



Moldova State University
Institute of Genetics, Physiology and Plant Protection
Laboratory Natural Bioregulators

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PLANT GROWTH REGULATOR USING BEECH SEEDS AND SEEDLINGS AS AN EXAMPLE

PATENT MD 1823, Patent application number s2023 0083, application date 2023.10.09

AUTHORS: Dina ELISOVETCAIA, Raisa IVANOVA, Elena LUTCAN

PATENT APPLICATION: K. agriculture – horticulture

AIM: Expanding the range of natural substances with a regulatory effect on plant growth by using a preparation based on an extract of the needles of *Juniperus sabina* L. with a high yield of biologically active substances, as well as to develop a procedure for using a juniper-based preparation that will ensure environmental safety and availability by reducing costs.

SOLUTION: Treatment of beech seeds (*Fagus sylvatica*) before sowing. Beech seeds from different localities and different years of collection, namely Humosu-2020 (Romania), Hirjauca-2021 and Cioreshti-2021 (Republic of Moldova) were treated by immersion before sowing with the preparation based on the dry extract of *Juniperus sabina* L. Gibberellic acid was used as a classical growth regulator in a concentration of 0.01%, beech seeds treated with water served as a control. Treated beech seeds were sown in the solarium.

ADVANTAGES: The germination index of seeds treated with *Juniperus sabina* was 1.5-2.0 times higher than in seeds treated with gibberellic acid and the control (Fig. 1). The positive effect of the treatment is also maintained in the development of seedlings (Fig. 2, 3). The height of beech plants in variants treated with *J. sabina* preparation exceeded the height of control plants by 0.7-3.2 cm and was higher than in plants in the gibberellin variant (Fig. 3).



Figure 1. Beech seeds germinated by stratification in laboratory conditions



Figure 2. Beech seedlings of Humosu-2020 origin in solarium conditions

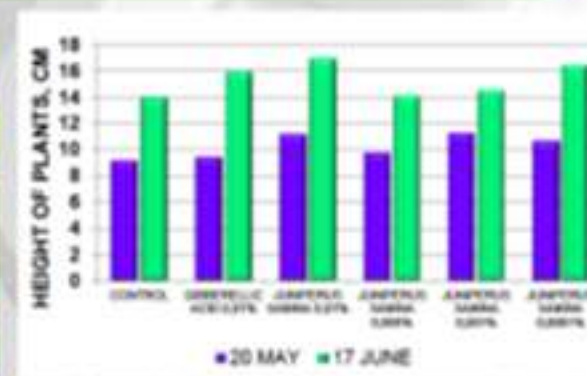


Figure 3. Growth dynamics of beech seedlings of Humosu-2020 origin (according to monitoring data)

IMPLEMENTATION STAGE: Product, greenhouse and field testing.

ACKNOWLEDGEMENTS: The research was carried out within the subprogram project 011101 "Genetic and biotechnological approaches to agroecosystem management under climate change", funded by the Ministry of Education and Research of the Republic of Moldova. The authors would also like to thank the Ministry of Education, Science, Research and Sport of the Slovak Republic for supporting Dina Elisovetcaia's project within the framework of the bilateral scholarship program for 2024-2025.



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HR EXCELLENCE IN RESEARCH

FAVOARE – NEW VARIETY OF *LAVANDULA ANGUSTIFOLIA* MILL. (LAVENDER)

PATENT: MD 426/ 2024.03.31

AUTHORS: Maria GONCEARIUC, Violeta BUTNARAS, Svetlana MASCOVTEVA, Pantelimon BOTNARENCO, Ludmila COTELEA, Zinaida BALMUS

APPLICATION FIELDS: K- Agriculture; Horticulture

AIM: Creation of a new variety of *Lavandula angustifolia* Mill. with high quality essential oil content.

SOLUTION: The invention relates to the branch of agriculture.



Lavender variety *Favoare* is a first-generation hybrid (F_1), with a high heterosis effect on a number important quantitative characters, vegetative multiplied with average vegetation period. The *Favoare* is a variety resistant to frost and winter, to diseases and drought resistant. Plant height is 68 cm. The productivity of the variety is 7.4 t/ha of inflorescences containing 2.077 % (60 % humidity) and 5.157% (dry. matter) of essential oil. The productions of essential oil constitute 155.2 kg/ha. The yields of the variety are 20.7 kg/t (of essential oil from the of fresh inflorescences).

ADVANTAGES: Production of ram maternal inflorescences -7.4 t/ha. Essential oil content – 2.077 % (60 % humidity) and 5.157% (dry. matter). Productions of essential oil constitute 155.2 kg/ha, efficiency 20.7 kg/t of essential oil per ton of fresh inflorescences.

IMPLEMENTATION STAGE: Homologate in Republic of Moldova -2024.

ACKNOWLEDGMENTS: The research was carried out within the Subprogram # 011102, *Increasing and conservation genetic diversity, agricultural crop breeding in the context of climate change*.



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HR EXCELLENCE IN RESEARCH

DIETARY SUPPLEMENT FOR THE PROPHYLAXIS OF HYPOTHYROIDISM IN CARBOHYDRATE METABOLISM DISORDERS IN RODENTS (RATTUS NORVEGICUS).

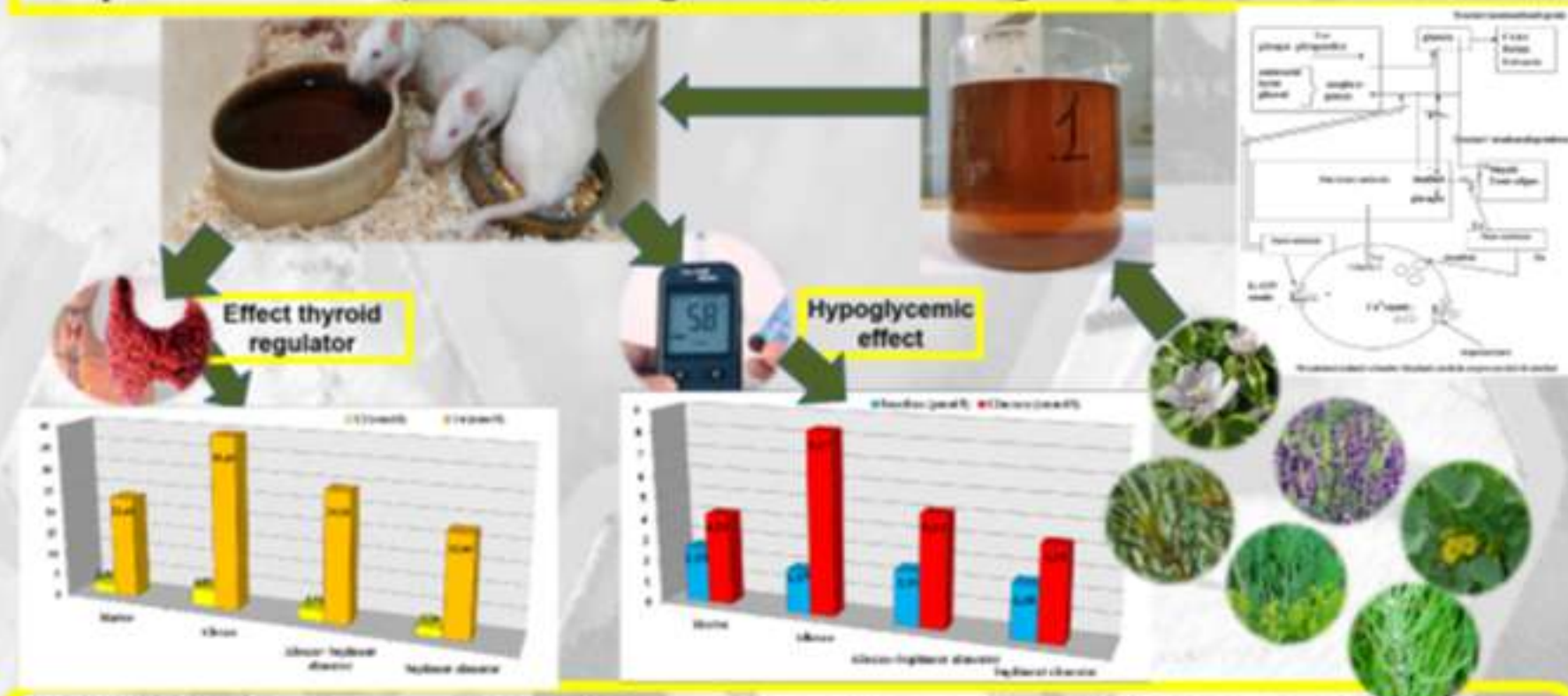
PATENT APPLICATION: A 2025 0005 din 2025.01.28

AUTHORS: Iurie BACALOV, Aurelia CRIVOI, Elena CHIRIȚA, Adriana DRUȚA

APPLICATION FIELDS: Health, Medicine, Cosmetics.

AIM: Prophylaxis of Hypothyroidism in Carbohydrate Metabolism Disorders.

SOLUTION: The present invention is a dietary supplement with homeostatic action, which ensures greater efficiency in the prevention of hypothyroidism caused by carbohydrate metabolism disorders, both by maintaining blood glucose levels and by regulating the functional state of the thyroid, which is often affected in endocrine pathologies. Thus, it maintains interglandular balance; being purer, it does not contain toxic substances and helps prevent the onset and progression of complications characteristic of both pathologies, as well as disorders of other endocrine glands. The developed dietary supplement, as a bioactive substance, contains an infusion of *Cucurbita maxima* leaves, *Hippophae rhamnoides*, *Cydonia oblonga*, and the aerial parts of *Equisetum arvense*, *Lavandula angustifolia*, *Anethum graveolens*.



ADVANTAGES: Compared to other remedies, the proposed dietary supplement has a dual effect (hypoglycemic and thyreotropic), which prevents the onset and progression of complications in carbohydrate metabolism disorders, maintains blood sugar levels, and improves the functional state of the thyroid gland, which is often dysregulated in this endocrine pathology.

IMPLEMENTATION STAGE: At the laboratory level

ACKNOWLEDGMENTS: This research subproject: 011001

Nitrate of 2,6-diacetylpyridine-bis(picolinoylhydrazone)-bis(aqua)iron(III)-hydrate(1/2.5) with stimulating properties on exocellular lipase synthesis for the *Rhizopus arrhizus* CNMN FD 03 fungal strain and nutrient medium for cultivation



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 Ciloci Alexandra³, Clapco Steliana³, Labluc Svetlana³, Matroi Alexandra³

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MD 4827

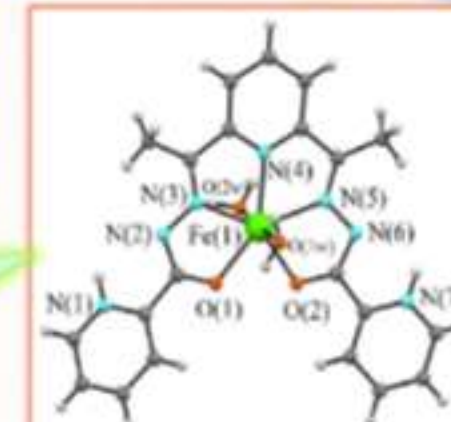
Coordination compounds derived from 2,6-diacetylpyridine (*dap*) hydrazones and transition metal ions have yielded a surprisingly rich chemistry. The *dap* ligands, due to their multicoordination sites, are capable of efficiently stabilizing the metal center by forming unique geometries.

As a result of interaction $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$ with 2,6-diacetylpyridine bis(picolinoylhydrazone) (H_2L) (molar ratio of 1:1) in methanol under refluxing (4 h), mononuclear coordination compound $[\text{Fe}(\text{H}_2\text{L})(\text{H}_2\text{O})_2](\text{NO}_3)_3 \cdot 2.5\text{H}_2\text{O}$ was synthesized.

The coordination polyhedron of the metal cation represents pentagonal bipyramid formed by N_3O_4 set of donor atoms going from the pentadentate Schiff base ligand and two oxygen atoms of the coordinated H_2O molecules.

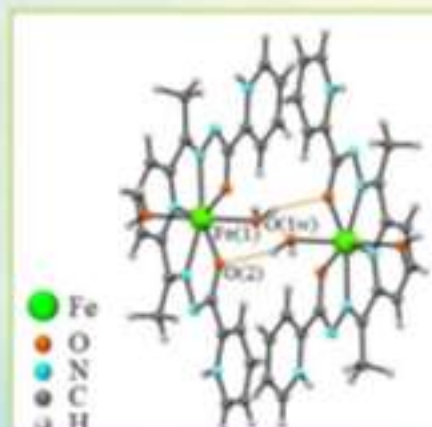
FeN_3O_4

$\text{Fe(1)-N(3)} = 2.186(2) \text{ \AA}$; $\text{Fe(1)-O(1)} = 2.0717(19) \text{ \AA}$;
 $\text{Fe(1)-N(4)} = 2.196(2) \text{ \AA}$; $\text{Fe(1)-O(2)} = 2.0842(19) \text{ \AA}$;
 $\text{Fe(1)-N(5)} = 2.185(2) \text{ \AA}$; $\text{Fe(1)-O(1w)} = 1.9979(19) \text{ \AA}$;
 $\text{Fe(1)-O(2w)} = 2.0393(19) \text{ \AA}$.



The compound $[\text{Fe}(\text{H}_2\text{L})(\text{H}_2\text{O})_2](\text{NO}_3)_3 \cdot 2.5\text{H}_2\text{O}$ was investigated by X-ray diffraction. It was established, that crystals consists from complex mononuclear cations $[\text{Fe}(\text{H}_2\text{L})(\text{H}_2\text{O})_2]^{3+}$, NO_3^- anions and solvated water molecules.

The complex is highly soluble in water, which ensures a practical use as a component of nutrient mediums.



Rhizopus arrhizus
 CNMN FD 03

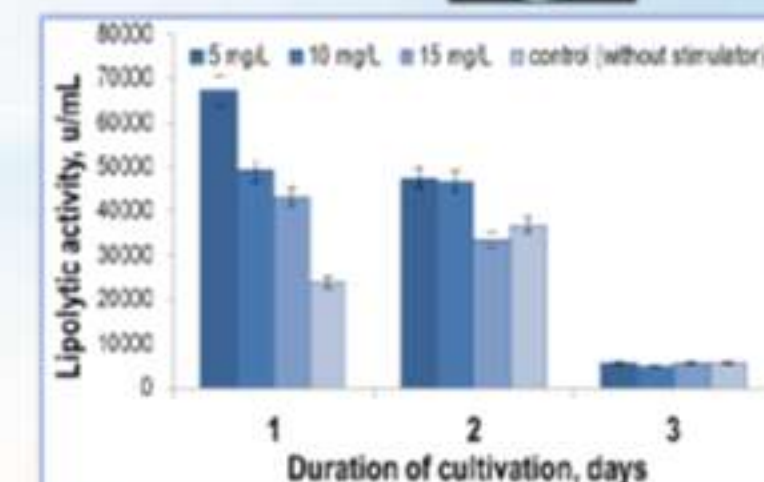


ADVANTAGE

The addition of coordination compound $[\text{Fe}(\text{H}_2\text{L})(\text{H}_2\text{O})_2](\text{NO}_3)_3 \cdot 2.5\text{H}_2\text{O}$ to the nutrient medium of *Rhizopus arrhizus* CNMN FD 03 fungal strain, in concentration of 5.0...15.0 mg/L increases biosynthesis of lipases with 17.4 – 82.7%, depending on the concentration and reduces the producer's cycle of cultivation by 24 h. Thus, the highest values of lipase activity were found at the first day of growth, while in the control (without stimulator) the maxim of activity was revealed on the second day. The most effective concentration for enzyme production was 5.0 mg/L.

APPLICATION

Industrial microbiology



Acknowledgments

The authors are grateful for the subprograms financed by the Ministry of Education and Research of R. Moldova 010602, 011202 and 020101.



Ti AND TiO₂ EPITAXIAL LAYERS FOR PHOTOVOLTAIC DEVICES

PATENT, PATENT APPLICATION OR RESEARCH PROJECT NUMBER:
MD4772/2022.05.31; MD1740Z2024.08.31; Decision granting the patent no.
1059 of 2025.03.14; MEC subprogram 011207

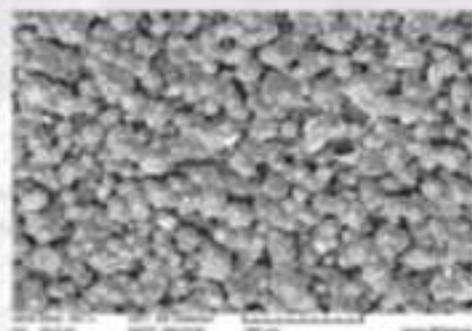
AUTHORS: Leonid GORCEAC, Vasile BOTNARIUC, Simion RAEVSCHI, Petru CHETRUS, Elena BERCU, Sergiu VATAVU

APPLICATION FIELDS: Optoelectronics. Unconventional energy sources.

AIM: Preparation of epitaxial layers of Ti and TiO₂ for photovoltaic devices (solar cells, photodetectors, etc.)

SOLUTION: The application of CVD (chemical vapor deposition) and HVPE (hydride vapor phase epitaxy) methods in separate flows of Ar and O₂ and respectively H₂ and HCl (gas) allowed the preparation of epitaxial layers of Ti and TiO₂ at deposition temperatures of 800÷850°C and 400°C.

RESULTS: 1. TiO₂ epitaxial layers; 2. ITO - TiO₂ - InP heterojunctions for photovoltaic cells and photodetectors in the visible region of the spectrum; 3. Ti epitaxial layers, SEM image (fig) and electrical parameters (table) for GaN ohmic contacts (photovoltaic devices).



SEM image of Ti layer (800°C),
on GaN/AlGaIn/Al₂O₃ support

Technology	Support	Deposition T, °C	Electrical parameters		
			R, Ω/□	n·10 ⁻²¹ , cm ⁻³	μ, cm ² V ⁻¹ S ⁻¹
HVPE (hybride vapor phase epitaxy)	Si (111)	850/1000	200	4,5	10
	GaN/AlGaIn/Al ₂ O ₃	800/850	3,0	4,6	80
	GaN/AlGaIn/Al ₂ O ₃	500/850	2,6	1,1	90
	GaN/AlGaIn/Si	700/850	5,0	14	5
	GaN/AlGaIn/Si	800/850	3,5	36	7

ADVANTAGES: The application of CVD and HVPE technologies allowed the preparation of Ti and TiO₂ epitaxial layers for enhancing photovoltaic devices parameters based on InP and GaN compounds with increased resistance to corpuscular radiation.

IMPLEMENTATION STAGE: Laboratory scale

ACKNOWLEDGMENTS: This research was supported by the MEC subprogram 011207



A SYSTEM OF INDICATORS FOR ASSESSING THE CONTRIBUTION OF AGRIBUSINESS TO THE SUSTAINABLE USE OF LAND AS AN ECOSYSTEM ASSET IN THE CONTEXT OF OVERCOMING THE ENVIRONMENTAL CRISIS

AUTHORS: Irina GOLOCHALOVA, Maria COJOCARU

APPLICATION FIELDS: Energy and Environmental Protection

V

AIM: Development of a system of key indicators of the interaction between agribusiness and land as a core ecosystem asset for assessing its condition and the contribution of agribusiness to overcoming the environmental crisis.

SOLUTION: The proposed indicator system, incorporating monetary valuation of land condition and agribusiness contributions to sustainability, integrates into financial reporting and provides a foundation for strategies addressing the environmental crisis.

Table. Set of Statistical Indicators for Assessing the Condition of the Ecosystem and the Contribution of Agribusiness to Its Maintenance

n/n	Indicator	Qualification of ecosystem condition indicators					Base of calculation	Originality
		Factors	Indicators	Impacts	Consequences	Adaptation		
1	Loss of land covered by natural vegetation, hectares	+					SEEA: Earth as an ecosystem	1
2	Total greenhouse gas (GHG) emissions resulting from agribusiness, thousand t CO ₂ -e	+	+				SEEA: Emissions into the atmosphere	
3	GHG emission intensity resulting from production, thousand t CO ₂ -e: • from fuel combustion • from land use changes	+	+				SEEA: Emissions into the atmosphere (monetary valuation is difficult)	
4	Carbon stocks in soil, thousand t CO ₂ -e			+			SEEA: Complexity of carbon accounting (monetary valuation is difficult)	2
5	The ratio of degraded land area to total land area, %			+			SEEA: Earth as an ecosystem	
6	Direct losses in agribusiness caused by ecosystem degradation (natural climate disasters), thousand USD (equivalent)			+			SEEA: Secondary ecosystem resources	
7	Share of expenditures on disaster risk reduction, %				+		Accounting data	3
8	Share of expenditures on resource and transportation taxes in the total volume of taxes and social security contributions, %				+		Accounting data	
9	Total volume of subsidies and similar transfers related to ecosystem degradation, thousand USD (equivalent)				+		Accounting data	
10	Net emissions (absorption of dioxide by soil), thousand t CO ₂ -e				+		SEEA: Complexity of carbon accounting (monetary valuation is difficult)	
11	Investments in productive and sustainable farming methods, thousand USD (equivalent)				+		Accounting data	
12	CAPEX and OPEX for the adoption of productive and sustainable farming methods, thousand USD (equivalent)				+		Accounting data	
13	Cost savings from implementing adaptive measures for productive and sustainable farming methods, thousand USD (equivalent)				+		Accounting data	
14	Share of agricultural land area where productive and sustainable farming methods are used, %				+		SEEA: Earth as an ecosystem	

ADVANTAGES: It substantiates the need for a set of indicators subject to monetary measurement in order to obtain information on changes in the condition of ecosystem assets and to assess the contribution of agribusiness to overcoming the environmental crisis. It demonstrates the interconnection between statistical indicators, the SEEA, and the accounting system. It serves as an argument in favor of developing a socially oriented methodology of accounting and reporting. It contributes to the formation of a reporting information field that enables agribusiness investors to assess risks when making environmental decisions.

IMPLEMENTATION STAGE: Certificate of Registration of Copyright and Related Rights **Seria OS** No. 8026 dated 07.10.2024 entitled "The Matrix of Indicators for Recognizing Agribusinesses' Ecosystem Assets: Convergence of SEEA and IFRS." AGEPI, Republic of Moldova.

ACKNOWLEDGMENTS: This research is supported by the scientific project "The Model of Accounting and Reporting Changes in Agribusiness Ecosystem Assets in the Context of an Environmental Crisis", registered under number 24.80013.0807.1TR in the State Register of Projects in the field of science and innovation of the Republic of Moldova.



Ecological biotechnologies for sustainable agriculture for the recovery of pharmaceutical waste

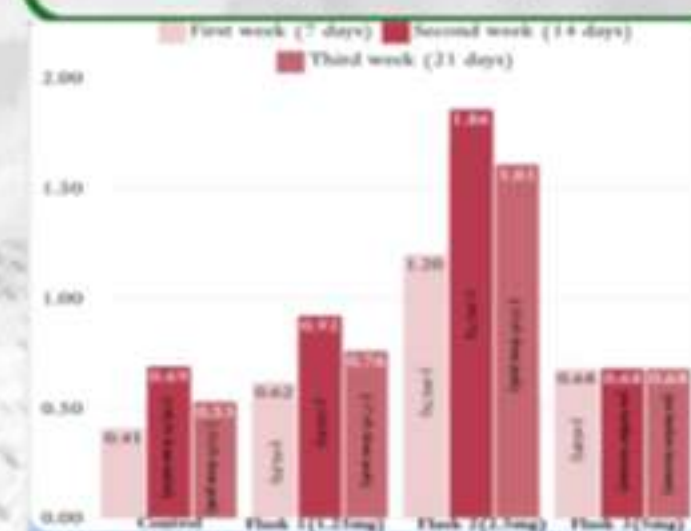
RESEARCH PROJECT NUMBER: RVEMAF 010102

AUTHORS: DR. ALINA TROFIM, FABIOLA PAVLOV

APPLICATION FIELDS: ECOLOGY, AGRICULTURE, BIOTECHNOLOGY, BIOREMEDIATION

AIM: To develop a reliable cyanobacteria-based biotech for recycling expired psychotropic medicines containing benzodiazepines and reuse its resulting recycled biomass as a powerful biostimulant in biotechnology and agriculture.

SOLUTION: Nostoc sp. heavily contributes to the bioremediation of the toxic pharmaceutical waste of benzodiazepines. The medium concentration preforms best during a time period of 7-14 days having the highest biomass growth yield. The liquid extract of the metabolites recycled via Nostoc sp. contains glycoproteins and shows extraordinary results in germinating tomato, cucumber, radish and basil seeds etc.



Growth trends of the Nostoc sp. biomass administered with pharmaceutical waste



Resulting biomass aspect and biochemical composition (UV-Vis)



Resulting germinated seeds that have been administered biomass stimulant

ADVANTAGES: The results of this research project can be used in the recycling of pharmaceutical waste that contains benzodiazepines that allows for a cyclic reuse of the remediated biomass the agricultural sphere. It is both eco-friendlier and more advantageous both economically and ecologically than the classical incineration method as well as opens the window for long term agricultural reuse.

IMPLEMENTATION STAGE: *Pilot*

ACKNOWLEDGMENTS: The following research has been conducted in the subprogram : RVEMAF 010102



New biotechnology with the valorization of cyanobacteria in the creation of biostimulants used in agriculture

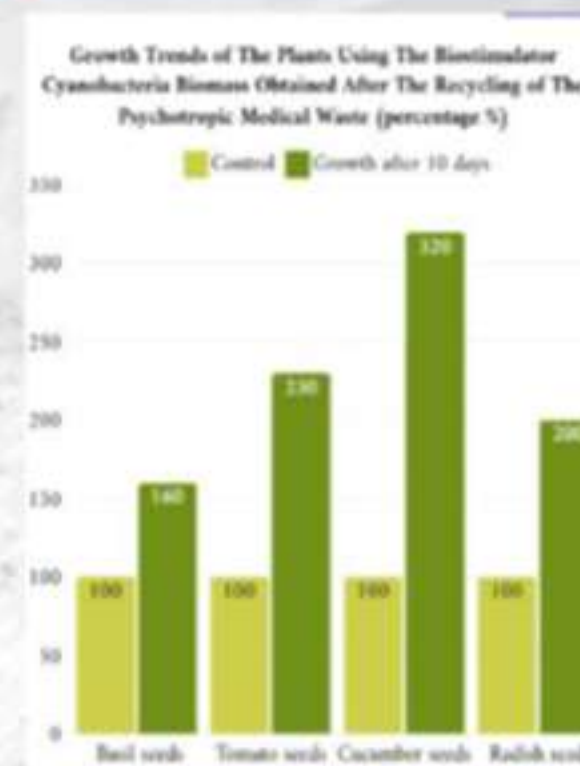
RESEARCH PROJECT NUMBER: RVEMAF 010102

AUTHORS: DR. ALINA TROFIM, FABIOLA PAVLOV

APPLICATION FIELDS: AGRICULTURE, BIOTECHNOLOGY

AIM: To develop a reliable cyanobacteria-based biotech for sustainable agriculture that uses the cyanobacteria biomass Nostoc halophilum to accelerate the growth of seedling growth/germination.

SOLUTION: The cyanobacteria Nostoc halophilum extract contributes to the accelerated germination of sunflower, corn, cucumber, tomato, basil, radish etc. seeds almost twice the size compared to the control samples that were not administered the biostimulant.



Resulting biostimulant extracted from the cyanobacteria biomass



Germinated plantules under the cyanobacteria based biostimulant



ADVANTAGES: This research provides a biological and eco-friendly method in sustainable agriculture that provides a biostimulant that has a 4-6 times higher growth rates than the control samples.

IMPLEMENTATION STAGE: *Pilot*

ACKNOWLEDGMENTS: The following research has been conducted in the subprogram : RVEMAF 010102



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A NEW VARIETY OF ORNAMENTAL PLANTS: *Hemerocallis x hybrida* 'COSÂNZEANA'

PATENT APPLICATION : V2024 0017 of 2024 08.19

AUTHORS: MANOLE Svetlana, Ph.D.; SÎRBU Tatiana, Ph.D.; ȘABAROV Doina

APPLICATION FIELDS: ENVIRONMENT , CONSERVATION OF BIODIVERSITY,
PLANT BREEDING, HORTICULTURE.

AIM: obtaining new more prolific and resistant varieties under native conditions.

DESCRIPTION: Rhizome perennial plant with abundant radical foliage: linear, light green, lines leaves about 50 cm. They grow about 80-100 cm tall in the flowering stage. It has simple funnel-shaped flowers, wide open, acuminate petal lobes. The diameter of the flower is about 14-17 cm. Internal tepals are intensely pink-reddish with cherry red spots at the base (173 CD; 178 BCD) and golden in the center (14 ABC). The external tepals are light brick-brown, tinged with burgundy (168 CD; 172 CD). The colors vary depending on the phase of flower development and light intensity. The inflorescence has 3-6 branches, each with 6-8 fragrant flowers. 5-7 year old plants form 12-18 flower stalks. The flowering stage extends from June to July, sometimes into early August. It lasts about 60 days. The variety can grow in sunny and half-shaded areas. It is undemanding towards soil, but prefers rich, well-irrigated substrate. The plants are very resistant to pathogens and pests. Universal variety with multiple uses: for cut flowers in various floral decorations, in landscape planning: flower beds, mixed flower beds, solitary groups, on the banks of water basins; can be promoted as a container plant.



ADVANTAGES: The variety created under the local pedoclimatic conditions have valuable decorative indices, is resistant to pollution, pathogens and pests. Being a perennial, polycarpic plant, it has a viability of about 20 years, if the requirements are respected. It is a prolific cultivar and can be multiplied vegetatively. It also forms seeds, so it can also be used in selection works.

IMPLEMENTATION STAGE: At the laboratory level.

ACKNOWLEDGMENTS: The research was conducted within the project 010101 "Research and ex situ and in situ conservation of plant diversity in the Republic of Moldova"

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A new winter common wheat variety (*Triticum aestivum* L.) – Bijuteria Zambrenilor

GORE Andrei, ROTARI Silvia, LEATAMBORG Svetlana, LUPASCU Galina,
JELEV Natalia, PLATOVSCHII Nicolai, ZDIORUC Nina

PATENT APPLICATION: MD v2022 0019 / 2022.11.04

APPLICATION FIELDS: Agriculture.

AIM: The obtaining of a variety of common winter wheat with high productivity, quality and resistance to adverse environmental factors by the individual selection method from the Moldova 5 spontaneous hybrid.

SOLUTION: The Bijuteria Zămbrenilor variety was obtained through individual selection from the spontaneous common wheat hybrid Moldova 5 for 7 years. The variety is part of the *Lutescens* variety. The height of the plants – 70-85 cm. The spike is white, medium length (9.0–10.5 cm), the grain – red, the weight of 1000 grains – 36-40 g, the number of grains in the spike varies from 40 to 60, contains 13.0–13.6% protein and 26–28% gluten. The variety is mid-early, the vegetation period – 270-275 days. It has good biochemical and baking qualities. The variety is included in the Catalog of Plant Varieties of the R. of Moldova, years 2025.



Advantages: The variety is productive and its potential of productivity reaches up 3.7-8.7 t/ha. It is more productivity than control variety Kuialnic with 0.2 – 0.7 t/ha. Tolerant to drought, wintering and the main fungal diseases (rust brown, root rot, septoriosi, fusariosi).

IMPLEMENTATION STAGE: Approved in the Republic of Moldova in 2024.

ACKNOWLEDGMENT: Research was carried out within the project # 23.70105.5107.04, funded by the National Agency for Research and Development of Republic of Moldova.



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THE RED DYE BETACYANIN FROM THE BERRIES OF POKEWEED
(*Phytolacca americana* L.) AND THE PROCESS FOR ITS OBTAINING

PATENT MD 1817 Patent application number s2024 0046, application date 2024.04.30.

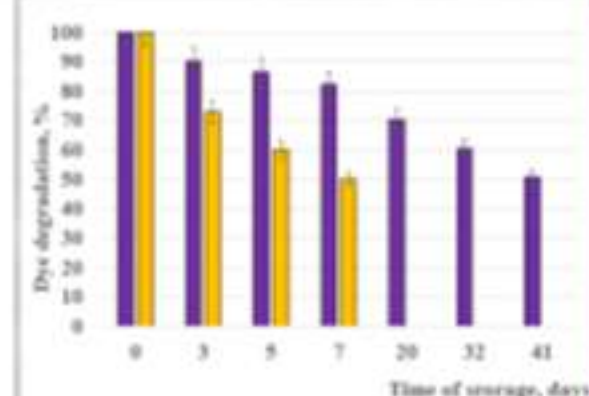
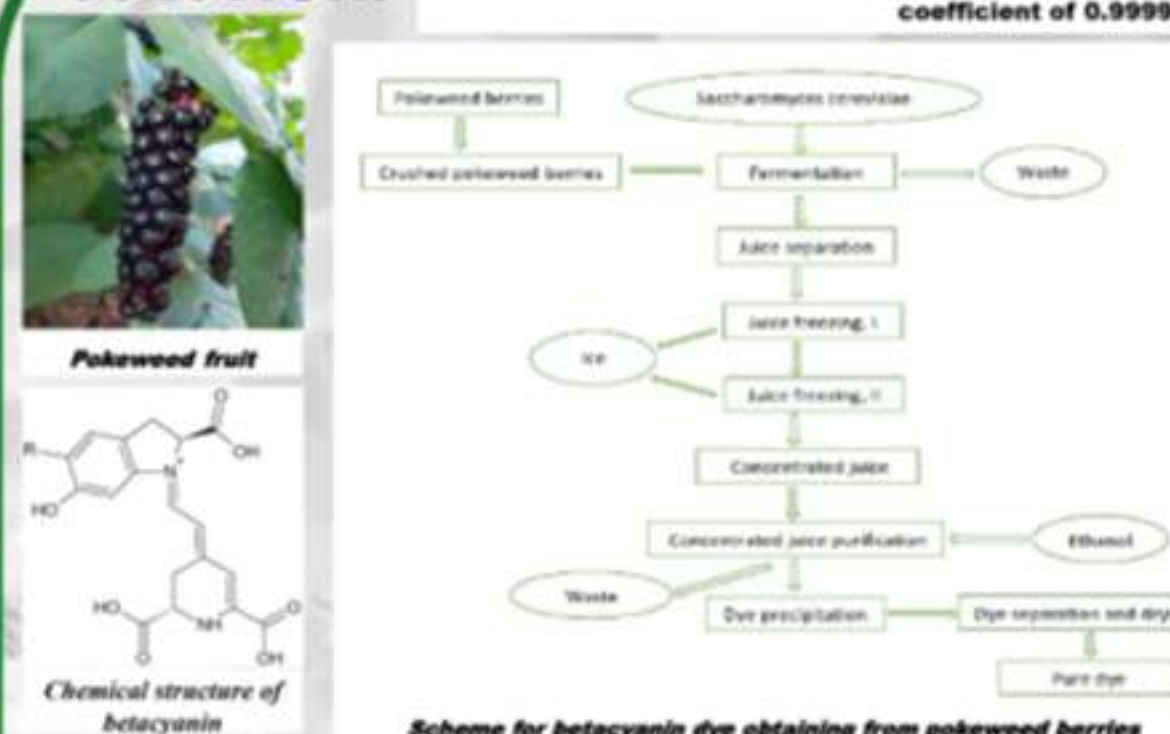
AUTHORS: Raisa IVANOVA, Igor CASIAN, Ana CASIAN

APPLICATION FIELDS: Agriculture, food, pharmaceutical and cosmetic industries.

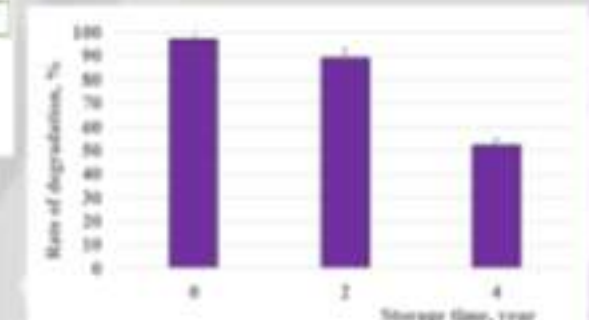
AIM: To obtain a natural red dye from inexpensive raw materials, beneficial use of invasive plants, particularly *Phytolacca americana* L.

SOLUTION:

By proposed scheme, a dark purple powder is obtained with a content of 14.0-18.0% betacyanin, which dissolves well in water. In the concentration range 0...0.10 g/L, the calibration curve of the absorption dependence on concentration has high linearity coefficient of 0.9999.



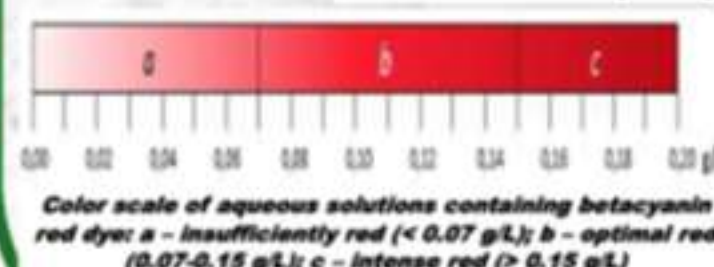
Dye degradation in aqueous solutions (1.0-1.2 g/L) at different storage temperatures: * - 4°C; □ - 30°C



Degradation of betacyanin dye in the powder form at temperature of 18-20°C.

Aqueous solutions of dye with concentration 1.0-1.2 g/L at temperature of +4±2°C lost up to 50% of its initial content during 38-40 days, at 30±1°C - 6-7 days, but at a temperature of +40±1°C within 46-50 hours of storage.

The red dye powder is stable at room temperature +18-20°C for 24 months; the dye lost only 10% of its initial content.



ADVANTAGES:

- > The sedimentation and purification of the dye by separating the ballast substances with the application of ethyl alcohol, which is approved for use in the food, cosmetic and pharmaceutical industries, allows obtaining the harmless finished product; this scheme is based on the use at different stages below freezing temperatures (-18...-25°C), low temperatures for sedimentation and purification (+4±2°C) and moderate positive temperatures in the dehydration process of the dye (40±2°C) which protected the betacyanin from thermal degradation and ensured the stability of the color during the dye storage;
- > the developed technological scheme eliminates the need to use dye stabilizers.

IMPLEMENTATION STAGE: product, laboratory research

ACKNOWLEDGMENTS: Research was carried out within the Subprogramme 011101, funded by the Ministry of Education and Research of the Republic of Moldova. The authors would also like to thank the Ministry of Education, Science, Research and Sport of the Slovak Republic for supporting Raisa IVANOVA's project within the framework of the bilateral scholarship program for 2024-2025.



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STRAIN *LECANICILLIUM LECANII* FUNGI STRAIN FOR THE CONTROL OF PESTS AND PHYTOPATHOGENS IN PROTECTED LAND

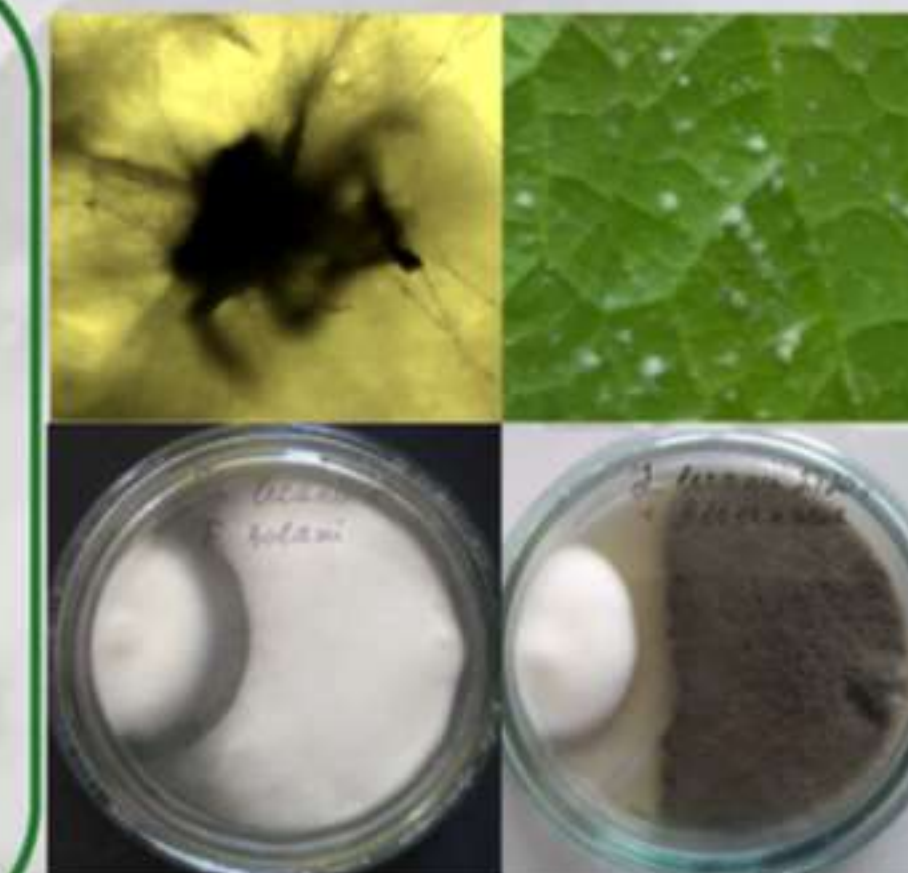
PATENT NUMBER: MD 4922 B1 / 2025.05.31

SCERBACOVA Tatiana, VOLOSCIUC Leonid, LUNGU Andrei

APPLICATION FIELDS: Agriculture

AIM: A new strain of the hyphomycete *Lecanicillium lecanii* for the production of a biological product to protect plants from sucking pests and a complex of phytopathogens in protected land

SOLUTION: The insecticidal activity of the spore suspension of *L. lecanii* on the 14th day at a concentration of 1×10^6 spores/ml against *Aphis gossypii* was 92,7%. The acaricidal activity against *Tetranychus urticae* at this concentration was 93,5%. The strain exhibits fungicidal activity against pathogens of fungal plant diseases: *Fusarium gibbosum*, *F. oxysporum*, *Fusarium solani*, *F. sporotrichioides*, *Sclerotinia sclerotiorum*, *Thielaviopsis basicola* et al. In a double culture with pathogens on agar medium, sterile zones with a radius of 5-16 mm are formed.



ADVANTAGES: The invention will enable protective measures to be taken against mites, sucking pests (aphids), and phytopathogens in closed ground conditions simultaneously.

IMPLEMENTATION STAGE: The biological product based on the hyphomycete *L. lecanii* is currently undergoing registration in the State register of phytosanitary products of the Republic of Moldova.

ACKNOWLEDGMENTS: Research was carried out within the subprogram 011103: "Development of environmentally friendly means of reducing the impact of harmful organisms on agricultural crops against the background of climate change".



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Ecological chemistry



WE EXCELLENCE IN RESEARCH

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Process for modifying cross-linked ionic polymers containing R₄N⁺ groups with Cr(III) compounds

PATENT, PATENT APPLICATION OR RESEARCH PROJECT NUMBER: 2624

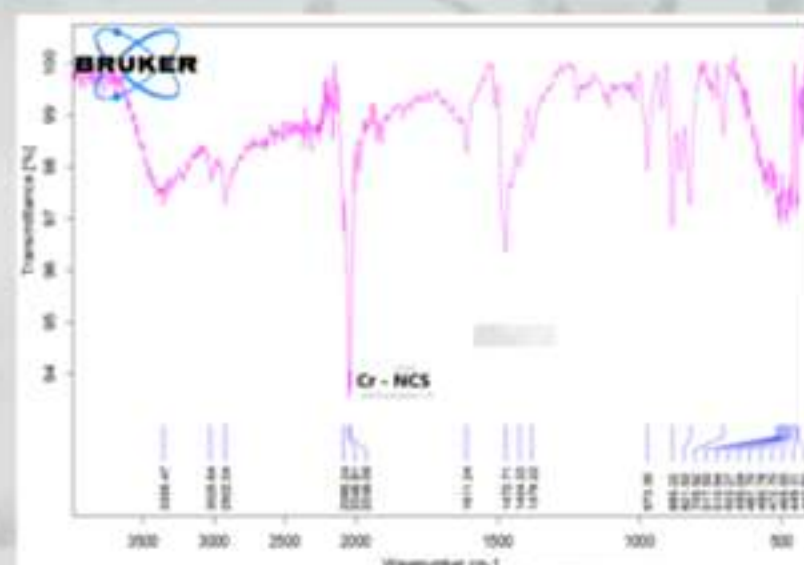
AUTHORS: Gutsanu Vasile, Botnaru Maria

APPLICATION FIELDS: Chemistry – Environment – Substances separation

AIM: Obtaining a new sorbet (catalyst) with selective properties.

SOLUTION: Loading commercial cross-linked polymer containing strongly basic groups with Cr(III) compounds under certain conditions.

Solution	Na ₂ CO ₃	KCl	NaNO ₃	Na ₂ SO ₄	NaF	Na ₂ S
Solutions with a concentration of 0.001M						
pH ₀	8.79	5.74	5.46	5.65	5.53	9.57
pH _f	6.95	4.46	4.43	4.48	4.63	6.34
Ds, mg Cr/g	0	Traces	Traces	Traces	Traces	0
Solutions with a concentration of 0.05 M						
pH ₀	10.01	6.00	5.46	5.76	7.30	9.87
pH _f	9.93	4.18	4.07	4.33	7.24	9.74
Ds, mg Cr/g	0	2.75	2.94	1.26	1.74	0



ADVANTAGES: The Cr-polymer composite is stable in aqueous solutions with high mineralization, has selective sorption properties in relation to some anions, the polymer is easily regenerated and can be reused to produce a new sorbent.

IMPLEMENTATION STAGE: At the laboratory level.

ACKNOWLEDGMENTS: This work was supported by the project no. 010603.



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WE EXCELLENCE IN RESEARCH

New F₁ Heterotic Hybrid Tomato INGSTAR

MD 453 2025.03.31

Milania MAKOVEI, Galina LUPASCU, Anatolie GANEA

Agriculture (cultivation in private farming and large associations for growing vegetables)

Food industry (for fresh consumption, production of juice and other tomato products)

AIM: For cultivation in film and high-tech industrial greenhouses

F₁ Heterotic hybrid tomato **INGSTAR**, with a plant of indeterminate type of growth (spⁿ). The vegetation period from mass germination of seeds to the beginning of fruit ripening is 113-117 days. The height of the main shoot is 180...250cm. The height of the first inflorescence, above 9...10 leaves, the following, every 3 leaves. Leaves are large, green to intensely green in color. Inflorescence is simple, with 6...9 flowers. The number of inflorescences on the main axis is 9...11. Fruits are round, slightly notched at the base, sometimes pointed, dark red, fleshy, with thick pericarp. Fruit mass 120-200 g. Fruits with high taste, dense, do not soften when stored, highly transportable. Fruits with a high dry matter content – 5.2...6.1% and sugar – 4.4...5.1%, as well as vitamin C – 27.7 mg/%. Sugar/acid index is 9.9. General yield – 25.7...32.9 kg/m², marketability yield – 92.2...95.9%.



ADVANTAGES: Powerful, highly productive plant with a well-developed root and vegetative system. With large, intensely red fruits. High flavor qualities (sugar/acid index - 9.9). Designed for fresh consumption, juice and other tomato products. Resistant to *Viral infections*, *Alternaria*, *Fusarium*, including *Meloidogyne incognita*. Characterized by good flowering and high fruiting in high-temperature regimes.

IMPLEMENTATION STAGE: Homologated in the Republic of Moldova in 2024 and is cultivated in associations of small and large farms

ACKNOWLEDGMENTS: The research was carried out within the Subprogram 011102, financed by the Ministry of Education and Research

ORGANIZATOR



MEMBRĂ A



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FLORA OF BESSARABIA, vol. V

PATENT NUMBER: ISBN: 978-9975-47-235-7

AUTHORS: A. NEGRU, Valentina CANTEMIR, V. GHENDOV, Gh. GÎNJU, Stela GÎNJU, Olga IONIȚA, Tatiana IZVERSCAIA, P. PÎNZARU, Elena TOFAN-DOROFEEV

APPLICATION FIELDS: protection of the environment, conservation of plant diversity

AIM: investigating the vascular plants in the spontaneous flora of the Republic of Moldova

DESCRIPTION: The monographic work "Flora of Bessarabia", vol. V includes the general characterization of families, genera and species of vascular plants (341 species, 98 genera, 5 families of the Magnoliophyta phylum), recorded in the spontaneous flora of Bessarabia. The species, included in the volume - 544 pages, are accompanied by synonyms, detailed descriptions of morphological, biological and ecological characters, general distribution, areas of use, as well as their original drawings. The conservation status of rare species is also indicated. The monograph "Flora of Bessarabia" (vol. V, 2022) is edited in 1000 hard copies and distributed through the international book exchange of the "A. Lupan" National Library to the main botanical institutions throughout the world, as well as to the educational institutions of the Republic of Moldova.



ADVANTAGES: The monograph edited for the first time in the republic contributes to: the improvement of the legislation regarding the conservation of rare plants; elaboration of the Cadastre of the vegetal world; development of the activities of education and information of the population regarding the conservation and protection of the environment.

IMPLEMENTATION STAGE: Monography. The book will serve as a scientific and informational foundation for pupils and students, teachers, in order to carry out training programs, education and conservation of floristic diversity.

ACKNOWLEDGMENTS: The research was supported within the project 010101 "Research and ex situ and in situ conservation of plant diversity in the Republic of Moldova"



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SOYBEAN VARIETY PENTATA

PATENT NUMBER: MD 417 2023.10.31

AUTHORS: HARCHIUC Oleg, BUDAC Alexandr

APPLICATION FIELDS: Agronomy

AIM: The relevance of new soybean varieties for ecological agriculture is linked to the replacement of corn with soybeans in Italy, Romania, and Hungary (Lauerwald R. et al., 2023)

SOLUTION: The new Pentata soybean variety was obtained through individual selection for seasons with sufficient water supply. The upper (8 and above) tiers of Pentata soybean plants have leaves with an increased (4-5) number of leaf plates.



ADVANTAGES: the crop consists of large (up to 250 mg dry weight) yellow seeds of a uniform light color. The photosynthetic parameters of Pentata leaves are identical when measured using two different photosynthetic instruments (Lcpro-SD, ADC Bioscientific Ltd., UK and *Smart Phyto-Sensor™ Pro* PLS-10R-485M, Bio Instruments S.R.L., Republic of Moldova).

IMPLEMENTATION STAGE: INITIAL IMPLEMENTATION

ACKNOWLEDGMENTS: Funded by Subprogram 011103: "Development of environmentally friendly means of reducing the impact of harmful organisms on agricultural crops against the backdrop of climate change".



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RESEARCH PROJECT NAME: "ECO-FARMING FOR INNOVATIVE PROTECTION OF NEW WALNUT VARIETIES: HARNESSING METHODOLOGIES AND TECHNOLOGIES"

RESEARCH PROJECT NUMBER: 25.80013.5107.01TR

AUTHORS: HARCHIUC Oleg, CHISTOL Marcela, STINGACI Aurelia,
SCERBACOVA Tatiana, VOLOSCIUC Leonid

APPLICATION FIELDS: AGRICULTURE, HORTICULTURE

AIM: the methods for the identification of the best walnut varieties for ecological agriculture in walnut orchards in the Republic of Moldova

SOLUTION: Differentiation of various autochthonous and foreign walnut genotypes was based on their photosynthetic parameters (photosynthesis, transpiration) in natural walnut orchards. For example, in village Rediul de Sus (SRL "Gospodarul-Rediu") in the morning leaf transpiration was smaller for variety Pescanski than for variety Chandler and water use efficiency of Pescanski leaves was higher: $12,1 \pm 0,3$ against $8,2 \pm 0,4$ g $\text{CO}_2/\text{kg H}_2\text{O}$.



ADVANTAGES: In walnut orchards the water use efficiency of different genotypes may be established from their photosynthetic parameters. Different photosynthetic devices can be used (LCpro-SD, ADC Bioscientific Ltd., UK and *Smart Phyto-Sensor™ Pro* PLS-10R-485M, Bio Instruments S.R.L., Republic of Moldova, gave identical photosynthetic parameters).

IMPLEMENTATION STAGE: initial use of innovation

ACKNOWLEDGMENTS: Research was funded by TÜBİTAK (Turkey) and the National Agency for Research and Development (Republic of Moldova)



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UVC-IR PULSED RADIATION AS AN INNOVATIVE APPROACH TO MICROBIAL INACTIVATION

AUTHORS: Turcan Marina, Bizgan Serghei, Paslari Tatiana, Starodub Elena, Tonu Viorica, Muntean Ion and Nicolae A. Enaki

RESEARCH PROJECT NUMBERS: No. 25.80012.5007.36TC

APPLICATION FIELDS: Efficiency of radiation, decontamination.

AIM: Ultraviolet C (UVC) and infrared (IR) radiation represent distinct regions of the electromagnetic spectrum, each exerting markedly different effects on biological molecules. In this study, both microscopic and spectrometric techniques were employed for comparative analysis of the results. photo thermal damage in biomolecules beyond what either radiation could achieve independently.

SOLUTION: New promising direction for further research lies in the advanced investigation of both UV and IR domains, with particular emphasis on the synergistic effects arising from their combined irradiation. Such findings hint that coupled UVC+IR treatments might amplify oxidative or photo thermal damage in biomolecules beyond what either radiation could achieve independently.

In this study, we propose a novel research approach to evaluate the effects of UVC and IR radiation on liquid media. The results indicate enhanced efficiency when both types of radiation are applied in combination, compared to their individual application. The liquid medium was prepared in advance of irradiation (see Fig.1). After irradiation, the results demonstrated that the stained yeast colonies were inactivated, indicating the effectiveness of the combined UVC-IR treatment and providing quantitative insight into the kinetics of microbial inactivation in Fig. 2. Microscopic observations were then performed using an optical microscope at 400 $\times$ magnification to assess cell viability. Progressive increases in radiation exposure time led to a corresponding enhancement in pathogen inactivation, as shown in Fig. 3. The synergistic application of UVC and IR radiation resulted in maximal decontamination of translucent fluids with minimal energy consumption, as illustrated in Fig. 4, highlighting the efficacy of the combined irradiation approach. With increasing exposure time, a gradual decrease in absorbance is observed, confirming the effectiveness of UVC radiation, see Fig. 5. Prior to UVC treatment, the solution was subjected to a 10-s IR pre-exposure to inhibit pathogen multiplication.

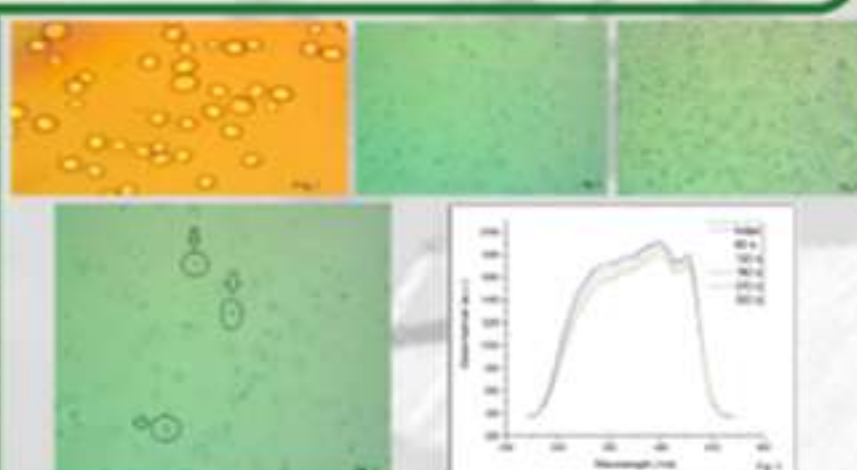


Fig. 1. The liquid medium before irradiation.

Fig. 2. The liquid medium at the time t=60 seconds after irradiation.

Fig. 3. Time-dependent inactivation of yeast cells in translucent fluids under UVC-IR irradiation.

Fig. 4. Maximal decontamination with minimal energy via synergistic UVC-IR treatment.

Fig. 5. Dynamics of pathogen inactivation as a function of UV radiation absorption.

ADVANTAGES: The results indicates the effectiveness of the combined UVC-IR treatment and providing quantitative insight into the kinetics of microbial.

IMPLEMENTATION STAGE: At the laboratory level.

ACKNOWLEDGMENTS: This research was supported by the research project:s No. 25.80012.5007.36TC; No. ANCD 24.80012.5007.26SE and subprogram code 011206.



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NEW TOMATO VARIETIES *Solanum lycopersicum* L. Desteptarea

MIHNEA Nadejda, GRATI Maria, LUPASCU Galina,
 BOTNARI Vasile, GRIGORCEA Sofia
 Plant variety patents: MD 279 / 2018.11.30

APPLICATION FIELDS: Agriculture, Horticulture

AIM: New variety of tomato, created by intraspecific hybridization, resistant to the factors of stressful temperature and *Alternaria alternata* fungus

SOLUTION: The fruits of the variety *Desteptarea* are of large size weighing – 110-130 g. The fruits contain 5.9-6.2% of dry matter, 5.3...5.9% – sugars, 22.0...26.0 mg/% – vitamin C, 0.45...0.55% – acidity. The variety is medium ripening, vegetation period is 114 days. In the transplant culture, the variety ensures a yield of 56.0...62.0 t/ha, while the standard fruit yield is high (93.0%).



Advantages: The variety *Desteptarea* harmoniously combines high productivity, good tasting qualities with the resistance to heat and *Alternaria alternata* fungus. The productivity is high at cultivation through both seeds and seedling transplants.

IMPLEMENTATION STAGE: Approved in the Republic of Moldova in 2017

ACKNOWLEDGEMENTS: Research was carried out within the project # 23.70105.5107.04, funded by the National Agency for Research and Development of Republic of Moldova.



New possibilities for pathogen inactivation using quasi periodic optical structures packed in the form of screw-shaped rotation channels upon propagation of UV-C radiation through them.

Project number: ANCD Subprogram code 011206

AUTHORS: MUNTEANU Ion, TURCAN Marina, TONU Viorica, STARODUB Elena and ENACHI Nicolae

APPLICATION FIELDS: Medicine – Food – Health – Hygiene.

AIM: Our investigation focuses on the application of different geometries of the packing elements that create the screw channels for pathogen acceleration through the elements of this metamaterial. The decontamination efficiency is related to the rotation of contaminated liquids and gases through the screw channels of the metamaterials, prepared from quartz optical fibers (or spherical elements tightly packed by the metamaterial) in the torsion configuration.

SOLUTION: Expanding the range of devices designed to inactivate pathogens using of different geometries of the packing elements (quartz balls and fibers) that create screw channels for pathogen acceleration through the elements of this metamaterial leads to an increase in the efficiency of the decontamination rate of the infected fluid.

Viruses and bacteria can enter the body not only through traditional transmission mechanisms (direct contact with other people), but recently a positive correlation has been observed between the spread of the virus and the pollution of fluids (water or air). The main idea is related to the rotation of contaminated liquids and gases through screw channels prepared from optical quartz fibres in the torsion configuration represented in fig. 1. Contaminated liquids are rotated along the flow direction. Given that the density of viruses and bacteria (or droplets, aerosols they contain) is higher than the density of liquids, the adhesion of pathogenic carriers to the rotation channels increases depending on the degree of torsion of the channels. Since the relative number of such channels in the proposed meta-material is large, the total surface area consists of the sum of the flow channel area between the fibres.

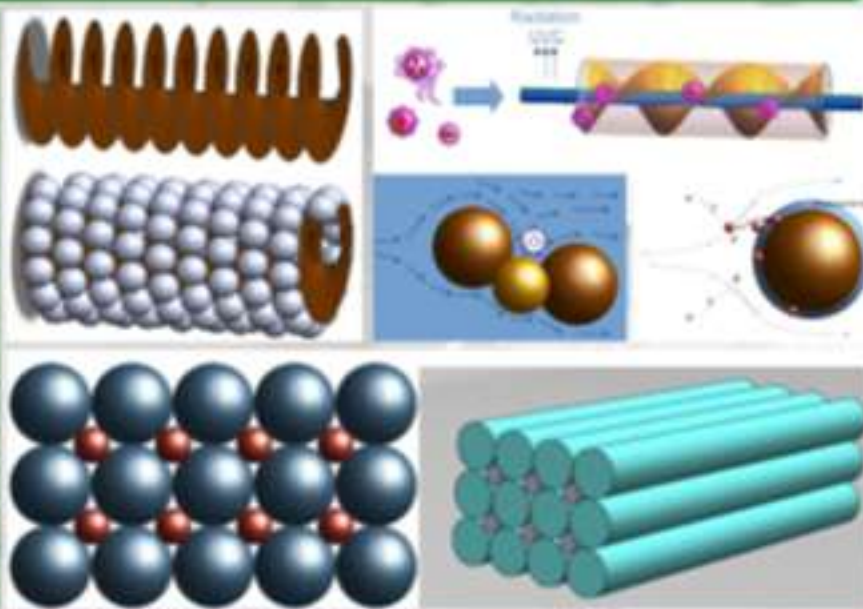


Figure 1. Shows a new method of decontamination using spheres and quartz fibers. Acceleration of pathogens around the metamaterial elements and possible turbulent flow with acceleration of pathogens in 'corks' or screw channels in the three-dimensional case. Achieving the evanescent zone of UV-C radiation of each fiber or sphere, the pathogens can be effectively inactivated.

ADVANTAGES: The advantages of this procedure consist in manipulating pathogens in the area of increased intensity of UV-C radiation which is due to the quasi-periodic optical structure packaged in the form of screw-shaped rotation channels where pathogens fall into areas of increased evanescence, therefore high doses of radiation received lead to their efficient inactivation.

IMPLEMENTATION STAGE: : At the laboratory level.

ACKNOWLEDGMENTS: This research was supported by the research project: Subprogram code 011206, Cifru 24.80012.5007.26SE.



INNOVATIVE PUREMED UV-SMART SYSTEM FOR CONTINUOUS AIR STERILIZATION AND SIMULTANEOUS DECONTAMINATION OF OBJECTS WITH IRREGULAR SURFACES

RESEARCH PROJECT NUMBER: Subprogram code 011206 /020402

AUTHORS: Ion Munteanu, Ciobanu Nelly, Gubceac Natalia

APPLICATION FIELDS: HEALTH-MEDICINE-COSMETICS

The project "Innovative PureMed UV-Smart" aims to extend the range of devices for decontamination designed for inactivation of pathogens and the development of a universal UV-C device for simultaneous sterilization of air and objects with irregular surfaces (e.g. surgical, dental instruments, measuring devices) in medical, educational and public institutions.

The compact device, with a design similar to a microwave oven, integrates a housing with reflective walls (99%), four UV-C sources positioned in the corners of the decontamination compartment, reflectors and a stainless steel holder for objects. The contaminated air is continuously purified by a filter and fan system, and a control module monitors the operation of the UV-C sources. The system operates in two modes: object decontamination (mode 1) and continuous air sterilization (mode 2), ensuring safety by blocking UV-C radiation.

The innovation consists of the strategic positioning of UV-C sources and reflective surfaces, which optimize the dispersion of radiation, significantly reducing the inactivation time of pathogens (bacteria, viruses, fungi) on irregular surfaces, compared to other devices.

The result is increased sterilization efficiency, minimizing the risk of infection and creating safer environments in hospitals, schools or public spaces.

The project includes the development of a prototype, clinical testing and scaling for various applications, such as ambulances or private practices. The expected impact is to reduce infections by 70-99%, contributing to public health and the safety of crowded environments.

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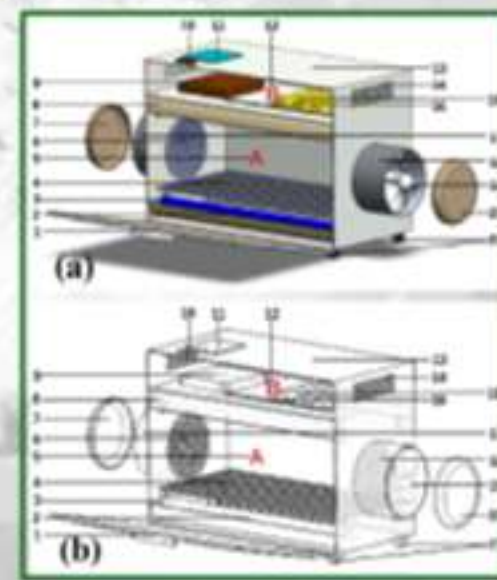


Figure 1. a) device diagram b) schematic representation of the decontamination compartment

Figure 1. includes the device housing (13), the legs (21), the door (1), the decontamination compartment A (5), the UV-C radiation sources (2), with the reflectors (8), respectively, a stainless steel support (4) is provided on which the objects subject to decontamination are placed, the inlet (17), the filter (6), the fan (19) that forces the decontaminated air to exit compartment A through the outlet (18), the covers (20) and (7) cover the holes (17) and (18), respectively, the compartment B (12) contains the electrical part such as: the set of electrical ballasts (15), the electrical wire (16) to the connector (3), providing current to the UV-C source (2), the switch (10), the control module (9) provides information about the UV-C radiation source and the working mode of the device on the monitor (11), the ventilation of compartment B is done through the holes (14).

Therefore, a bactericidal device is proposed, simple in construction, but which allows the disinfection of air in enclosed spaces but also of the surfaces of various irregular objects much more effectively compared to other devices, and due to its appearance similar to a microwave oven, it is very convenient to use.

ADVANTAGES: The advantages of this device are the significant reduction in the exposure time under the action of UV-C radiation of various objects with irregular surfaces by increasing the efficiency of the disinfection rate due to the dispersion of radiation in the decontamination chamber.

IMPLEMENTATION STAGE: At the laboratory level.

IMPLEMENTATION STAGE: At the laboratory level.

ACKNOWLEDGMENTS: This research was supported by the research project: Stimularea excelentei in cercetare 24.80012.5007.26SE. Subprogram code 011206 / 020402.



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METHODS OF COMPLEX APPLICATION OF PARA-AMINOBENZOIC ACID DERIVATIVES AND ENTOMOPATHOGENIC MICROORGANISMS FOR THE CONTROL OF HARMFUL ORGANISMS ON FRUIT AND VEGETABLE CROPS

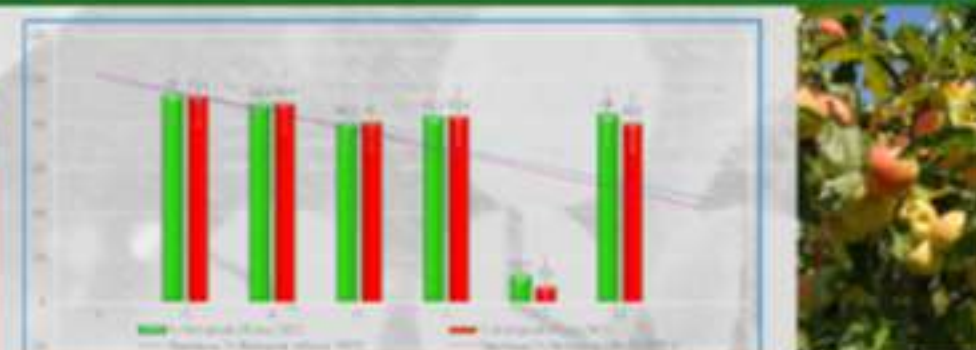
RESEARCH PROJECT NUMBER: 22.80013.5107.3BL

AUTHORS: STÎNGACI Aurelia, SCERBACOVA Tatiana

APPLICATION FIELDS: Agriculture

AIM: Establishing the possibility of using a mixture of entomopathogenic strains *Bacillus thuringiensis* subsp. *kurstaki* with para-aminobenzoic acid derivatives to determine their synergistic effect on increasing the biological efficiency of apple crops against the larvae the codling moth (*Cydia pomonella* L.).

SOLUTION: According to the data obtained from the control, the number of affected apple fruits was 91%. When the trees were treated with a suspension of *B. thuringiensis* subsp. *kurstaki*, the number of affected fruits was 19.3%, and the biological efficiency was 80.6%. The use of low concentrations of PABC 10⁻⁴ and PABC 10⁻⁶ in tank mixtures increased the protective effect, fruit damage decreased to 15.3% and 16.0%, and biological efficiency increased to 84.6% and 85.0%, respectively. Actual >F95% = 3.89 < 5.88



Variants: I- Control; II- Et. Avaunt-15EC; III- Et.biologic "Actoverm Formula", Ukraine; IV- *Bacillus thuringiensis* var. *kurstaki*+ PABA 10⁻⁴; V-*Bacillus thuringiensis* var. *kurstaki*+ PABA 10⁻⁶; VI-PABA 10⁻⁶; VII- *Bacillus thuringiensis* var. *kurstaki*

Fig. 1. Biological efficacy diagram for 2022-2023 of the bacterial suspension *Bacillus thuringiensis* var. *kurstaki* against the codling moth (*Cydia pomonella* L.), variety "Renet Simereu".



ADVANTAGES: The invention will enable measures to be taken to protect apples from the codling moth (*Cydia pomonella* L.).

IMPLEMENTATION STAGE: The biological product based on the *Bacillus thuringiensis* subsp. *kurstaki* is currently undergoing registration in the State register of phytosanitary products of the Republic of Moldova.

ACKNOWLEDGMENTS: Research was carried out within the subprogram 011103, funded by the Ministry of Education and Research of the Republic of Moldova.



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METHOD FOR THE PROPHYLAXIS AND TREATMENT OF ECTOPARASITOSE IN DOMESTIC WATERFOWL

PATENT: MD 1826 (13) Y

AUTHORS: RUSU Ștefan, ERHAN Dumitru, ZAMORNEA Maria, TODERAȘ Ion, RUSU Viorelia, MASCENCO Natalia, MELNIC Victor, GOLOGAN Ion

APPLICATION FIELDS: Veterinary Medicine, Parasitology

AIM: The invention can be used for the prophylaxis and treatment of ectoparasitoses in domestic waterfowl (such as ducks and geese), both in small-scale households and in specialized poultry farms, providing an ecological solution that is safe for humans, animals, and the environment.

SOLUTION: The procedure involves the individual immersion of birds and the complete soaking of each bird's plumage in a container with a total volume of 20.0 liters, filled with 15 liters of an aqueous solution containing the preparation Ectopalmilin 30% – a 30% hydroalcoholic extract obtained from the aerial parts of the plant *Linaria vulgaris* (common toadflax). For prophylactic purposes, the treatment is applied in a single session, while for therapeutic purposes, it is applied in two sessions, 14 days apart.

ADVANTAGES: The effectiveness of the procedure lies in achieving a maximum therapeutic effect, as evidenced by a 100% recovery rate in the treated birds. Due to the use of a natural extract, there are no restrictions on the consumption of products and by-products derived from the treated birds, making the procedure safe for animals, the environment, and humans.

IMPLEMENTATION STAGE: Implementation Act dated March 23, 2025

ACKNOWLEDGMENTS: The research was carried out within the State Program 010701 "Evaluation of the structure and functioning of biocenoses, aquatic and terrestrial habitats under the influence of biotic and abiotic factors in the context of ensuring ecological security and the well-being of the population".



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The local variety 'MARIA' of Jerusalem artichoke, *Helianthus tuberosus* L.

PATENT: MD 402 / 2023.02.28

AUTHOR: Victor ȚÎȚEI

The local variety of Jerusalem artichoke, *Helianthus tuberosus* L. 'MARIA' registered in the Catalogue of Plant Varieties (no. 0734840 /2023) and patented by the State Agency on Intellectual Property (AGEPI) of the Republic of Moldova is multi-purpose crops with food, fodder, medicinal, melliferous, ornamental and energy biomass applications.



The tubers contain 237g/kg dry matter with 10.24 % CP, 0.71% EE, 8.12% CF, 8.02 % ash, 1.6 g/kg Ca, 0.30 g/kg P, 72.90%NFE, 58.29% inulin, 5.10% starch and other carbohydrates, 11.45 MJ/kg metabolizable energy, eligible for feed, fodder and raw material for the pharmaceutical industry and biorafenary. The green mass productivity 84.5 t/ha or 18.4 t/ha dry matter with biochemical composition and nutritive value: 897 g/kg OM, 11.6 % CP, 25.1% CF, 29.2% ADF, 45.6 % NDF, 5.3 % ADL, 29.3%Cel, 16.4%HC, 24.8% TSS, 662 g/kg DMD, 12.98 MJ/kg DE, 10.66 MJ/kg ME, 6.67 MJ/kg NEI, RFV=135. The quality indices of prepared silage were: pH=3.95, 41.3g/kg lactic acid, 8.7g/kg acetic acid, 0 g/kg butyric acid, 14.5 % CP, 12.7 % ash, 29.9%CF, 31.8%g/kg ADF, 496%NDF, 3.3% ADL, 28.5%Cel, 17.8% HC, 641 g/kg DMD, 12.61 MJ/kg DE, 10.35 MJ/kg ME, 6.37 MJ/kg NEI, RFV=120. The biomethane potential of green mass and silage substrates varied from 322 to 356 l/kg ODM. The dry stalks mass for solid biofuel contains: 47.11% C, 5.51%H, 0.31% N, 0.05% S, 0.04%Cl, 1.03% ash and 18.83 MJ/kg GCV. The estimated theoretical ethanol potential from stalks mass cell wall carbohydrates averaged 571 L/t.

Financially supported, subprogram no. 01.01.02 "Identification of valuable forms of plant resources with multiple uses for the circular economy"



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The local variety 'Argentina' of Columbus grass, *Sorghum alnum* Parodi

PATENT: MD 344 / 2020.04.30

AUTHOR: Victor ȚÎȚEI

The local variety 'Argentina' has been created by individual breeding of synthetic populations of Columbus grass (perennial sorghum), *Sorghum alnum* Parodi, Poaceae family, herbaceous perennial plant with numerous tillers 250-270 cm tall. The annual productivity from three cuts reached 61 t/ha green mass or 14 t/ha dry matter.



The quality indices of harvested green mass significantly differed in dependence of the cut: 186-267 g/kg DM, 51.0-141.9 g/kg CP, 19.6-34.5 g/kg EE, 76.7.0-138.2 g/kg ash, 670-781 g/kg NDF, 440-493g/kg ADF, 45-62 g/kg ADL, 376-447 g/kg CEL, 249-315 g/kg HC, 5.2-5.3 g/kg Ca and 1.8-3.2 g/kg P, 24.00-45.59 mg/kg carotene, 10.17-11.16 MJ/kg DE, 8.35-9.16 MJ/kg ME and 4.37-5.18 MJ/kg NEI. The obtained silages were characterized by pH= 3.8-4.5, lactic acid 24.7-45.5 g/kg, acetic acid 6.3-9.1 g/kg, butyric acid 0-0.2g/kg, 7.58-9.52 % CP, 3.2-3.68 % EE, 7.72-10.76 % ash, 65.7-66.2 % NDF, 41.0-43.3 % ADF, 4.0-4.8 % ADL, 37.0-38.5% CEL, 22.9-24.7 % HC, 35.70-47.17 mg/kg carotene, 3.7-5.5 g/kg Ca and 1.8-2.7 g/kg P, 10.85-11.33 MJ/kg DE, 8.91-9.30 MJ/kg ME and 5.06-5.32 MJ/kg NEI. The prepared hay contained 84.8-111.3 g/kg CP, 12.4-14.4 g/kg EE, 110.3-113.2 g/kg ash, 661-678 g/kg NDF, 423- 442g/kg ADF, 46-49 g/kg ADL, 377-393 g/kg CEL, 236-238 g/kg HC, 4.1-4.7 g/kg Ca, 2.5-2.9 g/kg P, 4.00-7.67 mg/kg carotene with energy concentration 10.88-11.15 MJ/kg DE, 8.93-9.15 MJ/kg ME and 5.06-5.17 MJ/kg NEI. The biochemical composition of the grains: 10.1 % CP, 4.5 % EE, 10.5 % CF, 70.2 % NFE, 4.7 % minerals. The gas forming potential of fresh and silage mass substrates were 546-680 l/kg; the methane yield was 279-350 l/kg; the annual methane productivity achieved 4198 m3/ha.

The specific density of solid biofuel 783 kg/m3 of briquettes and 1008 kg/m3 of pellets, 2.73-3.71 % ash content, potential of energy production 190-270 GJ/ha, equivalent to 6.5-9.2 t coal or 4.6-6.4 t conventional oil. The dry stalks mass was characterized by optimal content of cellulose and hemicellulose with theoretical ethanol yield 560 l/t dry matter.

The variety 'Argentina' is useful in phyto-amelioration of salt-affected land, eroded land and phytoremediation of contaminated land.

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The local variety 'MARIA' of Jerusalem artichoke, *Helianthus tuberosus* L.

PATENT: MD 402 / 2023.02.28

AUTHOR: Victor ȚÎȚEI

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Procedeu și instalație de epurare biologică a apelor uzate menajere cu nitrificare și denitrificare simultană

VIȘNEVSCHI Alexandru
Brevet de invenție MD-1807. 2024

DESCRIEREA

Procedeu și instalația elaborate au fost implementate pe o linie de tratare a apelor uzate la stația de epurare din or. Căușeni, Republica Moldova, având un debit proiectat de 1.200 de m³/zi. Provocarea tehnică rezolvată constă în eliminarea necesității utilizării unui suport suplimentar plutitor pentru biofilm (precum nisip sau particule de cărbune activ) și a surselor externe de carbon (metanol, acetat etc.) pentru denitrificare.

Soluția se bazează pe utilizarea coconilor conglomerati ai peliculei biologice, care:

- Cresce concentrația masei microbiene, utilizând surse interne de carbon rezultate din liza și hidroliza microorganismelor din spațiul intracoccal;
- Favorizează procese simultane de nitrificare în zone oxice și denitrificare în zone anoxice, susținute de un mediu anaerob în centrul flocului;
- Permite fermentația și descompunerea materialelor organice complexe în compuși simpli, utilizabili de microorganismele exterioare.

Pentru a demonstra simultaneitatea proceselor de nitrificare și denitrificare în apele uzate în cadrul unui singur flux aerat al stației de epurare a apelor uzate din or. Căușeni, fără a delimita zonele oxice și anoxice, a fost calculată eficiența fiecărui proces la diferite temperaturi.

Nr.	Temp.	CCO _{Cr}	CCO _{Cr}	N-NO ₃	N-NO ₂	N-NH ₄	N-NH ₄	Eff N-NH ₄	Eff N
	°C	gO ₂ /m ³	gO ₂ /m ³	g/m ³	g/m ³	g/m ³	g/m ³	%	%
1	9.1	462	109.3	42.9	6.8	82.5	16.5	80.0	19.8
2	10.2	535.7	118.2	36.5	4.6	65.7	2.26	96.6	34.0
3	15.1	522.6	116.4	42.5	0.05	70.4	0.66	99.1	38.6
4*	15.9	556.8	93.1	12.1	0.19	49.5	2.41	95.2	70.2
5	17.3	616.2	99.1	1.65	8.11	103.3	7.9	92.4	82.9
6*	17.6	488.3	73.2	16.7	0.11	69.0	0.72	98.9	74.1
7	20.8	493.7	96.6	5.32	0.03	65.3	0.43	99.3	91.1
8*	20.4	341.1	29.5	6.3	0.11	61.2	0.62	98.8	88.6
9	25.4	622.5	64	13.4	0.45	79.8	0.94	98.8	81.5



Coconi aglomerați de microorganisme colectați din fluxul ciclului tehnologic la linia experimentală a stației de epurare din or. Căușeni.

AVANTAJELE

Eficiență crescută: Nitrificarea atinge o eficiență de până la 99.3%, iar denitrificarea variază între 38.6% și 91.1%, în funcție de temperatura apelor uzate.

Integrare facilă: Elimina necesitatea surselor externe de carbon și permite integrarea ușoară în instalații existente.

Reducerea deșeurilor: Procesul minimizează volumul de nămol activ în exces generat, sporind sustenabilitatea operațională.

APROB:

Directorul
Apă-Canal Căușeni LM.

Alexandru Gălcă

15 octombrie 2024

APROB:

Directorul
Metalia SRL.

Schivu Dumitru

15 octombrie 2024

APROB:

Directorul
Direcției Institutului de Chimie al
Universității de Stat din Moldova

Dr. hab. Anghela ARICI

15 octombrie 2024

de implementare a "Procedurii și instalației de epurare biologică a apelor uzate menajere cu nitrificare și denitrificare simultană" la stația de epurare din orașul Căușeni



Research project name: THE THERMODYNAMIC ELUCIDATION AND PREDICTION OF CHEMICAL SYNERGISM IN COMPLEX CHEMICAL PROCESSES

Research project number: 20.80012.5007SE

AUTHORS: dr. hab. POVAR Igor, SPINU Oxana

SOLUTIONS:

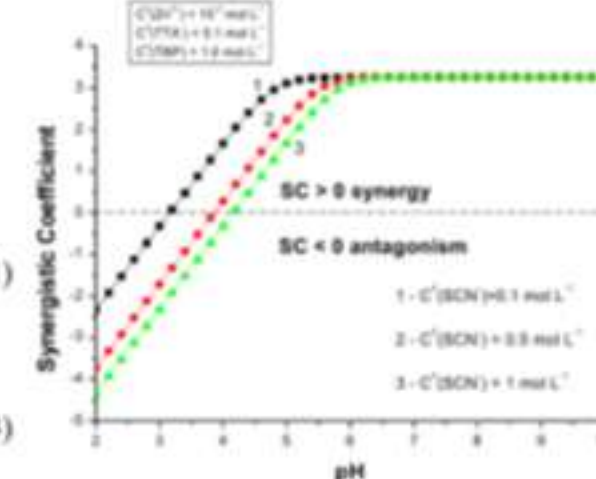
A rigorous thermodynamic approach to complex chemical equilibria is applied for the first time to theoretically predict synergism and antagonism phenomena in multicomponent two-phase liquid – liquid systems. Solvent extraction is widely used for separating and purifying metals, as well as in wastewater treatment, soil remediation, and various chemical industries. The developed methodology centers on a **generalized reaction equation (GRE)** that accounts for simultaneous reactions in both phases, enabling the evaluation of conditions under which synergism and/or antagonism occur. This methodology enables the evaluation of experimental conditions under which synergism and antagonism phenomena occur during the chemical process. A key conclusion emerging from our analysis is that if the neutral ligand *A* does not participate in complexation, or forms only very weak complexes in the organic phase when considered separately, antagonism does not occur. This challenges the common assumption that antagonism necessarily arises when either ligand *A* or the anionic ligand *L* is in excess relative to the other. An accurate definition of the synergistic coefficient is provided, which can be expressed in terms of the partial molar fractions of the respective species. The introduction of a quantitative synergistic coefficient, together with the GRE-based analysis, addresses a key methodological gap and opens new possibilities for experimental validation and broad application across various fields. A **mixed compound of type $ML_n \cdot A_{x(n)}$** underlies synergism, where the mixed system extraction efficiency exceeds the sum of its components due to the stability of the complex. This principle of chemical synergism applies broadly to heterogeneous systems, including enhanced catalysis in ligand-oxidant pairs, optimized precipitation in surfactant mixtures, and improved leaching of precious metals in ammonium thiosulfate media. A key advantage of the GRE lies in its flexible stoichiometric coefficients, which vary continuously based on the system composition and thermodynamic conditions rather than being fixed integers. This adaptability allows for a more realistic representation of chemical equilibria. When these fractions take on integer values, the GRE naturally reduces to a conventional reaction equation. In its generalized form, however, it is particularly well suited for describing complex heterogeneous systems such as saturated salt solution equilibria or two phase liquid extraction systems where numerous species interact simultaneously across phase boundaries.

This research presents a quantitative definition of the synergistic coefficient (SC), given by the expression:

where D_1 , D_2 , and D_{12} represent the distribution ratios of a metal ion between the organic and aqueous phases when using a single extractant or a mixture of extractants, respectively.

$$D_{12} = \frac{\sum_{i=1}^n \sum_{j=1}^m \sum_{k=1}^p [ML_n A_x H_i]_o}{(\sum_{i=0}^n [M(OH)_i]_i + \sum_{j=1}^m [MX_j]_i + \sum_{k=1}^p [MY_k]_i)} = \frac{\sum_{i=1}^n \sum_{j=1}^m \sum_{k=1}^p [ML_n A_x H_i]_o}{(\sum_i [M^+]_{aq,i})} \quad (1)$$

$$D_1 = \frac{\sum_{i=1}^n \sum_{j=1}^m [ML_n H_i]_o}{(\sum_i [M^+]_{aq,i})} \quad (2) \quad D_2 = \frac{\sum_{i=1}^n \sum_{j=0}^m \sum_{k=0}^p [MA_n H_i X_j Y_k]_o}{(\sum_i [M^+]_{aq,i})} \quad (3)$$



The expressions (1)-(3) precisely quantifies the synergistic effect resulting from the simultaneous presence of both ligands and the formation of the corresponding mixed complex.

The proposed methodology provides a precise definition of the synergistic coefficient, expressed in terms of the partial molar fractions of key species, enabling accurate identification of synergistic and antagonistic effects. The findings demonstrate that synergistic effects are influenced by the thermodynamic stability of mixed complexes, while antagonism arises from specific reactions in the organic phase, such as competitive complexation, adduct instability, and ion pair formation. Mitigation strategies, including optimizing reactant ratios, modifying extractants, and controlling phase conditions, were proposed to enhance synergistic outcomes. This concept extends beyond metal solvent extraction to diverse heterogeneous chemical systems, emphasizing the critical role of mixed compound formation in accurately identifying synergistic effects.

A key element that distinguishes this framework from existing approaches is the integration of all simultaneous equilibria in both aqueous and organic phases into a single thermodynamic formulation, rather than treating the phases separately or relying on empirical adjustments. Additionally, the SC introduced here represents a novel thermodynamic descriptor, allowing for the first time the numerical prediction of both the direction and magnitude of synergistic and antagonistic effects using only standard thermodynamic data.

Finally, the developed approach holds promising potential for applications in **rare earth element separation, hydrometallurgical processes, and environmental remediation**, where selective ligand coordination plays a crucial role.

* Povar, I., & Spinu, O. (2025). Forecasting chemical synergism and antagonism by thermodynamic analysis of complex equilibria in metal solvent extraction. *Chemical Engineering Journal Advances*, 100825. <https://doi.org/10.1016/j.cesj.2025.100825> (IF 7.1)