INTERNATIONAL SYMPOSIUM OF CONTEMPORARY HORTICULTURE

Bulduri, Latvia | May 22, 2025

Plant micropropagation

Biologically active compounds of plants

Plants and microorganisms

Digitalization and automation

Precise and climate controlled horticulture

BOOK OF ABSTRACTS

Bulduru Tehnikums

Bulduru Biotehnoloģiju centrs

NACIONĀLAIS ATTĪSTĪBAS PLĀNS 2020

EIROPAS SAVIENĪBA
EIROPA INVESTĒ LAUKU APVIDOS
Eiropas Lauksaimniecības fonds lauku attīstībai

Atbalsta Zemkopības ministrija un Lauku atbalsta dienests

Bulduru Tehnikums
BULDURU BIOTEHNOLOĢIJU CENTRS
NACIONĀLAIS ATTĪSTĪBAS PLĀNS 2020
EIROPAS SAVIENĪBA
EIROPA INVESTĒ LAUKU APVIDOS
Eiropas Lauksaimniecības fonds lauku attīstībai
Atbalsta Zemkopības ministrija un Lauku atbalsta dienests

EIP-AGRI projects support: "Production of healthy planting material and testing of innovative growing methods for crops, significant for the national economy", contract number 22-00-A01612-000011.

Organizers
Bulduri Technical School

Editors
Anta Sparinska, Līva Purmale-Trasune

Design, correction
Lauma Ķeire

Cover photo
Uldis Muzikants

© Bulduru Tehnikums, 2025

ISBN 978-9934-9252-4-5

Planned agenda

9:30-10:00		Registration, Coffee break	
10:00-10:10		Opening speech by the Chairman of the Board	2
10:10-10:45	Anta Sparinska, Marija Gailite, Liva Purmale-Trasune, Anna Korica, Janis Bremanis, Elga Ence, Gustavs Gulbis, Karlis Svirksts, Rafaels Joffe (LV)	Development of healthy planting material and innovative soilless cultivation methods for economically important crops	3
10:45-11:00	Lidija Vojevoda, Margita Damskalne, Anta Sparinska, Liva Purmale-Trasune, Marija Gailite (LV)	Healthy plant material as a guarantee for a quality harvest	4
11:00-11:15	Karlis Svirksts, Eliza Ilze Malceniece, Valdis Mizers, Marija Gailite, Daiga Birzleja, Eriks Sledevskis, Gita Riekstina, Anta Sparinska (LV)	Smart fertilization strategies in vegetable polycultures using sensor technology	5
11:15-11:45		Coffee break	
11:45-12:00	Akhmatova Sabrina Otabek Qizi, Komiljonov Otabek, Anvar Shamsiyev Akbarovich (UZ)	Methods and efficiency of micropropagation of sweet potato (*Ipomoea batatas* L.) under *in vitro* conditions	6
12:00-12:15	Liubov Tkhoryk, Larysa Semenko (UA)	Identification of promissing clonal lines of potato varieties 'Rodynna' and 'Bellarosa' by the complex of economically valuable traits	8
12:15-12:30	Khudaykulova Munira (UZ), Yoon Yeo-Jung (KR)	Advanced *in vitro* techniques for potato propagation and microtuber induction	10
12:45-13:00	Paula Oros, Corina Catana (RO)	Recent developments in tissue culture techniques for the commercial propagation of *Heuchera* species	12
13:00-13:30		Lunch break	
13:30-14:00	Yigitaly Tashputalov (UZ)	Masterclass: The Case of Uzbek Plov	21
14:00-14:15	Francisco J. Alfosea-Simón, Liva Purmale-Trasune, Lorenzo Burgos, Nuria Alburquerque (ES/LV)	Electrotherapy as a potential tool for pathogen elimination in apricot plants	13
14:15-14:30	Maksym Serdyuk, Oleksandr Chayka (UA)	Biofungicides as a plant protection tool: efficancy against spring barley leaf disease	14
14:30-14:45	Liga Strazdina, Roberts Krumins, Edgars Karklins, Juta Karklina (LV)	Bryophytes cultivation under controlled conditions	15
14:45-15:00	Corina Catana, Paula Oros (RO)	Herbarium - a modern perspective	16
15:00-15:15	Kristaps Kunrads (LV)	Palm House renovation: sustainable solutions for plants, people, and the planet	17
15:15-15:30	Iskandarov Salahidin Yarkinoglu (UZ)	Implementation of a modern monitoring system in agriculture through smart sensors	18
15:30-15:45	Roberts Krumins, Ravindu Upetha Balasuriya Appuhamige, Anta Sparinska (LV)	Impact of elevated carbon dioxide concentration on mizuna microgreen biomass, anthocyanin and phenol content	20
15:45-16:00		Final remarks	

Dear researchers, horticulturists and gardeners -

It is my great pleasure to welcome you to the third International Symposium on Contemporary Horticulture. This year's event is not only a continuation of a tradition, but a celebration of a turning point: for the first time, the symposium is organized by Bulduri Biotechnology Centre – a newly established scientific institution.

This marks the evolution of Bulduri Technical School from a vocational school into a research-capable entity at the national and international level. We are proud that our long-standing commitment to innovation, sustainability and international cooperation has matured into an officially recognized research structure.

One of the key topics this year is the final phase of the LAD-supported project on healthy planting material, where we have successfully tested Controlled Environment Agriculture (CEA) methods for strawberry, potato and soybean cultivation. Using *in vitro* propagation combined with hydroponics and aeroponics, we have achieved promising results that confirm the potential of clean, high-yield plant production under fully controlled conditions.

We are also delighted to see the growing participation of international partners, especially colleagues from Uzbekistan, whose knowledge and experience add depth and diversity to our discussions. Such collaboration is a vital part of building a truly global approach to resilient horticultural production.

Looking ahead, the biggest challenge – and opportunity – remains the same: how to turn precise, small-scale experiments into robust, automated production technologies that are economically viable and environmentally sustainable. And in this, the role of the scientific institution is central: to connect research, education, industry and policy in a shared mission for better food, healthier plants and smarter cultivation systems.

Thank you for joining us in this exciting journey. May this symposium spark new ideas, partnerships and scientific breakthroughs.

Happy gardening and researching!

RAFAELS JOFFE
CHAIR-MAN OF THE BOARD OF BULDURI TECHNICAL SCHOOL

DEVELOPMENT OF HEALTHY PLANTING MATERIAL AND INNOVATIVE SOILLESS CULTIVATION METHODS FOR ECONOMICALLY IMPORTANT CROPS

ANTA SPARINSKA*[1], MARIJA GAILITE[2], LIVA PURMALE-TRASUNE[1], ANNA KORICA[1], JANIS BREMANIS[1], ELGA ENCE[1], GUSTAVS GULBIS[4], KARLIS SVIRKSTS[1], RAFAELS JOFFE[1]

Bulduri Biotechnology Centre, Latvia[1],
Society 'Latvijas Dārznieks', Jūrmala, Latvia[2],
IK MIGL dārzi, Kuldīgas novads, Latvia[3],
University of Latvia[4]

anta.sparinska@bulduri.lv

Key words: in vitro propagation, hydroponics, aeroponics, strawberries, seed potatoes.

This study presents results from a national research project aimed at the year-round production of healthy, pathogen-free planting material using soilless technologies in climate-controlled environments. The focus was on economically important crops—strawberries, potatoes, and soybeans—as model species for assessing the viability of hydroponic and aeroponic systems.

For strawberries, a complete indoor cultivation protocol was developed starting from in vitro-propagated plants. Multi-level growing racks with ebb-flow irrigation and LED lighting enabled the production of mini-tray plants suitable for vertical farming systems. Results demonstrated varietal differences in runner initiation, rosette formation, and responsiveness to light spectrum composition. Notably, tray plants grown from acclimatized mother plants reached transplant quality within less than 8 months.

In parallel, potato mini-tuber production was tested in controlled conditions using peat, perlite, vermiculite, and aeroponic systems. Aeroponics yielded significantly higher tuber counts (up to 40 tubers/plant in 'Frieslander'), whereas traditional substrate-based systems produced fewer but larger tubers. The technology allows for year-round cultivation and repeated harvesting cycles.

These findings confirm the potential of closed-environment systems to produce clean, high-quality planting material and highlight crop-specific responses to cultivation substrates and environmental control, paving the way toward automation and energy-efficient vertical horticulture.

ACKNOWLEDGEMENTS

The study was conducted with funding from the Latvian Ministry of Agriculture and the Rural Support Service project titled "Production of healthy planting material and testing of innovative growing methods for crops, significant for the national economy", contract number 22-00-A01612-000011.

HEALTHY PLANT MATERIAL AS A GUARANTEE FOR A QUALITY HARVEST

LIDIJA VOJEVODA*[1], MARGITA DAMSKALNE[1], ANTA SPARINSKA[2], LIVA PURMALE-TRASUNE[2], MARIJA GAILITE[3]

Institute of Agroresources and Economics[1],
Biotechnology Centre of Bulduri Technical school[2],
Association "Latvian Gardener"[3]

lidija.vojevoda@arei.lv

Key words: potato mini tubers, soybean, aeroponics, substrate, seed quality.

Growing crops in open fields poses significant risks, including lower seed quality and yield losses due to diseases, pest infestations, and adverse climatic conditions. Ensuring clean, disease-free planting material is the first step toward producing a high-quality crops, where seed quality is a critical factor.

The aim of this study was to develop and compare innovative cultivation technologies for producing healthy planting material, specifically hydroponic and aeroponic systems at Bulduri Technical School, versus substrate-based cultivation under climate-controlled greenhouse conditions at the Stende Research Centre of the Institute of Agricultural Resources and Economics. Two crop species — soybean and potato — were used in the trials, comparing *in vitro*-derived material grown in hydroponics, aeroponics, and peat-based substrate.

The experimental trials began in 2023 and continued through 2025. At the Stende Research Centre, meristem-derived potato plants and aeroponically grown minitubers were evaluated in greenhouse pot experiments using peat substrate. Soybeans were grown in both greenhouse pots and open-field conditions. In 2025, soybean seed germination was assessed using material derived from aeroponics, greenhouse pots, and field-grown plants. The potato varieties 'Agrie Dzeltenie' and 'Frieslander', along with the soybean variety 'Erika', were included in the study. Yield components such as tuber and pod number per plant, and average tuber/seed weight, were recorded.

The influence of genotype from meristem-derived plants on tuber yield varied significantly (*F*_{fact} < *F*_{crit}). For 'Frieslander', the number of minitubers per plant ranged from 3 to 19, while for 'Agrie Dzeltenie', it ranged from 3 to 11. 'Frieslander' produced a significantly higher total yield — 361 tubers from 40 plants, with an average tuber weight of 0.034 kg — compared to 222 tubers from 40 plants of 'Agrie Dzeltenie', with an average tuber weight of 0.031 kg.

Germination results from aeroponically produced minitubers showed inconsistency. For instance, 'Agrie Dzeltenie' demonstrated faster and more uniform sprouting, while 'Frieslander' exhibited dormancy in several tubers. In general, minitubers were very small in both varieties (averaging 0.03 g), indicating a possible requirement for a dormancy period post-harvest. Genotypic differences likely influenced the duration of dormancy.

Soybean grown under climate-controlled greenhouse conditions exhibited vigorous vegetative growth, with stalk lengths ranging from 130 cm to 165 cm. In contrast, field-grown plants ranged from 90 cm to 110 cm. Leaf spot disease was observed in the greenhouse, likely due to the origin of the seed material (farm-sourced) or cultivation density, which may have impeded ventilation.

Germination tests showed that soybean seeds from the field and greenhouse pots had relatively low germination rates — 53 % and 50 %, respectively — while seeds obtained through aeroponics had 98–99 % germination. These findings demonstrate that aeroponically cultivated soybean seeds are of significantly higher quality. Additionally, *in vitro*-derived potato plants produced healthy planting material; however, minitubers obtained through aeroponics appear to require a dormancy period before being suitable for use in further propagation.

ACKNOWLEDGEMENTS

The research was carried out with the financial support of the Ministry of Agriculture of Latvia and the Rural Development Service of Latvia project "Production of healthy planting materials and trials of innovative cultivation methods for economically important crops", contract No 22-00-A01612-000011.

SMART FERTILIZATION STRATEGIES IN VEGETABLE POLYCULTURES USING SENSOR TECHNOLOGY

KARLIS SVIRKSTS*[1], ELIZA ILZE MALCENIECE[2], VALDIS MIZERS[3], MARIJA GAILITE[4], DAIGA BIRZLEJA[1], ERIKS SLEDEVSKIS[3], GITA RIEKSTINA[1] & ANTA SPARINSKA[1]

Bulduri Technical School, Bulduri Biotechnology Centre, Jūrmala, Latvia[1]
ZS Bračas, Allažu pagasts, Latvia[2]
Daugavpils University, Daugavpils, Latvia[3]
Latvijas Dārznieks, Jaunmārupe, Latvia[4]

karlis.svirksts@bulduri.lv

Key words: vegetables, sensors, irrigation.

The DigiDārzs project aims to develop sustainable fertilization and plant protection strategies in vegetable polycultures using smart technology. Implemented in both controlled and open-field environments, the project integrates dynamic, biological and integrated cultivation methods, focusing on carrots, cabbage, and leeks, with the possibility to expand crop diversity for broader data analysis. An innovative electrochemical multisensor prototype is being developed to precisely track dissolved nutrients in irrigation water, allowing real-time nutrient solution correction. This data-driven approach enhances yield, reduces agrochemical input and supports soil regeneration, aligning with the principles of circular and sustainable horticulture. A key component of the project is the creation of a vegetable phenology database, supported by real-time sensor data and manual measurements, to enable the development of AI algorithms for precision agriculture. Bulduri Technical School's research site hosts a demonstration garden – the DigiDārzs – where novel cultivation methods are tested alongside sensor prototypes for continuous monitoring of nutrients, pH and conductivity. Additional trials are conducted on-farm to evaluate technology scalability and farmer relevance. The project fosters synergy between automation, data science, and crop management, contributing to the development of economically viable, environmentally conscious production systems. Long-term goals include open-access data for farmers and integration of AI into daily decision-making for smarter horticulture.

ACKNOWLEDGEMENTS

EIP-AGRI projects support: "DigiGarden — development of strategies for fertilization and plant protection in vegetable polyculture plantations", Nr.24-00-C0LA1601-000006.

METHODS AND EFFICIENCY OF MICROPROPAGATION OF SWEET POTATO (*IPOMOEA BATATAS* L.) UNDER *IN VITRO* CONDITIONS

RAKHMATOVA SABRINA OTABEK QIZI*[1], KOMILJONOV OTABEK[1], ANVAR SHAMSIYEV AKBAROVICH[1]

Samarkand Agroinnovations and Research Institute[1]

sabrinarahmatova09@gmail.com

Abstract

This article analyzes the technology of micropropagation of sweet potato (*Ipomoea batatas* L.) under *in vitro* conditions, including the regenerative capacity of plant explants, sterilization protocols, nutrient medium composition, and the effect of hormones (phytohormones) on growth and differentiation. Based on experimental results, optimal conditions were identified, demonstrating high propagation rates and the possibility of obtaining healthy seedlings [2—4].

Key words: in vitro culture, sweet potato, micropropagation, phytohormones, MS medium, sterilization.

1. Introduction

Sweet potato (*Ipomoea batatas* Lam.), commonly known as batat, is a significant tuber crop widely cultivated in tropical and subtropical regions such as China, Japan, India, the USA, Korea, and several European countries [2]. In Uzbekistan, sweet potato is considered a new and promising crop, offering opportunities to diversify agricultural production and enhance food security. Recent studies have identified several sweet potato varieties suitable for Uzbekistan's climatic and soil conditions. Notably, varieties like 'Sochakinur', 'Toyloki', and 'Filial' have been bred for their high yield, early maturity, and adaptability. These varieties have been included in the State Register of Uzbekistan, indicating their suitability for cultivation in the region [4].

Research conducted in the Samarkand region demonstrates that with proper agricultural practices, such as transparent film mulching, optimal planting schemes (e.g., 70x25x1 cm or 90x20x1 cm), and appropriate irrigation regimes, sweet potato yields can reach up to 50 tons per hectare. Additionally, the application of mineral fertilizers at recommended rates further enhances productivity and marketable quality [4, 5].

Given its nutritional value, including high starch and sugar content, as well as its potential for industrial processing, sweet potato presents a valuable addition to Uzbekistan's agricultural sector. This article explores the current state of sweet potato cultivation in Uzbekistan, focusing on the development of suitable varieties, optimal cultivation technologies, and strategies for integrating this crop into the country's agricultural practices [5].

Sweet potato is a globally significant agroeconomic crop with high sugar content among root vegetables. In Uzbekistan, its cultivation potential is increasing, but the lack of high-quality planting material remains a major challenge in breeding and propagation. Therefore, *in vitro* technology plays a crucial role in producing virus-free, genetically stable seedlings [2, 3].

Main goals of sweet potato cultivation

- Ensuring food security: Sweet potato, with its high sugar and starch content, is an excellent source of energy. For developing countries like Uzbekistan, cultivating sweet potato can be an effective and cost-efficient way to ensure food production [2].
- Health benefits: Sweet potato contains numerous vitamins (A, C, B6), minerals (manganese, iron), and antioxidants, which help strengthen the immune system, support eye health, and detoxify the body [2].
- Raw material for industry: The high starch and sugar content of sweet potato makes it suitable for use as a raw material in the food industry and other sectors. This includes using sweet potato in the production of confectionery, chips, and other products [2].
- Agricultural diversification: Cultivating sweet potato helps diversify agriculture. In turn, this increases economic stability and allows farmers to produce various types of crops [5].

Challenges in sweet potato cultivation and potential solutions

• Lack of high-quality planting materials: A major challenge in Uzbekistan's sweet potato cultivation is the lack of high-quality planting materials. In vitro technology plays a vital role in producing virus-free and genetically stable seedlings [3].

• Adaptation to climate and soil conditions: Sweet potato is a plant that is sensitive to specific climate and soil conditions. In some regions of Uzbekistan, the soil and climate may not be suitable [4].

• Pest and disease control: Sweet potato can be affected by various diseases and pests (such as viruses and plant pests) [3].

• Water supply and irrigation: Sweet potato requires adequate water for growth [4].

• Market organization and export opportunities: Sweet potato has significant export potential, but the market system for its cultivation and processing is not well-developed [5].

2. Materials and Methods

The experiment was conducted in the International horticulture institute laboratory in the Samarkand region. Nodal explants from vine cuttings were cultured on Murashige and Skoog (MS) basal medium supplemented with various hormonal combinations (BAP, NAA, kinetin). Explants were sterilized in 0.1 % $HgCl_2$ solution for 10 minutes. Cultures were maintained under a 16/8-hour light/dark cycle at 25±2°C [1].

3. Results and Discussion

3.1. Sterilization Protocols

Sterilization with 0.1 % $HgCl_2$ for 10 minutes resulted in the lowest contamination rate (8 %) and highest survival rate (90 %) [1].

3.2. Growth and Propagation Coefficient

The MS medium supplemented with 1.5 mg/l BAP and 0.2 mg/l NAA produced an average of 4.7 shoots per explant. Callus formation was observed with 2.0 mg/l BAP + 1.0 mg/l 2,4-D [1].

3.3. Rooting Phase

Regenerated shoots exhibited 90 % rooting efficiency in MS medium with 1.0 mg/l IBA. During acclimatization, 80 % of plantlets survived [1].

4. Biological and Genetic Characteristics of Sweet Potato

Sweet potato (*Ipomoea batatas* L.) belongs to the *Convolvulaceae* family, is highly amenable to vegetative propagation, and is a hexaploid plant (2n=6x=90). Its tubers serve as both a food source and industrial raw material. Varieties differ in sugar content, pigmentation (e.g., anthocyanin-rich types), and drought tolerance, with genetic diversity being a key resource for breeding and *in vitro* propagation [2, 3].

Conclusion

This study demonstrates that micropropagation of sweet potato (*Ipomoea batatas* L.) under *in vitro* conditions is an effective method for producing virus-free and genetically stable planting material. The optimal sterilization protocol significantly reduced contamination while ensuring high explant survival [1, 3]. The best shoot proliferation was achieved using MS medium supplemented with BAP AND NAA, while efficient rooting was observed with IBA. The *in vitro* propagation system has the potential to produce up to 100,000 seedlings annually [3].

References

[1]: Murashige, T. & Skoog, F. (1962). A Revised Medium for Rapid Growth and Bio Assays with Tobacco Tissue Cultures. Physiol. Plantarum, 15, 473–497.

[2]: López-Marqués, R. L., et al. (2020). Sweet potato biotechnology: An overview. Plant Biotechnology Journal, 18(1), 32–44.

[3]: Rukundo, P., et al. (2017). Methods of propagation and their influence on virus incidence in sweet potato. African Journal of Agricultural Research, 12(18), 1524–1531.

[4]: Ostonakulov T.E., Shamsiev A.A., Amanturdiev I.Kh., Tursunov G.S. "Evaluation of sweet potato varieties and development of technology for their cultivation in Uzbekistan." International Research Journal, 2022, No. 4 (118).

[5]: Ostonakulov T.E., Shamsiev A.A. "Results of research on selection and development of technology of cultivation of varieties of batatas in the conditions of Samarkand region." JournalNX - A Multidisciplinary Peer Reviewed Journal, 2020.

ACKNOWLEDGEMENTS

This activity was supported by the project “Development of biotechnology and digital skills for climate-controlled agriculture (BioDigiSkills)”, Grant Agreement No. LV-57, funded by the Latvian Ministry of Foreign Affairs within the budget programme 07.00.00 “Development Cooperation Projects and International Assistance”.

IDENTIFICATION OF PROMISING CLONAL LINES OF POTATO VARIETIES 'RODYNNA' AND 'BELLAROSA' BY THE COMPLEX OF ECONOMICALLY VALUABLE TRAITS

LIUBOV TKHORYK*[1], LARYSA SEMENKO[1]

National University of Life and Environmental Sciences of Ukraine, Kyiv, Ukraine[1]

lt2003@ukr.net

Key words: potato, clonal micropropagation, statistics, biometric indicators.

1. Introduction

The present scientific research outlines the application of statistical methods for the evaluation of clonal lines of potato varieties 'Rodynna' [1] and 'Bellarosa' [2] during the process of healing.

It is demonstrated that employing clonal micropropagation techniques (Fig. 1) can significantly enhance the quality of initial material for the improvement of healthy potato varieties through biotechnological means, thereby facilitating the selection of highly productive virus-free lines. Clonal micropropagation is an effective method that allows for obtaining genetically uniform planting material, the rapid propagation of valuable genotypes, and the preservation of their unique characteristics [3].

2. Materials and Methods

Initially, *in vitro* potato lines require adaptation to *ex vitro* conditions [4]. This study investigated biometric indicators of *in vitro* potato lines of the 'Rodynna' and 'Bellarosa' varieties, including: stem length, leaf area, tuber mass, the number of tubers, the ratio of above-ground mass to tuber mass, and the mass of the clonal progeny [5],[6].

The coefficient of variation served as the basis for our calculations, and based on the analysis of this data, we were able to identify the most homogeneous lines for further research [7].

3. Results and Discussion

• Stem length — lines with a value within the average and below the average were counted.

• The area of the 4th leaf — values within the average and above the average were taken into account.

• Top mass — data close to the average and below the average were counted.

• Clone mass — values close to the average and higher than the average were taken into account.

• The average tuber weight and the number of tubers per plant — indicators within the average value and higher than the average were counted.

• The ratio of tops to tubers — values within the range of the average and below the average were chosen, because this indicator reflects the proportion between the aboveground and underground parts.

• Yield (t/ha) and — lines were chosen in which this indicator exceeded the control sample.

Based on the assessment of biometric indicators across all characteristics for the **'Rodynna'** variety lines, the following conclusions can be drawn:

- first place (lines 11 to 13) exhibited 8 positive indicators out of 8 possible;
- second place (lines 7 and 8) displayed 7 positive indicators out of 8 possible;
- third place (lines 7 and 10) presented 6 positive indicators out of 8 possible.

Based on the assessment of biometric indicators across all characteristics for the **'Bellarosa'** variety lines (Fig. 2), the following conclusions can be drawn:

- first place occupied 6 and 7 lines with positive indicators across 6 to 8 possible criteria;
- second place displayed 3 to 5 lines, possessing positive indicators across 5 to 8 criteria.

The yield capacity and stability of lines are key selection characteristics [8].

Further investigation is also suggested under varying environmental conditions, moisture levels, and fertilization regimes [9].

Conclusion

The results of the conducted analysis establish that the application of statistical methods for evaluating healthy planting material allows for the identification of nonvariable lines that do not deviate from the original phenotype, which is practically significant for accelerating the increased productivity of potato lines in seed production [10].

Figure 1. In vitro potato propagation.

Figure 2. Yield performance of potato variety 'Bellarosa' under field conditions.

References

[1]: IKAR Product Catalog. — URL: https://ikar.in.ua/wpcontent/uploads/2024/05/Katalog2024.pdf

[2]: Europlant Official Website. — URL: http://europlant.com.ua/uk/bellaroza.html

[3]: Microclonal propagation of plants. — URL: https://uk.wikipedia.org/wiki/Мікроклональне_розмноження_рослин

[4]: Seed potatoes, healthy initial material. Technical specifications DSTU 8243:2015.

[5]: Horodnii, M. M., Bykin, A. V., & Nahayevska, L. M. (2003). Agrochemistry (M. M. Horodnii, Ed.). Kyiv: Alefa LLC Publishing House.

[6]: Polupan, M. I., Solovei, V. B., & Velychko, V. A. (2005). Classification of soils of Ukraine (M. I. Polupan, Ed.). Kyiv: Agrarian Science.

[7]: Kuchko, A. A., Vlasenko, M. Yu., & Mytsko, V. M. (1998). [Physiology and Biochemistry of Potatoes].

[8]: Methodological recommendations for conducting research on potatoes (2002). UAAS, Institute of Potato Growing. Nemishayeve.

[9]: Tsarenko, O. M., Zlobin, Yu. A., Skliar, V. H., & Panchenko, S. M. (2000). Computer methods in agriculture and biology: A textbook. Sumy: University Book Publishing House.

[10]: Kozhushko, N. S., & Zavora, Ya. O. (2000). Evaluation of potato progeny in breeding for quality. Sumy National Agrarian University.

ACKNOWLEDGEMENTS

This activity was supported by the project “Development of biotechnology and digital skills for climate-controlled agriculture (BioDigiSkills)”, Grant Agreement No. LV-57, funded by the Latvian Ministry of Foreign Affairs within the budget programme 07.00.00 “Development Cooperation Projects and International Assistance”.

ADVANCED *IN VITRO* TECHNIQUES FOR POTATO PROPAGATION AND MICROTUBER INDUCTION

KHUDAYKULOVA MUNIRA*[1], YOON YEO-JUNG[2]

Samarkand Agroinnovations and research University, Samarkand, Uzbekistan[1]
International Horticulture Institute, Seul, South Korea[2]

muniraxudoyqulova18@gmail.com

Abstract

Microtubers have been known for almost 50 years, but their use as seeds is not consistent throughout the world. There is no agreement on the best methods for producing microtubers or how they compare to other types of seeds [1].

There is no agreement on the best methods for producing microtubers or how they compare to other types of seeds. This study presents advanced *in vitro* methods for potato propagation and microtuber induction under sterile laboratory conditions. The aim of the study was to produce disease-free, fast-growing plants, overcoming the limitations of traditional methods. Meristem and nodule segments were grown under 16-hours photoperiod, 22–23°C, and 2000–5000 lux of light. After 1–3 weeks of acclimatization at 20–25°C and 80–90 % humidity, 95 % viability was observed. The process of microtuber formation is being studied in 6-8% sucrose [2] at 18–20°C in the dark for 4-8 weeks.

Key words: in vitro cultivation, microtuber induction, sucrose, tissue culture, acclimatization.

1. Introduction

Potato (*Solanum tuberosum* L.) crops are vegetatively propagated using tubers and facing many risks caused by pathogens. It is important to prevent infection of pathogens during propagation. *In vitro* seedlings are free of most pathogens but may still be infected with viruses. Since viral diseases can cause severe yield losses, it is essential to use virus-free plants via meristem culture for propagation. Healthy seed potatoes are produced from virus-free *in vitro* plants through several generations of propagation. During propagation in the field, however, some of the disease-free plants can become newly infected by pathogens. Therefore, it is important to propagate disease-free plants or tubers as many as possible using *in vitro* techniques, and improved tissue culture propagation methods are needed for this purpose [2].

Traditional propagation methods are time-consuming, lead to the spread of diseases, and limit consistent production throughout the year.

The *in vitro* method allows for the rapid, efficient, and disease-free production of plants in a sterile environment.

This study aims to present the methodology and results of advanced *in vitro* methods for potato propagation and microtuber production. The aim is to demonstrate how these methods contribute to increasing the efficiency, scale and quality of potato production in laboratory and greenhouse conditions.

2. Materials and Methods

2.1. Plant Materials

This study utilizes root samples of commercially widespread potato varieties ('Sumi ChuBeak', 'Sante', 'Picasso', 'Nevsky') obtained from the General Seed Production Organization in Seoul, South Korea. These varieties were selected due to their extensive use in agriculture and suitability for *in vitro* experiments.

2.2. Environment:

For *in vitro* regeneration experiments, a liquid nutrient medium is prepared according to Murashige and Skoog (MS, 1962). The medium consists of: 4.4 g/L MS powder, 60 g/80 g/L sucrose, 0.5–2.0 mg/L (i.e., 2.3–9.2 μM) kinetin, and 0.1–0.5 mg/L GA_3 [3], with a pH adjusted to 5.8.

2.3. Selection of Explants and Culture Initiation

The propagation process began with the cultures of the apical meristem and node segments of potato (*Solanum tuberosum* L.) [3].

Cultures were maintained at a temperature of 22–23°C under a light [4] intensity of 2000 to 5000 lux with a 16-hour photoperiod. To ensure continuous shoot proliferation, subculturing was performed every 21–30 days.

2.4. Acclimatization

The obtained *in vitro* plants were acclimatized in a controlled environment chamber for 1–3 weeks under the following conditions: 20–25°C temperature, 80–90% relative humidity, and 4000–6000 lux light intensity [5]. This process allowed for a gradual transition from *in vitro* to *ex vitro* conditions.

2.5. Microtuber Induction

For microtuber induction, healthy *in vitro* plants were transferred to a modified MS medium containing 6–8 % sucrose [6]. Cultures were subjected to dark conditions or short-day photoperiods (8 hours of light) and maintained at 18–20°C for 4 to 8 weeks. The microtubers formed under these conditions were collected [7].

3. Results and Discussion

Microtubers began to form 3–4 weeks after the explants were placed in culture.

The formation of potato microtubers *in vitro* is a complex physiological process influenced by various factors — genotype (variety), growth regulators, sucrose concentration, light, and temperature conditions. This study investigates the formation of microtubers with the aforementioned additives in an MS-based liquid nutrient medium.

Conclusion

Nutrient Medium: The MS-based medium is being studied for its suitability for plant growth and microtuber formation [3].

Sucrose Concentration: The concentration of 6–8 % sucrose during the microtuber formation phase is being investigated for its role in induction and growth.

Phytohormones: The effects of kinetin and gibberellic acid (GA_3) on plant growth and microtuber formation are being studied.

Light and Temperature Conditions: Dark conditions and temperatures of 18–20°C [7] during the microtuber formation phase are being examined [8].

References

[1]: A. Canada, N. Bnmswick, and N. Brunswick, 'Potato Microtuber Production and Performance: A Review', Am. J. Potato Res., pp. 103–115, 2003.

[2]: B. Al-Safadi, Z. Ayyoubi, and D. Jawdat, 'The effect of gamma irradiation on potato microtuber production in vitro', Plant Cell. Tissue Organ Cult., vol. 61, no. 3, pp. 183–187, 2000, doi: 10.1023/A:1006477224536.

[3]: N. L. Biddington, 'The influence of ethylene in plant tissue culture', Plant Growth Regul., vol. 11, no. 2, pp. 173–187, 1992, doi: 10.1007/BF00024072.

[4]: J. Long, F. Yu, Y. Wu, Z. Xu, and X. Liu, 'Regulation of Different Lights on Energy Acquisitions, Microtuber Formation, and Growth of In Vitro-Grown Solanum tuberosum L.', Agronomy, vol. 14, no. 6, 2024, doi: 10.3390/agronomy14061232.

[5]: D. Pantelić, I. Dragićević, J. Rudić, J. Fu, and I. Momčilović, 'Effects of high temperature on *in vitro* tuberization and accumulation of stress-responsive proteins in potato', Hortic. Environ. Biotechnol., vol. 59, no. 3, pp. 315–324, 2018, doi: 10.1007/s13580-018-0043-x.

[6]: S. P. Dhital and H. T. Lim, 'Microtuberization of Potato (*Solanum tuberosum* L.) as Influenced by Supplementary Nutrients, Plant Growth Regulators, and *In Vitro* Culture Conditions', Potato Res., vol. 55, no. 2, pp. 97–108, 2012, doi: 10.1007/s11540-012-9212-y.

[7]: J. Gopal, J. L. Minocha, and H. S. Dhaliwal, 'Microtuberization in potato (*Solanum tuberosum* L.)', Plant Cell Rep., vol. 17, no. 10, pp. 794–798, 1998, doi: 10.1007/s002990050485.

[8]: M. Otroshy, F. Nazarian, and P. C. Struik, 'Effects of temperature fluctuation during *in vitro* phase on *in vitro* microtuber production in different cultivars of potato (*Solanum tuberosum* L.)', Plant Cell. Tissue Organ Cult., vol. 98, no. 2, pp. 213–218, 2009, doi: 10.1007/s11240-009-9554-6.

ACKNOWLEDGEMENTS

This activity was supported by the project "Development of biotechnology and digital skills for climate-controlled agriculture (BioDigiSkills)", Grant Agreement No. LV-57, funded by the Latvian Ministry of Foreign Affairs within the budget programme 07.00.00 "Development Cooperation Projects and International Assistance".

RECENT DEVELOPMENTS IN TISSUE CULTURE TECHNIQUES FOR THE COMMERCIAL PROPAGATION OF *HEUCHERA* SPECIES

PAULA OROS[1,2], CORINA CĂTANĂ*[1,2]

Dept. Of Micropropagation, Faculty of Horticulture and Bussines in Rural Development, Univeristy of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Romania[1], Center for Biodiversity and Conservation, Univeristy of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Romania[2]

corina.catana@usamvcluj.ro

Key words: mass propagation protocol, proliferation, rhizogenesis induction, *ex vitro* rooting.

This study focuses on developing an efficient and reproducible protocol for the large-scale *in vitro* propagation of ornamental *Heuchera* species, with the aim of supporting commercial production. Two cultivars were used as model varieties in the experiment: *Heuchera villosa* 'Silver Gumdrop' and *Heuchera x hybrida* 'Timeless Orange'. The research investigated the influence of different culture media and plant growth conditions on shoot proliferation, rooting, and acclimatization success. Murashige and Skoog (1962) basal medium, supplemented with Gamborg B5 vitamins, was tested with and without the addition of plant growth regulators (PGRs) to evaluate its effect on multiplication efficiency. Both solid (agarized) and liquid media were used to assess their impact on the growth and development of explants. In the liquid culture system, *Luffa cylindrica* were used as a natural support for the plantlets, providing a stable environment that facilitated nutrient uptake and air exchange. This approach proved especially effective in promoting rhizogenesis, leading to a high rate of root formation. Rooting of the regenerated shoots was carried out under both in vitro and ex vitro conditions. In both cases, the rhizogenesis rate exceeded 86 %, indicating the reliability of the developed protocol. For *ex vitro* rooting and acclimatization, two substrates were compared: Jiffy pellets and a 1:1 mixture of peat and perlite. The plantlets rooted in Jiffy pellets showed a higher survival rate and better adaptation to greenhouse conditions, suggesting this method as preferable for commercial-scale propagation. The combined use of optimized media formulations, appropriate plant growth regulators, and innovative support materials such as *Luffa cylindrica* provides a promising strategy for the micropropagation of *Heuchera* spp. This protocol offers significant advantages in terms of multiplication rate, rooting efficiency, and plantlet survival, making it a valuable tool for nurseries and tissue culture laboratories. Furthermore, it supports the rapid production of uniform and healthy planting material, facilitating the introduction of new varieties into the ornamental plant market.

ELECTROTHERAPY AS A POTENTIAL TOOL FOR PATHOGEN ELIMINATION IN APRICOT PLANTS

FRANCISCO J. ALFOSEA-SIMÓN*[1], LIVA PURMALE-TRASUNE [2], LORENZO BURGOS[1], NURIA ALBURQUERQUE[1]

Group of Fruit Tree Biotechnology, Department of Plant Breeding, CEBAS-CSIC, University Campus at Espinardo, Bldg. 25, Murcia, 30100, Spain[1]
Bulduri Biotechnology Centre, 6 Viestura Street, LV- 2010 Jurmala, Latvia[2]

fjalfosea@cebas.csic.es

Key words: electrotherapy, pathogen elimination, *in vitro*, *Prunus armeniaca*.

Electrotherapy is a simple and low-cost plant sanitation technique, which is presented as a promising alternative to other more common methods for the elimination of pathogens [1–2]. In this work, conducted in Latvia as part of a Short-Term Scientific Mission within the framework of the COST Action CA21157–European Network for Innovative Woody Plant Cloning (COPYTREE) a first approach to the use of this technique for the elimination of pathogens from *in vitro* shoots of apricot (*Prunus armeniaca* L.) infected with *Plum pox virus* (PPV) or *Hop stunt viroid* (HSVd), pathogens of great relevance in the Region of Murcia, Spain, was conducted. For this purpose, 10 shoots infected with each pathogen were subjected to three intensities of electric current (10, 20 and 30 mA) for 10 minutes in an electrophoresis tank with a 1M NaCl solution. The procedure was carried out under non-sterile conditions, and subsequently the shoots were sterilized with 10 % bleach for 10 min and rinsed three times with distilled water, before proceeding to meristem rescue under sterile conditions inside a laminar flow hood.

Meristem survival ranged from 50 % to 90 %, depending on the treatment applied. However, pathogen elimination was limited. In the case of HSVd, it persisted in all treatments, while only two of the nine meristems treated at 30 mA were free of PPV. Currently, more intense treatments are being evaluated in Spain, as well as the combination of electrotherapy with other sanitation techniques, such as the use of silver nanoparticles, with the aim of improving its efficacy. These preliminary trials are laying the basis for the development of more efficient protocols that contribute to the production of healthy plants and the control of diseases.

References

[1]: Purmale, L.; Korica, A.; Joffe, R.; Acta Horticulturae, 1359, 173–178, (2023). https://doi.org/10.17660/ActaHortic.2023.1359.21

[2]: Singh, B. and Kaur, A.; Journal of Crop Science and Biotechnology, 19(4), 285–294, (2016). https://doi.org/10.1007/s12892-016-0028-1

BIOFUNGICIDES AS A PLANT PROTECTION TOOL: EFFICACY AGAINST SPRING BARLEY LEAF DISEASES

MAKSYM SEREDYUK*[1], OLEKSANDR CHAYKA[2]

National University of Life and Environmental Sciences of Ukraine, Kyiv, Ukraine[1]
Zhytomyr National Agroecological University, Zhytomyr, Ukraine[2]

makschemestru33z@gmail.com

Abstract

In modern agricultural technologies, alongside chemical plant protection products, the proportion of preparations of natural origin is significantly increasing. Domestic and global experience shows that most biopreparations significantly affect the development of phytopathogens, increase crop productivity, and do not accumulate in the soil-plant-product system. Therefore, studying the effectiveness of new preparations and comparing their action with previously tested ones remains a highly relevant issue.

Key words: biofungicide, spring barley, leaf diseases of barley.

2. Materials and Methods

The research was conducted on an experimental field of Zhytomyr National Agroecological University on spring barley crops of the Sebastian variety. The experimental design included variants with a control (water spraying), the standard fungicide Acanto Plus, s.c. (at a rate of 0.5 l/ha), and the biopreparation Mikro-1 (the main active ingredient of which is the strain *Bacillus amyloliquefaciens* subsp. *plantarum* imv B-7404). The area of each plot was 0.20 ha, with four replications of the experiment. Agrotechnical measures were generally accepted for the region and the crop.

The development of diseases and the technical effectiveness of the applied preparations were evaluated according to the methodology developed by specialists of the Institute of Plant Protection of the National Academy of Agrarian Sciences of Ukraine [1].

Yield assessment of barley on the experimental plots was carried out by sampling sheaves. Statistical analysis of the experimental data was calculated using the analysis of variance method according to the methodology of B.A. Dospekhov, using the Ilyakov computer program [2].

3. Results and Discussion

As a result of the conducted research, it was established that on the plots with a single application of the biopreparation Mikro-1 (tillering) by spraying the crops with a titer of 1-3x10⁸ CFU/ml against diseases, its technical effectiveness was 50.6 %, and with a double application (tillering, heading) – 55.0 %.

The development of leaf diseases in the control variant of spring barley was 38.7 %.

In the variant with the application of the biopreparation at the "tillering" stage, it was 19.1 %, and at the "tillering" and "heading" stages, it was 17.4 %. With the application of Acanto Plus, s.c., at a rate of 0.5 l/ha, it was 18.2 % and 16.1 %, respectively.

The yield of spring barley in the control was 3.29 t/ha, while in the variants with the application of the biopreparation it was 3.77 t/ha and 3.82 t/ha, and with the chemical standard, it was 3.81–3.90 t/ha.

Conclusion

Thus, the biopreparation Mikro-1 showed a complex protective effect against leaf diseases of spring barley and increased its productivity by 14.6–16.1 %. The application of the biopreparation made it possible to save the yield from 0.48 to 0.53 t/ha.

References

[1]: Methodology for testing and applying pesticides // S.O. Trybel, D.D. Sigaryova, M.P. Sekun, O.O. Ivashchenko, and others. – K.: Svit – 2001. – 448 p.

[2]: Dospekhov B.A. Methodology of field experiment (with the basics of statistical processing of research results) / B.A. Dospekhov, 1 (5th ed., revised and expanded). – M.: Agropromizdat, 1985. – 351 p.

BRYOPHYTES CULTIVATION UNDER CONTROLLED CONDITIONS

LIGA STRAZDINA*[1], ROBERTS KRUMINS[2], EDGARS KARKLINS[3], JUTA KARKLINA[3]

University of Latvia Botanical Garden, Riga, Latvia[1]
Bulduri Biotechnology Centre, Bulduri, Latvia[2]
Riga Technical University, Liepaja, Latvia[3]

liga.strazdina@lu.lv

Key words: bryophytes cultivation, mosses propagation, vegetative propagation.

Bryophytes are the second largest group in the plant world, surpassed only by the angiosperms – flowering plants [1]. Botanically, mosses are non-vascular plants in the land plant division Bryophyta. Mosses, as the first plants on Earth for over 400 million years [2], survived climate changes and developed strong survival mechanisms [3] that unfortunately cost them relatively slow growth rates and small size. However, these disadvantages are compensated by the longevity of mosses, which significantly surpasses the relatively short-lived ornamental perennials commonly used in landscaping. Mosses are an important part of the ecosystem and provide various ecosystem services [4]; there are different applications possible - green roofs, walls, oases, so their use in greening solutions has become more widespread [5], supplementing the most common traditional use only as peat from *Sphagnum* mosses. For these applications, mosses are grown under sustainably controlled conditions, according to various protocols and cultivation methods [6]. Although cultivation protocols are narrated in the literature [7-10], authors have identified the gap in knowledge of moss species suitable for cultivation. Out of 1800 species that grow in Europe's temperate climate zone, 200 species that can survive in an urban environment were chosen. Then, 50 species out of these were selected based on their ability to provide ecosystem services. Subsequently, multivariate factor analysis was conducted to determine the most promising species. Then, the chosen species were tested for cultivation in laboratory conditions to determine their capacity to grow within 3 months in controlled conditions (Figure 1).

Results depict that moss species *Dicranum scoparium*, *Pleurozium schreberi*, *Hypnum cupressiforme*, and *Hylocomium splendens* are suitable for propagation, and the best results are when these species are grown in a mix. Different substrates were tested, with hemp fabric as the most efficient one. Further research must be done on proper conditions for the next step of relocation to greening solutions.

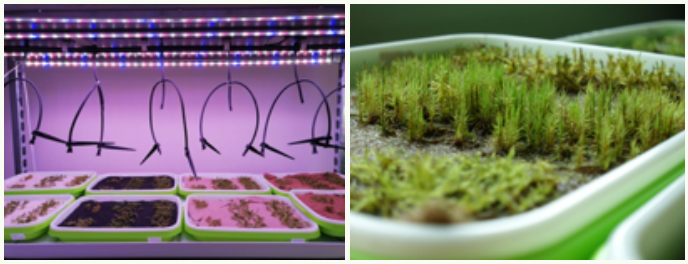

Figure 1. Moss cultivation in controlled conditions. Photo by the first and second author.

References

[1]: Mohanasundaram, B., Koley, S., Allen, D. K., Pandey, S., *Physcomitrium patens* response to elevated CO2 is flexible and determined by an interaction between sugar and nitrogen availability.; New Phytologist, 241, 3, (2023).

[2]: Strazdiņa, L., Liepiņa, L., Mežaka, A., Madžule, L. Sūnu ceļvedis.; Rīga: Latvijas Universitāte. 128, (2012).

[3]: Martin, A. The magical world of moss gardening.; Oregon: Timber Press. 238, (2015).

[4] Eldridge, D.J., Guirado, E., Reich, P.B. et al. The global contribution of soil mosses to ecosystem services.; Nat. Geosci. 16, 430–438 (2023).

[5] Nagase A., Katagiri T., Lundholm J.,Investigation of moss species selection and substrate for extensive green roofs.; Ecological Engineering, 189, (2023).

[6] Perini K., Castellari P., Giachetta A., Claudia Turcato C., Roccotiello E.,Experiencing innovative biomaterials for buildings: Potentialities of mosses.; Building and Environment, 172, (2020).

[7] Ónody, É., Fülöp-Pocsai, B., Mándy, A. T., Papp, B., Tóth, E., Ördögh, M., Comparison of propagation methods of different moss species used as wall and ground covering ornamental plants.; International Journal of Horticultural Science, 22 (3-4), (2016).

[8] Glime, J., Bryophyte Ecology.; Open Access Books. Michigan Technological University, (2021).

[9] Perini, K., Castellari, P., Gisotti, D., Giachetta, A., Turcato, C., Enrica Roccotiello, MosSkin: A moss-based lightweight building system.; Building and Environment, 221, (2022).

[10] Hasnain, A., Naqvi, S. A. H., Ayesha, S. I., Khalid, F., Ellahi, M., Iqbal, S., Abdelhamid, M. M. A., Plants *in vitro* propagation with its applications in food, pharmaceuticals and cosmetic industries; current scenario and future approaches.; Frontiers in Plant Science, 13, (2022).

ACKNOWLEDGEMENTS

This research was carried out under the provisions of the Contract on Experimental Moss Cultivation under Climate-Controlled Conditions (Agreement No. LI-25-56), concluded between SIA "Rīgas meži" and SIA Bulduru Tehnikums on 18.03.2025 in accordance with Decision No. SRM-2025-47 of 04.03.2025. The project is funded by the RTU Liepāja (RTU LA) consolidation project "Application of the Circular Economy Model for Air Pollution Reduction Display in Urban Environment" and the project "Innovative bryophyte propagation under controlled conditions for further urban deployment to provide ecosystem services " (no. 40011), which is implemented thanks to the donation of SIA "MikroTik", which is administered by the Latvian University Foundation.

HERBARIUM - A MODERN PERSPECTIVE

CORINA CĂTANĂ[1,2], PAULA OROS*[1,2]

Dept. Of Micropropagation, Faculty of Horticulture and Bussines in Rural Development, Univeristy of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Romania[1], Center for Biodiversity and Conservation, Univeristy of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Romania[2]

paula.oros@usamvcluj.ro

Key words: herbarium, 3D plant imaging, biodiversity informatics, natural digital collections.

Herbaria have existed for centuries, with origins in the Renaissance period. Initially, they were mainly for educational purposes, but their role has expanded into critical scientific research and conservation efforts. The present paper aims an overview of the current status of the herbarium concept, from theoretical foundations to practical applications. The herbarium, traditionally a collection of preserved plant specimens, is evolving in intriguing ways in our modern world. A herbarium is a repository of preserved plant specimens that are usually pressed, dried, and mounted on sheets. These collections serve as a reference for plant identification, taxonomy, and ecological research. Physical herbaria face challenges in terms of preservation, particularly in protecting specimens from pests, environmental damage, and degradation over time. In modern times, herbaria are not just physical collections but also digital databases. Digitization has allowed herbaria to be more accessible, enabling global collaboration and data sharing. The process of digitizing herbarium specimens involves photographing and cataloging them in online databases. The standard hardware used for herbarium specimen imaging is the HerbScann scanner. As global initiatives there are several projects on digitizing herbaria, such as the Global Biodiversity Information Facility (GBIF) and the Consortium of European Taxonomic Facilities (CETAF). These projects aim to create comprehensive digital libraries used for research in biodiversity, climate change, and conservation. Most of the historical herbaria were built with specimens collected without consent from indigenous communities. These days, the decolonization of herbaria became a general objective involving rethinking how specimens are collected, stored, and studied. It includes acknowledging the contributions of indigenous knowledge systems, respecting intellectual property rights, and involving local communities in botanical research and conservation efforts. Herbaria are no longer just collections of plants; they are dynamic institutions that play a critical role in preserving the natural world. Our team developed a new approach: photography of real plants and converting these hundred pictures in a moving 3D image of species. This is a viable tool for collections, limited plant resources or local restricted access to species.

This paper proposes the creation of a 3D digital herbarium, with a new technique for recording botanical objects so that plants can be studied tree-dimensionally, with their colours dimensions, volumes and morphology unaltered. For accurate databases information, the value of our innovative approach consists in the fact that these new 3D plant images, perfectly fit for databases, are based on real living organisms and not on AI various data compilation.

PALM HOUSE RENOVATION: SUSTAINABLE SOLUTIONS FOR PLANTS, PEOPLE, AND THE PLANET

KRISTAPS KUNRADS*[1]

University of Latvia Botanical Garden, Riga, Latvia[1]

kristaps.kunrads@lu.lv

Key words: botanic gardens, glasshouse, Palm House renovation.

Botanic gardens are havens of global plant diversity. Glasshouses have long been of particular significance as they allow safeguarding and showcasing plants from exotic locales that would otherwise be unable to survive the local climatic conditions. The Palm House of the University of Latvia Botanical Garden was initially built in 1928 and was only 9 m tall. Today, at 24 m, it is the highest glasshouse in the Baltics. Having housed subtropical plants, including relict and threatened species, such as *Wollemia nobilis* and *Metasequoia glyptostroboides*, for nearly 100 years, the Palm House had reached a critical condition that required renovation. The work on the Palm House began in January 2024 and included restoring the foundation, reinforcing load-bearing structures, replacing polycarbonate walls, and installing a glass roof. To optimize energy efficiency, an automated climate control system featuring shading screens, ventilation windows, airflow turbines, and an irrigation network was introduced (Fig. 1). This system was designed to reduce environmental impact while providing ideal conditions for conserving subtropical plant species and creating an efficient workplace for the caretakers of this unique collection. Redesigned pathways, improved lighting, and upgraded display infrastructure create a modern, engaging environment where visitors can learn about biodiversity. By integrating innovative technologies and sustainable solutions, the renovated Palm House merges plant conservation with environmental awareness and reduced carbon footprint.

Figure 1. Within the framework of the renovation, the building's energy efficiency is significantly improved, and optimal climatic conditions are created for the collection of subtropical plants.

IMPLEMENTATION OF A MODERN MONITORING SYSTEM IN AGRICULTURE THROUGH SMART SENSORS

ISKANDAROV SALAHIDIN YARKINOGLU*[1]

Samarkand Agroinnovations and research University, Samarkand, Uzbekistan[1]

iskandarovsalohiddin1@gmail.com

Abstract

This article discusses smart sensors that measure soil moisture, pH, fertility, temperature, and sunlight exposure, their technical capabilities, and ways to organize a real-time monitoring system on farms.

Key words: soil moisture, smart sensor, IoT, Arduino, digital technology, agriculture, automation.

1. Introduction

Saving resources and increasing productivity are among the most pressing issues in modern agriculture. Smart technologies, in particular smart sensors, are playing an important role in this regard. Such sensors provide the opportunity to monitor, analyze and make informed decisions in real time.

2. Goals and Objectives

The main goal of this article is to develop a smart sensor for soil moisture detection, analyze its technical and functional capabilities, and outline the scientific basis for its practical application.

The tasks include:

- Analysis of modern sensor technologies;
- Creating a sensor based on a microcontroller;
- Automation of the soil moisture measurement process;
- Performance evaluation based on test results.

The table 1 lists the functions, units of measurement, and areas of use of various smart sensors.

3. Theoretical Foundations

Soil moisture sensors are based on several technological principles:

- Capacitive sensors: Detect moisture by measuring the dielectric change in the soil.
- Resistive sensors: Measure the electrical resistance of the soil, but are not resistant to corrosion.
- TDR (Time Domain Reflectometry): Provides accurate measurements using electromagnetic waves.

Modern sensors allow real-time data transmission and analysis using IoT (Internet of Things) technology. This uses microcontrollers such as Arduino, ESP32, and Wi-Fi/ radio wave/Bluetooth modules.

3.1. The working principle of a smart sensor

The smart soil moisture sensor consists of the following parts (Fig. 1):

- Sensor (e.g. capacitive soil moisture sensor): Converts soil moisture into an electrical signal.
- Microcontroller (Arduino Uno, ESP32): Receives the signal and converts it into digital format.
- Data transmission module: transmits data to the server via Wi-Fi or radio waves or LoRa.
- Power source: Battery or solar panel.
- Software: Data visualization, monitoring, automatic irrigation system control.

The sensor also has the ability to be remotely controlled, allowing the user to control the device's performance via a mobile application or web interface. For example, the user can remotely start or stop the irrigation system, change the measurement frequency. This allows the user to effectively control the state of the ground, even when geographically distant.

3.2. Data collection and monitoring system

The table 2 shows the step-by-step process for collecting, transmitting, and analyzing data from sensors.

Practical results

Smart sensors, installed as a pilot project in irrigated areas of Uzbekistan, have enabled real-time monitoring of soil moisture. The data obtained showed the following results:

- Irrigation capacity is not more than 25–30 %;
- Productivity increased by 10–15 %;
- Labor resources were used effectively.

Data from the sensors was monitored via a mobile app or web interface.

Figure 1. The special device predicts the data received from the wired network and sends the time and amount of water and fertilizer to the farmer's mobile phone through a special application.

Table 1. Functions, units of measurement, and areas of use of various smart sensors.

Sensor type	The main task	Unit of meas.	Field of use
Humidity sensor	Determining the amount of water in the soil	%	Irrigation planning
pH sensor	Determining the acidity/alkaline status of the soil	pH	Plant selection, fertilization
Temperature sensor	Measuring ground and air temperature	°C	Monitoring the vegetation process
Sunlight sensor	Determining the level of light that affects photosynthesis	lux / W/m²	Watering, identifying shady areas
Productivity sensor	Measuring nitrogen, phosphorus, and potassium levels	ppm/mg/kg	Fertilization management

Table 2. Process for collecting, transmitting, and analyzing data from sensors.

Stage	Process name	Technology / Tool	Outcome / Goal
1	Data collection	Smart sensors	Real-time measurements
2	Data transfer	Wi-Fi, Radio wave, LoRaWAN, NB-IoT	Transfer to the cloud system
3	Storage and processing	Cloud servers	Data archiving and analysis
4	Monitoring	Mobile app / Web platform	Providing indicators to the farmer
5	Decision making	Artificial intelligence / Analytics system	Creating a watering, fertilizing, and maintenance plan

Summary

Smart sensors and their monitoring systems allow farmers to make decisions based on accurate, reliable, and real-time data. This is one of the important directions of modern agriculture. By widely introducing such technologies, Uzbekistan can take a big step towards digitalizing the agricultural system.

References

[1]: Zhang, Y., et al. (2020). Application of IoT-based Smart Agriculture. Sensors, 20(10), 2741.

[2]: Bacco, M., et al. (2019). Smart Agriculture: Opportunities, Challenges and Technology Enablers. Journal of Communications Software and Systems, 15(1), 4-18.

[3]: Wang, N., Zhang, N., & Wang, M. (2006). Wireless sensors in agriculture and food industry—Recent development and future perspective. Computers and Electronics in Agriculture, 50(1), 1-14.

[4]: FAO (2022). Digital Agriculture Report: Rural Transformation and Food System Redesign.

[5]: UzAgroTech. (2023). Prospects for the introduction of digital technologies in the agriculture of Uzbekistan. Tashkent: Publishing House of the Ministry of Agriculture of the Republic of Uzbekistan.

ACKNOWLEDGEMENTS

This activity was supported by the project "Development of biotechnology and digital skills for climate-controlled agriculture (BioDigiSkills)", Grant Agreement No. LV-57, funded by the Latvian Ministry of Foreign Affairs within the budget programme 07.00.00 "Development Cooperation Projects and International Assistance".

IMPACT OF ELEVATED CARBON DIOXIDE CONCENTRATION ON MIZUNA MICROGREEN BIOMASS, ANTHOCYANIN AND PHENOL CONTENT

ROBERTS KRUMINS*[1], RAVINDU UPETHA BALASURIYA APPUHAMIGE[2], ANTA SPARINSKA[1]

Bulduri Biotechnology Centre, Bulduri Technical school, Jurmala, Latvia[1]
Latvia University of Life Sciences and Technologies Faculty of Agriculture and Food Technology, Jelgava, Latvia[2]

roberts.krumins@bulduri.lv

Key words: microgreens, *Brassicaceae*, total phenol content, anthocyanin content, CO_2.

Microgreens are rich in vitamins, minerals, carotenoids and phenolic compounds, which are beneficial to human health. While recent studies have aimed to increase vitamin, total phenol and anthocyanin content in microgreens by altering light and temperature, the effects of elevated CO2 concentration remain understudied.

The aim of this study was to test whether elevated CO2 concentration would increase the biomass, total phenol, and anthocyanin content in *Brassicaceae* family microgreens. To achieve this aim, eight different *Brassicaceae* family microgreens were grown in normal and elevated CO2 environments. Fresh and dry mass, total phenol and anthocyanin content were measured. Additionally, the combined effects of fertilizer and elevated CO2 concentration on red mizuna (*Brassica rapa* subsp. *nipposinica* 'Red') microgreen biomass were determined. Lastly red mizuna was grown and harvested on days 11, 14 and 21 for biomass and anthocyanin determination.

Microgreens were germinated and grown in two climate chambers at a temperature of 22°C and relative air humidity 60 %. Both climate chambers were equipped with LED modules emitting white light with photon flux density of 124 µmol m–2 s–1 and a photoperiod of 16 h of day and 8 h of night.

One climate chamber had average CO2 concentration of 400 ppm and other 1200 ppm. Microgreens were irrigated with tap water or fertilizer once per day.

The results showed that elevated CO2 concentration did not increase biomass, total phenol and anthocyanin content in the eight different *Brassicaceae* family microgreens. However the acquired data about total phenol and anthocyanin content shows differences in species. Red mizuna microgreens grown with added fertilized showed a significant increase in biomass compared to those irrigated with tap water, but elevated CO2 concentration had no significant effect on biomass.

There were no statistically significant differences between harvesting days and elevated CO2 concentration. Red mizuna harvested at day 21 showed significantly lower anthocyanin content than days 11 and 14. Acquired data from this study does not align with other studies in the literature and challenge the assumption that CO2 increases plant biomass. It is hypothesized that higher light intensity may be required for plants to utilize additional CO2 in photosynthesis effectively.

ACKNOWLEDGEMENTS

The study was conducted with funding from the Latvian Ministry of Agriculture and the Rural Support Service project titled "Production of healthy planting material and testing of innovative growing methods for crops, significant for the national economy", contract number 22-00-A01612-000011.

MASTERCLASS: ETHNOBOTANICAL AND CULINARY TRADITIONS OF CENTRAL ASIA – THE CASE OF UZBEK PLOV

YIGITALY TASHPUTALOV[1], STUDENTS OF SAMARKAND STATE UNIVERSITY[1]

Samarkand State University, Uzbekistan[1]

yigitaly.tashputalov@samdu.uz

Key words: ethnobotany, culinary heritage, rice cultivation, traditional cuisine, Uzbekistan.

This masterclass explores the rich ethnobotanical background and cultural symbolism of Uzbek plov – a traditional rice-based dish central to social and festive gatherings across Central Asia. Led by Professor Yigitaly Tashputalov and students of Samarkand State University, the session combines live cooking demonstration with discussion on traditional ingredients, crop cultivation practices, and the historical evolution of plov as an element of intangible cultural heritage. Participants will gain insight into local agrobiodiversity, spice usage, and the importance of food in cultural identity preservation.

ACKNOWLEDGEMENTS

This activity was supported by the project "Development of biotechnology and digital skills for climate-controlled agriculture (BioDigiSkills)", Grant Agreement No. LV-57, funded by the Latvian Ministry of Foreign Affairs within the budget programme 07.00.00 "Development Cooperation Projects and International Assistance".