinus - pine. Moreover, the distribution of conifers in the Mediterranean area shows a clear division into the eastern and western parts. In the texts of Virgil's idylls there are only 6 names of conifers, the most problematic of which in the taxonomic classification is the word taeda. Nevertheless, such a small representation of conifers among the plants that build the world in his bucolics may prove that their distribution was so limited that the author had the opportunity to observe only some of them. It is worth adding that some species occupy high mountain positions, so the desire to observe them would need a long and probably tiring hike in the mountains, which might not be knocked out by Virgil's rather fragile health, if one believed the piece of information contained in the Vitae Vergilianae. On the other hand, however, a question may be asked about the need for the presence of a greater number of conifers in the presented world of idyll and how this could result in difficulties in interpretation. Virgil's works are aimed at an educated listener / reader, probably with basic knowledge of botany, but the excess of tree names could become a serious obstacle in reading. Perhaps the Mantuan does not need the accuracy and detail shown in his bucolics Theocritus of Syracuse, and a greater accumulation of names of conifers could cause unnecessary inconvenience in understanding the content of the works for a readers less familiar with botany. In addition, it can also be assumed that Virgil himself did not have extensive knowledge in filed of Botany.

Keywords: *Vergilius, Eclogues, Roman poetry, Bucolics, History of Botany, Phytogeography, Archeobotany*

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Agriculture and Natural Resources for Valorizing Peri-Urban Historical Landscapes: The Case Study of Stupinigi Royal Natural Park (Metropolitan City of Turin, Italy)

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Abstract

Valorizing historical agricultural landscapes in peri-urban areas is considered priorities by the international community. These sites provide a wide range of ecosystem services: food, wood, fiber and energy production; biodiversity conservation; waste management; soil protection; social and cultural inclusion. Their multifunctional character is strictly related to their historical development, thus governance strategies able to maintain the landscape identity promoting resilience in a productive perspective is needed. Stupinigi Royal Natural Park (Metropolitan City of Turin, Italy) is a protected area of Piedmont Region, and was recognized in 1997 as a World Heritage Site by UNESCO in the serial site "Savoy Residences". The Park, historically used for hunting by the royal family, covers about 1700 ha and it is characterized by specific land uses, with meadows and pastures, cereals, permanent crops (poplars) and natural woodlands (oaks and hornbeams). The research aims were to assess the landscape features, and to propose a list of action and strategies for the future sustainable development of the Park. Firstly, for identifying historical features of rural landscape and theoretical qualifying elements, historical and landscape analyses were performed. With the purpose of characterizing the sustainability of the present farming system and its multifunctionality, a participatory approach was adopted. Face to face interviews were performed to 29 local stakeholders (100% of the sample), investigating the farms' main characteristics. Supply chains, product distribution channels and marketing strategies were detected, as well as the farmers' attitude to multifunctionality. Further, with a series of Yes/No questions, the farmers' perception regarding the landscape in the Park was asked. The research allowed to understand the importance of the historical landmarks in the area and that their safeguard is a key point in the opinion of farmers. At the same time, it was highlighted that multifunctionality identifies the agriculture in this peri-urban context and can be used as planning strategies for the future.

Keywords: *Farmers, local products, tourism, governance*

Traditional Vegetables in a Semi Urban Landscape with Various Health Benefits: A Case Study in South Afric

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Abstract

The centuries old use of traditional vegetables has been reported around the world. A low intake of a sufficient amount of vegetables and fruit is among the top ten risk factors contributing to mortality. Traditional vegetables are edible plants that form part of the traditional systems, of indigenous communities throughout the world. Traditional vegetables are not necessarily indigenous to the specific area where it is used but include indigenous vegetables as well. The indigenous knowledge of vegetables is imperative for communities as it has health benefits, can contribute to alleviation of poverty, increase food security and contribute to livelihoods of communities. Unfortunately, indigenous knowledge is undocumented and passed on orally from generation to generation. The knowledge of traditional vegetables is thus vanishing throughout the world amongst all cultures and the perception that these vegetables are of low value and or seen as poverty food contributes to the loss of knowledge. Many of the traditional vegetables and food plants are seen as weeds, and are destroyed by people that are unknowledgeable. For centuries in Africa traditional vegetables have however formed a substantial part of the so called African diet and are a rich sources of micro nutrients, such as iron and Vitamin B. The emphasis should be on how we as the human population could increase the use of traditional vegetables in our landscapes to increase human health. This paper focuses on the key health contributions that selected traditional vegetables can have on human health in semi urban areas.

Keywords: *Traditional vegetables, health, semi urban areas*

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Household Knowledge of Growing Practices and Perception of Fruit Tree Diversity in Trinidad and Tobago

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Abstract

Fruits are vital components of a healthy diet and should be consumed daily to help prevent chronic diseases such as heart disease, diabetes, obesity, and cancer. However, fruit consumption in the Caribbean is below the recommended minimum intake per day and is believed to be one of the leading causes of chronic diseases. Home gardens even in urban communities may offer an opportunity for cultivating fruit trees, which can contribute to food and nutrition security by providing year-round vitamins and mineral-rich products for consumption and sale. However, there is a paucity of information about species diversity and significance of fruit trees for household food supply. The aim of this study was to create an inventory of fruit tree species diversity and uses and analyze household knowledge and perception towards growing fruit trees in home gardens in Trinidad and Tobago. A rapid appraisal technique was used to survey fruit trees species grown in home gardens throughout Trinidad and Tobago. Fruit trees in the home gardens of participants were identified to the species level, counted, and recorded. Similarity indices and indices of diversity in the occurrences of the species were determined among different municipalities. The perceptions of respondents on the fruit trees were also determined using a structured questionnaire which were administered on randomly selected individuals in each municipality. The study highlights the crucial role of fruit trees in contributing to the nutrition and livelihoods of consumers. Strategies that could improve fruit tree diversity and production including providing quality planting materials and tree management knowledge were proposed.

Keywords: *Ecosystem services, food and nutrition security, fruit trees, productive landscape, tree crops, urban biodiversity, and urban community*

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Historic Gardens Restoration. Preliminary Outcomes from a Synergistic Application of Visual Assessment and Geomatic Techniques to Optimize the Management of Arboreal Heritages

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Abstract

Italian historic gardens represent a relevant asset for the tangible and intangible landscape. Along with architectural and artistic heritage they also have financial relevance, promoting several types of tourism and providing invaluable ecosystem services. The huge amount of resources needed to maintain them caused some to be partly or fully untended for many years. In order to preserve the identity of historic gardens, restoration plans must therefore consider anthropic and natural processes influencing the evolution of the different components. Through the integration of census, visual assessment and traditional topographic survey of the trees, supported by GNSS (Global Navigation Satellite System) techniques, a procedure to collect and analyse data is under development. The work aims to optimize environmental and financial sustainability of the future restoration process. This paper presents the preliminary outcomes obtained from the first trial carried out into the historic garden of Villa Sorra in Castelfranco Emilia (MO, Italy). The digital mapping of the trees allowed to run several spatial analysis by GIS (Geographical Information System) tools. Consequently, it was possible to display and quantify the urgencies related to the management of the trees suffering from serious conditions. Overall, the interdisciplinary approach makes a multiscale planning possible and improves the efficiency if compared to the traditional assessment methodology.

Keywords: *Landscape management, historic gardens restoration, arboreal heritage, topographic survey, Geographic Information System*

Patchwork Quilt: A Methodology Proposed for the Study of Historic Gardens

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Abstract

The historic gardens are of great value to the public as they involve natural, social, and cultural aspects since their creation and also in the evolution, being possible to link the past to the present. To this end, the objective was to develop a suitable methodology to perform the historical, cultural and landscaping rescue of squares and gardens. The methodology consists of the combination of inventive analysis that perceives the physical evolution of the space and morphological transformations, associated with a subjective analysis that involves aesthetic, phenomenological and symbolic values. Indeed, indications for preserving and intervention in historic gardens are considered. So, the study of historic gardens, in addition to a cursory and direct interpretation, should also consider the social, spatial and historical contexts. Stitching together all these elements and pieces (patches) result in a quilt or a formulate history with understanding the evolution of the place.

Keywords: *Garden history, green urban gardens, landscape, squares, urban gardens.*

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Protecting Monuments and Plant Biodiversity in Archaeological Sites: The Case of the Etruscan Necropolis of `Monterozzi´ (Tarquinia, Central Italy)

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Abstract

In archaeological sites, plants and monuments have close interactions, with several positive and negative effects on both sides. Previous data showed that archaeological sites often host high plant biodiversity values, which benefits from the presence of semi-natural habitats arising from cultural heritage conservation policies. To further investigate such biological value, we selected the UNESCO WHS of "Monterozzi" of Tarquinia, an Etruscan necropolis hosting two sites of the Natura 2000 Network for the preservation of nature. In this area, we previously carried out studies on the positive effects of plant cover on the microclimatic stabilisation of the mural paintings in the hypogea tombs, and on the risks due to root penetration. To assess plant biodiversity and ecological characterisation of plant phytocoenoses, we carried out 42 phytosociological field surveys. The evaluation of the ecological features of such communities highlighted the dominance of classes of vegetation of the Mediterranean grasslands together with synanthropic herbaceous communities. Finally, we compared our flora with national and international red lists, laws, and directives to identify their natural interest. Our preliminary results showed a not negligible plant richness of plant communities, with the presence of protected, endangered, or rare species for the region, as in the case of different orchids. Our results highlighted the further natural value of the archaeological site and the importance of planning botanical investigations to balance interventions of plant management, when natural emergencies occur, and to favour the reconstruction of natural landscapes.

Keywords: *Biodiversity, cultural heritage, flora protection, monument conservation, UNESCO World Heritage Site, plant management*

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Composition of Flower Visiting Hymenoptera in Flowerbeds and Grasslands in Chiba City, Japan

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Abstract

Flower visiting insects play an essential role in both natural and managed ecosystems. However, there has been a concern for declining of number of Hymenoptera both regionally and globally. This research aims to provide habitat and feeding sites for the introduced honey bee, Apis mellifera, and native flower visiting Hymenoptera through their preference in the urban landscape. To achieve this aim, the abundance, number of species, and diversity of Hymenoptera species were studied in four urban flowerbeds and four grasslands in Chiba city, Japan. The study was carried out every two weeks from June to October 2019 in total 9 times. In total, 20 species of Hymenopteras were observed. Species richness and diversity (Shannon-Weiner Diversity Index) was significantly higher in flowerbeds than in grasslands, although there was no significant between them in abundance. We conclude that urban flowerbeds can contribute to sustaining diverse Hymenoptera flower visiting in the city. It is important to conserve grassland for A. mellifera and selective weeding is recommended to keep nectar source plants such as clover.

Keywords: *Biodiversity, Urban landscape, Bee conservation*

Section II: Historical landscape in urban areas - Poster

The Flora of Old Rauma, a Unesco World Heritage Site

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Abstract

Rauma is a medieval town located on the west coast of southern Finland (N 61°7'42'', E 21°30'42''). In 1991, UNESCO listed the core area of the town, Old Rauma, as a World Cultural Heritage Site due to the well preserved northern European wood architecture and urbanism. Current Old Rauma is a residential and commercial area of 29 ha, divided into 245 plots. The author investigated the spontaneous and cultivated flora of Old Rauma in 2017. The aim of the floristic survey was to assess the authenticity of courtyards and pavements in a historical urban setting. Altogether 242 plots were surveyed two times during summer 2017. All vascular plants were recorded for 114 plots, whereas in the remaining plots, only cultivated and cultural relict plants were surveyed. The total number of plant species registered was 528. Heritage varieties of fruit trees, berries and shrub roses were common, likewise such perennials as Aquilegia vulgaris, Saponaria officinalis, Convallaria majalis and Hepatica nobilis, traditionally grown in old Finnish gardens. The most characteristic cultural relict species was Corydalis nobilis, which originates from the mid-eighteenth century. The floristic survey indicated that large-growing trees with abundant seed production, such as Betula pendula, Acer platanoides and Ulmus glabra, may endanger the historic townscape.

Keywords: *Cultural heritage, plant inventory, urban vegetation*

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Agricultural Landscape and Historical Urban Landscape: Notes on the Case Study of Bologna (Italy)

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Abstract

The issue of protection of natural environment (including green spaces within the cities) is becoming increasingly important both in general terms and in relation to the current concerns of Italian cities. These issues are also relevant from an urban planning history perspective and in relation to the important line of studies dedicated to the history of the agricultural landscape (e.g. for Italy, the researches performed by Emilio Sereni). Recently, an evident awareness has emerged about another theme: the historical urban landscape, on which Unesco drew up the important "Recommendation on the historic urban landscape". Agricultural landscape and historical urban landscape can be effectively analysed in an integrated perspective, which considers the evolution of Italian cities from the Middle Ages to the late modern history, and the long coexistence of green spaces and built spaces inside the historic cities. These topics are currently linked to the sustainable development of urban suburbs (which needs the design and realization of new helpful green spaces for the people), to the new cultivation systems in urban environment, and to the indispensable interventions - even in urban contexts - of biodiversity safeguard. In the present work, the authors aim to highlight - also through an iconographic excursus - how the city of Bologna is, in this context, an important case study, which can be analysed in an interdisciplinary perspective, with the involvement of both historical and agronomic-naturalistic skills, not forgetting the reference to bibliography on urban planning, and to cartographic sources.

Keywords: *Urban gardens, landscaping history, urban agriculture*

Afuá: Autonomy and Appreciation of Riverside Landscapes in the Amazon

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Abstract

The Amazon is recognized worldwide for the importance of its majestic forest and the widest river in the world, the Amazon River. In this great aquatic and biodiverse inheritance, how can small riverside towns help in the conservation of this monumental Amazonian landscape? Thus, this study deals with the conservation of the Amazonian landscape on the scale of the small Amazon riverside town of Afuá. The timeless cutout of the landscape discussed here does not reject former constructions; on the contrary, it invests in the ideal of reconciling indigenous culture before the colonial period, the paradigm of modernity, and the resulting contemporaneity. It also increases the belief in the future for the multiple conserved Amazons, both real and imaginary, and in the diversity of the living forest reconciled with cities. For such, the study's guiding path supports the reinforcement and recognition of autonomies through the identification and conservation of Amazonian landscape motifs, the interchange at regional, urban, and local scales. This occurs in the anthropological approach to field research in the light of observation, informal conversations, and photographic records to recognize particular political, economic, social, and cultural relationships in everyday life. The result and proof are present in the "palafita" typology of the city; in the architecture; in the gardens; and in the riverside habits that are still preserved, such as the cultural link with the forest and the river. To reinforce landscape conservation, perspectives of production and income are suggested in the implementation of community-based scientific-cultural tourism in the urban and peri-urban space of Afuá-Pará.

Keywords: *Amazonian landscape, Amazonian landscape motifs, Conservation, Circular economy and sustainability, Community-based scientific and cultural tourism.*

The Biodiversity of Traditional Sicilian Green Areas

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Abstract

Product innovation represents a key element of ornamental plant productions, because it can activate the market, very sensitive to "novelty". Among product innovation, an interesting role could be played by the species present in neglected or "traditional" green areas, often only marginally present in current nursery production. In this context, the objective of the study was to describe and characterize the ornamental species found in the traditional green spaces of Sicily. In particular, a census was carried out of the species, often cultivated in pots, present in historical or historicized green areas and in minimal contexts (courtyards, balconies). In these contests, in particular, the climatic conditions, the socio- economic, historical and also ethno-anthropological traditions contributed to determine an articulated plant biodiversity. The survey identified a list of over 480 taxa belonging to 64 different families. Cactaceae, Crassulaceae and Compositae were the botanical families with higher number of taxa. Most of these genotypes are suitable, thanks to their tolerance to abiotic stress, and in particular the drought one, to be used in the sustainable landscaping. This list was also compared with the actual catalogues of nursery farmers to identify those taxa that are now marginally produced or no produced. 104 species and/or cultivars were thus identified, whose materials were collected and propagated to constitute a catalogue field, functional to their preliminary characterization and preparation of functional cultivation protocols.

Keywords: *New crops, ornamentals, biodiversity, historical gardens*

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Section III: Urban ecosystem and environmental engineering

Invited speaker

Trace Element Contents, Microbial Communities and Enzymatic Activities of Urban Soils. A Case Study from the City of Marrakech, Morocco

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Abstract

Soils in urban areas constitute the main connecting element between water, plants, air, and Man. For this reason, urban soils receive more attention considering their socio-economic importance and their influence on human health and wellbeing. Due to their proximity with the population, urban soils are heavily altered by anthropogenic activity and they receive considerable pollution from industry, traffic, and refuse. This may strongly affect their biological functioning and physico-chemical characteristics. The contaminated soils may pose a serious human health risk via direct (e.g., contamination of crops of urban gardens) and indirect contamination (e.g., inhalation, ingestion of soil particles) of the population of cities. Soil pollution has been of major interest in the study of urban soils. However, their biological functioning as a valuable indicator of human activities on soil health has so far remained little investigated in an urban context. The present work aims to improve our knowledge on the effect of human activities on the trace and major element concentrations and microbial communities' structure in urbanized soil. In this case study, Marrakech city in Morocco was taken as an example to illustrate this impact. In the urban zone of Marrakech city, Morocco, 9 topsoils were collected from different sites located along an anthropogenic gradient from a suburban area to the city center. Soil enzyme activities (dehydrogenase, alkaline phosphatase, and urease) were colorimetrically measured, and microbial communities were analyzed by using microbial counts and by denaturing gradient gel electrophoresis (DGGE). The total fraction of trace and major elements and their water-soluble fraction were also analyzed. In general, heavy metal concentration showed an increasing trend following the anthropogenic gradient, except for B and Cd. The aqua regia extractable fraction concentrations vary between 45.22 and 126.25 mg kg-1 for Zn, 10.04 and 73.69 mg kg-1 for Pb, 14.16 and 71.69 mg kg-1 for Cu, 12.75 and 20.42 mg kg-1 for Ni, 21.39 and 42.21 mg kg-1 for Cr, 6.65 and 10.18 mg kg-1 for As, 7.49 and 11.89 mg.kg-1 for Co and 0.21 and 0.28 mg kg-1 for Cd, while the concentration of B varies between 9.31 and 22.13 mg kg-1. However, concentrations of the total fraction of trace elements remained below the standard international limits for soils. The trace elements water soluble fraction concentrations are very low. The results show that the microbial abundance varies significantly between sites, this variation being directly

proportional and statistically significant ($p < 0.05$) to the anthropogenic gradient for bacteria (222.6157 - 1627.257 102 UFC/g soil dwt), while it is independent from this gradient for fungi (4.5 - 69.76 102 UFC/g soil dwt) and actinomycetes (69.78 - 170.64 102 UFC /g soil dwt). For the enzymatic activities, there is a significant decrease for dehydrogenase activity ($p < 0.05$) with the anthropogenic gradient (463.05 - 4.45 µg TPF/g soil dwt), while phosphatase and urease activities varied between sites independently of the gradient. The analysis of bacterial communities by DGGE revealed that bacterial diversity was not negatively affected by increasing anthropization level. There even seems to be a greater bacterial diversity in the soil collected near the city center, where their community structure seemed to be influenced by the total concentrations of Zn, As, Cr, Cu, Ni, Pb, and the technogenic fraction. In conclusion, the results confirm that anthropisation causes a wide spatial diversity of soils in urban and peri-urban environments regarding to their biological and physicochemical properties. Dehydrogenase activity was greatly affected throughout the urbanization gradient, evidencing as good indicators of the harmful effects of anthropogenic disturbances in soils.

Keywords: *Urban soils, trace and major elements, microbial concentration, enzymatic activities, anthropisation*

Section III: Urban ecosystem and environmental engineering
Oral

Consumer Attitudes to Vertical Farming in the United Kingdom and Germany

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Abstract

Vertical farming (VF) is part of a transition from outdoor to indoor agricultural production that is regarded as necessary to feed the world's growing population and manage threats to food supply caused by climate change and urbanisation, among other things. The present study explores consumer perceptions and beliefs about indoor VF, where crops are grown in vertically stacked layers under highly controlled conditions that allow for the optimisation of resource use, incl. nutrients, water, energy and space. The research was conducted in 2020 as an online survey with consumers from the United Kingdom (UK, n=1500) and Germany (n=1000). On average, consumers were more positive than negative about VF, but they were more accepting of fruit and vegetables (F&V) grown outdoors. More in-depth analyses revealed groups of consumers who were receptive to VF and those who were sceptical. It also emerged that consumers in both countries had lower expectations of the sensory quality and of fruit and vegetables from VF. When compared to expectations about the quality and eating experience of fruit grown organically, VF did not compare favourably. This points to the need for consumers to gain VF product experience and future research that uses tasted products.

Keywords: *Vertical farming, controlled environment production, attitudes, survey*

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Constructed Wetlands as Nature-Based Solution for Sustainable Wastewater Management in Urban Areas: A Critical Assessment by Experimental Studies and Literature

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Abstract

In urban areas, constructed wetland systems (CWs) have been recognized as one of the most valid technologies for sustainable wastewater management. They represent green infrastructures and provide solutions to treatment of wastewaters that cities and peri-urban areas produce in large amount due to increase of urbanization and industrialization processes. In particular, CWs offer the advantages of wastewater reuse for parklands irrigation, water storage and peak-flow attenuation, control of stormwater runoff, nutrient cycling and uptake, heavy metals sequestration, removal of organic compounds. In greener cities, these systems have the potential to perform not just hydrological and wastewater treatment functions, but also urban design and ecological aspects as demonstrated by numerous applications around the world. CWs, in fact, can function as urban wildlife sites, educational or recreational facilities, landscape engineering and ecological areas. The aim of this paper was to highlight the potential functionality of CWs in urban areas by a critical assessment of two experimental studies and literature. In particular, the two studies were carried out in Sicily (Italy) in order to evaluate: i) the reuse of treated wastewater for irrigation of turfgrass species; ii) the pollutant removal efficiency of a constructed wetland used to treat first-flush stormwater. The results confirm that CWs are efficient in the treatment and reuse of wastewater for irrigation purposes in modern cities, especially in those which suffer by prolonged water shortage during summer. Furthermore, CWs showed very high organic pollutant removal and a good efficiency in nutrients and trace metals, highlighting their important role in the treatment of stormwater in urban areas.

Keywords: *Constructed wetlands, urban areas, urban wastewater, stormwater, reuse, sustainability*

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Supplemental Daily Light Integral by Led Light to Improve the Growth of Leafy Vegetables in Aquaponic Systems

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Abstract

Developing sustainable food system is of primary importance to achieve the UN developmental goals. Aquaponic is a highly efficient production technique that relies on the food introduced for fish, as the only energy system's input for both growing fishes and vegetables, without the use of chemicals. During the winter, due to the combined effects of lower solar radiation and temperature, plant metabolic activity, growth rate and nutrient uptake (e.g., nitrate and ammonia) decrease, possibly causing their harmful accumulation for fish in the water. Growers use to renew periodically the water by discharging nutrients' enriched water in the environment with unaffordable environmental and economic costs. The winter aquaponic cultivation cycles can be integrated with supplemental light, to guarantee a constant Daily Light Integral (DLI), that could promote plant growth and nutrients' uptake. Aim of the study was to evaluate the morpho-physiological responses of lettuce (*Lactuca sativa* L.), escarole endive (*Cichorium endivia* var. *latifolia*) and curly endive (*Cichorium endivia* var. *crispum*) grown in floating raft in combination with tilapia (*Oreochromis niloticus* L.), under natural light (NL) or natural light integrated with 16 hrs of supplemental white LED lighting (IL, PPFD: 173 µmol m^{-2} s^{-1}, DLI, 10 mol m^{-2} d^{-1}) in a Recirculating Aquaponic System (RAS). The results showed species-specific morpho-physiological responses, with a higher productivity in the endives compared to lettuce, under both light regimes. Plant fresh biomass and leaf area were promoted under IL compared to NL accounting for a higher plant photosynthetic rate. IL promoted endive vegetative growth while lettuce leaf expansion and biomass allocation into the canopy were increased. To conclude, lettuce and endives well performed in the adopted RAS system. It appears highly recommendable to provide a fixed DLI during winter months to shorten crop cycle by improving plant growth and nutrient uptake. However, further studies are needed to optimize light application reducing energy costs and developing specific lighting protocols.

Keywords: *White spectrum, photochemistry, water use efficiency, root growth*

Plants & Polyester: Suitable Plants for a Textile-Based Living Wall System

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Abstract

The vertical greenery system "living wall" could green our cities and have many positive effects. Living walls help adapt to climate change consequences, promote biodiversity, and serves local recreation. Living walls have to look good all year round to be accepted in society. The functionality and the well-known benefits of living walls are achieved by plants. Knowledge of plants in living walls is limited to few climate zones and empirical values with unknown data determination. So, we studied plants in a new living wall system: the textile vegetation mat (mats) under a temperate oceanic climate. We monitored plant development like growth form and visual attractiveness. At the research location, four experimental walls angled to north, south, east, and west were built on. The pre-cultivated mats were fixed at experimental walls and stayed there for three years. Only plants which have a moist or wet habitat were chosen because the mat had no substratum and was constantly irrigated. Based on common designs from landscape architecture we created two plant modules "cascade" and "ground cover" with 30 perennials. The plant modules were analyzed in a randomized setup with four replicates. We determined the survival rate after two winter periods. Most of the plants survived the mild winter. After the cold winter with a late frost period, almost all plants showed damage and many plants died. We observed differences in plant development depending on the exposition, especially with ferns. Further results were that evergreen shrubs were visually attractive throughout the year. We discovered an occasionally nice flowering from some shrubs and geophytes. Attractive plant pictures and beautiful foliage decoration all year round showed the plant module ground cover. Until the beginning of winter, we observed an attractive plant picture with grasses, shrubs, and ferns. We discovered an unexpected establishment of moss.

Keywords: *Living wall, plant use, perennials, urban green infratstructure, vertical greenery systems*

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Impact of Shade Produced by *Prosopis glandulosa* (Honey Mesquite) on Surface Temperatures of Asphalt and *Cynodon dactylon* (Bermudagrass) in Palm Springs, California

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Abstract

Over one half of the population of the world now reside in cities. Climate change and urbanization contribute to urban heat islands (UHIs) that average 4-5°C warmer than surrounding rural areas. Surface temperatures are even more impacted, leading to potential tree root damage in asphalt-surfaced parking lots and temperature-related injuries to humans and pets. Actively growing landscape plants cool UHIs through transpiration and shade production. A study was conducted to measure the ability of Prosopis glandulosa (honey mesquite) trees to reduce surface temperatures of asphalt and warm-season turfgrass in Palm Springs, California, a desert city in the Coachella Valley. Surface temperature of shaded and unshaded portions of an asphalt-surfaced commercial parking lot and shaded and unshaded portions of an adjacent residential condominium lawn planted with Cynodon dactylon (bermudagrass) were recorded between 1500 and 1530 hours on 11 dates in May and June, 2021 with an infrared thermometer held 1 m above the surface. The temperature of the unshaded portion of the asphalt parking lot averaged 63.4°C and the portion shaded by mature mesquite trees averaged 36.3°C. The temperature of the unshaded warm-season turfgrass averaged 36.0°C and the temperature of turfgrass shaded by mature mesquite trees of similar age to those growing in the asphalt-surfaced parking lot averaged 32.9°C. Results of this study document the important role of urban trees to reduce impacts of climate change and urban heat islands, especially in desert cities with ambient temperatures in summer sometimes exceeding 48.9°C.

Keywords: *Urban heat islands, trees, landscape, Prosopis, desert, California, palm springs, shade, surface temperature, climate change, asphalt, turfgrass,* Cynodon dactylon

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Sub-Alpine Wildflower Meadows as a Template for Water-Conserving Landscape Design in the Western United States

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Abstract

Non-indigenous settlers in the Rocky Mountain region of the Western United States were largely of European heritage. Landscaping practices during the 19th and 20th centuries in this area were based on the gardening practices of Europe. Lush lawns, non-native plants, and intensive flower gardens are common even today. However, most people living in the Rocky Mountains reside in cities located at the base of mountain ranges. These areas are classified as semi-arid environments, meaning the potential evapotranspiration exceeds annual precipitation. Major water shortages and the threat of catastrophic wildfires at the urban- wildland interface are issues currently affecting millions of people in this region. Traditional landscapes may not be sustainable in the future. Sub-alpine meadows in the Western United States include a variety of grasses, shrubs and wildflowers. In locations where they currently thrive, these landscapes have survived numerous disturbances including grazing of domestic livestock. When installed at lower elevations, wildflower meadows require just a fraction of the supplemental irrigation as compared to traditional landscaping. Furthermore, wildflower meadows could serve as an important buffer against wildfire threats. Attempts to create these beautiful landscapes have almost entirely failed, for the following reasons: 1) Addition of nutrient-rich topsoil favors competitive weeds; 2) loss of soil structure during installation, resulting in precipitation runoff and soil crusting; 3) failure to include appropriate perennial bunchgrasses; 4) including primarily early-successional wildflowers in seed mixes; 4) selection of species that do not grow well together to create a compatible ecosystem; 5) failure to recharge the soil moisture reservoir prior to seeding; 6) employing an agronomic rather than an ecological focus to establishment and management. In short, the expertise to create successful wildflower meadow is largely lacking at the individual, company, or organization level. Based on decades of research coupled with hands-on approaches to ecological restoration, we have identified methods to overcome these obstacles. We will highlight two highly contrasting yet successful wildflower meadows based on sub-alpine ecosystems to illustrate how success can reliably be achieved.

Keywords: *Natural landscapes, seed ecology, sustainable urban landscapes, water-conserving landscapes*

Northeast Ohio Urban Farms Pivot and Thrive in 2020

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Abstract

Urban and peri-urban farmers contribute to food systems in urban centers. These farms tend to be small (less than < 2 hecteacres) and generally depend heavily on direct marketing for sales. The COVID-19 pandemic disrupted traditional marketing chains. Farmers had to adapt sales practices to accommodate health and safety restrictions imposed at markets such as reduced occupancy and minimal contact, resulting in the adoption of new marketing strategies. Successful strategies included utilizing on-line sales platforms, home delivery systems and farm pop-up sales. In addition, food insecurity issues during the pandemic resulted in the increase in government funds to expand nutrition incentive programs which resulted in sales increases for small farms participating at farmer's markets. This presentation will describe farmers' market restrictions in imposed by the Ohio Department of Agriculture for 2020, the use of nutrition incentive programs to increase sales, and highlight methods small urban farmers utilized to continue basic operations and often increase sales in 2020. This presentation will also include comparisons of sales between the first seven months of 2020 compared to the same time period in 2021.

Keywords*: Urban farmer, farmers markets, produce incentives*

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Section III: Urban ecosystem and environmental engineering
Poster

Evaluation of Different Plant Species Arranged in Panels for Indoor Vertical Gardens

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Abstract

Vertical gardens are vegetable walls that can be used in different indoor conditions such as houses, offices, public buildings, etc. They provide a pleasant environment and they also increase air quality; therefore they improve working conditions and can increase the productivity of human work teams, as well as aesthetic and property value. Creating self-supporting panels with fully developed live plants shortens gardening work time for installation and makes maintenance more efficient by reducing the replacement time of plants one by one. The success of the nursery production requires testing the behavior of plants according to the growth conditions. The aim of this work was to evaluate the speed of establishment and coverage of the panel surface of eight different species of plants, comparing variables such as the type of substrate used or the position (height) in the panels. The self-supporting plant panels consisted of rigid polyvinyl chloride sheets 35 cm wide and 50 cm height, covered with a double layer of fabric stapled making pockets to introduce substrate between them. Two different substrates were used, one mineral consisting of arlite and other organic based on coconut and wood fibers. The plant species tested were *Fittonia albivenis*, *Ficus pumila* 'Variegata', *Asparagus setaceus*, *Hedera helix* 'Miniata Variegata', *Plectranthus scutellarioides* 'Great Falls Niagara', *Lysimachia nummularia*, *Chamaedorea elegans* and *Nephrolephis exaltata*. Foliar coverage of the panel surface was evaluated though photographs taken periodically. The plant species that covered the panels the fastest were N. exaltata, P. scutellarioides, F. pumila 'Variegata'and A. setaceus. The height of the plants in the panel also had a general influence on their growth, reaching greater foliar coverage those located in the upper part and therefore closer to the light, especially for *F. pumila* and *H. helix* 'Miniata Variegata'. However, the type of substrate did not significantly influence plant growth.

Keywords: *Green walls systems, indoor plant species, pockets, arlite, organic substrate*

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Urban Trees Felling and Failures: Preliminary Results from an Investigation on an Urban Green Infrastructure. Locating The Most Sensible Species and Optimizing their Management

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Abstract

Urban arboriculture increasingly requires integration between data collection and management. Today, it is fundamental to quickly shift from detailed to large-scale evaluations. Urban arboreal heritages are truly complex, heterogeneous and scattered infrastructures. At the very beginning few administrations willed to develop a full knowledge about their green assets. Currently, the need for high-proficiency tools is urgent due to communitarian policies and trends. Moreover, risk assessment practices represent a powerful tool to sustainably manage biological and structural variability of urban trees. From 2010 on, the University of Bologna has been carrying out a long-term experimentation collaborating with the Municipality of Senigallia (AN, Italy) in order to master and efficiently manage their urban green infrastructure. Preliminary results from data processing concerning felled and failed trees are here presented. Four key parameters were extrapolated from the VTA (Visual Tree Assessment) database established between 2016 and 2021: (I) health status, (II) structural flaws, (III) likelihood of failure, (IV) site disturbances. First, these factors were used to highlight the most affected species. Additionally, individual and combined causes were defined. Eventually, by means of a GIS (geographic information system) map, the results were used to define the sites where sensible species gathered, providing useful information to prioritize future data surveys, monitoring activities and interventions.

Keywords: *Arboreal heritage; Sustainable management; UGI; Geolocation; Visual Tree Assessment*

Recirculating Aquaponic Systems: The New Era of Food Production Hyping the Nutrients Loop

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Abstract

In order to develop sustainable City/Region Food Systems (CRFS), a shift toward more eco-friendly and efficiently production systems is needed. On its side, aquaponic systems rely on the equilibrium and interaction between fish, plants and bacteria and are part of the so-called integrated production systems. Compared to other production techniques, it offers several advantages thanks to its feasibility of management and operating costs. Recirculating Aquaponic Systems (RAS) offers the opportunity to finely close loop nutrients inside an ecosystem and catch the best it can offer. Here we aim to highline the strengths and weakness of RAS systems, presenting as a case of study a RAS prototype of the CAISIAL (Centro di Ateneo per l´Innovazione nell´industria agro alimentare, Portici) started in November 2020 to growth leafy vegetables and Tilapia fishes. Results provide useful scientific and practical information for amateurs, schools as well as small and/or large-scale commercial growers. Furthermore, highline the feasibility of this systems to be embedded in urban areas from rooftop agriculture, vertical farms to other Controlled Environment Agricultural (CEA) systems as well as the opportunity that it can offer for abandoned urban areas.

Keywords: *Integrated production systems, nutrient losses, water quality, Plant factory with artificial lighting (PFAL)*

Beyond Vegetables: Effects of Led Light on Secondary Metabolites in Medicinal and Aromatic Plants, Edible Flowers and Microgreens

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Abstract

Secondary metabolites in plants are compounds not necessarily linked with growth or development, but that play a crucial role in crop environmental adaptation. They often feature antioxidant properties, therefore also resulting in important adjuvants for human health. Light is one of the main factors that modulate the biosynthesis of plant secondary metabolites, thanks to the cascade response mechanisms activated by photoreceptors and the consequent modulation of expressed genes and biosynthetic pathways. The recent evolutions in horticultural LED technologies allowed for easy adjustment and higher efficiency of lighting parameters. Accordingly, specific light spectral composition, intensities and photoperiods have been linked with altered metabolite content in a diversified range of cropped plants. This review aims at analyzing the effect of lighting recipes and management on the secondary metabolites content in different typologies of cropped species (namely medicinal and aromatic plants, microgreens and edible flowers) focusing on the most recent literature from the last five years.

Keywords: *Horticultural Light Emitting Diodes (LEDs); indoor farming; vertical farms; nutraceuticals; antioxidant.*

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Sustainability at the Edge: Reviewing Opportunities and Risks for Vertical Farming in Africa

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Abstract

In the coming years, the rapid rise of food demand, fuelled by population and income growth, will provide important opportunities for agricultural and food systems to transform African economies. Concurrently, the prevalence of food insecurity leading to hunger and malnutrition issues and unsustainable farming practices represent challenges for the future development of African agriculture. In this context, African urban areas are rapidly growing while their food supply still represent the prospective largest and fastest-growing market opportunity available for the local farmers. Indoor vertical farming represents an innovative method for growing food in urban areas that allows cultivation to be stacked vertically inside controlled indoor environments. This farming technology has been gaining relevance in several cities around the World, thanks to its potential in enabling high food productivity rates, enhancing food quality and safety, and by contributing to sustainable resource (e.g. water or mineral nutrient) use. Nevertheless, in order to assess whether a new technology may feasibly and sustainably contribute to local food systems, different impact categories, e.g. in the environmental, social, and economic spheres, need to be appropriately considered. The present study aims to examine the feasibility of the integration of vertical farming technology within the African continent through a deep analysis of major opportunities and challenges that each territory features. The study builds on an updated database of development indicators from 53 African states and on recent high resolution information on crop areas, yield and productivity, substantiating opportunities and risks associated with current food systems, resource accessibility and demographic indicators.

Keywords: *Vertical Farming, Food Security, Urban Agriculture, Food Security, Africa, Plant Factories with Artificial Lighting (PFALs).*

Effective Microorganisms Collected from Urban Gardens Favors Native Lawn Growth

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Abstract

When planning gardens in urban areas, the presence of vegetation is a priority, especially when seeking both thermic and environmental comfort. The existence of long-lived plant specimens (trees and shrubs) on a natural surface (local soil with litter) allows for the maintenance and enrichment of the native microbiota. However, these ecological functions are often unnoticed by landscape gardeners, due to a lack of intellectual and technical knowledge. Commonly, these areas of the garden are abandoned and not managed, or even devalued due to aesthetic prejudice. Nonetheless, by the concept of functional zoning from permaculture design, there is zone 5, the most remote and least visited area; This is the natural zone, the Eden, a piece of virgin nature, original inside the garden and without the necessity to be frequented, but essential to the whole garden equilibrium. This work aims to evaluate the quality of effective microorganisms collected in urban gardens and their effects on plant growth of native lawns, integrating techniques drawn from natural agriculture (effective microorganisms), permaculture (design in 5 zones), and agroecology in urban gardens. Effective microorganisms (EM) were collected in an urban garden (restricted access and residential lot) and an urban university campus garden (public access) in 2020. The microbiological analysis of extracts showed 31 bacteria and 35 fungi in the urban garden, and 21 bacteria and 3 fungi in the university garden. The EM extract from the university garden was diluted and applied every 15 days on the native lawn (Axonopus sempervirens) in summer 2021. After 57 days, the foliar area was 193% higher. We conclude that to keep gardens healthy, from the design to the maintenance, it is fundamental to integrate and apply knowledge about agroecology and sustainable agriculture.

Keywords: *Natural agriculture, permaculture, regenerative design, urban agroecology, organic lawn production, EM.*

Characterisation of the Etna Volcanic Ash to Explore its Suitability as Growing Media

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Abstract

Mount Etna volcano (Sicily, Italy) is the highest and most active volcano in Europe. From 2011, its activity has considerably increased in relation to previous years. Ashes ejected from the Etna volcano cause much nuisance to inhabitants of the area, and also to farmers, burying agricultural lands, and destroying crops. Volcanic eruptions, in fact, produce great amount of volcanic ash (tephra), which needs to be separated and disposed as a different waste in Italy. This material, on the other hand, can represent resource for farmers to improve land fertility and also to obtain growing media for pot cultivation. The granulometric aspect of the ashes is of fundamental importance; in sensu stricto tephra refers to ashes that are less than 2 mm in diameter. This material has great properties already studied as growing media for ornamentals, such as low density, high porosity, C, so could be employed in plant nurseries and in green infrastructure (green roofs, green walls), but a complete characterisation is necessary to fully understand its potential. All the properties necessary for the definition of the suitability as growing media have been investigated in tephra coming from Etna eruptions of spring 2021. Electrical conductivity (EC), pH were determined according with Sparks et al. 1996, macro, micro and trace elements (Cd, Cr, Cu, Ni, Pb, Zn, As, Hg, Ca, Fe, K, Mg, Mn, V, Na, P, Al, Ti) total and H2O soluble quantities were determined according with EPA method 6010. EC was 582 µS cm-1 pH was 6.7. All the potentially toxic elements were low especially as soluble values. The investigation carried out represents a preliminary study for the feasibility of the use of Etna tephra as component of growing media.

Keywords: *Tephra, growing media, pH, EC, minerals*

Section IV: Planning, design and policies in cities

Invited speaker

Policies for Food Production in Cities: from Ignorance to Cooperation and Strategic Support

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Abstract

With the enormous increase in urban agriculture (UA) activities throughout the world in recent decades, as evidenced recently by the growing interest in allotment gardening and urban gardening propelled by the COVID-19 pandemic, many city administrations and civic society initiatives have become aware of their potential influence on the food system. And yet, the production of food in the city has been common practice ever since. The emergence of UA has been and is closely linked to crisis-prone developments in the city, the term "crisis" referring primarily to times of economic upheaval, although it can also be extended to social transformations. With more and more globalised food markets, the growing interested in UA also reflects an increasing desire for traceability and knowledge about the origin of food and way food is produced. Since 1999, when Pothukuchi and Kaufmann stated the need to include food and agriculture in urban planning and policy-making, a body of academic literature has explored how UA can be strengthened through policies and governance, and initiatives like e.g. the Milano Urban Food Policy Pact have led to an increasing support by local policies. All in all, there is a turn from ignoring UA to acknowledging it to using UA as a strategic tool to increase the sustainable development and resilience of cities. In return, the question how resource-efficient the production of food with cities is, gains importance. The aim of this presentation is to give an overview on policies aiming at regulating, funding or promoting resource-efficient urban agriculture and analyse their main characteristics. The analysis is mainly based on policy data collected from five case study areas in Europe and the U.S.: New York (U.S.), London (U.K.), Nantes (France), Gorzow Wielkopolski (Poland), and the Ruhr Area (Germany) taking part in the FEW-meter project (www.few-meter.org) and on interviews conducted in the five case-study regions to explore which policies types are considered helpful. Results reveal the differences in policy support among the five compared countries. The research further provides insights into what extent existing governance structures can support or inhibit sustainable UA in different contexts.

Keywords: *Urban agriculture; food policies; resource-efficiency; urban development*

Additional notes or remarks to the convener/editor (if any):
* with contributions by the FEW-meter team, especially Kathrin Specht, Caitlin Kirby, Nevin Cohen, Silvio Caputo, Victoria Schoen, Rositsa Ilieva, Bèatrice Béchèt, and Lidia Ponizy

Section IV: Planning, design and policies in cities - Oral

Evaluation of Horticultural Activity from the Perspective of Administrators and Participants at Facilities Supporting Higher Brain Dysfunction

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Abstract

We evaluated horticultural activities from the perspective of administrators and participants at facilities supporting higher brain dysfunction (traumatic brain injury and cerebral vascular disorder). We queried program administrators through questionnaires and interviews and found out that 1) administrators needed some horticultural expertise to successfully manage the activities; 2) participants interacted and communicated with each other during the activity; 3) participants appeared to enjoy the activities, although this was difficult to evaluate. We used Interpretive Structural Modeling (ISM) to identify relationships among participant's interest in plant and horticultural activities, awareness of their disability, and increased communication. The text mining analysis results of the participant's impression suggested 1) temperature extremes made participation in horticultural activities more difficult and 2) cultivation, harvesting, cooking, eating and communication were fun activity. Administrators pointed out both negative and positive aspects of the horticultural activities; however, in general, we found that administrators with experience in horticultural activities were the most successful. We also concluded that while inclement weather can hinder and even prevent execution and enjoyment, it was clear that participants enjoyed working together on horticultural activities.

Keywords: *Traumatic brain injury, Cerebral vascular disorder, Interpretive Structural Modeling (ISM), rehabilitation, text mining*

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Mediterranean Green Buildings: Vegetation Cover and Runoff Water Quality Assessment in a Green Roof System

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Abstract

Urbanization not only supports social and economic development but also causes various problems, such as increase of population, traffic, pollution (water, air, noise), heat island effects and reduction of resources and biodiversity. Urban nature-based solutions (NBS) generally defined as solutions that are inspired or supported by nature, have been brought forward as ecosystem services delivered by urban green or blue infrastructure. Green roofs represent one of the most important NBS of the urban green spaces. Since 2018 we are studying technical aspect of a green roof system having focused on i) waste & recyclable materials ii) types of Mediterranean plants and their adaptability iii) green roof as a tool to improve water quality and to reduce storm water runoff. The technological installation of a green cover was on a flat terrace in an industrial site of Livorno, applying temperature sensors and a rainwater recovery system. We use very simple and light substrate, made up of lapillus, pumice and compost (20% -65% -15%) and green roof was divided into two prototypes that differ each other exclusively for the woody vegetation planted (all shrubs suitable for the Mediterranean climate, but with green or grey leaves). Monitoring was performed using three data loggers for measuring the external temperature and that recorded under each type of substrate. The simultaneous installation of a weather station allowed to check temperature, wind, humidity and rainy events in the site. The results obtained in the two years of experimentation show the effectiveness of the roof in containing temperatures, able to keep the underlying environment cooler by about 2°C during the thermal peak and warmer by the same amount at the minimum external temperatures, with variability due to substrate humidity and to colour of plant cover (albedo). The physiological performance of vegetation was also detected by indexes as photochemical efficiency of photosystem II, electron transport rate and leaf gas-exchange parameters. Leaf gas exchanges were carried out to evaluate the contribution of the different species to carbon sequestration and to the cooling effect due to leaf water transpiration. All species are resulted available to planting site and substrate, with low management (only one fertilization a year and survey irrigations in summer). The analyses of rainfall, very scarce over the two years, revealed the good quality of rainwater and the low level of pollution before and after the leaching of the substrate. Moreover, the results highlight that not only this system allows to reach environmental improvement, but it also brings to a decrease of the loads bearing on the structure with positive repercussions on the building, suggesting to consider them in term of the sustainability for building engineering and architecture. Further research can be developed to implement the best method and application in the Mediterranean climate, especially in urban cities and industrial sites.

Keywords: Helichrysum italicum, Lavandula angustifolia, Rosmarinus officinalis 'Prostratus', Satureja hortensis, Senecio cineraria, Thymus vulgaris, Thymus *x* citriodorus

Wildflowers: Opportunities for Urban Landscapes

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Abstract

The concept of "sustainability" is also becoming of great interest in the management of ornamental and territorial greenery. The new trends in the design of green spaces are aimed both at enhancing their "natural" aspects and at researching schemes characterized by lower maintenance costs. Spontaneous vegetation represents a characteristic component of the urban environment and is always adequate to the conditions of the site in which it is located. In this context, the role of spontaneous herbaceous plants becomes fundamental and constitutes an effective response to the current demand for the defence, conservation and enhancement of biodiversity. So far, the use of spontaneous vegetation for ornamental purposes, in public and private areas, is somewhat limited. The full potential of wild herbaceous species is often not achieved due to a lack of planning, management and limited species-specific knowledge. The objective of the work concerned the determination of some biometric characteristics of spontaneous herbaceous species found in the urban area of the city of Palermo in order to identify the best ones for ornamental purposes. The survey involved 18 species belonging to 13 different botanical families. The most represented families are Asteraceae, Poaceae and Brassicaceae. It emerged that the plants had diversified sizes always characterized by a high showiness of the floral structures. Although the Mediterranean flora is generally dominated by yellow flower structures, during the survey were found plants with white, pink, lilac, orange, lilac-violet and violet flowers, which are interesting for a possible use as wild flowers. Finally, the heterogeneity of the height found in the different plants allows us to support the possibility of using the species in various combinations in relation to the type of area to be planted.

Keywords: *Wildflowers, Ornamental plants, Urban sustainability, Biodiversity, Biometric characteristics*

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A Framework for Selecting Fruitful and Nutritious Crops for Urban Cultivation Systems

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Abstract

The choice of vegetables to grow in urban areas is mainly based on productivity and profitability values which often results in the selection of few niche products (e.g. leafy greens). Although these are a good source of some specific functional ingredients, the current supply of fresh fruits and vegetables from urban farming lacks nutrient diversity. Therefore, in view of a more varied diet or compensation of nutrient deficiencies, it is necessary to study a wider range of crops and evaluate their feasibility in urban horticultural systems. This study develops a method for the selection of crops in urban cultivation systems that takes into consideration human nutritional requirements as well as resource use efficiency, crop traits (nutritional content, growth characteristics) and cultivation system constraints, by weighting their relative importance. An existing methodological framework for crop selection in space missions is adapted and integrated. Scientific literature and expert knowledge are used as main data sources. The framework includes the selection protocol, the evaluation criteria (and sub-criteria), their weighting factors to rank the choices, a list of crops and their resulting scores. The developed framework is applied to two different cultivation systems typical of urban context, namely open-air rooftop farming and indoor vertical farming, in the city of Amsterdam. The outcomes show that a combination of different crops is needed to meet the dietary requirements of the urban population. The list includes varied nutrient-dense fruits and vegetables that are not commonly grown in urban farming systems and are worth investigating further in terms of technical feasibility and sustainable use of resources. The methodological framework can be extended by adding new candidate crops, sub-criteria and by weighting the main evaluation aspects according to the users' priorities and requirements.

Keywords: *Methodological framework, crop selection, fruits and vegetables, urban horticulture, indoor farming, rooftop farming, human nutrition, resource use*

The Dilemma and Countermeasures of Flower-Themed Tourist Attraction Development in China

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Abstract

Since the 1st International Symposium on Chinese Flower Culture, which focused on Flower and Tourism, had been held successfully at Nanjing, China in 2007, tourist attractions with the theme of flower and flower culture began to receive widespread attention and developed dramatically over the last decade in China. However, blind construction of unsustainable flower-themed attractions occurs quite often nowadays, such as some flower-sea attractions with problems of single variety of plants, poor design, bad management, low economic benefit and cultivated land invasion, which has brought a tremendous negative impact to the horticulture development in China. Based on this context, this paper analyzes the current situation of the flower-themed tourist attractions by site investigation, and put forward with five countermeasures to promote a healthy and sustainable flower tourism as follows: (1) we are resolutely opposed to develop flower-themed tourism on fertile lands for food production; (2) we disapprove to develop any flower tourism landscape with the only function of beauty viewing;(3) we encourage to develop flower tourism on flower-planting regions;(4) we give priority to develop destinations with natural flower resources such as wild flower tourism;(5) we propose to make use of Chinese traditional flower culture in urban park system.

Keywords: *Flower tourism, flower culture, sustainable, developing strategy, site investigation*

Section IV: Planning, design and policies in cities

Invited speaker

Urban Gardens: A New Oasis

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Abstract

This paper looks at the role of gardens in improving environmental sustainability and the mental health of city dwellers. Faced with the current environmental and climate chrises the role of both private and public gardens becomes increasingly important as a contributor to biodiversity and the building of resilient landscapes. With 600 modern plant extinctions and an estimated 2 out of every 5 plants facing extinction there is need to fill the resulting genetic voids in order to build resilience through diversity. The recent worldwide pandemic has amplified, already increasing human stress factors with urban populations becoming more divorced from nature and life processes. Enforced isolation, economic damage from job losses and national and local lockdowns have created mental health issues for many people. Green spaces offer an opportunity to create landscapes that are diverse and resilient, forming green corridors in urban areas, provide habitat for wildlife, and benefit water management reducing flood risk and loss of resource. Green space is now recognised as an important factor in maintaining good mental health and access to green space in urban areas is an increasingly important part of urban planning. For those without private outdoor green space, access to a community garden breaks down isolation and helps to build a community with shared interest and experience and improves self determination and confidence. Examples of recent work in both London and Sheffield will illustrate the value of this work.

Keywords: *Resilient-landscapes, Sustainability, Green- corridors, climate-change, mental-health, green- space*

Section IV: Planning, design and policies in cities - Poster

Phytosociological Approach to Implement a Sedum-Dominated Plant Community in Extensive Mediterranean Green Roofs

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Abstract

Extensive green roofs (EGRs) provide some important ecosystem services, including the increase of urban biodiversity. The establishment of plant species with different functionality, besides the highly employed genus Sedum, can enhance the habitat opportunity. Drought, extreme climate conditions and low nutrient availability here affect the plant development. Herbaceous species belonging to spontaneous plant communities, which are adapted to such difficult conditions, can improve this urban green infrastructure. Then, we tested the possibility of improving the biodiversity and the flowering period of a Sedum EGR, using wild ephemeral Mediterranean species, selected with a phytosociological approach. We used as test areas 12 plots of 10 cm depth, which were previously established and filled with three different substrates composed of compost, pelletised paper sludge, and tephra (commercial name Vulcaflor), as follows: VC (Vulcaflor+Compost), VPC (Vulcaflor+Paper+Compost) and VP (Vulcaflor+Paper). In the previous tests, annual and perennial forbs, annual and perennial legumes, geophytes, CAM and grasses were planted and seeded in the boxes. After five years the plant community was dominated by CAM (Sedum) and few annual species. In the present seeding of species, we selected plants belonging to coming from slightly-nitrophilous (Stellarietea mediae), xerophilous (Thero-Brachypodietea), or sandy (Koelerio-Corynephoretea) pioneer communities of Mediterranean fields. From October 2019 to June 2020, we monitored the total canopy cover with the point-intercept method, such as the plant diversity (Shannon, Evenness and Simpson indices) and the percentage of plant functional types. The different nitrogen contents (VC > VPC > VP) of substrates showed a relevant role, since it reduced the spread of CAM in VPC and VP, allowing the annual seeded species to colonise. The resulting enrichment of the plant community in terms of composition led to an increase in plant diversity, improving also the flowering periods, especially in VP substrate. Phytosociological approach resulted suitable to select plant species able to establish in such conditions, as well as to coexist with CAM, increasing the diversity in poor nutrient substrate.

Keywords: *Species richness, point-intercept method, functional groups, nitrogen, tolerance strategy*

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Exploring Latin America's Urban Green Status and Research Gaps

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Abstract

Rapid population growth and urbanization in Latin America (LA) are putting pressure on people and biodiversity in cities. Urban green (UG) represents an opportunity to mitigate adverse consequences by providing a habitat for flora and fauna and a healthy urban environment for its inhabitants. However, research to understand and improve the functioning of green infrastructures as well as their implementation has been limited in LA. To describe the current status and trends of UG and UG research in LA, a structured literature review of English and Spanish articles published between 2000 and 2020 was undertaken using various databases (Web of Science, RedIB, Latindex, and Dialnet). A total of 163 English and 79 Spanish articles were listed. Data on urbanization (trends and challenges) or UG (green area per capita, type of green area studied) were recorded, as well as the main topics covered in these studies. Brazil has the highest number of publications (67) and its cities (Curitiba and São Carlos) had the largest reported area of UG (52 and 19 m^2/inhabitant). This is much higher than the recommended by the WHO (9 m^2/inhabitant). On the other hand, the lowest number of studies on UG were conducted in Bolivia, El Salvador, Guyana and Paraguay (less than 2), with no records about the amount of green space. "Biodiversity" was the most studied topic with 84 articles in English and 15 articles in Spanish. The most commonly discussed challenge regarding urban planning in LA was the uneven distribution of green areas. Overall, our findings suggest that UG implementation and research on UG are still poorly developed. Some of the knowledge gaps identified were that only five countries had collaborations with researchers from other countries. Finally, Spanish databases do not allow structured searches, impeding the synthesis and progress of scientific research.

Keywords: *Green areas, review, urbanization, urban planning*

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Towards an Energy Alternative Solution Through Open Cast Lignite Mine Reclamation

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Abstract

Opencast mining operations are unavoidably intrusive as the topography is altered and the original ecosystems are removed, creating a severe impact on the landscape and environment. Hence post-mining landscapes are often called "landscapes without a memory". Depending on the type of mine, the scale of the operation, and method applied opencast mine reclamation is often challenging, especially when following a sustainable approach. Moreover, opencast lignite mining is associated with pollution generated by lignite combustion. Often, in many regions worldwide, to gain lignite, in addition to natural resources, settlements, farmland, and other infrastructures are completely removed. Such effects raise the need to integrate the region's socio-economic aspects within the reclamation proposal. The proposed reclamation of a typical example of extracted lignite generated derelict land within the Mediterranean, located at Amyntaio in Western Macedonia, Greece is presented. The former opencast lignite mine occupied a large surface area of agricultural land for the production of energy. The development of recreational green space is proposed based on a detailed site analysis with emphasis given on the socio-economic impact of the lignite mine in the region and expressed through the concept "Earth produces energy - from lignite to renewables". The topography of the mine is generally preserved; spoil tips are vegetated and the main pit converted to a lake and planted on the periphery with emergent plants referring to the process of lignite formation. On the other hand, agricultural land is reintroduced with the cultivation of energy crops and other small-scale green energy modules are developed within the site. By considering thesocio-economic impacts of the lignite mine the site's "landscape history" is enhanced and the memories of the local people preserved.

Keywords: *Derelict land, preservation, memory, agricultural land, energy crops*

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Current Status and Global Distribution of Commercial Vertical Farms

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Abstract

In recent years, a rapid growth of the vertical farming sector has been experienced worldwide. The present review paper builds on a global inventory of more than 150 commercial vertical farms, discussing their distribution and evolution over time. From the initial evolution of the technology in North America (38% of observed cases) and Asia (29%), the sector has followed a more recent growth also in Europe (28%). Moreover, although with limited business cases, commercial vertical farms are also emerging in Latin America, Oceania and Africa. The research integrates information on the cultivated surfaces, grown species and adopted technologies, enabling the implementation of scenarios on their potential contribution to local food systems and their integration within innovative business models. It appears that while average farm size highly varies among regions (with farms being twice as big in North America as compared with Europe), most adopted growing systems fall within few typologies worldwide. Innovation mainly take place in the form of product diversification (from leafy vegetables toward herbs, sprouts and plant based products with cosmetic or medicinal uses), or integrations within the supply chain (e.g. grocery stores, restaurants or public institutions, but also in-farm direct selling of food and non-food products and services).

Keywords: *Indoor farms, Light Emitting Diodes (LEDs), Yield; Plant factories with artificial lighting (PFAL)*

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Green Roof Strategies for Substrate-Based Food Production in Urban Areas

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Abstract

Green roofs are used to introduce green space to cities by growing plants on rooftops, especially in dense urban areas. They have both function and beauty, and often use space that is otherwise unoccupied. Many cities have vast amounts of roof space, with much belonging to unused and flat roofs. Potential benefits span from economic to environmental impacts. To add even more function to green roofs, fruits and vegetables can be grown on roofs for consumption. Methods of design, possible community engagement, irrigation practices, growing substrate, and other strategies of 15 green roof gardens were examined. Geographic Information Systems software was used to identify some of the local institutions that could help foster community-wide benefits from the rooftop farms and gardens. Many trends that were highlighted by the survey were expected, such as almost all rooftops providing additional irrigation and receiving at least 6 hours of sunlight each day. There were also a large variety of plants that were reported to do well, suggesting that rooftop farms and gardens can successfully grow a number of different crops. One unexpected aspect was the common use of rooftop farms and gardens for restaurants and the unique culinary production associated. Overall, the surveyed roofs generally followed very similar designs, with a few distinct aspects that made them unique. In the long term, more of these food producing green roofs could further promote locally sourced healthy food within communities. The evidence obtained from the survey results of this study define the strategies and feasibility of urban agricultural practices on green roofs that improve local food systems, and provide a template to design a rooftop garden.

Keywords: *Green roofs, Urban Agriculture, Design, Rooftop Farms*

Landscapes Within Urban Environment

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Abstract

In recent years several patterns of sustainable city have been outlined by researchers working in the fields of ecology, spatial planning, environment protection, architecture and landscape architecture. They stress out the importance of nature in the urban environment where plants play the most crucial role if we talk about place development and welfare of its inhabitants. In order to make any place more sustainable and resilient, it becomes more important to follow the recommendations offered within EU Green Deal action or UN Sustainable Development Goals initiative. Although each country understands and deals with it differently, the changing climate more and more affect our cities which has expanded quite rapidly in last decades. Urban environment is changing and we need to work with more complex scenarios to find the balance for all aspects of life taking into account increasing number of population living in the cities and resources provided by nature to supply ecosystem services. People choosing the place to live more often looking for both tangible economic benefit, social justice, and possibility to enjoy the nature and to have access to clean air and water. Separate elements of urban environment – plants, architecture, infrastructure, facilities or water - can be seen as stimulating or unnecessary issue depending on a pattern of the city. The most important thing is to revise the role of all mentioned elements in spatial planning priorities to provide or foster the growth of any place.

Keywords: *Sustainable city, sustainability, landscape architecture, urban environment, resilience*

Section V: Impact of the anthropic activities: Interaction and synergies

Invited speaker

Air Pollution and Urban Green Infrastructure

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Abstract

The more people live in the cities, the higher is the need of clean air. In spite of control measures, air quality is still below the standards for human health protection in most of the globe, especially for the air gaseous pollutant ozone and the airborne particulate matter. In tandem with many other benefits, urban green infrastructure may help ameliorate air quality, providing that a scientifically-sound selection of species and planting is applied. This presentation will overview the major air pollutants of urban air and their trends, with a focus on the way they interact with plants. Criteria of species selection for air quality amelioration will be discussed and critical gaps of knowledge will be stressed. Major highlights are that: Fagus, Acer, Fraxinus species may be recommended for uptake of gaseous pollutants; large conifer species, in particular those with scale-like leaves, may be recommended for uptake of particulate matter; Salix, Quercus and Populus species should be avoided in areas subject to ozone exceedances; in street canyons, plant canopy 'tunnels' must be avoided while hedges or green walls/roofs may be recommended; trees have higher removal capacity than green roofs, with lower installation and maintenance costs. In conclusion, science-based urban green infrastructure use is a valuable nature-based solution for air quality improvement in the cities, with a percent improvement that is on average low (< 2-3%) and a peak improvement that may reach 15%.

Keywords: *Ozone, particulate matter, species selection, urban forests*

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Section V: Impact of the anthropic activities: Interaction and synergies - Oral

Evaluation of Soil Organic Carbon Stocks Within Urban Soils According to Different Land Use Types

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Abstract

Carbon (C) storage is an important ecosystem function of soils that has gained increasing attention in recent years. Changes in soil C impacts on, and feedbacks to, the Earth's climate system through emissions of CO2 and CH4 as well as storage of carbon removed from the atmosphere during photosynthesis. Due to urban expansion, urban soils are receiving increasing attention, they can be sink or source for CO2 depending on many factors such as land use and practices (Dignac et al., 2017). This work aims to determine the soil organic carbon stock (SCOS) in urban soil according to different land use types. SCOS was calculated according to four methods that vary in use the bulk density (BD) and rock fragments content parameters (Allory et al., 2019). In the first method (M1), there is no separation between the fine and the coarse soil fraction. Thus, for M2, the coarse soil content is counted only for the BD, but is not considered in the SCOS estimation. However, the opposite is true for the M3 where rock materials are determined, but only applied to reduce soil volume and not to determine BD. Regarding M4, the coarse soil fraction is accounted for both BL and SCOS (Peoplau et al., 2017). The results revealed a conceptual difference in widely used methods for SCOS calculation. Thus, two out of the four SCOS calculation methods produced systematically overestimated SCOS with highly positive correlation between M1- M2 (r=0.995) and between M3- M4 (r=0.995), thus SCOS values tend to be predicted more accurately with M4 than with M3, while M1 and M2 give overestimated results. Consequently, is essential to use M4 to accurately calculate SCOS in urban areas which is considering coarse fraction impact, while M1 is accounting only fine fraction. Indeed, urban soils can be characterized by a high volume of coarse fragments (δ > 2mm v/v). Overall, regardless the methods for SCOS calculation, suburban agricultural soil irrigated with wastewater showed a SCOS nearly 3 times higher than that control, while no significant difference was observed for the rest of studied land uses.

Keywords: *Soil organic carbon stocks (SCOS), Urban soil; Land uses, Climate change*

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Spontaneous Urban Weeds: A Resource Against Environmental Pollution

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Abstract

Quality of the environment and social well-being, both at a collective and individual level, are closely interrelated issues. It is, in fact, a relationship that invests values of primary importance, such as those relating to human health and safety, heritage and resources to be passed on to future generations. Plant growth and survival can be challenged by harsh urban conditions. Many studies show the persistence of endemic species in built-up areas and document the ecosystem services provided. With this research we wanted to investigate the bioaccumulation of heavy metals such as cobalt (Co), nickel (Ni), copper (Cu), zinc (Zn), arsenic (As), moliben (Mo), cadmium (Cd), lead (Pb) and mercury (Hg), in some spontaneous plants found along Viale Regione Siciliana, the most important thoroughfare of the city of Palermo with high traffic intensity. The protocol provided for the removal of the most present spontaneous plants, including, Daucus carota, Verbascum sinuatum, Sorghum halepense, Sonchus oleraceus, Plantago lanceolata in two distinct seasons (spring and summer), drying and subsequent analysis for the survey of heavy metals. In both periods investigated, the most present element was zinc, while the other elements, Co, Ni, As, Mo, Cd, Pb and Hg, which in the spring season showed concentrations of about 0.01 mg kg-1, falling within the normal range, in the summer season they sometimes showed values higher than 20 times, which in some investigated species exceeded the expected limits. The investigation, albeit preliminary, confirmed the ability of some herbaceous plants to accumulate heavy metals, suggesting the use of a set of herbaceous plants for biomonitoring in response to the need for monitoring and verifying environmental sustainability.

Keywords: *Potentially toxic metals, invasive weeds, biomonitoring, urban areas, enviromental pollution*

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Investigation of *Apis mellifera* L. Foraging Behaviour to Promote Pollinator-Friendly Urban Cities in Japan

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Abstract

Urbanization is a primary cause of pollinator biodiversity loss because it depletes floral and nesting resources. Since green areas are limited in urban zones, it is crucial to promote urban greening to provide pollen and nectar sources for pollinators. To investigate the floral resources of the urban environment, we used an efficient floral bio-sampler, Apis mellifera L., to identify the contribution of the urban road network to plant diversity. Pollen samples were collected every month at four study sites (Kiba, Kashiwanoha, Yaesu, and Nishichiba) during 2017 and 2018. DNA metabarcoding of pollen samples was used to identify the taxonomic composition of the floral resources. The results showed that 168 species belonging to 57 taxonomic families were acting as pollen sources, with a large number of honey-plant species in the Fabaceae (15 spp.), Asteraceae (14 spp.), or Rosaceae (8 spp.) families. Fifty-two per cent of the floral resources were alien species, 20% were cultivar species, 25% were native to Japan, and the remaining 3% were not identified. We observed that spontaneously colonizing plant species and street plantings were important sources for urban honeybees. We then located the spatial occurrences of the most foraged species by honeybees around hives. Sixty floral species on urban roads were targeted, and after 60 transects in May 2019, 24 of them were identified. Our results suggested that the urban road network could be not only the refuge of a majority of exotic pollinator species (63%) but also of a large proportion of cultivar species (25%) and a minority of indigenous species (13%). Urban greening programmes based on our findings could enhance biodiversity by creating green spaces suitable for all pollinators, whether generalists or specialists.

Keywords: *Biodiversity, Urban Greening, Urban Ecology*

Section V: Impact of the anthropic activities: Interaction and synergies - Poster

Screening and Selection Heavy Metal Tolerant Ornamental Plants for Urban or Peri-Urban Areas

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Abstract

The urban and peri-urban garden can be often polluted by heavy metals released from the high vehicular traffic. Considering that they have increased significant relevance due to their social, cultural, and economic, benefits they may pose a potential risk for people that come to this area. In the past, the predominant heavy metal in the urban and peri-urban area was lead (Pb) since it was a component of fuel for a long time. Nowadays, vehicles are still sources of heavy metals since the tire wear can still release Pb but also zinc (Zn) and Cd. Ornamental plant species used in urban areas could have several benefits in addition to their aesthetic value, soil conservation, and windbreakers, related to reduce heavy metal pollution. Some plants have the ability to absorb heavy elements in different plant tissues thus, their selection is very important to choose suitable species in relation to the pollution degree. These plants must satisfy the requirements related to the visual appearance of the area so, their aesthetical quality is extremely important, and this can be obtained if plants do not show eco-physiological alterations such as leaves yellowing, necrosis, or abscission induced by heavy metal contaminants. Considering that soils are often polluted by different metals and that plants show a capacity to accumulate only a few pollutants, special attention should be paid to the possibilities to use plant consociation and ornamental woody and herbaceous species could be integrated into the urban and peri-urban gardens. In this work, a working scheme for screening and selection of ornamental plants for heavy metals tolerance suitable for the urban and peri-urban gardens will be proposed.

Keywords: *Aesthetical value, indicators, markers, selection*

Alien Herbaceous Ornamental Plants as A Risk of Biodiversity Degradation in Habitats of Urban Areas

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Abstract

The loss of biodiversity of ruderal areas, native or semi native habitats located in or near to urban areas are a problem all over the world. The horticultural industry has gained a prominent role in alien plant naturalization. The aim of the study is to compare ornamental herbaceous plants – already garden escapers and newly introduced taxa showing escape depending on taxa biological properties in the light of probable threat to biodiversity outside plantings. Eleven target species were observed. The ascertaining of the spread of the species was performed in Riga – capital of Latvia hosting population over 620 000 people and rich in gardens. The biology of the species – growth pattern, reproduction etc. peculiarities were studied by observing ex situ specimens in the Botanical Garden of the University of Latvia. The results show, that newly introduced taxa - Aster umbellatus Mill., Boltonia asteroides (L.) L`Her, Kalimeris incissa (Fisch.) DC. resemble already known garden escapers by dominant index values, adaptation and invasiveness risk degree. This leads to the suggestion that these taxa may become garden escapers, especially if their use in horticulture is not restricted.

Keywords: *Garden escapers, adaptation, dominant index, invasiviness*

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Risk Assessment for Heavy Metals in Urban Gardens of Teresina, Brazil

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Abstract

Urban Agriculture (UA) contributes actively to food security cities worldwide. Urban crops can be polluted by heavy metals (HMs) emitted by several sources, therefore health risk linked to HMs contamination need to be assessed. The present study assess HMs contamination risks in the city of Teresina, Brazil, where a wide network of urban gardens exists. Both soils and vegetables (lettuce, coriander and chives) were sampled in five gardens (three within the city, one in the peri-urban fringes, and one from the nearby rural area). HMs contamination risk was assessed both for gardens' soils and for vegetables, performing respectively the Geoaccumulation Index (Igeo) and Healt Risk Index (HRI). Moreover, the effect of two cropping system (traditional soil vs soilless system) on HMs pollution was investigated. Results shows that urban soils account for the most elevate total concentration of HMs, with highest contamination observed in the high-traffic urban area. The highest concentrations of Cr, Pb, Ni and Mo in plant tissues were however detected in vegetables grown in rural environment, suggesting that uptake by plants was more affected by bioavailability than total HMs concentration in soil. Only Sb has been mainly accumulated by plants grown in urban soils. Overall, the lettuce grown in the different community gardens of Teresina can be considered safe for children's consumption, according to the assessed Health Risk Index. The study demonstrates that even when HMs contamination is relevant, agronomic strategies that allow to reduce their bioavailability and the uptake by plants (i.e. the addition of organic matter to the soil, or the adoption of simplified soilless system) may be an efficient tool for guaranteeing the absence of health risks.

Keywords: *Heavy metals, allotment gardens, urban agriculture, metalloids, health risk assessment*

Cadmium (Cd) and Nickel (Ni) Accumulation in Different Organs of Basil Plants

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Abstract

Basil (Ocinum basilicum) is one of the most common aromatic plant which is grown in urban environment, due to its aesthetic, nutritional and therapeutic value. However in many studies it is reported that basil accumulate high concentrations of heavy metals when irrigated with contaminated water or exposed to aerial pollution. This study aimed to investigate the heavy metals accumulation (Cd and Ni) in different plant organs (root, shoots, leaves) of basil plants grown for a short period in a greenhouse. For that reason, 33 basil potted plants were divided into three treatments groups where: a) two solutions of 250 mL contained 10 mg/L Cd(NO3)2 4H2O and 20 mg/L Ni(NO3)26H2O respectively were applied in nine plants per treatment every 2 weeks through irrigation, b) foliar application with 240mg CdO and 450mg NiO per plant was performed after plants transplanting in three plants per treatment and c) nine control plants were irrigated only with tap water. The results at the end of the experiment, indicated that: a) plants irrigated with Cd contaminated water, showed high Cd concentrations in leaves (257.02 mg/kg d.w.), while those irrigated with Ni condaminated water had the highest concentration of Ni in shoots (761.52 mg/kg d.w.); b) plants treated with heavy metals foliar application, presented high Cd concentration in new leaves (3722 mg/kg d.w.) while the highest concentration in Ni was measured in shoots (5237 mg/kg d.w.); c) control plants appeared high concentrations of Ni in shoots and leaves similar to those irrigated with Ni contaminated water. From the above it is resulted that basil plants can accumulate high amounts of Cd and Ni in shoots and leaves either through irrigation with contaminated water or by elements foliar deposition.

Keywords: *Heavy metals, pollution, aromatic plants, contaminated water, ornamental*

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Section VI: Plant functionality and stress in urban ecosystem

Invited speaker

Benefits of Applying Deficit Irrigation Strategies in Ornamental Plants

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Abstract

The application of deficit irrigation with different objectives has been widely studied in tree crops, less has been investigated in ornamental plants that grow in pots. Under these conditions it is more difficult to manage the desirable water deficit to achieve a good quality plant. This is due to the fact that the speed in the development of a certain stress is faster due to the amount of water available in the root zone is limited and because the substrates retain water at low tension, which can lead to sudden changes in humidity. Another aspect to consider is that not all the phenological phases of a plant are equally sensitive to the water deficit and have the same water use efficiency, which can have consequences on the quality and appearance of the plant. In this sense, the importance of factors such as the degree of water stress imposed, and the time and duration of the stress according to the species has been assessed. Thus, an acceptable level of deficit irrigation can produce beneficial effects such as more compact plants, earlier and greater intensity of flowering and an increase in the resistance of plants to environmental stresses. However, if the water restriction is too severe, the effects can be negative, such as a significant decrease in ornamental value, affecting the number of flowers, and even the death of the plant. Controlling the variables of water consumption, transpiration, stomatal regulation and level of hydration of the tissues in each phase is essential to change the irrigation amount and to understand the relationships between the absorption of water by the roots and other physiological processes. In addition, successive stress cycles can also induce acclimatization or hardening in plants before transplanting. This implies functional and structural adaptations, which include regulation of plant growth, osmotic adjustment, decreases in stomatal conductance and changes in the properties of the cell wall among others, which help to withstand the shock of plant transplantation.

Keywords: *Acclimatization, evapotranspiration, plant quality, root to shoot ratio, water stress*

Acknowledgments: This work was supported by MCIU/AEI/FEDER, UE [RTI2018-093997-B-100].

Section VI: Plant functionality and stress in urban ecosystem
Oral

Simulating the Impact of Nature-Based Solutions on Runoff Control by Using I-Tree Hydro+: A Case Study in Padova (Italy)

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Abstract

The progressive soil sealing in urbanized areas increases runoff due to surface imperviousness and leads the traditional drainage systems to a critical level, increasing flooding phenomena. The adoption of Nature-Based Solutions (NBS) can mitigate the risk of flood and increase territorial resilience to climate change. As part of the preparation of the Green Plan of the municipality of Padova (Italy), a simulation of the hydrological balance was carried out using i-Tree Hydro+ software to assess the effect of the increase of permeability due to inclusion of NBS. The potential for improving the infiltration capacity relative only to urbanized surfaces was estimated considering three types of NBS: rain garden, green roof and permeable pavement. The amount and the surfaces potentially improved with NBS have been calculated through the application of i-Tree Canopy. The simulation covered the years from 2014 to 2019. More precise analysis for an exceptional event that occurred in May of 2018, and an intense event that occurred in May of 2019, were conducted. Results show that the more effective in reducing runoff are rain gardens (about 50% on average); significant effect has been shown from the permeable pavements and the green roofs (about 41% and 30% on average, respectively). As the intense and exceptional events, results shows for the exceptional event a reduction of about 35% of the runoff with rain gardens, and about 27% and 17% respectively for permeable pavements and green roofs; whilst for the intense event the results are a reduction of about 41% with rain gardens, 36% with permeable pavements, and about 26% with green roofs.

Keywords: *Resilience, flooding, green infrastructures*

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A First Approach for Evaluation, Breeding and Promotion of Native to Greece Sage Species for Use as Landscape Plants

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Abstract

Following the current tendency for xeriscaping and considering the ecological, environmental, economical and aesthetic advantages of native plants, clones of native in Greece sage species were evaluated and interspecific crossings were performed. Aim was to obtain hybrids with floricultural characteristics sought on the international market of ornamental herbs, such as compact plant, abundant and prolonged flowering, drought tolerance and ease of growth. Salvia fruticosa and S. officinalis were crossed with S. pomifera spp. pomifera, S. ringens and S. tomentosa and each clone was used both as a pollen and seed parent for all crossings. Crossability was observed when S. officinalis and S. fruticosa were used either as seed or pollen parent, apart from the crosses in which they were used as pollen parent with S. ringens and S. pomifera. Hybrids with desirable characteristics were selected for further experimentation concerning photoperiod, substrate and fertilization, drought resistance in nursery culture and in a green roof. S. officinalis × S. ringens hybrids developed more and rather shorter shoots and grew faster under low water supply, while S. officinalis × S. tomentosa had longer shoots. Experiments on photoperiodism did not show a qualitative short- or long-day effect on flowering, while poor fertilization resulted to better growth. Seed germination of S. fruticosa and S. pomifera was up to 40 and 60% respectively at 10 and 15 ºC, whereas for S. officinalis, S. tomentosa and S. ringens germination was very low and further investigation is required. Propagation by cuttings was highly successful (70-100%) for all species and hybrids, excepting during summer when lower rooting rates were recorded (30-75%). As regards micropropagation, shoot multiplication was favored in MS medium with 0.4-0.8 mg L-1 BA and 0.01 mg L-1 NAA, and rooting in half-strength MS medium with 0.25-1.0 mg L-1 IBA. Plantlets acclimatized ex vitro at percentages higher than 80%.

Keywords: *Native Mediterranean xerophytes,* Salvia fruticosa, Salvia officinalis, Salvia pomifera, Salvia ringens, Salvia tomentosa

Section VI: Plant functionality and stress in urban ecosystem
Poster

The Effect of Alternating Irrigation with Fresh and Saline Water on the Growth and Water Relations of Hibiscus Plants

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Abstract

Applying saline water resources for irrigation ornamental plants is becoming a widespread practice in urban areas in many regions, but it can restrict plant growth and lead to environmental problems. A strategy to reduce the adverse effects of saline water irrigation is the alternate irrigation with fresh and saline water at different phases or different sides of the rooting zone, but this irrigation practice is still not well understood. In this experiment, 120 hibiscus plants (Hibiscus rosa-sinensis) were grown in a commercial substrate with the root system divided equally between two plastic pots (3L). Plants were subjected to three irrigation treatments lasting 6 months: control (both sides irrigated with freshwater, 0.8 dS m-1; F), a saline treatment (both sides irrigated with moderate saline water, 4.0 dS m-1; S) and a fresh-saline treatment (F-S). In F-S, during each irrigation time, half of the root system was irrigated with freshwater (0.8 dS m-1), while the remainder of the root system was irrigated with saline water (8 dS m-1). All the plants were irrigated daily to field capacity. Results showed that biomass accumulation was affected more by moderate saline treatment (S) than by alternating fresh and severe saline water (F-S), while plant height was reduced similarly in both treatments. Plants of F-S treatment were those with greater number of inflorescences per plant throughout the experiment. Both saline irrigation treatments induced active osmotic adjustment, especially plants with both sides of the root system irrigated with saline water. Saline treatment affected leaf color and relative chlorophyll content and induced an important decrease of biomass accumulation due to the leaf tissue dehydration and a high Cl and Na accumulation in the plant tissues. When alternating fresh and saline water irrigation (FS) was used, most of these responses were mitigated.

Keywords: *Salinity, ornamental plants, irrigation, root system, osmotic adjustment, ion uptake, flowering*

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An Appraisal on Adaptation to Xeric Environments of Tree and Shrub Species Through Wood Anatomical and Chemical Traits

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Abstract

Woody perennials are planted in streets, public recreation areas, landscapes and xeriscapes for their aesthetic quality, but also for coping with the need of environmental criticism mitigation in urban and peri-urban greening zones. The empirical knowledge on growth and physiological performances of species adapted to drought, frequently emphasises the importance of phenology, habitus and modifications of some tissues, especially at leaf level, to survive during arid periods occurring in Mediterranean areas. Despite the minor interest addressed to the adaptive nature of wood anatomy in the recent past, the study of structural aspects of xylem represents the first step in gaining knowledge of efficiency in water transport. The latter is also influenced by chemical composition of cell walls, thus lignin content and composition. Correlation between various wood anatomical traits and the environment, as well as between wood chemical features and ecological factors, have been revealed separately, whereas understanding if and how the interaction between anatomical and chemical characteristics of cell wall can affect and significantly constrain the whole- plant hydraulic conductance is less studied. The aim of this study was to characterise both anatomical and chemical features of one-year-old shoots of three species (Fraxinus ornus, Ostrya carpinifolia and Pistacia chinensis) to verify the occurrence of attributes favouring adaptation to xeric environments, being shoots the last connectors to leaves and thus influence conductivity.

Shoots were collected from greenhouse grown plants and processed for light, and epifluorescence microscopy, and digital image analysis allowing quantification of wood anatomical traits and occurrence of phenolic compounds in different tissues. Chemical analyses were performed to determine lignin content and composition. Microscopy observations showed that specific lignin composition was strictly linked to structural features. The overall interpretation of anatomical and chemical results allowed a better comprehension of functional traits providing some advantages in enduring drought without suffering permanent damages.

Keywords: *Drought, hydraulic conductance, phenolic compounds,* Fraxinus ornus *L.,* Ostrya carpinifolia *L.,* Pistacia chinensis *L.*

Evaluation of New Promising Hybrids of Greek Sage (Salvia Sp.) Species in Relation to their Growth

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Abstract

Hybridization is a tool of high conservation value being of high significance in introduction of new taxa, promoting the use of native plant species in modern landscape and enhancing genetic, species and ecosystem diversity. Therefore, research took place to investigate the possibility of using six new hybrids between Mediterranean sage species, aiming to obtain mother plants that could be used as plant-clones for horticultural use. The hybrids derived by interspecific crossings of four wild sage species found in Greece, i.e., Salvia officinalis, S. ringens, S. pomifera and S. tomentosa. Hybrids were evaluated as regards their growth in a greenhouse culture. Rooted cuttings, one-month old, were transplanted in two different peat- based substrates, i.e., peat mixed with wood fibre (PWF, pH 5.0-5.5), and PWF: perlite (1/1 v/v), in plastic pots. They were fertilized either once or four times per month with a water- soluble fertilizer (10N-3P-11K). The water had a pH of 5.9 and an EC of 2.3 dS•m–1. Plant growth was evaluated on a monthly basis for three months, recording the number of lateral shoots formed, and the length and node number of three lateral shoots. All hybrids had vigour growth without any effect of substrate type and irrigation schedule. The two S. officinalis × S. tomentosa hybrids tested had similar plant growth between them while they had longer with more nodes shoots compared to all other hybrids. One out of the two S. officinalis × S. ringens hybrids tested had more compact growth due to shorter and slightly more laterals compared to all other hybrids, and more laterals developed the second hybrid from the same parental species as well. All six hybrids were promising for use in the Mediterranean landscape.

Keywords: *Fertilization, modern landscape, native xerophytic ornamentals, plant breeding, substrate*

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Effect of Cutting Type and Indole Butyric Acid on Propagation of *Salvia fruticosa* with Cuttings

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Abstract

The effect of cutting origin and application method and concentration of indole-3-butyric acid (IBA) on rooting stem cuttings of Salvia fruticosa Mill (f. Lamiaceae), was investigated, aiming to find the most effective rooting method that could enhance its potential use in floriculture industry. Apical and basal cuttings (10-12 cm long) were collected from annual shoots in early May. They were treated either with dusting powder for soft wood cuttings Rhizopon (0.5% w/w IBA) or their bases were dipped for 1 min in solution IBA (50% ethanol) with concentration 0 (control) or 500 or 1500 or 3000 or 4500 mg L-1 and were placed for rooting on peat-perlite 1:1 (v/v) in a mist for 2 weeks. Then, they remained on the greenhouse bench in a semi-shaded location for another 4 weeks. Regarding cuttings from greenhouse mother plants, apical ones rooted at higher percentage (80%) than the basal cuttings (60%), both after treatment with IBA powder. The highest fresh and dry stem weight values and fresh root weights were obtained after treatment with IBA power. On the other hand, basal cuttings from native mother plants rooted at 80%, the higher rooting percentage of terminal cuttings reducing at 55%, at 4500 mg L-1 IBA. The use of IBA powder led to high fresh and dry stem and root weight, but reduced rooting percentages of basal cuttings to 50%. As regards time needed for rooting, cuttings from greenhouse plants reached their highest rooting percentage faster (in two weeks) than cuttings from native plants, which required four weeks. So, an effective method for commercial propagation of Salvia fruticosa, that would enhance use of desirable clones in xeriscaping, could involve the use of greenhouse grown mother plants, by apical cuttings and their treatment with IBA powder for soft wood cuttings.

Keywords: *IBA, apical cuttings, rooting, native xerophytic ornamentals*

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Adopting Nature-Based Solutions to Cope with Flooding Phenomena: The Partecipatory Approach of the Life Beware Project

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Abstract

The LIFE Beware Project addresses the problem of the increase in flooding phenomena that has been registered in Italy and many other Countries due to climate change. Started in 2018, it proposes an integrated multiple approach aimed at adopting Nature-based solutions (NBS) to mitigate the risk of flood and increase territorial resilience to climate change with: i) information and raising awareness activities involving multiple stakeholders at the local, national and international level; ii) participatory processes for the involvement of the local communities in the development of effective public policies to mitigate the risk of flood in the Altovicentino area (North-east Italy); iii) support to citizens interested in adopting sustainable water retention, infiltration and storage measures; iv) training and educational processes targeting professionals, technicians and students; iv) networking and replicability activities to multiply the impact of the generated good practices and increase the sustainability of the project actions. The core element of the project is its participatory approach, made by different actions that aim at the involvement of citizens, farmers, professionals and stakeholders, together with information, diffusion, educational activities (i.e. conferences cycle and events) from primary schools to University masters, training initiatives at local, national and international level (webinars, publications). Several raising awareness and knowledge dissemination activities have been organized to boost citizens' active involvement as it is the case of the conferences' cycle, with national and international experts in climate change and resilience, the School of Common Goods to increase citizens' knowledge about the concept of "common goods" and reflect about the challenges faced by the territory of the Altovicentino, the set of educational activities for students and teachers to have an impact on the youngest generation and improve their knowledge and awareness about climate change, with a specific focus on the cycle of water and sustainable hydraulic management. Furthermore, through the hydraulic restoration tour, the visitors, students, schools and citizens have the opportunity to discover and visit the different measures that can be implemented to mitigate the flood risk in urban and rural areas. The project proposes a direct support to those citizens who are interested in investing in small water retention and storage measures through the creation of a help desk and the activation of a purchasing group for NBS.

Keywords: *Resilience, education activities, citizens*

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The Suitability of De-Inked Paper Sludge as Growing Media Amendment for Ornamental Potting Plants

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Abstract

Paper industry produces tons of de-inked paper sludge (DPS) with high disposal costs and negative impacts for the environment. The recycling of DPS in growing media for ornamental plants could be a sustainable strategy to reduce greenhouses gases and improve soil properties, in a circular economy prospective. For this purpose, Primula obconica, Viola x wittrockiana Cool Wave Frost and Dianthus caryophyllus were grown in control (commercial gardening), 30% S, 50% S and 50% P (S=sludge, P=pelletised sludge) growing media. The substrates were analysed in terms of chemical properties (pH, electrical conductivity, and nutrient elements); plant growth (n of flowers, biomass) and the photosynthetic parameters (total chlorophyll index SPAD and electron transport rate ETR) were measured. The substrates containing 30% S, 50% S and 50% P had lower conductivity than control; 30% S had similar values of exchangeable nutrients (Mn, Ni and Mg) to control. After 4 months of growing, Primula showed a reduced number of flowers in all substrates with DPS, and Viola produced the same number of flowers in the 30% S substrate and in the control. Dianthus did not show significant difference as flower numbers in all substrates. The shoot biomass decreased in Primula and Viola growing in substrates containing DPS associated with a reduction of photosynthetic ETR, while Dianthus had similar values for shoot biomass and ETR in all substrates. Primula reduced the total chlorophyll index in DPS substrates, except for 30% S, while Viola and Dianthus did not show significant difference amongst substrates. The growing media composed of 30% S resulted the most suitable for plant growth and amongst tested ornamental plants, Dianthus positively responded to the amendment with DPS.

Keywords: *Chlorophyll content, nutrients, photochemical efficiency, pot plants, substrates*

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Impact of Mulch on Tree Caliper and Root Characteristics of Four Species of Drought- Resistant Landscape Trees

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Abstract

Trunk caliper and root characteristics of four species of drought-resistant landscape trees (Pistacia 'Red Push', Parkinsonia x 'Desert Museum', Chilopsis linearis 'Bubba', and Prosopis glandulosa 'Maverick') maintained under a 7.6 cm layer of organic mulch were compared to no mulch controls. Trees transplanted from 57 L containers were planted on 6.1 m centers in a randomized complete block design at Chino Basin Water Conservation District in inland Southern California October 2016. Trees were irrigated with recycled water at 80% reference evapotranspiration (ETo) for one year which was reduced to 50% ETo through May 2020 when irrigation ceased for the remaining 15 months of the study. Trunk circumference at 15.2 cm and 91.4 cm above ground were recorded quarterly and root systems were characterized in July 2021 using non-destructive ground penetrating radar. Mulch had no effect on trunk caliper of Parkinsonia x 'Desert Museum' while differences among other species were significant.

Keywords: *Mulch, drought, root growth, ground penetrating radar, landscape, trees, root characteristics, California*

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Growth of Aromatic and Ornamental Species in Sods for Different Gardening Uses

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Abstract

The implantation of fully developed and rooted live plant sods for different uses in gardening provides great economic, technical and time advantages. Therefore, studying attractive species that can be adapted to this use is crucial to improve the quality of green roofs, the regeneration of slopes or simply the appearance of conventional gardens. The aim of this work has been to compare the growth speed — the capacity to cover the surface and to form stable structures of sod — of different aromatic and ornamental species (peppermint, thyme, oregano, helicrysum, soleirolia and lysimachia). Two substrates of different characteristics and two coconut fiber blankets of different weight were also compared as a support. The sod structures were elaborated on a metallic mesh to ensure good drainage. They consist of coconut blanket, substrate and cuttings of the different species, which were inserted without using growth hormones. The test began in June, under greenhouse conditions, and lasted for 6 months. Photographs were taken periodically to evaluate the foliar coverage, and the weight of plant aerial and root biomass were measured at the end of the trial. The species that showed the best foliar coverage at the end of the trial after 6 months of growth were lysimaquia, peppermint and soleirolia, reaching in average terms coverage greater than 75% of the substrate surface. This was confirmed by the dry weight values of the aerial part also at the end of the assay. In general there were no significant differences in the growth of the species regarding the different materials used as substrates or the different blanket thicknesses. It should be noted that the foliar coverage of most of the species began to decrease once the colder months of autumn entered.

Keywords: *Green ground cover, foliar coverage, cuttings, oregano, peppermint, thymus*

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Establishment of Five New Hybrids of Mediterranean Sage Species (Salvia Sp.) on an Urban Green Roof, as Affected by Irrigation Frequency

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Abstract

This study investigated the effect of irrigation frequency on establishment of five new hybrids of sage (Salvia) species native to Greece (Salvia fruticosa, S. officinalis, S. pomifera ssp. pomifera, S. tomentosa and S. ringens) on an urban Mediterranean green roof, aiming to evaluate their drought tolerance. Rooted cuttings were planted in April 2021 in plastic containers with a green roof infrastructure fitted (moisture retention and protection of the insulation mat, drainage layer and filter sheet) and placed on a second floor roof. The substrate used was grape marc compost: perlite: pumice (3: 3: 4, v/v) and had 10 cm depth. Two irrigation frequencies were applied, starting from every 3 days (normal) and 5 days (sparse) and followed (after the end of May) by every 2 and 4 days, respectively. Two months after planting all plants had survived. The type of hybrid affected all growth parameters, whereas irrigation frequency affected only plant diameter and total axillary shoot length. Plants irrigated normally had greater diameter (19.2-24.8 cm) and greater total axillary shoot length (32.4-180.8 cm), compared to those irrigated sparsely. Hybrids S. officinalis x S. tomentosa and S. pomifera x S. ringens had shorter foliage height (10.5-12.5 cm) than the others (20.6-24.5 cm), but when height of the inflorescences was included, S. pomifera x S. ringens was the tallest of all (90.0 cm). Hybrids S. officinalis x S. pomifera and S. officinalis x S. tomentosa had the greatest diameter (24.5 cm), when irrigated normally, while they produced more axillary shoots (14.4-18.3) of greater total length (126.4-180.8 cm) too. Only in hybrids S. officinalis x S. tomentosa and S. pomifera x S. ringens, almost all plants flowered producing 5-10 flowering shoots per plant, whereas in others, 16.7-75% of plants flowered producing 1.0-2.2 flowering shoots per plant.

Keywords: *Green roof technology, native xerophytic ornamentals, salvia hybrids, water stress, soilless substrate, grape marc compost, pumice*

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Interspecific Crossability as a Mean to Improve Mediterranean Sage Species with Ornamental Value

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Abstract

Interspecific hybridization is a common and important evolutionary mechanism in plants, which is used by plant breeders in order to create new plant forms or broaden genetic variability. Aim of the present study was, through the proposed crossings, to utilize particular characteristics of five Salvia species native to Greece, such as the bright flower color of S. pomifera spp. pomifera, the rich early flowering of S. fruticosa, the low height of S. ringens and S. tomentosa, the minimum water requirements of S. pomifera and S. fruticosa, in order to obtain hybrids with desirable ornamental and commercial characteristics. S. officinalis and S. fruticosa were not crossed with each other, because there have already been several hybrids of them in the market. So, selected clones of these two species were crossed with selected clones of the other three species. Each clone was used both as a pollen and seed parent for all crossings. For each crossing 100 flowers were fertilized in order to estimate the effectiveness of fertilization. In spring 2019 and 2020, S. officinalis was crossed with S. pomifera spp. pomifera, S. ringens and S. tomentosa. Crossability was observed at lower percentage (5-7%) in these three combinations compared to self-crossing (80%), when S. officinalis was used as seed parent, but was unsuccessful when it was used as pollen parent. In spring 2020, S. fruticosa was also crossed with the other three species. When S. fruticosa was used as seed parent, crosses with S. ringens and S. tomentosa were more successful (19% and 28%, respectively) than those with S. pomifera (8%). When S. fruticosa was used as pollen parent, only the cross S. tomentosa × S. fruticosa was feasible. Produced seeds were sown and hybrids with desirable characteristics were selected for further experimentation.

Keywords: Salvia fruticosa, Salvia officinalis, Salvia pomifera, Salvia ringens, Salvia tomentosa, *native Mediterranean xerophytes,* Salvia *hybrids*

Evaluation of Giant Granadilla Accessions in a Pergola System

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Abstract

Passiflora quadrangularis is a vine plant used as a fruit crop and as an ornamental. Various parts of the plant are reputed to have natural substances that support human health for conditions such as asthma, diabetes, hypertension, osteoarthritis, cancer, and inflammation. Its potential for several purposes has increased the interest in its consumption and its production as an organized crop in rural areas for marketing and for household use. It can also be grown in urban areas for its fruits, as well as ornamental and/or medicinal uses. In Puerto Rico, there has been little research with this plant. A study was conducted in Puerto Rico to assess three accessions of Passiflora quadrangularis in a pergola system in a periurban setting. The accessions, designated "PR-A", "PR-B", and "PR-C", were collected in western Puerto Rico, cloning three mother plants by stem cuttings. The resulting plants were established in a pergola structure in a complete randomized block design with three replications and 12 plants per accession. Growth rate, biomass accumulation, leaf area, greenness, fruit productivity, and attractiveness as ornamentals were evaluated. Among the three accessions, 'PR-A' had the greatest growth rate, biomass accumulation and productivity. 'PR-B' had greater leaf area values than 'PR-A'. In contrast, 'PR-C' had the lowest values for all those variables. 'PR-A' and 'PR-B' were comparable in leaf greenness, and 'PR-C' was paler. Scores for attractiveness were similar for the three accessions, as some people prefer paler plants and others prefer leaves with a darker green, and some prefer denser canopies and other prefer more space foliage. 'PR-C' may be a good accession for urban areas with less space for growth and where high fruit yield may not be the main factor. 'PR-A' and 'PR-B' seem more suitable for commercial plantings, or for urban areas where large plants can be accommodated or pruned more frequently to confine them to a determined area.

Keywords: Passiflora quadrangularis*; tropical horticulture*

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Avocado Tree Growth and Fruit Yield in Response to Nitrogen Fertilization Regimens in Urban Ecosystem

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Abstract

In many countries in the tropics and subtropics, avocado (Persea americana) is an important fruit tree for backyards, gardens, and organized commercial orchards. The avocado fruit is used in many dishes, and it is rich in minerals, vitamins, phytosterols and unsaturated fats. The leaves contain quercetin and polyphenols, among other substances, and are used in herbalist treatments for high blood pressure, diabetes, kidney stones, inflammation, and pain. In Puerto Rico, many households in urban and rural areas have and avocado tree in their yard. Moreover, avocado is one of the top fruit crops grown commercially in the island. Nitrogen (N) is an essential nutrient for plants, and its application to crops in urban and rural areas may have a large impact on tree growth and yield, as well as in the environment. An experiment was performed in a periurban location in southwestern Puerto Rico to determine the effects rates and distribution of N fertilizer during the production cycle. 'Butler' avocado trees growing in an open field were fertilized with 12 N regimens. The regimens (treatments) differed in the amount of N applied per tree annually and the times of the year N was applied. All other nutrients were applied as needed based on results of laboratory analysis. Trees fertilized with lower rates of N and/or with less frequent applications tended to be smaller and to have lower fruit yields. In comparison, tree size and fruit yield tended to be greater when N applications were more frequent and at higher rates. Fruit yield was positively correlated to fruit number, as fruit size was not significantly affected by N regimens. From a horticultural viewpoint, these results indicate that in urban areas avocado tree size may be managed to be larger or smaller by choosing different N fertilization regimens, knowing that fruit yield may be affected by the choice. Similarly, from a horticultural point of view, larger fruit yield may be achieved with some N fertilization regimens in commercial avocado orchards. In urban situations and in commercial orchards, tree managers need to heed the environmental concerns and regulations related to potential N pollution, and must also calculate the costs of purchase and application of N to determine the feasibility of using either more restraint or more rate- and frequency-intensive N fertilization regimens in avocado.

Keywords: *'Butler' avocado, Urban horticulture*

Seed Germination of Five Sage Species (Salvia Sp.) of Native to Greece Populations

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Abstract

In the present study, the effect of seed pretreatment and incubation temperature, on seed germination rate of five Mediterranean sage species Salvia fruticosa, S. officinalis, S. pomifera, S. ringens and S. tomentosa was examined. Seeds of all five species were collected from native populations in August 2019 and stored at room conditions, in darkness, for 5 months. The seeds were placed for germination, either without pretreatment (control) or after chemical surface scarification, by immersion in dense H2SO4 for 15 min. The seeds were incubated at constant temperatures of 10, 15, 20 and 25 oC, under darkness. Two different substrate types were used, peat: perlite substrate, 1: 1 v/v and filter paper moistened with water, in Petri dishes. In S. fruticosa, higher seed germination rates were observed in peat: perlite substrate at temperatures of 10 and 15 oC, without seed pretreatment (33% and 23% respectively), while same trend was observed in Petri dishes. In S. pomifera high seed germination rates were observed in peat: perlite substrate at temperatures of 10, 15 and 20 oC, without seed pretreatment (45%, 38% and 43% respectively). At 25 °C S. fruticosa and S. pomifera seed germination was very low (0-6%) under all treatments. In the other three species very low germination rates (< 13%) were generally observed under all treatments. In conclusion, lower temperatures of 10 and 15 oC had a favorable effect on seed germination of S. fruticosa and S. pomifera, whereas in S. officinalis, S. tomentosa and S. ringens further investigation is required. Generally, it was observed that both on peat: perlite sustrates and Petri dishes, seed germination was improved for seeds that were not pretreated with chemical scarification.

Keywords: *Seed pretreatment, incubation temperature, chemical scarification, native xerophytic ornamentals, Mediterranean xerophytes*

Breeding of New Tulipa Cultivar through Interspecific Hybridization between Tulip Variety 'Bolroyal Dream' and Tulipa Altaica

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Abstract

Interspecific hybridization is an important method in plant breeding for improving modern cultivars introducing traits from wild species. In our study, the interspecific hybridization was performed between tulip cultivar ('Bolroyal Dream') and wild species (Tulipa altaica). A total of 102 hybrid seeds were obtained from the interspecific hybridization cross in 2004 and 18 surviving seedlings flowered in 2009. The best promising breeding line (Code No. 2004-16-08) was evaluated and named 'Zhao Xia' in 2018. The new cultivar 'Zhao Xia' has more attractive and smaller flowers than T. altaica and 'Bolroyal Dream', respectively. 'Zhao Xia' had a little earlier florescence than 'Bolroyal Dream' in Shenyang city. In conclusion, 'Zhao Xia' is a promising new tulip cultivar in Northeastern China with novel flower color and shape.

Keywords: Tulipa *spp., Interspecific Hybridization, breeding, cultivar*

Ll002 Treatments Delayed Drought Stress Symptoms in Turf: From Pot to Plot

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Abstract

Lawns are subjected by increasing water deficit during the summer period. In this context, the use of biostimulants is often encouraged to increase turf resistance against drought and heat stress. Biostimulants are products that, in small quantities, can stimulate plant growth and increase stress tolerance. The aim of this study (funded by EU Project LIFE18 ENV/NL/000043 Plants for Plants) was to test an innovative product in the biostimulant world, a completely characterized, standardized and optimized plant derived product. LL002 is part of the bigger Plant for Plants® family of products, and is specifically tailored to increase drought stress tolerance. The first trial was performed in turf grown in pots. Three treatments were performed before the start of drought stress (maintenance of 33% of field capacity). After the drought stress, a recovery was performed. The second trial was performed in microplots under tunnel. The drought stress was imposed after two applications, as reduction of irrigation. Treatments with LL002 delayed drought symptoms in both trials and was able to induce a better turf health status in critical conditions. In pots, treatments induced a delay in the wilting appearance and a lower % of dry area. Moreover, they induced a lower decrease in photosynthetic efficiency. The trial on microplots showed that plots treated with LL002 have reduced impact of stress, in particular in the first weeks, as seen by a slower drop of living ground cover, Turf Quality and NDVI. In conclusion, tools such as biostimulants, directly targeting the plants physiology without impacting the environment, are becoming of growing interest. The prototype LL002 proved to be an efficient tool to delay the appearance of negative symptoms generated by water deficiency on turf, in particular in the first weeks after the onset of drought stress both in pots and in field conditions.

Keywords: *Biostimulants, lawn, plant extract*

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Can be Used Pedoclimatic Needs as a Marker for Ornamental Plant Selection in Mediterranean Area?

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Abstract

The choice of plant species represents a key point in the design of green spaces, especially in the environments where abiotic stresses are frequent, such as the areas of the Mediterranean Basin. In this frame, the aim of this work was to understand if, and to what extent, the definition of soil and climatic plant requirements could help in the choice of suitable plant species. In particular, on 150 plant species, which had a frequency of more than 10% in historical and/or traditional Sicilian gardens, we adopted specific codes to indicate the pedoclimatic requirements, to calculate the relative frequency of the different parameters that expressed the biological and cultivation characteristics of these species. The suitability of the plant species was confirmed by the analytical determination of the soil and climatic requirements and especially of the traits most associated with a positive response to sub-optimal conditions. The categorization of these requirements has allowed us to analyze their frequency. The analysis of the pedoclimatic requirement frequencies showed a biological frame dominated by wood species, often rather rustic, able to adapt to the abiotic conditions and stresses, in particular drought stress, typical of the Mediterranean environment. In future, the research activities will carry out to consider morpho-anatomical (leaf structure, stomata characteristics and positions, etc.), physiological (gas exchanges, chlorophyll a fluorescence, etc.), and even molecular (identification of drought-associated traits) parameters. All these traits, of fundamental importance for the success of the garden realization, especially in more stressful environments, can be used to allow a rational choice of plant species, and overcome the sole criteria of aesthetic parameters until now used to carry out a very important decision for the success of the establishment of green areas.

Keywords*: Historical gardens; Mediterranean basin; biological characteristics; woody species.*

Section V: Impact of the anthropic activities: Interaction and synergies - Oral

An Assessment of Mechanical Pest Control Methods in an Urban Landscape

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Abstract

Pests in urban environments offer many control challenges, especially when managers need to balance effective control methods while having minimal impact on non-target arthropods. In the southern U.S., crepe myrtle bark scale (CMBS) (Acanthococcus lagerstroemiae) has become an important pest of crepe myrtle (CM) (Lagerstroemia indica). CMBS is best controlled using insecticidal drenches. Unfortunately, CM is a major pollen source for honeybees, and plants translocate sufficient active ingredient to the pollen to cause acute and chronic effects to individual bees and the hive. In 2019 and 2020, 24 existing CM, all with confirmed CMBS infestations, were divided into four blocks and assigned to one of four treatments: no treatment, dinotefuran drench, power wash, and scrub with a soft bristled brush and soapy water. Mechanical cleanings were conducted in February, and dinotefuran drench was applied in Mar 2019 and May 2020. Plants were scored from June to September using a 0-10 scale for both CMBS and sooty mold, with 0 indicating the complete absence of CMBS or sooty mold and 10 a complete infestation. During year one, treated and untreated plants had similar CMBS and sooty mold scores, likely due to natural bark loss and abundance of predatory insects. In year two, dinotefuran, brush, and power wash treated plants had lower CMBS (1.0, 0.1, and 1.3) and sooty mold scores (0.8, 0.0, and 0.6) than the untreated control (4.0, 2.8) in July. In September, the dinotefuran treatment scores remained better than the untreated control, but the mechanical treatment benefits had lessened, and scores could not be separated from either the chemical treatment or the untreated control. Mechanical controls appear to provide immediate benefits, and the control provided may be satisfactory. However, the efficacy and longevity of control is dependent upon the fecundity of the target pest.

Keywords: *Crepe myrtle, Lagerstroemia, crepe myrtle bark scale, Acanthococcus, dinotefuran, neonicotinoids*

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Commonplace or Commonly Replaced? Presence and Population Distribution of *Balsamorhiza hookeri* Var. *Hispidata* in Utah Compared to Historic Records

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Abstract

As the Great Basin region of the Western United States becomes warmer and drier, human communities and natural ecosystems are impacted by drought. Strategies to save water become increasingly relevant. Governments and water conservancy districts emphasize reducing water usage in landscaping. Practices like xeriscaping and "Localscaping" focus on creating landscapes that have aesthetic appeal while reducing water requirements. Using native plants adapted to climate conditions is another water-saving strategy, yet native plants are currently not widely used in designing Great Basin landscapes. Balsamorhiza hookeri var. hispidata (Hooker's balsamroot) is a beautiful flowering-perennial with bright yellow flowers that bloom in early spring. It formerly grew widely throughout low-elevation mountain areas, foothills, and valleys where urban development exists today. In addition to potential landscaping applications, Balsamorhiza species are relevant to the conservation and restoration of sage-brush steppe communities which they frequently inhabit. This study seeks to investigate current distribution of B. hookeri var. hispidata in order to understand how this distribution differs from historic records. We hypothesize that due to anthropogenic change, the plant no longer occupies many locations where it has grown in the past. A historical dataset (1877-2000) of species population locations in Utah, USA was created using Intermoutainbiota, an online database of herbarium specimens created by SEINet, the regional network of North American Herbaria. Using GoogleEarth and in-person field observations, we were able to a) determine if locations were currently natural or developed land areas b) observe if B, hookeri was now present or absent in the location and c) to make observations regarding site conditions where the plant was formerly but not currently observed (i.e. if the land was privatized, inhabited by invasive species, or used for grazing). Of the 48 observations included in the dataset, the presence of Hookeri was confirmed at 4 locations. Hooker's balsamroot was no longer observed at 13 points because of urban development. In at least 15 sites considered natural areas where B. hookeri was not found, there was an abundance of invasive species which could outcompete native populations or evidence of impact from grazing. These findings paint a telling picture of the displacement of a plant that was seemingly once common. Balsamorhiza hookeri var. hispidata has a role to play in our native plant communities and has the potential to be incorporated as a beautiful water-saving perennial in man-built landscapes, as evidenced by the abundantly reported previous distribution. However, the plant is currently absent in many of locations where it previously grew limiting available germplasm for use as a resource in both natural and manmade landscapes.

Keywords: *Native plants, climate change, drought tolerant landscape plants, urban development, displacement*

International student competition Urbanfarm

Invited speaker

The International Student Competition Urbanfarm: Results from Three Years of the Challenge

Giuseppina Pennisi*, Emanuele Durante, Roberta D'Ercole, Laura Carotti, Giorgio Gianquinto, Francesco Orsini

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Abstract

Student challenges are becoming a paramount testing ground for the application of a number of innovative educational methodologies. Design thinking/case study, inquiry-based learning, project-based learning, gamification and distance learning are catching on in education systems around the world, enhancing students' ability to retain information and acquire new skills. The International Student Challenge "UrbanFarm", organized by the University of Bologna, has been an important opportunity to put these methodologies in place and observe and study their effects on students' learning process. Multidisciplinary student teams, with members from different Universities from all around the world, were asked to deliver innovative urban agricultural project proposals for the recovery of abandoned/vacant urban sites, by integrating architectural and technological innovations while pursuing social, environmental and economic sustainability. At present, while there are several international student challenges fostering student growth worldwide, and some follow-up surveys to assess their effect on participants were designed, disseminated and eventually analyzed, there is a lack of scientific work addressing the real outcomes of such challenges. The hereby study aims to quantitatively assess how participation in UrbanFarm Challenge has affected students' acquisition of new information, their ability to work within a multidisciplinary and international team, along with their future job perspectives. Furthermore, the study also assess how the student's experience in the Challenge was affected by the ongoing pandemics. Data are collected through an online survey circulated both to students from Universities worldwide, including both UrbanFarm participants of all three editions (2019, 2020 and 2021) and other students that did not participate in UrbanFarm.

Keywords: *Urban farming; student challenge; innovative education methodologies; survey analysis*

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International student competition Urbanfarm
Project presentation

From Siapa to Siepe: Urban Farming as a Social and Environmental Sustainability Tool for the Vacant Industrial Land of Galliera, Bologna

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Abstract

The international university challenge UrbanFarm2020 called upon students from several countries to form interdisciplinary teams working on innovative solutions for the regeneration of three abandoned industrial areas. The Hop-E team with its SIEPE project (Sustainability, Inclusion, Energy, Production, Environment) addressed the renovation of the Ex-SIAPA (Società Italo Americana Prodotti Antiparassitari), a vacant industrial site in the town of Galliera (Bologna). The project proposal aims at restoring the once town's engine by fostering sustainable economic, cultural and social growth through soil-less agriculture and circular economy tools. After a theoretical site assessment supported by data gathering and site analysis, green smart interventions are proposed to attain SDGs.Producing food in a polluted environment is approached by soil-less technology, taking place both indoor (intensive, targeted, and efficient) and outdoor (towards an agro-ecological approach). Vertical farm units are designed as embedded elements into a purposely retrofitted architecture. Among the innovations, a focus is given to the hydroponic cultivation of Hop Humulus Lupulus. The aquaponics production model integrates with a native fish reintroduction programme. Planning also involves recreational, therapeutic and educational gardens and a student greenhouse as a farming experimentation area. Nonetheless, soil reclamation is needed. Therefore, differentiated phytoremediation treatments have been chosen and integrated within a green corridor that attracts and nourishes biodiversity. The project then calls for further interventions to reduce water and CO2 footprint and implement on-site energy production, with a business model based on an iterative process. In contrast with an old view of exploitation and consequent abandonment that historically marked out western industrial areas, this project creates an opportunity to restore the identity and the dignity of a place, envisioning entrepreneurial activities and the engagement of students, locals, immigrants, and people that society left behind.

Keywords: *Urban farming, international university challenge, sustainability, vacant industrial land recovery, circular economy, soil-less agriculture*

Participating in International Student Competitions and Opening a Tartup Firm: The Case of Aquaponic Design

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Abstract

In the short term, a greater role will be played by cities in the decisive shift to create more resilient communities. Aquaponic Design® wants to be part of this shift through the design and construction of modular, customizable urban aquaponic systems, promoting public awareness on environmental issues, particularly as they relate to food production and distribution. Aquaponic design was born in 2018 from the joint effort of 3 students from the University of Bologna who first met in the framework of the international student challenge UrbanFarm. The passion for aquaponics and the desire to work as a team led them in September 2019 to establish the association Aquaponic Design a.p.s. To date they have organized and carried out several training courses with schools and individuals involving about 200 people, they have also designed and built dozens of aquaponic systems throughout Italy and manage the first Italian You Tube channel that delivers webinars about aquaponics and urban agriculture with more than 7'000 subscribers. Aquaponic Design is currently on its way to become a Spin Off of the University of Bologna, focusing their business model on the design of plants, the sale of materials and customizable consulting services. In this study, the different steps (from taking part in international design contests to prototype development, implementation and testing) that led Aquaponic Design to rapidly become a reference in the sector are analyzed, also assessing the impact of their diversified dissemination and communication activities, to serve as a reference and model for future urban agriculture entrepreneurs.

Keywords: *Urban agriculture; City farming; Aquaponics; Sustainability; Business model*

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Nurturing the Soul at the Urban Garden: A Project for Salus Space, Bologna, Italy

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Abstract

From march 2020, the lockdown associated with the ongoing pandemic has constrained the lives of many within their houses or neighborhoods. As a consequence, a greater awareness on the need to redesign urban spaces to make them more socially, economically and environmentally sustainable has evolved in civil society. The international student challenge UrbanFarm aims at rethinking vacant urban spaces, turning them into places for social innovation and food production. During the UrbanFarm2021 edition, the team Soul Farmers developed a project for Salus Space, a multifunctional hub in Savena district, Bologna. The main goal was to create a urban farm that could foster wellbeing and social inclusion while integrating innovative technologies. The project objectives toward the three pillars of sustainability are hereby presented. Social sustainability was addressed through tailored programs involving people who suffer from cyber-addiction. Accordingly, integrated landscape elements were designed to allow residents and visitors to reconnect with themselves and the environment, also through active involvement in leisure and educational activities. The environmental sustainability also plays a key role in the project, thanks to the cultivation of a diversified range of plant species (from traditional vegetables to new and exotic crops, e.g., ginger and aromatics), as well as the inclusion of innovative growing systems (e.g. a rooftop greenhouse equipped with hydroponics, and a vertical farm inside a shipping container). Alongside, animal proteins are produced inside a versatile insect farm solution. Rainwater collection systems and constructed wetlands have been designed to recover water and ensure its efficient use. Furthermore, an integrated solid waste management system has been developed to recycle waste. Overall, the use of sustainable materials in construction and the minimization of the carbon footprint were the driving principles for the built elements. Finally, the project economic sustainability is tackled by a diversified set of income sources associated with a number of activities, toward the principles of circular economy.

Keywords: *Urban farm, well-being, cyber-addiction, hydroponics, insect farm, urban viability, urban landscape, biogas, constructed wetlands, integrated solid waste management system*

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AGRiS: Agriculture, Growth and Regeneration Inspired by Sustainability

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Abstract

Urban agriculture (UA) is sprouting up in the empty spaces of post-industrial landscapes, such as vacant lots, warehouses, urban parks. UA not only represents an opportunity to improve local food supplies and economies, but also to foster social integration and environmental sustainability. The project AGRiS (winner of the UrbanFarm2021 competition) has been developed for Troisi Park in Naples, Italy, an urban park wherein an agricultural area spanning 0.5 ha (hosting 4 greenhouses and 2 open spaces) is currently abandoned and in need of renovation. Following a multi-disciplinary design approach, UA was chosen to support the environmental, social, economic, and cultural well-being of the local community. To create a design solution which was feasible and economically sustainable both in the short- and long-term, an incremental approach was proposed, building on a multi-criteria analysis to select the most preferable project scenario in which to invest the initial funding. The environmental impact of AGRiS was considered by assessing the energy demand, water usage, and emissions associated with facility operations. Additionally, renewable energy sources, rainwater collection, and zero-waste strategies were integrated to minimize resource/material inputs and waste outputs. The design also incorporated sustainable crop production practices which promote biodiversity, such as crop rotation and intercropping, compost for fertilization, recyclable growing-media, organic pest management and seed-to-seed cycles. Moreover, the architectural elements of the design were conceived from a circular-economy perspective, and relied on the participation and feedback of project stakeholders. The social sustainability of the design was addressed by collecting informal feedback through surveys, distributed among local residents through social media networks. The 720 responses received from the polls were overwhelmingly positive and indicated a strong desire within the community for social revival to be realized through the AGRiS project. The strong emphasis on feasibility and community involvement suggested that this UA project in Troisi Park is readily achievable, and could also serve as a model for similar sites in need of renovation.

Keywords: *Urban agriculture, sustainability, multi-criteria analysis, local communities, participatory design, sustainable architecture*

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The Bright Side of Vertical Farming: First Experimental Experience at AlmaVFarm

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Abstract
Vertical farming with artificial light represents a great opportunity for producing high quality crops with elevate yield in the urban environment. On the other hand, there are several challenges that impact on performance and feasibility of vertical farming, hindering to date its large-scale uptake. Bringing together complementary and interdisciplinary expertise is critical to address these challenges. In the framework of the EU Project "Food systems in European Cities – FoodE" (H2020-862663), AlmaVFarm, an experimental vertical farm dedicated to research and dissemination activities has been realized at the University of Bologna. AlmaVFarm is equipped with different technologies including: two growing systems (ebb-and-flow and aeroponic) and dimmable LEDs lights, allowing the modulation of light parameters: intensity, spectrum and photoperiod. To introduce students to this technology and management requirements, a participatory activity has been organized within the Master degree in Agricultural Sciences and Technologies. Students were asked to design a light spectrum for growing lettuce (Lactuca sativa var. Canasta) in aeroponic or hydroponic systems and to evaluate the effects of light treatments on the crop, taking into account the final yield and morphological parameters. The aim of the work was to encourage students to get familiar with the management of an indoor farming experimental trial focusing attention on the management of light, an aspect that requires high optimization. The activity carried out consists of 4 different phases: 1) design of the light spectrum based on the analysis of the literature, 2) management of the growth cycle, 3) data collection and 4) analysis of the data and presentation of the results. With exception for the spectrum, designed by the student teams, all other light (intensity, photoperiod) and environmental parameters (temperature, humidity, CO2) were constant. Some teams worked on the ebb-and-flow hydroponics, others on the aeroponics and in both growing systems a control treatment (red and blue spectrum with R:B ratio of 3) was included. While for data collection students were highly supported to ensure methodological correctness, for the other phases of the project students were given general guidelines to allow them to approach and elaborate the research independently. During the interactive workshop, the 10 student teams involved in the research will bring and discuss their results on the effects associated with the different light treatments on crop performances.

Keywords: *Urban agriculture, Problem-Based Learning, Innovative teaching methods, LED light management, Vertical farming*