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KEYNOTE TALKS

SUSTAINABLE AGRICULTURE IN THE FACE OF CLIMATE CHANGE: RESEARCH, EXTENSION AND HIGHER EDUCATION

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Global greenhouse gas emissions from conventional agriculture and associated land use currently account for around one fifth of total emissions from all economic activities. Agriculture should be carried out with less availability of arable land, less inputs, within a climatic change scenario and economic and social uncertainty. The new paradigm for feeding the world requires an agroecological approach based on the right of all people to food and the recognition of the social function of the soil.

Agroecology is conceived as a holistic model of global change that encompasses environmental, political, economic, social and cultural dimension and can analyze the complexity of the food system for the construction of the eco-agri-food system.

The agroecological transformation is a gradual process of co-innovation for biological input integration, adjustments and technological changes in the design and management of agroecosystems, which leads to leaving behind the conventional focus on agricultural production.

Agroecology is connected to all the Sustainable Development Goals (SDGs) and can contribute both directly and indirectly to their progress by offering technical and social strategies to transform global food systems. Scientific research has demonstrated that agroecology can boost crop yields, and enhance overall farm output. It also improves production stability through diversification, strengthens farm resilience to climate change, enriches diets and incomes, conserves biodiversity and natural resources, and reduces farmers' reliance on external inputs.

This denotes that the ways of studying, designing, and evaluating agroecosystems will need to change considering aspects such as ecological footprint/biocapacity, carbon and water footprint, agroecosystem diversity and technology, energy efficiency, multifunctionality of agroecosystems, ecological economics, virtual soil and water, environmental costs, weak and strong sustainability, vulnerability of natural resources, concept of environmental goods, human values (commitment, ethics, dignity and respect), social organization, food sovereignty, among others, in summary, rethink the sense of development. This requires the collective will to change.

The presentation will discuss examples of how education, extension, and participatory research are interconnected within the context of agroecology.

PLANT HEALTH - TRENDS AND CHALLENGES

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Fruit and vegetable producers have a very limited ability to control all factors affecting the final production. With the exception of agriculture, these circumstances are not known to any other economic sector. These factors include primarily weather conditions, which in recent years have increasingly caused extreme phenomena such as drought, hail, and sudden rainfall causing local flooding of areas. The key issue in cultivation is counteracting climate change, which is also reflected in a change in the spectrum of pathogens and pests that threaten plants. New threats are also directly related to international trade in plant materials, which carries the risk of introducing new ones that have not yet occurred in a given geographical region and which, in the face of global warming, have a greater chance of establishing themselves. These threats force us to take new actions, such as improving systems for the early detection of pathogens and developing effective methods of plant protection and their rational use. At the same time, agriculture in highly developed countries aims to reduce chemicalization by introducing pro-ecological production systems. This is due to the awareness of their negative impact on the environment, as well as the increasing awareness of consumers in the field of environmental protection. Consumers want to eat healthy products that do not harm their health and are produced in such a way that they do not harm the environment. All these factors are a big challenge for horticultural production, and their implementation requires new solutions, and these solutions must be very diverse, reflecting a holistic approach to the problem.

A dynamically developing trend in agriculture is precision farming using remote sensing and photogrammetric technologies, AI and deep learning, and UAVs (Unmanned Aerial Vehicles). However, in terms of support in crop protection, there are practically no solutions available in this field on the market. Another challenge is the search for new safe means/solutions in plant protection. In addition to the trend of reducing the consumption of chemical plant protection products, such tasks are necessitated by the reduction in the number of active substances permitted for use in the EU. The search for alternatives such as agents based on microorganisms or substances that induce resistance, and the introduction of agroecological methods are a clear trend in scientific research and development. Great hope is also placed in NGTs (New Genomic Techniques) aimed at developing precise tools to improve plant characteristics in a controlled manner. However, solutions developed in scientific laboratories must reach the field and orchard in order to work. A big challenge is to convince consumers, that new solutions are safe and farmers to implement new methods and to stop activities that are often unnecessary or even illegal. For the latter, it is necessary to know the barriers and mechanisms of farmer decision-making in the field of plant protection. This may be crucial for more effective implementation of new tools that are part of an integrated approach to plant protection.

ART AND SCIENCE DISSEMINATION: ANY FRUITFUL CONNECTIONS?

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From the first cabinet of curiosities to the great national science museums, from interactive science centers to hybrid cultural institutions, the world of scientific exhibitions and communication has greatly changed in terms of objectives and appearance.
Today, when we present the history, status or results of scientific research and innovation, we want to make sure that the stories we recount really make sense for those who encounter them.
Can the arts help us do this? Should they be used as a “tool” of science communication? Do they bring threats or benefits to fact-based education? Can they help reframe scientific research itself?
The talk aims to offer a brief initial reflection on the specific role that contemporary art may play in the context of science engagement.

ORAL PRESENTATIONS

ENHANCING RESILIENCE IN ORGANIC MEDITERRANEAN AGRICULTURE: ASSESSING AGROECOLOGICAL STRATEGIES IN MITIORG LONG-TERM EXPERIMENT

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In the Mediterranean regions, the agriculture increased vulnerability due to the rising frequency, severity, and scale of extreme events linked to climate change, such as heatwaves, droughts, and heavy rainfall. Adaptive agroecological practices tailored to the site-specific local level are crucial for promoting both mitigation and adaptation strategies with simultaneously enhancing the resilience to climate change-related challenges. The sustainability of agroecological practices in addressing climate change effects was assessed in a long-term experiment on organic horticultural crops (MITIORG), featuring a soil hydraulic arrangement in ridges and strips, incorporating cover crops with different management options within cash crop rotations, and studying different organic amendments. We estimated this sustainability by converting crop yield and biomass production into energy outputs and carbon storage within diversified horticultural systems. The outputs obtained (quantified in energy and carbon equivalents) were assessed taking into account the site-specific meteorological data across over 10 horticultural cropping cycles, from autumn-winter 2014-15 to autumn-winter 2020-21. During extreme climate events, the Ridge and Strips system 1 (RS1), characterized by cover crops as living mulch on ridges and break crops in strips, both with no-till termination, showed an 18% increase in energy output and carbon storage compared to RS2, which utilized green manured cover crops on ridges and strips. Furthermore, RS3, consisting of ridges and strips without cover crops, reached a decrease of approximately 5 and 9% in energy output and carbon storage, respectively, compared to the average of RS1 and RS2. Our findings underscore the effectiveness of diversified agroecological systems in enhancing resilience during extreme weather events, saving at least a part of crop production. Hence, it is crucial to integrate techniques promoting long-term resilience, such as selection and management of cover crops, tailored to specific site and system conditions.

TESTING THE EFFICACY OF A TRACTOR-MOUNTED INSECT VACUUM AGAINST VARIOUS HEMIPTERAN SPECIES OF SHIELD BUGS ON CROPS OF SOYBEAN, ALFALFA, SORGHUM, AND SUNFLOWER

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In 2023, we conducted a field experiment to assess the efficacy of a tractor-mounted insect vacuum as an eco-friendly alternative to chemical pesticides, targeting shield bugs (Pentatomidae) on sorghum (*Sorghum bicolor* [Moench]), alfalfa (*Medicago sativa* [L.]), soybeans (*Glycine max* L. [Merr.]), and sunflowers (*Helianthus annuus* [L.]). The four selected crops demonstrate high attractiveness to a variety of shield bugs, indicating their potential as trap crops within Integrated Pest Management (IPM) systems, including those utilized in orchards. Assessing the effectiveness of a vacuum cleaner on these crops could lead to a decrease in pest populations and reduced damage, benefiting both, trap crops and primary crop species cultivated in orchards. The experiment took place on the laboratory field of the biotechnical faculty in Ljubljana, and was divided into three blocks. Within each block, two rows of each selected crop were sown. The efficacy of the tractor-mounted vacuum was tested three times during the growing season on July 18, 2023, August 11, 2023, and August 24, 2023. We measured efficacy by comparing the occurrence of shield bugs at specific locations before and immediately after vacuuming. To record the occurrence of shield bugs, we employed a visual inspection method on ten different plants and six different locations within each row, covering all selected plant species. Rows were then subdivided to assess vacuum speed and nozzle position impact. Results showed up to 40% reduction in soybean and alfalfa shield bug populations, while sorghum and sunflower adult counts remained unchanged, with larvae decreasing by up to 70%. Notably, at higher airflow (P2) and speed (H2), significant shield bug reductions occurred post-vacuuming. Further insights and other informations regarding the impact of vacuuming on shield bugs will be presented in this study, along with considerations for potential future device implementations.

MICROARTHROPOD'S FUNCTIONAL INDICES TO ASSESS MYCORRHIZAE INOCULA ACROSS EUROPE

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The use of bacterial and fungal rhizospheral inocula and their consortia is important for sustainable crop systems when their use allows a reduction of chemical fertilizer inputs and plant protection products , and / or enhance soil biodiversity supporting soil health. Therefore, the identification of suitable ecological indices to assess soil health is crucial for monitoring the effects of those inocula on resident soil communities. In this work we evaluated two inocula i) different endophytic arbuscular mycorrhizal fungi (AMF, n=14) and ii) the AMF with the addition of bio - effectors (i.e. products showing biostimulating effects, AMF_B f , n=1 2) in 1 6 sites across Europe. Three-year AMF effects on soil-dwelling microarthropod communities were compared to untreated control plots (UTC, n=1 6) on tomato, strawberry, and apple cropping systems, managed with integrated and organic methods. The microarthropod community was classified in biological forms (BFs) by their functional adaptation to the soil life. In total, 4955 animals in 33 different BFs were extracted and identified from 129 soil samples. Seven biodiversity indices based on BFs were compared among the treatments. Results evidenced that the most effective biodiversity ind ices for the microarthropod community were those based on BF presence (QBS- ar an d QBS-arBF) compared to those based on BF abundances (e.g. Acari / Collembola abundance, Shannon, QBS-ab). Overall, AMF treatments increased the arthropod diversity comparing to UTC (by 57% cases and 71% cases for QBS-ar and QBS-ar_BF, respectively). Unexpectedly, the increase rate was less frequent when the bioeffector was added (QBS- ar : 4 2% ; QBS- ar BF : 42%). Indeed, the treatments were more effective under integrated compared to organic management. In conclusion, the novel QBS-ar_BF index was useful in discriminating among treatments and management systems. In addition, results suggest that organically managed soils, which have a more complex and stable community, may benefit less from AMF treatment. Nevertheless, the inoculation with AMF fungi was beneficial for microarthropod diversity in most cases and encourages new perspectives to enhance soil health.

This study has received funding from the European's Union Horizon 2020 research and innovation programme under grant agreement No 817946 (EXCALIBUR).

CROP WILD RELATIVES (CWRS): A PROMISE FOR THE FUTURE OF THE EUROPEAN ORGANIC FARMING SYSTEMS

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The Crop Wild Relatives (CWRs) are the cousins of domesticated crops which have represented since some decades an important source of natural genetic variation for the urgently required agroecological transition. In fact, CWRs can be important allies for reaching the transition results for more sustainable and nutritious food, in line with the EU Green Deal policy and the UN Sustainable Development Goals. In fact, currently 75% of the world's food is generated from only twelve plant species and since the 1900s, some 75% of plant genetic diversity has been lost as farmers worldwide have left their diverse set of local varieties and landraces for genetically uniform, high-yielding varieties. From this perspective, Crop Cousins are a promise for the future. In this frame, 26 partners from 12 European countries joined their effort to set up the European Union-funded project "Crop Wild Relatives Utilization and Conservation for Sustainable Agriculture" (COUSIN - Project: 101135314 m HORIZON-CL6-2023-BIODIV-01). For five flagship crops, i.e. barley, brassica, lettuce, pea, wheat, the COUSIN main objectives are to: i) identify pathways to use CWRs to strengthen sustainable agriculture; ii) recognize preferred in situ genetic conservation reserves; iii) determine stakeholder-demanded characteristics of CWRs; iv) implement CWRs into breeding and farming activities; v) provide information about CWRs in an accessible format to stakeholders and potential users; vi) train and raise awareness about the value of CWRs in the society. As results of the project it is foreseen to provide new organic heterogenic materials (OHMs) to use for organic farming of the five flagship crops above mentioned to increase the resistance to biotic and abiotic stress and to increase the organoleptic and nutraceutical traits of the produce. Moreover, COUSIN will develop a trans situ conservation strategy that coordinates in situ and ex situ approaches for an efficient and effective conservation of CWRs. The project COUSIN began last January 2024, and it will finish at the end 2028.

THE EXCALIBUR DECISION SUPPORT SYSTEM (DSS) FOR SOIL QUALITY ASSESSMENT

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Soil is a central quality indicator because it involves numerous processes, such as nutrient cycling and biodiversity protection. Defining a comprehensive indicator of soil quality is quite complex and, therefore, has often been represented by more easily measured chemical variables. In the context of soil quality, a DDS based on a class-modelling approach was developed in the Excalibur project to construct soil quality indices based on basic physicochemical parameters, namely pH, organic matter (OM) content, total phosphorus (P), total potassium (K), total calcium (Ca), total magnesium (Mg), the K/Mg ratio, and cation exchange capacity (CEC). Soil quality was then calculated using SIMCA analysis. This class modelling technique builds a model for each class considered, determining the assignment of an object to any of the classes considered. The SIMCA-DSS output incorporated a coloured QR code expressing the quality of each soil sample with a colorimetric scale. The input user interface of the DSS web platform consists of several sections: soil position, soil texture and chemical parameters. The results showed that in the artificial dataset analysed with the SIMCA "Soil Physicochemical Quality" model, 96.5 per cent of the artificial samples were accepted and included in the model (i.e., 5790 samples; sensitivity = 0.97), while the higher ones were rejected, thus showing high model performance. The innovation of the web form (https://agritechlab.crea.gov.it/model/formSE.html) made it possible to generate a quality index. The web technology developed allowed for the generation of a dynamic QR code for consulting soil quality from initial parameters. Such DSS will enable the identification of the soil quality associated with a colour code. This technology is very useful and easy to be applied.

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IMPACT OF INNOVATIVE ORCHARD FLOOR MANAGEMENT STRATEGIES USING LIVING MULCHES ON APPLE ORCHARDS BELOWGROUND BIODIVERSITY AND SOIL NUTRIENT STATUS

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Fruit trees are considered to be high-yielding but also very demanding crops. Organic farming does not have a large arsenal of external resources that can be used to ensure good tree growth and health. Consequently, tools and practices that are capable of addressing multiple requirements at the same time are highly needed. The introduction of in-row living mulches into orchards could represent a possible solution, as it can reduce the competition from weeds, provide nutrients, be a shelter for beneficial arthropods and can provide additional income. A frequently overlooked ecosystem service provided by living mulches could derive from their footprint on soil biodiversity. The impact of living mulches grown on the tree row on belowground communities, as well as on the apple trees and soil nutrient status and fruit yield was assessed in both just established or mature (9-12 year old) apple orchards. The following plant species were tested and compared to natural cover as a control: *Alchemilla vulgaris*, *Mentha x piperita*, *Fragaria vesca*, plant mixtures consisting of either *Festuca ovina* and *Trifolium repens* or 10 or 40 different flowering species suitable for the establishment of flower strips. Both short-term (one year after the establishment) and long-term (three years after the establishment) effects were assessed on belowground microorganisms populations using Biolog EcoPlates or 16S rDNA amplicon sequencing as well as on nematodes communities using classical morphological methods. Living mulches affected soil nutrient availability, bacterial activity and diversity and nematodes trophic communities composition. The overall effect was dependent on the age of the orchard in which the experiment was conducted. Despite the positive effect on soil microbial biodiversity, competition for soil resources was observed between the living mulches and the main crop, particularly in the newly established orchard, which sometimes negatively affected the growth and yield potential of the apple trees.

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ROOT DISTRIBUTION IN FRUIT ORCHARDS WITH CONSERVATIVE SOIL MANAGEMENT

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Soil conservation techniques through an agro-ecological approach are fundamental in modern and sustainable fruit production. A vegetal cover of the soil has multiple advantages, it limits soil erosion and nutrient leakage, ameliorates the soil structure and microporosity, reduces soil temperature, increases soil water retention and soil organic matter content. Moreover, it enhances the whole orchard biodiversity maintaining a higher level of herbaceous species and macro and micro flora and fauna and providing additional agro-ecological services. However, management needs to be carefully studied because the vegetal cover can be a competitor to the fruit tree for water and nutrients. In particular, the presence of herbaceous species will influence root development, growth, distribution and function. This is particularly important in modern fruit orchards, where tree densities are increasing, and roots systems have a smaller soil volume to be explored. The alternate use of different soil management techniques has been tested in a biodynamic farm in central Italy and the distribution of tree root system was evaluated. A yearly rotation of spontaneous cover, shallow tillage, cover crop and green manure lead to different root distribution and depth in the inter-row.

ASSESSMENT OF COPPER RESIDUES IN ORGANIC AND TRADITIONAL OLIVE GROVES IN GREECE AND SPAIN AND THE POTENTIAL OF ELECTROKINETIC SOIL REMEDIATION STRATEGIES

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An important environmental and health concern resulting from current olive farming practices is the intensive application of copper-based fungicides, largely applied against diseases. Serious concerns are though raised regarding copper accumulation and the negative effects on soil organisms, carrying a potential risk for soil fertility. In parallel, a wide variety of soil remediation technologies exist. In the case of copper, a main remediation approach includes its mobilization and extraction through an electrokinetic process applied in soil. In our study 4 olive groves located in Kalamata (Greece), and 11 olive orchards located in Spain, were investigated with regards to the presence of copper at two different soil horizons (0-10 and 10-20 cm). Copper concentration in soil was determined by means of Atomic Absorption Spectroscopy (AAS) following the ISO 11466:1996 standard (Soil quality - Extraction of trace elements soluble in aqua regia). Electrokinetic remediation was also pilot tested at lab scale by applying two different electric fields (1 and 1.7 V cm -1) and the addition of different flushing fluids (nitric acid, citric acid and EDTA) to improve the Cu mobility through soil. Results showed that Cu levels are slightly higher in the first 10 cm, being the mean value higher in organic Spanish orchards compared to Kalamata (99 vs 48 mg kg^{-1}) and lower in conventional ones (41 vs 65 mg kg^{-1}). Electrokinetic remediation showed that only the free ionic Cu can be mobilized, being most of the copper strongly bounded to soil particles. This is related to the new copper-biocides formulations, which can become more persistent. The above findings can support the evaluation of effectiveness of novel remediation practices, as well as help promoting sustainable agricultural practices, including those that contribute to halting or preventing the degradation of the soil ecosystem.

SUSTAINABLE DEVELOMENT FROM ROOT TO FRUIT

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The microbiological stability of the soil is an important issue within the sustainability of agriculture, often neglected when discussing nutrient cycling. To ensure the stability of the agricultural system, it is crucial to provide microbial activators that will increase the availability of nutrients. Effective formulations should ensure that the microbes are delivered in their active state at the right time and place. The microbial products should also adhere to plant structures such as seeds, tubers, cuttings, seedlings and mature plants, and they should be simple to apply and consistent with agronomic procedures. Even under adverse biotic and abiotic stress conditions, the microbial products should be available in the soil for an extended period of time. Since bacteria do not exist in isolation in the natural environment, a group of bacteria may be more beneficial for promoting plant development than a single bacterium. The development of bacterial consortia and their composition, however, is a difficult task as the members of the bacterial mixture must be compatible with one another. The bacteria selected for the bacterial consortium should also be adaptable to the unfavorable circumstances present in agricultural fields and have a variety of capacities to promote plant development. In order to improve plant production and physiological parameters and to regulate plant health, the application of distinct microbes can increase the range of biocontrol activity, improve the efficacy and dependability in suppressing disease incidence, and promote plant growth without the need for the use of genetic engineering techniques.

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PROTECTION OF ORGANIC POTATO: STRATEGIES FOR DISEASE MANAGEMENT WITH BASIC SUBSTANCES

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Organic farming requires specific methods and protective measures that can be used to obtain yield. The entire management process on the farm is based on agrotechnical, preventive and non-chemical methods, which should be implemented comprehensively. As part of direct protective treatments, in addition to plant protection products, other substances supporting protection may be used, such as basic substances, biological methods and all methods ensuring good plant nutrition and strengthening or stimulating the plant defense system. The potato (*Solanum tuberosum* L.) is an important crop that provides food for over a billion people around the world. It is the third most important food crop, after rice and wheat. Its adaptability, yield potential and nutritional value make it an essential component of cropping systems. Organic potatoes, like other vegetables, are eagerly purchased by consumers, but their protection is difficult due to the limited range of fungicides that can be used to control late potato blight and early potato blight. The base of protection is crop rotation and selection of potato varieties, but this is not always possible. Therefore, studies were undertaken using basic substances that were tested in laboratory and field conditions for their potential against *P. infestans* and *Alternaria* spp. Basic substances are defined as compounds that are not predominantly used as plant protection products but may be useful in crop protection. They have no toxicological concerns and do not cause adverse effects on humans, animals or the environment. Basic substances have no residue limits. Several basic substances were selected for studies, their suitability and concentration/dilution was determined, and then the effectiveness of the developed strategies was verified in field conditions in several locations using different potato varieties. Sunflower oil and white onion bulb extract have been found to be very useful. A protective program has been developed combining these substances with a limited dose of copper.

APTAMER-BASED QCM-D PLATFORM FOR MONITORING BIOFERTILIZERS IN SOIL

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The application in agriculture of products containing microorganisms is steadily increasing, particularly in organic farming. The field application of such products requires their registration at the EU and national levels, together with an indication by the manufacturer of various specifications and analytic methods making it possible to trace their destiny in the environment and prove their medium- and long-term effectiveness, aspects that are closely connected with the ability of the microorganism to adapt and persist in the soil environment. At present, 22 microbial strains are registered as pesticides, while 4 groups of microorganisms including various species are admitted for registration as microbial biostimulants. Among them, Bacillus subtilis is a bacterial species having potential functions of stimulating plant growth or protecting against agrophages following the inoculation into soil. In this context, the EFSA is working to establish methods useful for evaluating the risk and traceability of microorganisms introduced into soil. The greatest difficulty in the research and development of molecular markers to be used in soil lies in the fact of being able to identify markers that are species- or strain-specific, i.e., which are capable of discriminating a species, or a strain from another one in the soil. An aptamer capable of acting as a biosensor to detect the presence of Bacillus subtilis was identified and has been patented. Experiments with different soils collected among those used for field trials of the EXCALIBUR project were carried out to develop a procedure based on this aptamer suitable for registration or monitoring purposes. The method is based on Quartz-Crystal Microbalances with Dissipation (QCM-D) device. The procedure has allowed to discriminate the B. subtilis from soils of different chemical-physical characteristics that were additioned with the strain or a different species (Pseudomonas sp.), simulating the common dose of a biofertiliser. The method thus opens new opportunites for monitoring and tracking bioinocula in soil.

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USE OF ARBUSCULAR MYCORRHIZAL FUNGI (AMF) IN FRUIT AND VEGETABLE CROPPING: EXCALIBUR TRIALS TESTING DROUGHT STRESS ON TOMATO. QUESTION ABOUT FORMULATION AND REGISTRATION FOR COMMERCIAL MYCORRHIZAL PRODUCTS

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The majority of fruit and vegetable crops are potential host plants of arbuscular mycorrhizal fungi (AMF). A lot of studies showed the positive effects of AMF on the growth, on the harvest quality, and also on the resistance of plants to some biotic and abiotic stresses. Drought stress (DS) is a serious abiotic stress and a major concern across the globe. In the frame of the EXCALIBUR project, greenhouse trials have been set up in 2021 and 2022 on tomato for evaluating the effect of biostimulant inoculation against DS. We tested three commercial biostimulants: Rhea (AMF) alone and in combination with two plant extracts: i) Stronger and ii) GHI SN837. Experiments have been conducted during 10 weeks with 2 DS (20% less and 40% less). Globally, the use of AMF gave a better development of plants than controls. The use of the mix AMF-the plant extract GHI SN837 allowed to increase considerably (until 30%) growth of plants even in drought conditions. We will discuss these results. Furthermore, the current challenge of use of AMF in crop production is to optimize combinations of crop plant - AMF inoculum as well as inoculation methods. So, the development of an industrial activity producing mycorrhizal inocula is a complex procedure for companies, as it involves not only the development of the necessary biotechnological know-how but also the ability to respond to specifically related legal, ethical, educational and commercial requirements. We will discuss the case of AMF products in France and the consequences of the European regulation 2019/1009 applied since July 2022, for France and European producers and consumers.

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COMBINING AN ENTOMOPATHOGENIC FUNGUS WITH PREDATORS FOR BIOCONTROL OF SPIDER MITES IN STRAWBERRY TUNNEL PRODUCTION

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Strawberry plants are attacked by a complex of arthropods, making it challenging to design biological control strategies for all pest assemblages. Further, below-ground pests are concealed, creating difficulties in the delivery of biocontrol agents. Entomopathogenic fungi (EPF) can be applied to the growth medium to target insects directly by infection. However, several EPF species can also affect insects and mites indirectly through the plant by modulating plant physiology and plant defences. Thus, EPF can potentially be utilised to antagonise pests both below- and above-ground allowing for spatially separated application of biocontrol agents. We evaluated the biocontrol effects of spider mites, *Tetranychus urticae*, in strawberry production in Denmark, where the EPF *Metarhizium brunneum* was applied to the growing substrate as biocontrol strategy against soil-borne insect stages. The below-ground M. brunneum application led to reduced spider mite population growth on above-ground parts of strawberry plants. Spider mites were also targeted with the predatory mites *Neoseiulus cucumeris* as macro-biological control agent. The combined effect of *M. brunneum* and *N. cucumeris* was additive in climate room experiments indicating a potential of integrating indirect effects of EPF in biocontrol programmes against *T. urticae*. Further, the strategy was tested in two commercial strawberry tunnels during one growing season from April till September with a single application of *M. brunneum* at the start of the season and regular releases of *N. cucumeris*. The above-ground arthropod pest communities were monitored regularly. The plots with combined biocontrol applications showed delayed pest population build-up or no difference in comparison to single application or control plots. In September, *M. brunneum* successfully infected insect bait larvae in substrate samples. In this way, *M. brunneum* can affect pests both below- and above-ground in strawberry.

DETECTION OF PESTICIDE RESIDUES IN REGULAR VERSUS ORGANIC CROPS AND FOOD IN POLAND

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Plant protection products (PPP) are commonly used in conventional agriculture to control pests and increase crop yields, but their residues can remain in/on fruits, vegetables, and grains, posing a potential risk to human health when consumed. Organic farming, on the other hand, prohibits the use of synthetic pesticides and promotes natural methods of pest control. In Poland, as in other EU countries, the detection of pesticide residues in regular and organic crops and food is a subject of research and monitoring by regulatory authorities, scientific institutions, and private laboratories. Data presented in this study comes mainly from the Food Safety Laboratory in National Institute of Horticultural Research (FSL) as this laboratory participates in official monitoring and at the same time analyzes samples from the private sector. Monitoring on the correct use of PPP by Polish farmers in their conventional crops, carried out for the Ministry of Agriculture and Rural Development (MARD) in 2023, shows that: out of a total of 1,300 samples tested, no residues of PPP were found in 510 samples, i.e. 39.2% of the total analyzed. In 755 samples, i.e. 58.1%, residues below the maximum residue level (MRL) were detected, among them - 167 samples contained residues of incorrect pesticides, i.e. not registered by MARD for the tested crops. MRL violations specified in EU regulations were found in 35 cases (2.7% of the total number of samples). At the same time, in 202 samples sent for analysis by certification bodies in organic farming, residues were detected in 33 cases (16.3%). These were most often detections of single pesticides occurring at low levels. On the other hand, organic samples sent by companies verifying food products before sale showed that approximately 30% of the nearly 350 samples analyzed by FSL in 2023 contained pesticide residues.

EVALUATING THE EFFICACY OF BIOINOCULANTS ON SOIL FUNCTIONING IN HORTICULTURE: INSIGHTS FROM THE EXCALIBUR PROJECT

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Bioinoculants, have shown promising benefits in horticulture, but they also come with some limitations. Their efficacy can be variable and influenced by several factors such as soil characteristics, environmental conditions, formulation and application method. In the EXCALIBUR project we developed different combinations of microbial strains and bioeffectors and tested them for their efficacy in promoting soil functions and fertility under field conditions. In this work we evaluated the effects of selected beneficial microorganisms (probiotic), with or without the addition of the so-called "prebiotics" (i.e. compost) on 3 cropping systems (tomato, apple, strawberry), under different management (organic, conventional). More specifically, we used the Phenotype Microarray technology to assess the metabolic activity of soil microbial communities, with a specific focus on carbon sources. The results confirmed how the soil characteristics play a key role in the efficacy of the treatments. Overall, the combination of pre- and probiotics promoted a better use of carbohydrates than the other treatments, especially on soils under conventional management. Interestingly, bioinoculants containing microbial consortia showed a broader range of metabolic potential than single-strain products. Specific potential applications and the main soil features driving the efficacy of the treatments will be discussed.

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GUIDO.IO AN AUTONOMOUS UGV FOR HORTICULTURAL GREENHOUSE APPLICATIONS

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Unmanned Ground Vehicles (UGVs) are revolutionizing greenhouse applications, offering precise and efficient solutions for various tasks. Equipped with advanced RGB and multispectral sensors, UGVs navigate autonomously through greenhouse environments, in tight spaces between rows of crops, minimizing damage to plants while maximizing productivity. These devices have the ability to operate continuously collecting data for mapping purposes or real-time task deployment ensuring sustainable agricultural practices. Under the project AGRIDIGIT (DM 36503.7305.2018 del 20/12/2018 n sub project AGROFILIERE) was developed a flexible UGV for greenhouse applications. The vehicle is characterized by an innovative structure that allows variable working height and track width. The autonomous navigation system is based on an advanced data fusion algorithm relying on ultra-wide band antennas and an RTK system, allowing precise navigation (around 2 cm) even in environments where GPS signal is poor. The system onboard is developed using ROS (Robotic Operating System) 2. The vehicle is equipped with a specifically developed hyperspectral linear sensor that through an ANN is able to recognize pathogens on fresh-cut salads and produce real-time an output triggering signal to pilot the control system. The ANN can be trained on needs to recognize different pathogens and or weed in several crops.

EFFECTS OF COVER-CROPS ON SOIL QUALITY AND AGRONOMICAL PERFORMANCES IN ORGANIC ORCHARDS IN SOUTH-EAST FRANCE

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Cover crops in organic horticulture can have beneficials effects on ecosystemic services, such as carbon storage and pest control, but also negative effects, such as nutrient and water competition with crops. Different cover-crops were compared with a tillage reference in apple, apricot and peach organic orchards in order to quantify their effects on soil quality and agronomical performances under Mediterranean climate in south-East France. *Phuopsis stylosa*, *Thymus serpilum*, *Achillea millefolium* and *Melilotus officinalis* were assessed as living mulches grown in the tree row. Moreover, the interest of nitrogen fixing plants (e.g *Pisum* sp., *Vicia* sp.) grown between the tree row, and mulched on the tree row, was also assessed. We showed that *P. stylosa* had significant effects on the soil microbial biomass, nematodes population, the dynamic of nitrogen mineralization and aboveground biodiversity. As expected, a soil nitrogen uptake by the permanent cover-crops was observed while a nitrogen release was observed from Leguminous mulched on the tree row. According to the cover-crops species, soil water availability was affected, and a strong decrease of water availability in the tree row was observed under *A. millefolium* cover. Two years after cover crops implantation in the peach orchard, a decrease of tree growth and yield was observed in comparison to the tillage reference. The main positive and negative effects observed will be presented.

MULTIPLE STRATEGIES ARE NEEDED TO CONTROL WEEDS IN ORGANIC APPLE ORCHARDS IN A HUMID CLIMATE

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Weed management remains a major barrier to the success of certified organic apple production in New York, USA, and other regions with humid climates, where weed competition in the first 3-5 years after planting can diminish long term yield potential and return on investment. We evaluated the efficacy of in-row weed management strategies and documented changes in the weed community during the establishment period of a high-density apple orchard. Eight rows of 'Honeycrisp (Firestorm)'/'Budagovsky.9' apple trees planted in 2015 were raised under NOFA-NY certified organic management at a research orchard in Ithaca, NY. A split-plot experimental design was implemented in 2016 with three main treatments comprising an untreated Control (main Control), cultivation with a Wonder Weeder® (Cultivation), and surface-applied wood chip mulch (Mulch); and four split treatments comprising an untreated Control (split Control), mowing with a string trimmer (Mowing), and organic herbicides Suppress (Capric acid) and Final-San-O (Ammoniated soap). All treatment combinations were implemented four times per season from 2016 to 2019, approximately monthly from May to August, except mulch which was only applied once, in spring 2016. Mulch treatment maintained significantly less weed biomass than the main Control through 2019, regardless of split treatment or sample period. Among the split treatments, an abundance of creeping herbaceous perennial weeds, such as *Solidago* spp. and *Symphyotrichum lanceolatum* resulted in significantly more weed biomass in the split Control compared to the three other split treatments, regardless of main treatment. Monocot weed biomass increased significantly in the two organic herbicide split treatments compared to the split Control, except within the Mulch treatment. Conversely, the two organic herbicides improved suppression of simple herbaceous perennials in the Cultivation treatment and main Control. In the absence of secondary management, biomass from creeping perennials was statistically similar among all main treatments. Regardless of main treatment, biomass from creeping perennials was significantly reduced when the Mowing, Ammoniated soap, or Capric acid split treatments were implemented. Therefore, the effects of stacked weed management tactics varied, based on the type of weeds present, highlighting the importance of considering the existing weed community to optimize weed control while minimizing costs.

IMPACT OF COMPANION PLANTING IN ORGANIC BERRY PRODUCTION ON SOIL MICROBIOME

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In recent decades, consumers have become increasingly aware of the importance of a healthy diet, the consumption of pesticides free food and the importance of more environmentally friendly production systems. The ResBerry project addresses these challenges and develops various strategies to strengthen organic horticulture in Europe in the long term. As part of the project, trial plots with organic raspberries were established at Rodagria Agricultural Cooperative farm (Ogoru, Calarasi, Romania) in 2022. Companion plants were used for flower strips, trap plants and cover crops. Flower strips of *Borago officinalis* L., annuals (*Ocimum basilicum* L., *Ocimum citriodourm* Vis., *Tagetes patula* L, *Trifolium resupinatum* L.) and perennials (*Lotus corniculatus* L., *Onobrychis viciifolia* Scop, *Trifolium pratense* L., *Thymus vulgaris* L.) were sown along the tunnel poles next to the raspberry rows, while mixture of Gramineae species and microclover (*Trifolium repens* L. var. Pirouette) were used as cover crops and sown between the rows. Soil samples were taken at the beginning of May 2023 to analyze the microbiome of fungi and bacteria. The molecular analyses of the soil samples indicate that the inclusion of companion plants in general can influence the presence of beneficial and harmful microorganisms. While the sowing of cover crops of a Gramineae mix promoted the presence of beneficial bacteria of the Streptomycetaceae family, the use of perennial flower strips resulted in an increase of Lysobacter bacteria in the soil of raspberry plants. On the other hand, the latter approach also showed a relatively high proportion of plant-damaging Fusarium fungi and Globisporangium species. In soil samples of raspberries, next to which flowering strips of annual plants were sown, a high proportion of the plant pathogenic fungus family Plectosphaerellaceae was recorded. To gain further insights into the performance and dynamics of the soil microbiome, replicate experiments are currently being carried out.

ZOMBI PEA: A NEGLECTED BUT POTENTIAL CLIMATE RESILIENT CROP

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Zombi pea (*Vigna vexillata*), an underexploited tuberous legume with edible tubers and pods, has the potential of sustainable food production. Being a legume vegetable with the ability of biological nitrogen fixation, natural reservoir of genes for biotic and abiotic stresses, it is an important future element in organic agriculture system for enhancing food and nutritional security. It also plays a crucial role as green manure crop, enhancing soil productivity and restoration of soil fertility. Compared to conventional tuber foods like cassava and sweet potatoes, it has a higher protein level. The zombi pea is one of the domesticated Vigna species that has received the least attention in in the Indian subcontinent. In this regard, during the 2021-2022 crop season, an experiment was carried out at the research farm of the Central Tuber Crop Research Institute, Regional Centre, Bhubaneshwar. The experiment was laid out in the randomized block design with eight treatments (consisting of four levels of spacings combined with and without deblossoming) and three replications. The findings showed that the highest plant height, fresh weight of the leaf and stem, number of tubers per plant, weight of the tubers, length, girth, and yield of tubers per plant were all achieved with the widest spacing. The significantly highest green pod yield and tuber yield (150.85 q/ha) were recorded at the closest spacing. Deblossoming conditions encouraged more vegetative growth with the highest tuber yield per hectare (120 q/ha). The crop phenotype expressed fully in the wider spacing, while maximum total yield was experienced with narrow plant spacing. Retaining the flowers resulted in a significant pod yield, but removing the flowers increased the tuber yield. Understanding the potential of zombi pea for food and nutritional security in the face of climate change is made possible by the current work.

EFFICACY OF BIOCONTROL AGENTS AND BIOSTIMULANTS ON SOIL-BORNE PATHOGENS MANAGEMENT AND YIELDS: A THREE-YEARS FIELD STUDY ON FRESH TOMATO

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Three field trials were carried out on a commercial farm located in Piedmont, Italy, during three consecutive years (2021, 2022, 2023) to evaluate the effects of biological control agents (BCA) and biostimulants to control soilborne pathogens on tomato plants cv Cuore di Bue. Isolations from infected plants over the years confirmed the widespread occurrence of two major fungal pathogens: *Fusarium oxysporum* f. sp. *lycopersici*, causal agent of Fusarium wilt, and *Rhizoctonia solani*, causal agent of crown and root rot. Treatments included a non-microbial biostimulant of natural origin (GH), a microbial biostimulant containing *Paenibacillus polymyxa*, a microbial biostimulant containing mycorrhiza (AMF), a mixture of AMF+GH and a combination of the antagonistic microorganisms *Fusarium oxysporum* (MSA35) and *Trichoderma asperellum* (FC80). Treatments were applied at first to seedlings in nursery and seven days later at transplanting. During the trials, disease incidence and severity and tomato yield (g/m 2) were compared to the untreated control. Under an average DI (49.3) and DS (32.2) in the untreated controls, GH, AMF and MSA35+FC80 provided a 51%, 42% and 37% reduction in disease incidence compared to untreated plants, respectively. In addition, a disease severity reduction of 55%, 46% and 40% was observed by, respectively, GH, AMF and MSA35+FC80. Plants treated with AMF and MSA35+FC80 showed a yield increase of, respectively, 48% and 51% compared to the untreated plants (1162 g/m^2). These results highlight the potential use of BCAs and natural biostimulants as an effective strategy to control soilborne pathogens on tomatoes under field conditions. AMF and MSA35+FC80 showed a positive effect in both disease management and yields improvement, resulting in a promising solution to be commercially exploited.

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STRUCTURAL DATA OF POLISH ORGANIC VEGETABLE AND FRUIT PRODUCTION – WITHIN THE PERIOD FROM 2010 TO 2022

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This study is based on data compiled by the Polish Ministry of Agriculture and Rural Development from the annual inspection reports on organic farms and makes publicly available via JIHARS. Only the fruit and vegetable growing sectors are analysed. The analyses on fruit result from the data on 16 listed fruit species and 3 unspecific categories such as 'other tree fruits', 'other soft fruits' and 'other fruits'. In the vegetable group, these are 19 individual species in addition to 6 further non-specific categories. The analysis spans a period between 2010 and 2022, with data collected every two years. The area used for fruit growing fell by over 50 % between 2010 and 2022. In 2010, 45481 ha were used for fruit growing, in 2022 only 21525 ha. Within the individual species, apple and blackcurrant are of particular economic interest, apple with areas under cultivation of over 5000 ha, blackcurrant with increasing shares from 3694 ha in 2010 to 5015 ha in 2022. It is noticeable that in the individual years the area under cultivation is dominated by 3 species between 55 and 80 %. In 2010, the walnut area exceeded all other species. In addition to currants, raspberries and chokeberries were important berry fruits the cultivation share of which ranged between 6.6 and 11 % for the first and from 5.3 to 17.1 % for the second. From a regional perspective, Lubuskie is one of the most important regions for organic fruit farming in Poland, covering between 11.8 and 20.6 % of organic farmland. For years, this also applied to Zachodniopomorskie with similar figures from 28.7 and 8.3 % in 2022, which obviously is amounted to a serious structural change. Vegetable cultivation played a rather subordinate role in 2010, its area of 1248 ha was less than 0.5 % of the total certified area. In 2022, it was now just under 16000 ha (=0.4 % of the total area). Among the vegetables species, peas, pumpkins and cucumbers are the ones with the largest areas under cultivation. Lubuskie and Zachodniopomorskie in particular can be identified as important centres of vegetable cultivation among the voivodeships. There is a growing interest for the cultivation of vegetables among farmers (2010: 2.3 %, 2022: 7.3 % of all farmers). Fruit growing always reached a level between 15 and 21 % of all operators.

REDISCOVERING ONION LANDRACES: HARNESSING THE POTENTIAL OF OLD VARIETIES FOR ORGANIC FARMING

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Introduction and Objectives Onions are a globally significant vegetable, prized for their distinctive flavor and aroma. With rising awareness of sustainability and quality, the demand for organic onions is increasing. Ideally, this demand should be fulfilled with locally produced organic onions. However, the limited availability of suitable varieties presents a major challenge. The market is dominated by hybrid varieties, but few are adapted to organic farming. The extinction of traditional landraces affects many vegetables, including onions. Farmers often lack knowledge about the yield, quality, and stability of these old varieties, leading to a preference for hybrids. The ZwiebÖL project seeks to evaluate the potential of old onion landraces for organic farming. This study compared three old onion landraces with three well-known hybrid varieties over two consecutive years at two different organic farming locations. The harvested onions were stored for 7 to 9 months, during which both external and internal quality parameters were measured. The key question of this study is: Can landraces compete with popular hybrid varieties in terms of yield, quality, aroma profile, and storability? Methods Onions were grown organically in 2020 and 2021 at the University of Hohenheim, Stuttgart and DLR Rheinpfalz in Germany. The landraces Birnenförmige, Stunova, and Rijnsburger 4, along with hybrid varieties Hytech F1, Hylander F1, and Summit F1, were analyzed. Quality parameters were assessed monthly during storage under cold storage conditions (2-3°C, 60% humidity). Results and Discussion Preliminary results indicated that the landraces were comparable to hybrids in terms of yield and growth parameters. However, storability varied by variety. The landrace Birnenförmige remained marketable for seven months without significant changes in firmness and dry matter content, which was also reflected in its metabolome and aroma profile. Conclusion The investigated landraces did not exhibit lower yields than the hybrids. Under organic farming conditions, they performed equally well in the field. Storability was variety-specific, with Birnenförmige being the only landrace storable for seven months. These findings underscore the potential of onion landraces, particularly Birnenförmige, for organic farming, diverse applications, and future breeding strategies.

POSSIBILITIES FOR THE UNCONVENTIONAL USE OF ENTOMOPATHOGENIC FUNGI IN HORTICULTURE

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Entomopathogenic fungi (EPF) are microorganisms with an ability to infect and kill arthropods. In their natural environment, they play a significant role in regulating insect populations. They can be easily cultivated on a large scale and are commonly used as bio-insecticides. In organic horticulture entomopathogenic fungi are mainly used as biopesticides as a safe alternative to toxic chemical insecticides. Species of Beauveria and Metarhizium are the most commonly used entomopathogenic fungi in practice. However, entomopathogenic fungi can also perform other functions in the environment such as degrading or eliminating toxic pollutants. For example, *Metarhizium* strains can degrade triazine herbicides such as ametryn, while *Beauveria* strains can eliminate pyrethroids like cypermethrin from their growth environment. Additionally, entomopathogenic fungi have the capability to remove *Fusarium* mycotoxins like zearalenone and convert it to less toxic derivatives. Although the mechanisms regulating the pathogenesis of insects by EPF are relatively well understood, the bioconversion and biodegradation abilities of entomopathogenic fungi still remain unclear and underestimated in horticultural and agricultural practice. Recently, the accumulation of chemical insecticides by entomopathogenic fungi has attracted special attention. During our studies, we have revealed that the neonicotinoid insecticide acetamiprid accumulated in the spores of *Metarhizium brunneum*. Using the spores of this fungus with the accumulated insecticide achieved a similar killing effect to the chemical insecticide alone at a dose 180 times lower. Therefore, it appears that the potential of entomopathogenic fungi is not yet fully understood and further research is needed to use this microorganisms not only as bioinsecticides but also in combination with other agents and in environmental remediation processes.

ORGANIC SWEET CHERRIES – HOW TO IMPROVE THEIR STORABILITY

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In 2021-2024, the storage ability of organic sweet cherries was assessed. Fruits of 'Kordia' and 'Staccato' cultivars were harvested in the Organic Experimental Orchard in Nowy Dwor, nearby Skierniewice, which belongs to National Institute of Horticultural Research. The fruits were collected from trees grafted on 'Gisela5' and 'Gisela6' rootstocks. The research was focused on the effect of post-harvest fruit treatments, inter alia, with hypochlorous acid (Bio ActiW 2000) or ozone and the use of MAP packaging (Xtend bags) on reducing unfavourable quality changes in the fruit during storage. Sweet cherries were stored at a temperature of 1°C for up to 60 days (depending on the research season). Regardless of the season, cherries of the 'Kordia' variety were characterized by higher storage ability compared with the 'Staccato' variety. The intensity of skin red colour correlates with the total soluble solids content (TSS) and titratable acidity (TA) of the fruit. Regardless of the variety, fruits from trees grown on the 'Gisela 5' rootstock exhibited higher TSS content than those from the 'Gisela 6' rootstock. The application of MAP packaging and hypochlorous acid postharvest treatment increased the storability of the fruit. However, in the case of very severe infection, the symptoms of fungal diseases were not fully eliminated, but only significantly reduced.

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APPRAISAL OF AGRONOMIC, SEED YIELD AND REPRODUCTIVE TRAITS UNVEILED BREEDING POTENTIAL OF INDIAN CAULIFLOWER LINES

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Breeding to enhance biodiversity by developing diverse sets of genetic materials is an important element in achieving sustainable agriculture and developing varieties for organic food systems. The successful exploitation of genetic material depends upon their phenotyping for an array of traits. Thus, different sets of cytolines in Indian cauliflower have been developed through backcross breeding programme during the past two decades at ICAR-Indian Agricultural Research Institute, Regional Station, Katrain, Himachal Pradesh, India. About 50 lines were characterized for their reproductive and seed yield related traits. the seedlings were planted in a plot size of 3 m x 3 m with three replications. The variance analysis and principal component analysis (PCA) revealed presence of high amount of genetic variability. The Indian cauliflower lines, Ogu402-6A, Ogu76-33A were identified for developing early maturing varieties, while Ogu13-85-6A and Ogu309-2A have the potential to develop high yielding cauliflower varieties with compact curd. High heritability indicated the scope of selection in crop improvement. All the cytolines under study had normal ovary and were devoid of functional pollen grains. Ogu34-8A exhibited highest numbers of silique per plant. The seed yield ranged from 8.40 g to 35.85 g/plant, where (Ogu17A) exhibited minimum seed yield and Ogu307-6A produced highest seed yield. The PCA analysis revealed the maximum contribution of numbers of silique per plant and seed yield in total variation. The study paves the way for formulating the strategy to breed cultivars for sustainable agriculture and enhancing food and nutritional security.

EFFICIENCY EVALUATION OF LOW-DOSE ULVAN SPRAY AGAINST GLOMERELLA LEAF SPOT ON APPLE TREES

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Organic apple farming in Santa Catarina state, the largest producer in Brazil, emerged in the late 1990s and has significantly increased over the years. However, challenges posed by plant diseases like Glomerella Leaf Spot (GLS) continue to be a central constraint for this activity. In this scenario, the use of ulvans, sulfated heteropolysaccharides naturally obtained from marine green algae (*Ulva* spp.), has shown in previous studies to offer a potential solution in reducing disease severity and inducing resistance to GLS. Thus, this investigation aimed to assess the efficacy of consecutive foliar applications of ulvan at a lower concentration to mitigate GLS severity and defoliation in apple trees. For this study, two outdoor pot experiments were conducted, during which three-year-old Gala apple trees were pretreated twice with ulvan solution (1 mg mL -1) and then treated weekly after inoculation with a conidial suspension of *Colletotrichum chrysophilum*. GLS severity was assessed visually every 3 days. The area under the disease progress curve (AUDPC) was calculated for severity, and defoliation was monitored. Due to severe defoliation, evaluations were conducted until the 29th and 56th days after inoculation (DAI) in the first and second experiments, respectively. In the first experiment, GLS symptoms appeared 3 DAI, while in the second, they appeared at 13 DAI due to colder conditions. Ulvan applied three times in the first experiment reduced leaf severity by 30% at 29 DAI compared to untreated plants, but in the second, it did not affect disease severity. Defoliation began about 8 DAI in the first experiment, peaking between the 8th and 14th DAI, whereas in the second one, defoliation started around 17 DAI, with the highest intensity between the 17th and 22nd DAI. In both experiments, weekly ulvan spraying failed to prevent defoliation.

INSIGHTS FROM A COURSE EXPERIENCE ON ECOLOGICAL MANAGEMENT IN ORGANIC FRUIT FARMING

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In response to local demand, in 2018, the Federal University of Santa Catarina in Brazil introduced a pioneering course entitled "Ecological management of plant diseases and pests" within its postgraduate program in Agroecosystems. This course, delivered annually, spans 45 instructional hours per semester and is structured to address the comprehensive diagnosis of agricultural issues through a holistic lens, while also delving into crop protection strategies within the framework of diferent types of alternative agriculture. Central to the course's curriculum is the cultivation of adept strategies for ecologically sound control of plant diseases and pests, anchored in a meticulously crafted pyramid model comprising six tiers:1) Agroecological zoning, 2) Nutritional optimization and genetic resistance, 3) Design and orchestration of agroecosystems, 4) Utilization of biological agents such as predatory insects, parasitoids, and exogenous resistance inducers, 5) implementation of selective control methods like insect traps and repellents, and 6) application of naturally derived biocides such as the Bordeaux mixture, lime sulfur and plant extracts. The underlying concept of this model accentuates its foundational tier; thereby emphasizing that methods situated at the lower echelons of the pyramid denote systems characterized by heightened expansiveness, efficiency, stability, and sustainability. Furthermore, discussions within the course extend to topics including organic product certification, pertinent legislative frameworks, and ongoing research and technological advancements in the realm of organic fruit cultivation.

THE EFFECT OF FOLIAR APPLICATION OF CHITOSAN ON GROWTH AND BIOCHEMICAL CHARACTERISTICS OF ERUCA SATIVA

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Chitosan is widely applied as an biostimulant to increase plant growth, abiotic stress tolerance and to induce pathogen resistance. Nevertheless, the plant response to chitosan treatment is complex, and its effectiveness depends on many factors, e.g., the method of application, dosage, plant species and its developmental stage. The aim of the study was to investigate the influence of chitosan foliar spray in three concentrations (50, 100 and 150 mg/L) on growth and some biochemical parameters (the contents of chlorophyll, carotenoids, phenolics and phytosterols) of Eruca sativa Mill. This plant, known as rucola, arugula or rocket salad, is gaining popularity due to its potential health-benefits including antioxidant, immune boosting, and anti-inflammatory properties. The fresh mass of E. sativa aerial parts harvested at 1 week of post-treatment cultivation decreased slightly (by 8%) after treatment with 50 mg/L chitosan, and more significantly (approx. by 30%) after treatment with higher concentrations. The length of the aerial parts decreased up to 16%, whereas the length of the roots increased up to 30%. The contents of chlorophyll and carotenoids increased by 10% and 7%, respectively, in E. sativa leaves sprayed with 50 mg/L chitosan, whereas they decreased by approx. 8% and 12%, respectively, in leaves treated with higher concentrations. Conversely, the total content of phenolics decreased by 64% after treatment with 50 mg/L chitosan, whereas it increased up to 2-fold after treatment with higher concentrations. The content of phytosterols (comprising brassicasterol, campesterol, isofucosterol, sitosterol and stigmasterol) decreased in a concentration-dependent manner by 1.9-, 2.2- and 2.6-fold after treatment with 50, 100 and 150 mg/L chitosan, respectively. The results revealed that the selection of the applied chitosan concentration is crucial for its effectiveness; however, the plant response to chitosan treatment is not uniform, thus leading to diverse changes in accumulation of various types of metabolites.

HOW ADJACENT PLANTS MAY AFFECT CROP PRODUCTION AND BIO-PREPARATIONS EFFICACY ON THE EXAMPLE OF ORGANIC TOMATO CULTIVATION

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Increasing biodiversity in the environment is one of the key ambitions of the EU biodiversity strategy for 2030 and the European Green Deal. Maintaining of high biodiversity generally aims to alleviate the impacts of climate change, protecting of wildlife, to improve food safety or to make the environment more resilient to the disease outbreaks. The same assumptions are relevant to agriculture. However, to keep a higher diversity, e.g. by introduction and diversification of plant species in agro-ecosystem, not always guarantee expected quality and quantity in crop production. In horticultural crops cultivation very important is the choice of neighboring plant species. It may affect not only crop plant development but also the efficacy of applied agro-technical treatments. As an example, the results of two years field experiments in organic tomato culture, grown in the vicinity of herbal plants (thyme and basil), are presented. The herbs were planted in strips every few rows of tomatoes. It was found, that thyme significantly increased tomato yield, while basil as an adjacent plant affected the crop plants opposite. Both herbal plants influenced the biomass parameters of tomato plants. In the experiment, in addition to the herbal proximity, the plants were also treated with various biological preparations, such as different formulations of Trichoderma fungi or spraying with encapsulated essential oils. Thyme and basil indicated significant influence on the activity of used applications as compared to control variants.

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THE POTENTIAL OF ENTOMOPATHOGENIC FUNGI IN BIOLOGICAL CONTROL OF PESTS IN ORGANIC HORTICULTURE

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Entomopathogenic fungi (EPF) have a wide distribution and live in almost all terrestrial ecosystems in the world. They are an important factor in the regulation of insect pests that can cause great levels of mortality, and they are capable of breaking down pest populations during outbreaks in forest and agricultural habitats. Recent studies demonstrate that entomopathogenic fungi, often exclusively considered as insect pathogens, playing additional roles in nature viz. plant disease antagonism, endophytism, plant growth promotion and rhizosphere colonization. More than 700 fungal species from 100 orders are estimated as potential bioagents; however, a majority of important insect pathogens belong to the phylum Ascomycota and order Hypocreales, as well as to Entomophthoromycota, order Entomophthorales. The biological control of pests by using EPF is an attractive alternative to the use of chemical pesticides, mainly because these fungi are safer for humans, animals, and the environment. Commercial products based on some of the EPF are primarily based on *Beauveria* spp., *Metarhizium* spp., *Cordyceps* spp. (formerly *Isaria*), and *Akanthomyces* spp. (formerly *Lecanicillium*). The list of active substances approved in the EU includes 12 strains of EPF. There are several biopesticides based on EPF available in the market for use in IPM schemes against insect pests in greenhouses. These include Mycotal based on *A. muscarium* against whiteflies and thrips, PreFeRal based on *C. fumosorosea* against whiteflies and Mycotrol based on *B. bassiana* against aphids, thrips and whiteflies. Although EPF are mainly isolated from arthropod carcasses, their natural habitat is soil. Our research found that EPF formed on average more colony forming units (CFU) in 1 g of soil in soil from organic cultivation than in soil from conventional fields. On the other hand, it has been shown in laboratory studies that fungicides containing copper approved for use in organic farming, can negatively affect the development of EPF. Sulfur-based preparations appear to be safe for these microorganisms. To preserve EPF and thereby their beneficial services, data are needed on how cultural, biological and mechanical practices in cropping systems may affect EPF. Furthermore, crop producers may be able to take advantage of ecosystem services provided by EPF through conservation biological control by adopting practices that enhance these fungal pathogens abundance, including use of organic fertilizers and landscape management. In this presentation, advantages and difficulties related to potential use of arthropod pathogenic fungi for control of pests in organic outdoor and greenhouse production will be discussed.

EFFECT OF FOUR ORGANIC FERTILIZERS ON SPINACH YIELD IN THE SALINAS VALLEY, CALIFORNIA

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Crop nutrition is one of the most important challenges in organic crop production. The objective of this project was to compare the effect of four organic fertlizers and an untreated control treatment on baby spinach (oleracea) yield under commercial production scale in the Salinas Valley, California. The fertilizers used were 13-0-0, 8-5-1, 6-6-2, and 4-4-2. Fertilizers were applied pre-planting at 135 kg/ha. The experiment was laid out according to a completely randomized design with four replications. Fresh matter production in treatment 13-0-0 was 17.7 Mg/ha, which was significantly higher than all other treatments. All other fertilizer treatments were statistically similar. The control treatment presented the lowest yield, although not statistically different from treatments 8-5-1 and 4-4-2. These results show that fertilizer choice is important in organic crops.

ENCAPSULATION TECHNOLOGIES IN AGRICULTURE

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In the field of modern agriculture, the search for sustainable practices and innovative techniques is increasingly topical. Everyday more than 8.7 million of farmers in 27 EU countries must face a huge challenge and responsibility to produce adequate quantities of a high quality and safe food. Furthermore, the latest projections by the United Nations suggest that the world's population could grow to around 8.5 billion in 2030 and 9.7 billion in 2050. It is predicted to reach a peak of around 10.4 billion people during the 2080s and to remain at that level until 2100. As the global population grows, the agricultural sector faces increasing challenges to produce more food while minimizing environmental impact. In this context, encapsulation has emerged as a pioneering technology with tremendous potential to transform agricultural practices. Macro-, micro- and nano-encapsulation involves surrounding of active ingredients in a protective shell, creating capsules that can be used in various aspects of agriculture. The aim of the presentation is to provide a comprehensive state of the art of encapsulation in agriculture, from improved nutrient delivery to sustainable pest management, and its potential to usher in a new era of environmentally friendly and efficient agricultural practices. The preliminary effects of the microcapsules used in field experiments are shown.

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COMBINING PHENOMICS AND GENOMICS FOR BIOPRODUCT DEVELOPMENT AND USE IN AGRICULTURE

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Environmentally sustainable practices are a need for present and future agriculture. The European Community is committed to pursue the reduction in the use of synthetic fertilizers and pesticides, both impacting biodiversity and soil health. Bioproducts are formulated products containing beneficial microorganisms that can be released in the environment with the aim of promoting plant growth thanks to their biostimulant, biopesticide, and/or biofertilizer functions. However, we need to increase our knowledge on the biological processes determining their efficacy in the field, to further promote their use. In this work we present the biofertilizer and biopesticide potential of the *Paenibacillus polymyxa* K16 strain, isolated from roots of tomato, as an application scenario for the pre-market characterization of a novel bioproduct. Phenotypic characterization was performed by plate methods and by phenotype microarray (carbon, nitrogen, and phosphate/sulphur utilization), the production of volatile organic compounds was evaluated, and the genome was sequenced, allowing potential functions inference using different mining methods. K16 strain have different biofertilizer (conversion of nitrate in ammonia; phosphorous solubilization; siderophore production) and biopesticide (plate antagonism; FusaricidinB and PolymyxinB gene; production of pyrazine volatile compound) potential functions, but poor presence of antibiotic resistance genes. Phenomic analysis showed strong carbon sources utilization, but the highest median activity was observed on phosphate/sulphur compounds. The observed genes and measured metabolic activity were connected in metabolic pathways analysis, pinpointing the features of K16 strain for nitrogen and sulphur metabolism. Overall, different data types were used to explore each function that a bioinoculum should possess to survive and then exert a beneficial action on plant growth, highlighting bio-products inherent multifunctionality.

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ANALYSING ORGANIC HORTICULTURAL GROWERS' ACCEPTANCE OF IT TOOLS FOR NUTRIENT MANAGEMENT – A CASE STUDY FROM GERMANY

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In agriculture, an increasing number of IT tools are being utilised to enhance efficiency, economic viability, and environmental sustainability. However, IT tools to optimize nutrient management do not seem to be widely used in organic vegetable production. Nutri@Ökogemüse project, a survey was conducted among vegetable growers and large-scale vegetable farmers to identify factors that promote or impede the use of IT tools. The analysis of the survey data showed that 61% of the participants already use IT tools (for general purposes) on their farms and that almost 34% of IT tool users were below the age of 40. The farmers use these tools to provide data for administration, farm inspections and certification as well as for area/crop rotation and fertilizer planning. 66% of the IT tool users farmed more than 40 ha, and of these, 43% had farms of more than 100 ha. In general, the majority of the current users were satisfied with the tools they used. The other users would especially like to see better user-friendliness and a larger selection of vegetable crops within the software tools. Among the non-users, 80% stated that they were growing less than four ha of vegetables. Our survey showed that small farms and those with a low proportion of field vegetables tend not to use IT tools, as the solutions currently available are not suitable for these farms. Enhancing user-friendliness and expanding the selection of vegetable crops in nutrient management IT tools could lead to greater acceptance of these technologies. Key strategies to enhance the acceptance of these tools include simplifying their complexity, for example, through app-based applications or integration with other IT programs currently in use.

LAVENDER (LAVANDULA ANGUSTIFOLIA) CULTIVATION FOR OIL PRODUCTION ON THE SWABIAN ALB IN SOUTH-WEST GERMANY – IS IT POSSIBLE?

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In many regions of Germany, such as Baden-Wurttemberg, future projections suggest rising temperatures and increased periods of prolonged drought due to climate change. A crop which is adapted to these conditions is English lavender (*Lavandula angustifolia*), used primarily for essential oil production, which is typically cultivated in dry, sunny, and elevated regions with calcareous soils. English lavender therefore appears to be a crop that is well adapted to the conditions of the Swabian Alb in the Southern part of Germany offering new prospects to farmers. This was confirmed in our on-farm trials on three locations on the Swabian Alb with varieties originating from France and Bulgaria. In our experiment, planting in early spring led to a higher establishment rate in the first year of cultivation compared to late planting at the end of November. Differences in plant development between the three locations and the varieties were documented for the first two years of the trial. The Bulgarian varieties 'Hemus' and 'Sevtopolis' and the French variety 'Rapido' exhibited a strong tendency towards full flowering one week before the French varieties 'Diva' and 'Maillette'. The oil yields varied depending on location and varieties. However, weather conditions and harvest time also seem to have an influence on the oil yield. The Bulgarian varieties ('Hemus' and 'Sevtopolis') achieved the highest oil yields on all three farms ranging from 1.57 to 2.74 % for 'Hemus' and 1.92 to 2.88 % for 'Sevtopolis'. At this stage, no assessment of the oil quality can be made. The residues obtained after distillation were examined for their fibre production potential. In initial trials, fibres could be obtained from the lavender stems. The aim for the future is to further improve fibre extraction methods and investigate possible uses of these fibres.

BIOSTIMULANT EFFECT OF SEVERAL SEAWEED-DERIVED BIOSTIMULANTS IN STRAWBERRY PRODUCTION

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Use of biostimulants in commercial horticulture has been promoted as one of key approaches for sustainable food production. These biostimulants are claimed to have the potential to reduce resource inputs - such as water and mineral fertilisers. We investigated the effect of several seaweeds-derived biostimulants produced on strawberry crops under two production conditions: optimal irrigation//fertigation conditions and at 40% reduced irrigation/fertigation. Plant growth, fruit yield, fruit quality, and fruit shelf life were measured for statistical assessment of biostimulant effects. The tested biostimulants did not have any significant effects on any measured plant growth/development properties. There appeared to be a slight increase in flower numbers and aboveground dry wright as well as better fruit appearance, but none of the improvements was statistically significant. The dry weight of runners was noticeably reduced in the biostimulant-treated plants compared to the untreated, but again the difference was not statistically significant

THE EFFECTS OF MICROBIAL AMENDMENT AND WATER STRESS ON APPLE RHIZOSPHERE AND ROOT MICROBIOME

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Successful establishment of young apple trees following planting is critically important for commercial apple production. Tree establishment can be affected by unpredictable climatic conditions and plant diseases. Beneficial microbes such as arbuscular mycorrhizal fungi (AMF) and plant growth promoting rhizosphere bacteria (PGPR) can assist plants in tolerating abiotic and biotic stresses. We carried out a potted tree experiment to study the effect of water stress and amendment with AMF and/or PGPR at planting on the apple trees, and on rhizosphere and root (rhizoplane + endosphere) microbial community structure. To assess the effects of microbial amendment and water stress on disease development, trees were inoculated with the apple canker pathogen (*Neonectria ditissima*) post planting. In addition to amplicon sequencing qPCR was used to estimate total bacterial and fungal biomass. Water stress significantly reduced tree development; none of the treatments affected the incidence of apple canker development in the inoculated leaf scars. Rhizospheres and roots differed greatly in their microbial community structure as well as the relative bacteria:fungi biomass ratio. Rhizosphere had greater species richness and high fungi and bacteria ratio than in roots. Fungi are more likely to be affected by water stress, and AMF/PGPR amendment than bacteria, particularly in the rhizosphere. Overall, the effect of water stress and AMF/PGPR amendment on the overall microbial structure was limited but water stress and AMF inoculation affected relative abundance of many specific microbial taxa, particularly fungi in the rhizosphere. Water stress led to reduced relative abundance of nine AMF OTUs in the rhizosphere; AMF amendment led to increased relative abundance of a couple of AMF OTUs in rhizosphere/roots. Further research is needed to understand the effect of the overall microbial biomass in the roots as well as the microbial structure on plant development.

EFFECTS OF DIFFERENT FERTILIZER AND IRRIGATION REGIMES ON AMARANTH YIELD AND SOIL HEALTH IN NORTHERN GHANA

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Fertilizers and irrigation play a crucial role in vegetable production. In recent years, the rising costs of chemical fertilizers have sparked interest in and demand for alternative and organic fertilizers, such as calcinated rock phosphate and compost made from municipal organic waste (MOW). Soil health is also a key concern in the context of sustainable agriculture and fertilizer use. In Africa, where population growth is rapid, and food demand is increasing, the Gunia Savanna Climate Zone poses unique challenges. Here, farmers are struggling with maintaining or improving vegetable yields despite limited irrigation water and the need to preserve soil health. This study aims to reveal the relationship between applied fertilizer type and irrigation quantity/frequency and the yield of the leafy vegetable Amaranth in the dry season and its influence on soil health. In our experiment at three sites under the agro-topography environment in northern Ghana in 2024, we applied three types of fertilizer: chemical fertilizer, calcinated rock phosphate fertilizer, and compost, the primary material of which was MOW, under four different irrigation regimes: 8mm/time/day, 4mm/time with two times/day, 2mm/time with two times/day, and 2mm/time/day, ideal irrigation volume and assumed difficulty in obtaining water for irrigation which the conditions often faced by farmers in the region. The soil organic carbon (SOC) and earthworm population were measured before planting and after harvesting as indicators of soil health. The findings of this study could potentially guide farmers in the region to optimize their fertilizer and irrigation practices, improving crop yields and soil health.

POSTERS

AGRONOMIC AND ENVIRONMENTAL PERFORMANCES OF FERTILIZERS DERIVED FROM FINE COAL WASTE ON ORGANIC CAULIFLOWER IN MEDITERRANEAN ENVIRONMENT

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Coal mining generates large amounts of fine waste, which is often disposed of due to its low value. Rich in humic substances, this waste holds potential for soil fertility management, despite lacking direct fertilizing properties, thanks to its biostimulant effects and synergic interactions with fertilizers. Therefore, this study was carried out to evaluate the agronomic and environmental performances of coal mining waste after co-composting with industrial compost from municipal wastes plus Urea (T1), plus lawn mowing residues (T2). These treatments were compared with simple mixtures of the two substrates (T3) and with on-farm compost made from crop residues (T4). A split-plot experimental design was set up in a 2-year cauliflower-zucchini rotation. Crimson clover was intercropped with cauliflower and terminated before zucchini transplanting, either as green manure (GM), or flattened by roller crimper technique (RC). Cover crop management, including a control with no cover (CT), was the main-plot factor, while the fertilization treatments the subplot factor. In this paper the results from two years of cauliflower cultivation are reported. In the first year, the yield did not differ significantly among fertilizer treatments, while, in the second one an overall 7.7% reduction occurred, due to adverse climate. In the second year, minimal differences were found between co-composted coal waste (T1 and T2) and on-farm compost (T4). Conversely, the non-composted mixture (T3) showed the lowest yield, highlighting the importance of composting as sustainable agronomic strategy. Furthermore, in the last year the CT treatments showed 22% of reduction, while the cover crops treatments almost the same performance, indicating the positive effects of their introduction in organic crop rotation. The fertilization, among other factors, had the greatest impact on energy consumption and greenhouse gas emissions. The findings highlighted the importance of agroecology strategies (composting, organic fertilization, and cover crop management) in enhancing agroecosystem resilience.

ORGANIC FERTILIZERS INNOVATIVE APPLICATION ON BROCCOLI PERFORMANCE IN MEDITERRANEAN ENVIRONMENT

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Compost and organic amendments could address a possible solution to reduce the degradation of soil quality in the Mediterranean region caused by intensive farming practices and climate change-induced loss of organic matter. However, their transportation and distribution costs are higher compared to traditional synthetic fertilizers, and therefore there is a need to modify agricultural practices including distribution methods and types of materials. In this matter, an experiment was carried out in Mediterranean conditions to assess different fertilizing materials and localized application in an organic cropping system, aiming to optimize both the amount and distribution timing. In this note we presented the results of the first crop cycle of broccoli (*Brassica oleracea* L.). In a randomized block experimental design with 3 replicates, we compared: organic fertilization with on-farm compost (OFC), organic commercial amendment (CA1), microbial-enriched organic commercial amendment (CA2), and mineral fertilization (MIN). Each organic fertilizer was applied on the entire plot surface at 100% plant requirements compared to local distribution along the row, with a 40% of reduction. The reduction of the fertilizers by 40% reached broccoli yields in line with traditional strategies. However, the lower distribution quantity showed a greater yield reduction in the MIN (13%) treatment compared to the organic ones (on average 3.7% decrease). The nitrate contents in the broccoli heads remained below the thresholds regulated by current legislation in all treatments. These findings pointed out that it is possible to achieve satisfactory yields with organic fertilization, even if the MIN at 100% showed the highest yield. Additionally, the fertilizer reduction through localized application could be an effective innovative strategy in organic cropping systems.

STUDY OF THE INSECTICIDAL EFFICACY OF VARIOUS INERT DUSTS AGAINST THE MOST IMPORTANT CABBAGE PESTS

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In 2022 and 2023, we conducted field experiments at the Biotechnical Faculty in Ljubljana, focusing on environmentally friendly inert dusts as alternatives to pesticides for cabbage pest control, assessing their insecticidal properties and potential for Integrated Pest Management (IPM). The experimental plot, spanning 240 m 2 , was cultivated with the 'Sweety F1' cabbage variety, divided into three blocks, each hosting seven randomly assigned treatments. These treatments included zeolite (Z), quartz sand (QS), diatomaceous earth (DE), wood ash (WA), and Ailanthus altissima leaves dust (AA), alongside positive (Karate Zeon 5 CS) and negative controls (untreated plants). All plants received fungicide treatment (ORTIVA) throughout the growth cycle to manage Alternaria sp . We evaluated the efficacy of the chosen inert dusts using assessment scales from the European and Mediterranean Plant Protection Organization, recording damage indices for key cabbage pests from May 18, 2022, to July 12, 2022, replicated six times in 2022 and five times in 2023. Results from 2022 highlighted the effectiveness of the positive control treatment in preventing damage from assessed pests (*Phyllotreta* spp., *Eurydema* spp., and various lepidopteran larvae), yielding the highest crop yield (about 1300g per cabbage) and lowest damage index (around 1). Treatments with DE and WA closely followed, exhibiting satisfactory yield outcomes (DE 1100g per cabbage; WA 800g per cabbage) but higher damage indices (both, around 2). In 2023, we replicated the experiment with consistent findings. The positive control treatment remained most effective, limiting damage (index under 2) and yielding 950g per cabbage, though less effective than in 2022. Subsequently, treatments with WA and AA showed yield results around 750g per cabbage and similar damage indices around 2. Further insights into the efficacy of inert dusts among cabbage pests and their potential as pesticide alternatives will be elucidated in this study.

SEED YIELD AND QUALITY OF TOMATO (SOLANUM LYCOPERSICUM L.) IN RELATION TO DIFFERENT NUTRITION PROTOCOLS FOR ORGANIC FARMING

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The amount and the quality of the organic seeds are one of the main limiting factors in the organic farming systems. One of the objectives of the H2020 BRESOV project (Breeding for Resilient, Efficient, Sustainable and Organic production) has been to improve the quality of seeds for both phytosanitary and productive point of view. In this context, the effect of amino acids and PGPM (*Trichoderma harzianum*, *T. asperellum* and *T. atroviride*) treatments were evaluated on tomato (*Solanum lycopersicum* L.) seed production. Eight landraces was evaluated under three different nutrition protocols (NP): NP0 (only background fertilization), NP100 (application of amino acids and PGPM) and NP100F (NP100 with additional treatment based on microelements and biostimulants). The selection of genotypes consisted in three "elite breeding lines" selected within the project ("Cherry negro", "Huevo de paloma" and "ONT1") and 5 landraces from the genebank of the Department of Agriculture, Food and Environment of the University of Catania ("Corleonese", "Pizzutello", "Tondo", "Pizzoni" and "Francavilla"). The seedlings were sown in a commercial peat mix and at the stage of 2-true leaf, the plantlets were transplanted (crop density of 4 plants m^{-2}) adopting a split-plot experimental design. The main plot was represented by the NP while the sup-plot was represented by the genotype. Yield (kg m^{-2}) and the following fruit quality parameters were evaluated: color (by CIE L*a*b), solid soluble contents (Brix°), fruit weight (g), fruit diameter (mm). The seed yield (g m^{-2}) was calculated from the 1000 seed weight (g). A seeds germination test was performed to evaluate the effects of the treatment on it. Significant differences in terms of fruit yield and quality were recorded, more specifically an interaction between the experimental factors was observed with the higher values recorded for "Pizzutello" under NP100 (2.22 kg m^{-2}) compared to the lowest for "Huevo de paloma" under NP0 (0.12 kg m^{-2}). Differences in seed yield due to the interaction of the experimental factors was recorded, with the highest value recorded for "Pizzoni" under NP100 (83.8 g m^{-2}) compared with the lowest for ONT1(2.5 g m^{-2}). Furthermore, the germination test highlighted differences in germinability due to the interaction of the experimental factors with the highest value recorded for "Pizzutello" under NP100F (81.3 %) compared with lowest recorded for "Francavilla" under NP0 (30%).The efficacy of the tested nutrition protocols varied among the genotypes and in relation to their adaptability to the environment. Nevertheless, the highest values in terms of fruit and seed production as of fruit and seed quality were observed when the PGPM and the Amino acids were applied, which confirm their potential as alternative tools in organic seed production.

A NOVEL APTAMER-BASED APPROACH FOR DETECTING A TARGET MICROORGANISM IN SOIL

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Monitoring the fate and persistence of bioinoculants in soil encompasses ecological, technical, and regulatory aspects, mainly to ensure a correct environmental risk assessment while allowing for application optimisation. A rapid, precise and species-specific detection tool is essential for these scopes. Evaluating the effects on native soil microbial communities and detecting the inoculants once applied in the soil can also add knowledge to bioinocula formulation development. However, observing, monitoring and quantifying microorganisms embedded in a complex matrix as soil requires rigorous procedures. Exploiting nanoscale biosensors is considered a cost-effective, robust, sensitive, specific and compelling solution for detecting microbial target species in complex environmental matrices. Among the most used biosensors, aptamers represent optimal candidates due to their high heat stability, high affinity, quick reaction, flexible structure, and economic feasibility. In this study, we used a toggle-cell SELEX method to isolate, select and characterise ssDNA aptamers to detect a *Bacillus subtilis* strain that is being tested as a PGPR formulation. Two ssDNA aptamers (patenting application n.102022000022590) showed strong affinity and specificity for *B. subtilis* strains, with values of the kinetic parameters Kd in the nanomolar range and Bmax around 1. Validation of the suitability of the aptamers was validated on three inoculated soils characterised by different chemical-physical features and in soil from a field trial with the formulated B. subtilis PCM/B 00105 strain. These are considered essential features to monitor B. subtilis strains in soil, applicable to optimize bioinocula application methods, support regulatory processes and regulatory processes, and foster the shift of agricultural production toward more sustainable cropping systems.

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SOIL QUALITY IMPROVEMENT IN CULTIVATION OF ORGANIC RASPBERRY CROP THROUGH INCLUSION OF COMPANION PLANTS

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Today, there is robust evidence that enhancing agroecosystems biodiversity, both above- and belowground, leads to an improved quality of life through increased soil fertility and crop pro-health properties. Numerous strategies have been developed to promote and sustain biodiversity while simultaneously improving soil health, as crop rotation, crop diversification, cover crops, biofertilizers. Additionally, the use of companion plants has recently been recognized for their multiple benefits, that include pest deterrence, weed suppression, soil fertility enhancement, enrichment of the soil's microbial ecosystem, improved pollination, and increased overall crop yield and plant health status. Especially for organic growers, such supporting, sustainable practices increase their chances to remain economically viable and to produce healthy crops with increased pro-health properties. The present study aimed to assess the impact of inclusion of companion plants on the soil properties in organic raspberry cultivation at the Rodagria Agricultural Cooperative in Southeastern Romania. The Kwanzaa raspberry was grown under organic conditions in polytunnels, with two types of cover crops (Gramineae species mix and microclover- *Trifolium repens* L. var. Pirouette) and three types of flower strips (*Borago officinalis* L., perennials, and annuals) sown along tunnels poles lines. Soil samples collected in April and October of 2022 and 2023 were analyzed for physicochemical and microbiological parameters, including pH, electrical conductivity (EC), total carbon (TC) and nitrogen (TN) and total population of bacteria and fungi, Streptomyces spp. and Pseudomonas spp. Results showed that inclusion of flower strips and cover crops significantly influenced soil characteristics. Borago, annuals, and perennials effectively reduced soil conductivity and soluble salts, particularly notable from spring to autumn 2023. Gramineae plants moderately increased total soil carbon. Both Gramineae and microclover led to higher populations of Streptomyces spp. and fungi. Inclusion of all flower strip variants enhanced bacterial and fungal populations, with Borago and annuals, having the most pronounced effect. The cooperative farmers deemed the tests highly relevant, leading to their implementation on a larger commercial scale of organic crop production in 2024.

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IS IT POSSIBLE TO OBTAIN NDVI FROM RGB IMAGES?

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The Normalized Difference Vegetation Index (NDVI) is the most widely used metric for assessing the density and health of vegetation in terms of water stress, nutritional deficiency, and plant disease, for precision agriculture purposes. Usually, it is extracted from images acquired by remote sensing using hyperspectral and multispectral optical sensors which can often represent an unaffordable expense for smallholders. NDVI is calculated as the normalized difference between reflectance values at visible red and near-infrared bands, thereby ranging from -1 to 1. In this study, a model based on a shallow-regressive neural network (SNN) to predict NDVI from sRGB images was developed. The model was trained on images of different plant species at different growing vegetation stages acquired by a snapshot hyperspectral camera (Specim IQ), captured in natural environmental light conditions, and then calibrated. The model performs a pixel-to-pixel regression and shows the calibrated RGB values have a strong correlation with the NDVI, for the validation dataset (r=0.91). The same shallow-regressive neural network was tested on a set of data acquired with a different non-co-registered sensor. Specifically, the application of the model to around 1000 drone images acquired by a 6x Sentera sensor still has good performances (r=0.71). To demonstrate the reliability of the proposed method, k-means clustering (k=2) was applied to NDVI images to make a comparison between observed and predicted results evaluating r2, SSIM, and accuracy mean values. Therefore, this work shows the efficiency of the AI approach to estimate vegetation index: for the first time crop conditions could be monitored by computing NDVI using data from a low-cost RGB device. The application of this method can be an important resource for small-sized farms and a first step to making this type of technology accessible to improve production, reduce costs, and minimize environmental impact.

POTENTIAL USE OF FUNGAL BIOFERTILIZERS AND BIOPESTICIDES IN INTEGRATED AND ORGANIC STRAWBERRY PRODUCTION IN SLOVENIA

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Environmentally friendly production technology of horticultural plants is the key to sustainable farming. One of the main goals is to reduce the use of chemicals globally in order to improve soil quality in the long term. As part of the Excalibur project, the Slovenian partners tested the effect of selected biofertilizers and biopesticides (bio-inocula) in strawberry (*Fragaria x ananassa* Duch.) cultivation under field conditions. Selected bio-inocula included a formulation based on arbuscular mycorrhizal fungi arbuscular mycorrhizal fungi (AMF), improving nutrient uptake; *Clonostachys rosea*, antagonist of fungal plant pathogens; and *Metarhizium brunneum*, an entomopathogen. The fungal formulations were applied near the roots during planting in two fields with either integrated or organic production. The plants were planted in July 2021 and the trial lasted until July 2023, allowing evaluating two production seasons. Various traits such as plant biomass, abundance of above-ground arthropods, strawberry yield and plant development were evaluated. After the first production season in 2022, strawberry plants grown under integrated production technology were smaller and had a lower yield compared to organic production. The bio-inocula showed no significant effect on the observed parameters in 2022, which is why they were applied again in spring 2023. Interestingly, monitoring in the second season showed significant differences due to bio-inocula treatments. The plots with AMF treatment had a higher number of flower stems in the organic field; however, the organically managed plants had more flower stems than those managed under the integrated regime across all treatments. Plots with *M. brunneum* treatments resulted in higher root biomass in both production systems. All treatments resulted in a higher yield compared to the untreated control plants in the organic field. The total number of arthropods was significantly higher in the organically managed field. Since the positive effect influence of bio-inocula was only observed in organically grown strawberries, we hypothesize that bio-inocula have a greater effect when used in production that is less dependent on external inputs.

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TECHNOLOGY FOR SOIL APPLICATION OF LIQUID BIOPRODUCTS IN ORGANIC BERRY PRODUCTION

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Soil pathogens threaten berry production, thus causing risk of significant economic losses. In organic berry production this may be mitigated by enrichment of soil microbiome with the specific microbial antagonists. This was one of the objectives of the project ResBerry (ERA NET CORE Organic Cofund) where such strategy was implemented with regard to strawberries and raspberries as the target crops. When the antagonists are lacking in soil a consortium of specific microbes was added in form of the appropriately composed biofertilizer or a specially formulated organic fertilizer enriched with antagonistic microorganisms. One of the challenges was to develop simple, practical and cost-effective technology for soil application of high volumes of liquid bioproducts to be applied into the soil, possibly closest to the rhizosphere of berry plants. In order to meet this requirement, the fluted disc coulters of a stubble seeder were adapted for the soil applicator of liquid products. The coulters were mounted under the frame of the inter-row cultivator so that during application, two of them ran next to both sides of the plant row and made 8-10 cm deep furrows in the soil for the liquid product to be applied. Above the frame of the cultivator the liquid supply system of the applicator was mounted. For the experimental purposes it included air compression liquid tanks, pressure adjustment valves, remotely controlled shut-off valves, liquid hoses, calibrated orifice discs for the liquid flow adjustment and TPU TeeJet nozzles of high flow rate, ensuring application of more than 1500 L/ha liquid volume. The field tests showed that deep soil application prevented the liquid products from drying out, and thus ensuring proper activity of the introduced antagonistic microbes in close proximity to the plant roots. The applicator can be easily adapted for application of granulated products.

PRACTICAL IMPLEMENTATION OF AKIS ON ORGANIC PRODUCTION

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The AKIS - Agricultural Knowledge and Innovation System, is a network of organizational units and individuals creating, disseminating and implementing agricultural knowledge in rural areas. The efficiently functioning system of knowledge exchange and innovation is a condition for accelerating restructuring and modernization of agriculture. The cooperation of individual partners in the field of knowledge sharing, exchange of experiences and the use of this knowledge in agricultural practice, as well as the dissemination of good practices is of key importance for the efficient functioning of the AKIS. Public agricultural advisory services play an important role in the exchange of knowledge and innovation in agriculture. The Agricultural Advisory Center of Poland, with its branch in Radom has been carrying out operations under the "Knowledge Transfer" of the RDP 2014-2020, which aims to disseminate good practices or innovative solutions used in the organic food production system among farmers. The operations have been implemented within a consortium consisting of 24 units: 16 agricultural advisory services and 8 scientific institutes. 265 demonstration facilities were established in 161 organic farms in the whole country. Twenty-five topics were covered by the demonstration trials, that included orchards (9 trials), vegetables (31 trials) and herbs (15 trials). Methods applied, topics addressed, and the outcomes of the different dissemination activities will be presented.

COMPARISON OF SOIL NEMATODES COMMUNITIES IN ORGANIC AND CONVENTIONAL HORTICULTURAL CROPPING SYSTEMS

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The use of nematodes as indicators of soil condition and health has been increasing in the last decades in respond to demand of better knowledge about the impact of different agricultural practices on soil biodiversity and functions. The soil nematode community has been proven to be a suitable bioindicator to assess the impact of different agricultural cropping management systems. Ecological indexes, particularly those based on nematodes trophic levels, area proxy of the food web complexity: a greater diversity of trophic groups represents an improved functioning of the ecosystem. The status of nematodes communities was evaluated in 15 locations situated in Poland, Italy, Austria, Denmark, France, Germany, and Italy, with three cropping systems managed according to organic and integrated methods, which have been selected to verify the overall impact of agronomical practices, particularly the use of microbial-based products on soil biodiversity. The method of field management (i.e. integrated vs. organic) did not affect the overall nematodes' population size and had little impact on the abundance of the trophic groups. However, the cropping system factor highly impacted the nematode communities: a decreasing gradient from long-term to medium-term and seasonal vegetable cropping systems was observed in the total number of nematodes. The abundance of the five nematode trophic groups found in the studied sites was similar to that recorded in various terrestrial environments, but differences were recorded on some trophic groups, including plant parasites.

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BIODYNAMIC FRUIT PRODUCTION: A CASE STUDY IN ITALY

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Currently, 250 ha of biodynamic fruit (blueberries, kiwis, pears, apricots, cherries, persimmons, nectarines, grapes, oranges, lemons, clementines, peaches, plums, almonds) are cultivated in 4 Italian regions, mainly Emilia Romagna, Puglia, Basilicata under 2 brands (Demeter, VERDEA). Biodynamic is recognized worldwide through the Demeter brand; Apofruit decided to create its own biodynamic brand (VERDEA) active since 2019. Farms that apply for certification are asked to have advanced organic experience and to follow a training, which is mandatory for the VERDEA regulations. There are several difficulties in some regions which give less support to training. For Apofruit, biodynamic fruit production started in the early 2000s with the organization of various courses, initially basic and then gradually more in-depth; over a hundred farms were involved; of these, fifteen were selected and continued to follow all the initiatives proposed every year. A working group was formed with these farms to prepare 3 biodynamic preparations at the Biondi's farm. This activity is still continuing, and it is very important because biodynamic must be also a social activity and exchange of ideas. Apofruit has long investigated the possibility of setting up piles for the creation of quality compost (mainly cattle manure); but the farms are reluctant due to legislative and practical problems: the regulations oblige the construction of a concrete base and the neighbors often complain about the composting site. Since biodynamics gives great importance to the heap, which need to have specific characteristics, Apofruit has not foreseen the use of purchased compost (which, moreover, was often of very poor quality). As a result, Apofruit has been focusing more on stimulating natural humification using green manuring; a very complex topic and for which there are only few evidences or experiences that can help biodynamic farms. Cornerstones of this last agronomic aspect are: 1) sowing of green manure mixtures and their management for incorporation into the soil; 2) the management of correct oxygenation (or rather micro-oxygenation) of the soil and of the biodiversity of the microbiome.

WINFOLIA SYSTEM - A USEFUL TOOL FOR ASSESSING PEST AND DISEASE RATE ATTACKS ON PEAR LEAVES

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In this study, we will follow the health status of the pear leaves of the trees planted in the Experimental Field of the Faculty of Horticulture within USAMV Bucharest. Six cultivars, Euras, Cristal, Romcor, Corina, Orizont, Tudor, and three new hybrids, were included in the study. Each cultivar has been grafted on two types of rootstocks: quince and pear, the third variant being on its roots. At the same time, another experimental factor was fertilization with compost compared to control. During the growing season (May, June, July, August, and October), leaf samples were collected to evaluate the incidence of the disease using the WinFolia system and the morphologic parameters simultaneously. This way, the influence of the cultivar and the rootstock on the attack degree and the difference between the control and the fertilized with compost variant was shown. The WinFolia system has proved to be a handy tool for this type of evaluation, offering valuable information without being time-consuming.

SOIL FERTILITY IN GERMAN APPLE ORCHARDS – FARMERS´ MANAGEMENT STRATEGIES AND THEIR IMPACT ON SOIL PROPERTIES

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An online survey on soil fertility was conducted with German organic fruit growers. It was sent to 219 farmers via the organic fruit growers' association FÖEKO e.V. mailing list and 58 respondents completed the survey. Farmers were asked about their soil management strategies: maximum tillage depth, tillage treatments per year, fertiliser inputs and biomass transfer from the inter-row to the tree row. Farmers were also asked about management changes in the last five years and their observations regarding effects on the orchard soil or trees. To further examine the effects of different soil tillage and fertilization treatments on physical soil properties, water infiltration measurements were taken in a trial involving three years of different management regimes at the Competence Centre for Fruit Growing at Lake Constance. Farmers' answers could be grouped into three main clusters, based on the stated maximum tillage depth, tillage treatments per year and nitrogen input. The majority of farmers (66%) tilled to a depth of up to 10 cm, 12% of the farmers only tilled the soil superficially and 3% tilled deeper, up to 20 cm. The average number of tillage treatments and the nitrogen input increased proportionally with the tillage depth applied. The inter-row mulching strategies were not linked to tillage or fertilisation. The farmers who had observed an improved soil structure through their management changes indicated either less and/or shallower tillage and/or increased inputs of base fertilisers in the past five years. Regarding water infiltration, the tillage treatment with horn meal tended to result in the lowest infiltration rate, compared to the tillage treatments with compost, vinasse or peas as well as the treatment with only superficial soil tillage and horn meal. Based on these results, soil fertility can be enhanced by organic matter input and soil conservation practices.

IDENTIFICATION OF BENEFICIAL MICROORGANISMS IN THE SOIL, AS COMPONENTS OF BIOPRODUCTS, USING THE PCR-DGGE TECHNIQUE, TO IMPROVE THE PROTECTION OF TOMATO PLANTS AGAINST SOIL-BORNE PATHOGENS

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The development of bioproducts intended for horticultural crops, enriched with beneficial microorganisms, makes it necessary to monitor the survival rate of microorganisms in the soil, to optimize the bioproduct formulations, application method, dates and doses. The technique of denaturing gel electrophoresis (PCR-DGGE) enables the identification of microorganisms in the soil, based on specific molecular profiles and on sequence analysis. The aim of the study was to identify the bacteria *Paenibacillus polymyxa* and the fungi *Trichoderma harzianum* and *Clonostachys rosea* with plant protective properties against soil phytopathogens (*Phytophtora nicotianae*, *Fusarium oxysporum*), applied to the soil, in tomato growing, in greenhouse conditions. Identification of bacterial and fungal strains was performed using primers amplifying the 16S rRNA gene for bacteria or the ITS region for fungi. The control consisted of DNA samples of the tested microorganisms. Identification of microorganisms was based on determining the position of bands in a denaturing gradient gel in relation to bands from control samples and sequence analysis by determining similarity to sequences in the NCBI database. For DNA samples obtained from the soil, to which the *Paenibacillus polymyxa* strain was applied, bands were obtained at the same position in the gel, as the control bands. Analysis of the sequences showed the highest similarity of the 16S rRNA gene sequence to bacterial species of the *Paenibacillus* genus. For soil samples to which the strains of *Clonostachys rosea* strain or *Trichoderma harzianum* were applied, bands were observed at the same gel position, as the bands of the reference strains, which indicates the presence of the applied fungal species in the soil. The applied PCR-DGGE technique enabled the identification of applied strains of microorganisms and revealed their presence in the soil, which contributes to the development of effective bioproduct formulations and to the biological protection of tomato plants against soil pathogens.

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TRIALS WITH ESSENTIAL OILS TO REDUCE THE DAMAGE FROM SEA BUCKTHORN FRUIT FLY AND SOME FRUIT DISEASES ON SEA BUCKTHORN ORGANIC PLANTATIONS

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In Poland, the land area of sea buckthorn plantations, particularly organic ones, is growing steadily also due to its great health-promoting qualities. However, the threat from pests and diseases also increases. The major pest is the fruit fly *Rhagoletis batava*, which larvae affects the fruit, making difficult to control them. Other pests such as the buckthorn honeybug and aphid or leaf-eating caterpillars can also occur. Among the fungal pathogens that can occur on sea buckthorn can be listed the soil-borne fungi *Verticillium* spp. and *Fusarium* sp. and various types of fruit rot decay, caused by *Pythium* sp., *Alternaria* sp., and *Botrytis* sp. However, there are no specific plant protection products allowed in organic farming registered for these pests. Trials were thus designed to determine the suitability of four essential oils (clove, cinnamon, coconut and oregano) for reducing populations of *R. batava* (field tests) and pathogenic fungi (laboratory tests). The results showed that some oils could be suitable to reduce the damage and colonization by fungi, while there was a very low efficacy to reduce the damage by the fruit fly.

FUNGAL BIOFERTILIZERS AND BIOPESTICIDES APPLIED IN INTEGRATED AND ORGANIC STRAWBERRY FIELDS IN DENMARK

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Horticultural production needs alternatives to chemical inputs to sustain and improve soil health. Project EXCALIBUR aimed at testing different bio-inocula in field trials across Europe for their effects on plant yield, protection against pests, and on soil biodiversity. Tested bio-inocula consisted of Arbuscular Mycorrhizal Fungi (AMF, enhancing nutrient uptake), *Clonostachys rosea* (antagonist of fungal plant pathogens) and *Metarhizium brunneum* (an insect pathogen). Formulations of these three fungi were applied in the soil near the roots of strawberry plants of two commercial fields, either integrated or organically managed. Both trials were located in eastern Denmark and spanned the entire crop cycle from spring 2021 to late summer 2023. Different traits were measured including plant biomass, abundance of aboveground arthropods, fruit yield and quality, and root mycorrhization. The integrated strawberry field produced larger plants, as well as more and bigger fruits than the organic field. No effects of the three bio-inocula were observed in 2022, hence the bioinocula were re-applied in spring 2023. Some effects were observed in 2023: compared to the control plots (i.e., untreated), plots with AMF and C. rosea showed a reduced number of flower stems in the integrated field while *C. rosea* and *M. brunneum* treatments resulted in lower root biomass in both management systems. However, these effects had no consequences on the yield, which remained the same for all treatments and the AMF treatment did not increase the observed root mycorrhization. Few effects were observed on the abundance of arthropod pests. While these types of fungal inocula are efficient in controlled laboratory conditions, various factors, including climate or competition with native soil microorganisms, may render their effects at field conditions more subtle. Optimization of bio-inocula selection, formulation or timing of application is thus needed to ensure obtaining the expected beneficial effects.

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THE INFLUENCE OF ORGANIC FERTILIZERS ON THE SOIL MICROBIAL COMMUNITY STRUCTURE AND DIVERSITY

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Fertilisation has a significant impact on the number and species structure of microorganisms and, thus, influences the whole functional composition of the complex of soil microorganisms. The main objective of this study was to investigate the impact of organic fertilizers on soil microbial community structure and diversity, as evaluated by T-RFLP (terminal restriction fragment length polymorphism). In our study, we applied five different organic fertilizers once in May by watering the apple trees in various combinations, with three technical replications. We sampled the soil at three time points: 1st in May, before treatments (T0), 2nd in July (T1), and 3rd in October (T2), resulting in a total of 6 soil samples per combination. We extracted total DNA from bulk soil and conducted PCRs with fluorescently n labelled primers to amplify DNA of all Bacteria, Archaea, and filamentous fungi. The PCR n products were then digested with restriction enzymes and the fragments were analysed through capillary electrophoresis, allowing for the precise measurement of product sizes. We scored the sizes of the products for Bacteria, Archaea, and fungi and compared them for different combinations and time points. On the basis of obtained fragments in T-RFLP assay, it was possible to estimate changes in number of OTU (Operational Taxonomic Units) and Shannon H' index diversity of Archaea, Bacteria and fungi. Results and conclusions: Organic fertilisation caused changes in the microbial community structure of the population of Bacteria, fungi and Archaea, expressed as changes in the number of functional taxonomic units (OTU) and genetic diversity (Shannon H'-index), observed 2 and 5 months after application. The most significant changes of these parameters were observed for the Archaea and Bacteria populations, while the lowest for fungi. However, no relations were observed between the type of fertilizer used and the observed changes.

FLAME TREATMENT IN AGRICULTURE: INSTANTANEOUS HEATING AS A TECHNOLOGY FOR WEEDING AND DISINFECTION IN SUSTAINABLE FARMING

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Open flame technology in agriculture can reduce pesticide use, improve food safety by implementing sustainable management practices. This paper describes a range of innovative farm machinery developed specifically to extend the application of LPG flaming technology in horticulture, in the orchard, and in poultry. The initial research activity was conducted for use in weed management. The subsequent research aimed to integrate the flame treatment in other cultural practices and has led to the development of many applications, such as preparation of seedbeds for horticultural crops, control of weeds via broadcast surface treatments or band applications for row crops. The list of applications includes horticultural crops (fresh-cut leafy greens, asparagus, garlic, etc.), fruit tree species and many other species (maize, potato, alfalfa, etc.). LPG flaming was tested in the vineyard to eliminate suckers, replacing hand removal and in the hazelnut orchard to effectively eliminate basal shoots. Instant heat was tested to reduce the inoculum pressure of plant pathogens (fungi and bacteria) and insect pests, overwintering on crop residues (orchard, kiwifruit, greenhouse). Instantaneous heat has also been tested in poultry farms to disinfect the stable floor and the bedding material at the end of the production cycle. The machinery developed for the application of the thermal treatment is characterized by simplicity of construction, low upfront investment, requires low maintenance and low cost of use. Flaming can be easily integrated into ordinary cultural practices. The results achieved with the instant heat technology, applied in many crops with different machines, have been generally successful. These treatments can reduce the use of synthetic chemicals, promoting environmental protection, improvement of working conditions and workers' health due to lower exposure to harmful chemicals. Further dissemination and transfer of results is necessary to overcome a widespread skepticism toward these innovative technologies, based on non-chemical low-impact methods.

RESPONSES OF CARROTS (DAUCUS CAROTA) TO ORGANIC MANURE APPLICATION RATES WHEN CULTIVATED UNDER DIFFERENT PLANT SPACING METHODS

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Carrot (*Daucus carota*) is an important vegetable crop cultivated worldwide, valued for its nutritional content and culinary versatility. In the pursuit of sustainable agriculture.: Despite the potential benefits of organic manure application in carrot production, the optimal application rate that maximizes crop performance remains uncertain. Our experiments at the Federal University Oye-Ekiti, Ekiti State, Nigeria, were carried out to determine the effect of plant spacing and organic manure application rates on growth and yield of carrot. The experiments were set according to randomized complete block design and were replicated four times. The results showed that plants that received the maximum rate at 15 t/ha had taller plants with more leaves and larger leaf length compared to the lower rate at 10 t/ha and the zero application rate that were not significantly different. Moreover, except for the number of leaves where there was no significant difference among treatment, the moderate spacing of 50mX40m (50,000 plants/hectare) performed better in plant height and leaf length compared to lower responses from least spaced 50mX30m (66,000 plants/hectare) and widely spaced plants at 50mX50m (40,000 plants/hectare) in the parameters measured. In conclusion, carrots performances were optimum at 15 t/ha manure rate and when cultivated at 50 m X 40 m plant spacing.

A MULTIVARIATE SELF-ORGANIZING MAP APPROACH FOR SOIL BIODIVERSITY

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Soil biodiversity plays a crucial role in ecosystems' functionality and healthiness. A powerful machine learning technique called Self-Organizing Map (SOM) was applied for the analysis, visualization and classification of data on soil physical-chemical characteristics and biodiversity as a function of soil management practices in horticultural crops as part of the H2020 EXCALIBUR project. The objective was to enhance the understanding of the relations between these features to optimize the use of bioinoculants according to soil type and other available field variables. The SOM is based on classifying input data through neural networks without external supervision. The resulting map makes identifying patterns and relationships between different data points easy. A data set comprising soil characteristics (chemical, physical) and several biodiversity parameters related to microorganisms, micro-, meso- and microfauna communities were analyzed by applying the SOM method. The data set included data from different sites in Europe under different pedo-climatic conditions. SOMs were performed on datasets considering different groups of variables including microbial genes, other trophic levels of soil biota, and environmental parameters considering 6 factors (Crop, Treatment, Site, Crop Management, Condition, and Climatic Zone). SOM is an intuitive and descriptive method that can be used to analyze, visualize, and classify soil data. Its unsupervised learning approach, combined with its visual representation, makes it an effective tool for exploratory data analysis and research in soil science.

This study has received funding from the European's Union Horizon 2020 research and innovation programme under grant agreement No 817946 (EXCALIBUR).

DO COVER-CROPS AFFECT SOIL MICROBIAL ACTIVITY OF ORCHARDS? TWO-YEARS RESULTS IN CONTINENTAL AND MEDITERRANEAN CONDITIONS

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Monospecific perennial cropping system limits the possibility of crop rotation and the number of species in the ecosystem. The set-up of plants in the tree row or between the tree row is thus encouraged to enhance biodiversity. The introduction of cover-crops in organic orchards can have many beneficial effects (e.g. reducing weed growth, year-round soil cover, attracting beneficial entomofauna, promoting protection against diseases and pests,) but also negative ones (e.g. nutrient and water competition with crops, attract voles). The effects of cover-crops on soil microbial aspects are poorly described. Different cover-crops were compared with a tillage reference in apple, apricot and peach organic orchards in order to quantify their effects on soil microbial properties in Poland (continental climate) and France (Mediterranean climate). Results showed that soil *Pseudomonas* abundance and dehydrogenase activity was significantly affected by *Melilotus officinalis* and *Phuopsis* cover-crops. A strong effect of the date of sampling was also observed, whatever the cover-crops species. The effects observed are difficult to generalize. They highlight the complexity of the interactions and the need for work quantifying the potentially positive and negative effects for the crop in order to identify the most appropriate soil management solutions.

The work was carried out in the framework of the project BioHortiTech, financially supported by the NCBR grant n. SUSCROP/II/BioHortiTech/01/2021 within the program ERA-NET Cofound SusCrop

TWENTY COVER-CROPS ASSESSED IN ORCHARD TREE ROWS: WHAT'S LEFT AFTER 5 YEARS?

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Cover crops in the tree row can provide shelters for beneficial arthropods, promote the biological functioning of the soil, provide nitrogen for fruit trees. However, potential disadvantages should not be neglected, such as water competition, the provision of a place favorable to voles. Twenty cover-crops species were sawed and assessed in an apple orchard in sub-Mediterranean conditions in South-East France in 2017. Observations were carried out over five years in order to identify adapted plant species, i.e. able to develop and maintain themselves sustainably. The criteria for choosing species focused on several characteristics: attractiveness for beneficials, ease and/or speed of development, low competition, allelopathic and/or insect repellent effects, etc. The species selected combine at least two potentially interesting criteria. Over five years of observation, the average ground coverage rate varies between 0 and 77%, reflecting the very high variability observed in the orchard. The greatest abundances and biomasses of earthworms were observed under *Sanguisorba minor* cover-crop. A typology of the species was observed: species maintaining a high ground cover (e.g. *Agrostis stolonifera*, *Achillea millefolium*, *Centaurea jacea*), species with a fleeting ground cover (e.g. *Lobularia maritima*, *Onobrychis viciifolia*), species that only developed after several years (e.g. *Artemisia absintium*, *Mentha x piperita*), species that never significantly developed (e.g. *Anthemis nobilis*, *Cota tinctoria*, *Hiercium pilosella*, *Teucrium chamaedrys*). The five years of monitoring highlight varied plants behaviors. In our pedoclimatic conditions, *Achillea millefolium* appears to be the best fitted species: high coverage and interesting for promoting functional biodiversity thanks to an abundant and spreading flowering period.

INTERCROPPING OF BERRY CROPS WITH FLOWERING PLANTS AS A BIODIVERSITY-BASED PRACTICE TO FACILITATE PEST CONTROL

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The insufficient number of plant protection products registered to control pests in organic fruit production may limit its predicted development. Research on selected intercropping practices that exploit the potential of functional biodiversity in reducing pest pressure was therefore conducted. Three biodiversity-based practices were studied: (i.) living mulch of white clover in inter-rows; (ii.) flower strips, i.e. patches of different flowering species adjacent to crop on one side; (iii.) flower islands, i.e. patches of the same species as in the flower strips but located in the central part of crop. All three practices were effective in reducing the incidence of major raspberry and strawberry pests, showing also positive impact on beneficial entomofauna. Aphid pressure in raspberry was lower in each of the intercropping systems compared to control. The living mulch reduced strawberry blossom weevil pressure in strawberry, while the flower strip reduced the abundance of thrips in raspberry.

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POSSIBILITIES OF PROTECTING BROCCOLI GROWN IN AN ORGANIC SYSTEM AGAINST THE MOST DANGEROUS AGROPHAGES

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The aim of the studies was to evaluate the efficacy of biopreparations and basic substances in the protection of broccoli (*Brassica oleracea* var. *italica*) against Alternaria black spots of crucifers (*Alternaria alternata*, *A. brassicae*, *A . brassicicola*) and cabbage whitefly (*Aleyrodes proletella*). The studies were carried out in 2021-2022 on a certified organic field of National Institute of Horticultural Research. Evaluation of the efficacy of tested products in controlling cabbage whitefly was carried out before each treatment by counting adults, egg batches and larvae. The degree of leaf infection by fungal pathogens was assessed using an eight-point scale. Obtained results showed different effects of the tested products on the development of Alternaria black spot. Miedzian Extra 350 SC and Limocide were the most effective in protecting plants against pathogens. In the 2021 trials, the efficacy of these products was initially 80-88% and decreased to around 62% as the disease progressed. In 2022, these products protected plants at 74-76% in the early stages of disease development. Their effectiveness decreased to around 60% one week after the last spray treatment. In both years of the pest experiments, sunflower oil, rapeseed oil, Spruzit Koncentrat, Fitter and Limocide had the best effect in reducing cabbage whitefly adults on broccoli, achieving efficacy of over 80% after spraying the plants 3 times. The lowest number of whitefly egg batches, i.e. from 2.8 to 8.4 deposits/leaf, was found on plants treated 3 or 4 times with rapeseed oil, sunflower oil and Fitter. At low initial larvae numbers, the products used reduced larvae abundance by more than 90%, while at high larvae numbers, their effectiveness was lower.

The research was financed by the Ministry of Agriculture and Rural Development within the Task 7.2 'Development of technologies for the production of vegetables and edible mushrooms in the organic system'

EFFECT OF BIOCONTROL AGENTS AND RESISTANT INDUCERS AGAINST PHYTOPHTHORA CROWN ROT, CAUSED BY PHYTOPHTHORA CAPSICI, ON ZUCCHINI AND SWEET PEPPER IN A CLOSED SOILLESS SYSTEM

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Several experimental biocontrol agents BCAs (*Trichoderma* sp.TW2, the Trichoderma mixture *T. gamsii* + *T. asperellum*, the mixture of Pseudomonas FC7B, FC8B, FC9B, *Fusarium solani* FUS25 and *Pseudomonas* sp. PB26) and resistance inducers based on K-phosphite and K-silicate, used at various concentrations alone or combined and for a different number of applications, have been tested to establish their ability to control *Phytophthora capsici* on hydroponically grown zucchini and sweet pepper plants. The treatments were applied according to different protocols to seedlings, which had been grown for two days in a peat medium before being artificially inoculated with the pathogen. Plants were monitored for symptoms development to evaluate effects of the tested products on Phytophthora crow and root rot incidence (% of dead plants), and as the fresh weight of plants. Among the biocontrol agents tested on the pathosystem pepper- *P. capsici*, *Fusarium solani* FUS25 provided a more consistent disease reduction (60-65%) and a greater fresh weight. Potassium phosphite, applied before the infestation of the peat medium with the pathogen, provided the best disease management in a dose-dependent manner, K-silicate alone partially reduced the percentage of dead plants of pepper. No improvement in the containment of the pathogen was observed when K-silicate was applied in combination with phosphite. The results against Phytophthora crown and root rot of zucchini showed that the level of control provided by potassium phosphite was higher than that of the BCAs (62 to 94 disease severity reduction), which showed a partial efficacy, and resulted comparable with the *Trichoderma gamsii* + *T. asperellum* formulated mixture (29 to 47 disease severity reduction). These results provide more information on the strategies that can be adopted to manage the Phytophthora crown and root rot of sweet pepper and zucchini grown in soilless systems.

LABORATORY EVALUATION OF SELECTED SUBSTANCES AND BIOPREPARATIONS WITH REPELLENT AND BIOINSECTICIDAL ACTIVITY AGAINST THE SPOTTED WING DROSOPHILA (DROSOPHILA SUZUKII)

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Drosophila suzukii is a dangerous, invasive pest of Asian origin. Its larvae feed on the fruit of many plant species. As spotted-wing drosophila control during fruit ripening is very difficult due to the pre-harvest interval period, alternative options are being sought to reduce the damage caused by this pest. The repellent effect of essential oils, as well as geosmin, beet peel extract, octenol, and edible mushroom extract against the spotted-wing drosophila was evaluated under laboratory conditions. Studies indicate that oils such as peppermint oil, lavender oil, thyme oil, and melissa oil applied to fruit under laboratory conditions at concentrations of 1.0 and 0.5 % have a repellent effect on the spotted fly and significantly reduce the number of eggs laid by females. However, their application to fruiting plants as a spray is impossible due to phytotoxicity. Beet peel juice and mushroom juice like the geosmin solution did not show a repellent effect. In the case of octenol, a significantly lower number of eggs laid to fruit treated with this compound was obtained. This substance had no visually noticeable adverse effect on the fruit, but it had a characteristic odor, which may discourage consumers from eating such fruit.

EFFECTS OF SOIL-DEPLOYED FUNGAL BIOINOCULA ON STRAWBERRY CANOPY ARTHROPODS

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Strawberry plants are attacked by various arthropods, including insects and mites. They cause damage to different parts of the plants and at different times of the year. The most common pests are aphids, thrips, weevils, cutworms, sap beetles, tarnished plant bug, whiteflies and mites. It is well evidenced that entomopathogenic fungi, deployed as soil bioinocula, can decrease the proliferation and consequent damages of mites in the canopies. However, strawberry plantations also harbour beneficial arthropods such as predatory mites, epigeal predators (e.g. carabids and spiders), lacewings, pollinators (e.g. honeybees and bumblebees), parasitoids and hoverflies (both predators and pollinators). In the field study performed within the EU project EXCALIBUR we monitored, identified, quantified and categorized the main pest and beneficial arthropods in both integrated (IPM) and organic (ORG) strawberry production in Slovenia and Denmark. The primary objective was to determine whether soil-deployed bioinocula based on beneficial fungi influence the aboveground arthropod assemblage. We applied three species/groups of beneficial fungi: *Clonostachys rosea* (mycoparasite), *Metarhizium brunneum* (entomopathogen) and arbuscular mycorrhizal fungi (biofertilizer). Soil-deployed bio-inocula had limited impact on aboveground arthropod assemblages; however, in treatment with *M. brunneum* the number of predators in Slovenia was significantly increased. Higher abundance of arthropods was observed in Slovenia compared to Denmark, likely influenced by geography, climate, experimental setup, and surrounding vegetation and landscape. Agricultural management strongly affected arthropods, with organic trials promoting greater diversity and abundance of arthropods compared to integrated trials. The observed differences in arthropod abundance and species diversity monitored in the fields between Slovenia and Denmark, as well as within different agricultural management systems, underscore the complexity of ecological interactions in agroecosystems. The promotion of arthropod abundance and diversity in organic fields suggests the potential benefits of sustainable farming practices. However, the nuanced relationship between herbivores, beneficials, and pest infestations invites further investigation to unravel the underlying ecological mechanisms shaping pest dynamics in diverse agricultural landscapes.

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MICROBIAL CONSORTIA AS COMPONENTS OF BIOPREPARATIONS STIMULATING PLANT GROWTH, YIELDING AND REDUCING LOSSES OF MINERAL NUTRIENTS TO THE SOIL, WATERS AND AIR - ECONUTRI PROJECT

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Excessive mineral fertilization and the application of chemical plant protection products, as well as organic waste from agriculture pollute the soil, water and air by leaching nitrate, phosphate and other mineral ions into surface and groundwater and by emitting ammonia and greenhouse gases into the atmosphere. The EcoNutri research project developed and implemented innovative technologies for horticulture and agriculture crop, in order to reduce soil, water and air pollution resulting from excessive use of mineral fertilizers and chemical plant protection products and inappropriate use of organic waste. Microbiological plant cultivation technologies have been developed, using innovative biofertilizers containing selected strains of beneficial bacteria of the genera: Bacillus, Priestia, Klebsiella, Streptomyces and Pseudomonas, increasing the absorption of nitrogen, potassium, phosphorus and other macro- and microelements by plants. The effect of three newly developed microbial consortia applied to the soil separately or in combination with biochar on the growth and yield of strawberry, cucumber and apple trees was assessed. The use of biochar with microbial consortia increased the yield and average fruit weight of cucumber plants. The use of biochar in combination with microbial consortia had a positive effect on the efficiency of photosynthesis in photosystem II (PS II). The use of biochar or consortia of beneficial microorganisms, as well as their combined application with biochar, increased the degree of colonization of cucumber, strawberry and apple roots by arbuscular mycorrhizal fungi. A beneficial effect was found, after combined application of microbial consortia and biochar on the formation and occurrence of AMF spores in the rhizosphere soil of strawberry, cucumber and apple plants. Innovative microbiological technologies will contribute to reducing soil, water and air pollution and water contamination with organic biomass waste from agriculture.

AN OVERVIEW ON INNOVATIVE TECHNOLOGIES AND RECENT ADVANCES IN ORGANIC FARMING SYSTEMS

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In this article, there is an overview on an agricultural economy, and till date, considering nations that thrive on agriculture. Over the past agriculture has been mainly subsistence-based, which has trembled due to the population explosion. During the mid-20th century, to provide food for the huge population, farmers finally adopted the technologies proposed by the Green Revolution. This had resulted in a spectacular yield increase; however, in the long run, many adverse effects of the green revolution on soil and the environment were recorded. As people became more aware of the health hazards caused by the ingestion of food loaded with chemicals, the organic revolution began. Organic farming sounded like a better alternative, but due to the reduction in yield over conventional farming, it has not been fully accepted. Several new innovations in this field have the potential to overcome this drawback. This article deals in detail with the concept of organic farming, innovations in this field, and types of certifications in countries like India. Organic farming is an agricultural approach that aims to produce food and other agricultural products using natural and sustainable methods. It is a holistic system that seeks to minimize the use of synthetic inputs, such as pesticides and fertilizers, while emphasizing the importance of soil health, biodiversity, and ecological balance. It is necessary to standardize the use of suitable organic sources for a certain crop and to look for lucrative markets for the produce. Growing support for organic farming as a potential key tool in the fight against poverty. All sustainable agriculture and rural development objectives are favorably impacted by organic farming, which also improves the socioeconomic standing of farmers and increases crop yield.

OBTAINING STABLE FORMS OF IN VITRO CULTURES FROM CATHARANTHUS ROSEUS (L.) G. DON PLANTS - A POTENTIAL TARGET FOR THE APPLICATION OF THE CRISPR/CAS9 GENOME EDITING TECHNIQUE

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Diseases of civilization, particularly cancer, affect more and more people every year. The right choice of methods and drugs can lead to cancer remission. Cytostatic drugs that inhibit the division of cancer cells include vinblastine and vincristine, alkaloids synthesized by the Madagascar plant *Catharanthus roseus* (L.) G. Don. They are used in the treatment of Hodgkin's lymphoma, acute lymphoblastic leukemia, lung and testicular cancer, among others. Due to complex biosynthesis, the content of these alkaloids in plants is very low. Therefore, it is necessary, using in vitro cultures, to increase the production of plant biomass or alter the plant's metabolism using genetic engineering techniques. The goal of this study was to obtain stable and fast-growing callus and somatic embryo cultures. Different variants of temperature, light access and medium composition were used. The results show that seed germination requires long imbibition, darkness and a temperature of 28-30ºC. Induction of hypocotyl callus was most efficient in medium supplemented with benzyladenine (BAP), naphtylacetic acid (NAA) and 2,4-D hormones (1 mg/L each), and somatic embryos with BAP (0.5 mg/L), NAA (1.5 mg/L) and gibberellic acid (GA3) (1 mg/L). The developed procedure for stable callus cultures can be used for further experiments, including genome modification by CRISPR/Cas9 technique to increase vinblastine and vincristine biosynthesis under in vitro culture conditions.

THE AIMS AND OUTCOMES OF BIOHORTITECH PROJECT: IMPROVED BIOINOCULA AND LIVING MULCHING TECHNOLOGIES FOR INTEGRATED MANAGEMENT OF HORTICULTURAL CROPS

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Modern agriculture, after years of intensifying production, elements of which have proved environmentally destructive, has been challenged to introduce more sustainable cultivation methods. However, it is a difficult process, requiring knowledge and precision in introducing new techniques, meeting the requirements of pro-environmental EU strategies. BioHortiTech project's research is closely related to EU action plans: Green Deal, biodiversity restoring, zero pollution. The aim of the project is to develop effective technologies of innovative bio-inocula production and application, and living mulching implementation in organic and integrated culture systems. The experimental work was concentrated around the developing of the innovative hybrid microcapsules containing biologically active substances and microbial formulations based on biodegradable polymers, to be used to promote plant growth or their resistance in crop production. To make the crops more resilient to biotic and abiotic stresses, the biodiversity of the plant culture was increased by introduction of herbal plants as living mulching. It is also important to know the population dynamics of micro-organisms introduced into the soil or applied to the plant surface. Therefore, a research was carried out to develop a mathematical model to predict the survival rate of micro-organisms applied as bio-inocula under different conditions. It is important that the studies were performed in different cultural and climatic regimes. The main outcomes of the project will be presented.

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AN OLFACTOMETER TO STUDY THE BEHAVIOUR OF SOIL-DWELLING LARVAE UNDER VARIOUS STIMULI

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Soil-dwelling insect larvae, including beetle larvae, cause great damage to crop production. Despite the fact that many methods of controlling soil-dwelling pests have already been developed and applied over the years, their population is still numerous and they cause a lot of damage, both in horticultural crops and in forestry. The damage caused in our country by larvae of the May beetle is recorded in most areas, in a variety of crops, but is particularly dangerous in strawberry crops. In order to gain a better understanding of the behavior of May beetle larvae in the soil under the influence of supplied stimuli (plant solutions), a behavioral olfactometer was developed and constructed, which allows a single choice test to be carried out and observe the larvae behavior. The olfactometer was constructed from five circular elements: one element with a diameter of 40 cm was the centre (arena) of the device, then four elements with a diameter of 20 cm in which strawberry plants or strawberry plants with plant extracts were placed as required. were connected to the arena via 15 cm long tubes with a diameter of 10 cm. All elements of the olfactometer were made of transparent plastic so that the behavior of the larvae could be tracked. The reactions of larvae to alcohol extracts of velvetleaf, marigold, buckwheat and dandelion (root) were tested. Individual larvae reacted differently to the extracts, showing different preferences or repellent effect of the extracts.

EFFECT OF MICROBIAL AND ORGANIC BIOSTIMULANTS ON THE DEGRADATION OF LEAVES AND ON THE SOIL NEMATODES POPULATION IN ORGANIC APPLE ORCHARD

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Fallen leaves in apple orchards can be a source of disease infection and sometimes also a place where pests overwinter. In conventional orchards, urea solution sprayed when leaves fall is often used to accelerate their decomposition, while in organic orchards mechanical removal is applied, reducing the possibility of providing organic matter to the soil. Trials were carried out for three seasons testing microorganisms and organic biostimulant to enhance degradation of fallen leaves. A frame of 50x50x5 cm size was positioned on soil and filled with 200 g of leaves, which were treated with cellulolytic microorganisms or a by-product of yeast production (Vinassa), separately or together. Urea solution (5%) was used as control. The effectiveness of the treatments was not dependent on the apple variety and leaves degradation ranged from 50% to 80%, similarly to the control. However, the combination of the treatments did not increase the efficacy. Weather conditions during the winter season affected the level of leaves degradation. An impact of the treatment on soil nematodes was also assessed.

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EVALUATION OF DIFFERENT ATTRACTANTS FOR MONITORING OF RHAGOLETIS CERASI AND R. CINGULATA IN CHERRY ORCHARDS

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Cherry species have been traditionally grown in Poland, and currently there is an interest in growing both sweet and sour charry under organic management, due to demand for fresh consumption and processing. However, the control of the common fruit flies (*Rhagoletis cerasi* and *R. cingulata*) is challenging in organic orchards, being monitoring particular important to the application of possible measures for their control. In order to develop a strategy for the control of these fruit flies in organic orchards, several kinds of traps containing different attractants were tested comparing them with standard chromotropic yellow sticky traps for several years in different locations. The attractants included both home-made and commercial products, including prototypes and attractants known to be effective with *Ceratitis capitata*. To better identify which compounds were more effective in attracting the adults, an analysis of the smell pattern was carried out using an electronic nose. The start of the flies' detection depended on the species, the climatic conditions of the season and the location of the orchards. The length of the flight period ranged from about 45 days for *R. cerasi* to about 60 days for *R. cingulata*. Both chromotropic and lure traps attracted the different *Rhagoletis* species, though not to the same extent. However, the most suitable products were characterized by containing ammonia compounds.

IMPACT OF BIOLOGICAL CONTROL AGENTS ON THE DEVELOPMENT OF SYMBIOSIS BETWEEN THE TOMATO ROOTS AND ARBUSCULAR MYCORRHIZAL FUNGI

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Due to the negative effects of chemical plant protection products on soil, water, and agricultural biodiversity, it is increasingly being sought to replace them with environmentally friendly alternatives like antagonistic bacteria and fungi. However, a commonly overlooked aspect of Biological Control Agents is their effect on native beneficial microorganisms. One of the aims of the EXCALIBUR project was to evaluate the impact of developed inoculants, with antagonistic properties against Fusarium and Phytophthora, on the colonization of tomato roots by arbuscular mycorrhizae fungi. The two-year trials, were carried out in 2021 and 2022 on the conventionally managed field at National Institute of Horticultural Research in Skierniewice, in central Poland. The experimental treatments consisted of: 1) untreated control (UTC) and formulations based on 2) *Trichoderma harzianum* (strain WT40Ai, InHort), 3) *Clonostachys rosea* (strain KIS1881, KIS) and 4) *Paenibacillus polymyxa* (strain K16, Inhort). Before starting the experiment, the field was fertilized taking into account the nutrient content of the soil. During the vegetation season, tomato plants were protected against late blight (*Phytophthora infestans*) using registered fungicides. In both 2021 and 2022, on average, plants inoculated with *C. rosea* (KIS1881) and *T. harzianum* (WT40Ai) had a higher percentage of roots colonized by AMF (F% index) in comparison with untreated control. In contrast, the results obtained from plants treated with *P. polymyxa* varied depending on the year. The obtained results indicate that strains WT40Ai and KIS1881 did not have a negative impact on native mycorrhizal fungi and could be used in combination with AMF inocula.

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EFFECT OF BIOCONTROL AGENTS AND BIOSTIMULANTS FOR MANAGING FUSARIUM WILT OF TOMATO UNDER GREENHOUSE CONDITIONS

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The scientific community has made considerable efforts to explore sustainable alternatives to synthetic fungicides and fumigants against soil-borne pathogens. Fusarium wilt of tomato, caused by *Fusarium oxysporum* f. sp. *lycopersici* (Fol), continues to cause significant crop losses worldwide. Encouraging results have been achieved using genetic resistance, biocontrol agents (BCAs) and biostimulants of natural origin. The aim of this study was to evaluate the efficacy of different combinations of BCAs and biostimulants against Fol under controlled conditions in greenhouse. Four trials were carried out on tomato (cv. Cuor di bue) grown into 12L pots (6 plants/pot) and five replicates. The experimental treatments included different combinations of antagonistic microorganisms (*Fusarium oxysporum* MSA35 and *Trichoderma asperellum* FC80 used at 1x10 7 conidia/mL), obtained from suppressive soils, a microbial biostimulant containing mycorrhiza (AMF, 0.5 g/L), a microbial biostimulant based on *Paenibacillus polymyxa* and a non-microbial biostimulant of natural origin (GH, 0.1%). Treatments were applied on 15 days-old seedlings in the nursery and 15 days later, directly to the infested peat soil (1g/L of fungal biomass), immediately before transplanting. All treatments were compared to azoxystrobin and to a commercially available product based *Trichoderma gamsii* + *T. asperellum* . Plants were monitored for symptoms development and disease severity (DS). Under severe disease pressure in the untreated control (DS from 41 to 61), best results were provided by MSA35+FC80 (45-87% efficacy) and MSA35+GH (64-83% efficacy), while biostimulants alone showed variable efficacy. Considering these results, further research is needed to optimize the type and timing of application of BCAs and biostimulants in view of their inclusion in integrated pest management strategies.

EFFICACY OF BIOCONTROL AGENTS AND BIOSTIMULANTS AGAINST STRAWBERRY CROWN AND ROOT ROT CAUSED BY RHIZOCTONIA SOLANI UNDER GREENHOUSE CONDITIONS

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Strawberry crown and root rot caused by *Rhizoctonia solani* is a serious threat to strawberry production worldwide and leads to significant yield losses. The use of biological control agents and biostimulants is increasingly investigated in response to the need for sustainable disease control measures. Three trials were conducted on potted strawberry plants cv. Elodi (FC.12.025.01) to evaluate the efficacy of experimental antagonists (*Fusarium oxysporum* MSA35 and *Trichoderma asperellum* FC80), isolated from suppressive soils, and biostimulants (microbial AMF and non-microbial GH), against *R. solani* in greenhouse. The plants were planted in 12 L plastic pots filled with a peat substrate infested with the pathogen biomass, using 4 plants/pot, with four replicates (16 plants/treatment). Products applied alone (MSA35 and FC80 1x10 7 conidia/mL, GH 0.1% and AMF 0.5 g/L) or in combination were compared to tolclofos-methyl and to the marketable available products based on *Trichoderma gamsii*+*T. asperellum* and *Glomus* spp.+*Trichoderma* spp.+rhizobacteria. Treatments were first applied by root immersion immediately before transplanting, and 15 days later, by soil drench. Plants were monitored for symptoms development. At the end of the trials disease severity (DS) data were pooled and subjected to one-way analysis of variance (ANOVA). Under a severe disease pressure (DS60) in the untreated control plants, disease severity was significantly reduced by FC80 (38% efficacy), FC80+GH (42% efficacy), FC80+MSA35+GH (43% efficacy) and AMF+GH (40% efficacy). Results showed the impact of the type and timing of applications of biocontrol agents and biostimulant on Rhizoctonia solani crown and root rot. Further studies are required to evaluate the effect of these products used alone or combined under field conditions.

ENHANCING INSECT DIVERSITY THROUGH COMPANION PLANTS FOR CREATING A RESILIENT ORGANIC STRAWBERRY CROPPING SYSTEM

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By promoting biodiversity and reducing reliance on external inputs, insects contribute significantly to the sustainability and success of organic strawberry cropping systems. The presence of diverse insect populations fosters ecosystem resilience, helping organic strawberry crops withstand environmental stresses and disturbances. We introduced companion plantings such as trap plants like amaranth or flowering plants like buckwheat alongside an organic strawberry experimental field at Hochschule Geisenheim University (Germany). In 2023, samples were taken over the entire growing season using a Vortis insect suction sampler and then morphologically evaluated with a microscope. The results show that important insect families such as Anthocoridae (Heteroptera) and Nabidae (Heteroptera), as well as a large number of parasitoid Hymenoptera, were able to colonize the experimental field in a short time. The companion plants play an important role not only by providing food resources through pollen and nectar, but above all by providing additional habitats. Planting diverse species with different heights and structures and keeping them over long-time periods creates stable microhabitats that offer shelter and nesting sites enhancing the overall biodiversity and strengthening ecological balance within organic strawberry cropping systems. Together, trap plants and flower strips foster a resilient cropping system, promoting holistic and sustainable agriculture practices in organic farming by reducing pest pressure and enhancing natural pest control through an elevated functional insect diversity.

THE INFLUENCE OF FERTILIZATION WITH ORGANIC POLYSULPHATE FERTILIZER ON YIELDS AND QUALITY PARAMETERS OF SELECTED SOFT FRUITS

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There were 47,615 ha of organic permanent crops in Poland in 2022, according to IFOAM data. This includes blueberries and raspberries, which, despite the use of fertigation, also require nutrients to be applied to the soil. Blueberries and raspberries were the focus of this experiment, which aims to investigate whether fertilization with a natural mineral - polyhalite - can improve the yield and quality parameters of the plants. Polysulphate is a natural mineral (polyhalite) found below the North Sea, off the coast of the UK. Polysulphate provides 17% CaO, which is easily absorbed by plants, and also contains 48% SO 3 . The sulfur from the fertilizer is released gradually over time. In addition to sulfur, the fertilizer contains 14% K 2 O and 6% MgO - all in the sulfate form. Polysulphate is approved for use in organic farming, with a certificate issued by IUNG in Puławy. This paper presents the results of field experiments conducted with Polysulphate fertilizer in the cultivation of blueberries and raspberries. The control in both experiments received standard fertilization. For blueberry, the control consisted of UAN 200 kg/ha, Trifosgran 300 kg/ha, potassium sulpfate 70 kg/ha, kieserite 60 kg/ha. For raspberry crops UAN 250 kg/ha, Trifosgran 200 kg/ha, potassium sulfate 125 kg/ha, kieserite 70 kg/ha. The test treatment for blueberry was UAN 200 kg/ha, Polysulphate 250 kg/ha, Trifosgran 300 kg/ha. For raspberry, the treatment was UAN 250 kg/ha, Polysulphate 300 kg/ha, potassium sulfate 40 kg/ha, Trifosgran 200 kg/ha. Preliminary results show Polysulphate had a positive effect on yields and fruit quality parameters. Blueberries, in particular, require calcium fertilization for optimum yields, but due to the low pH of the soil that this plant prefers, calcium uptake can be difficult. The form of calcium in Polysulphate is well suited to these conditions, making Polysulphate an interesting fertilizer for blueberry production. However, further research is necessary to determine Polysulphate's mechanisms of action, and to determine precise doses and fertilization schemes depending on the species and habitat conditions.

VOLATILE ORGANIC COMPOUND ANALYSIS REVEALS RICH FLAVOR IN APPLE UNDER ORGANIC AGRICULTURE IN YUNGUI PLATEAU

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Organic agriculture has been claimed to produce safe and quality products, however, there are few studies on the comparison of the organic product flavor with conventional product. Current study tries to explore the differences of volatile organic compounds (VOCs) composition and content, and their impacts on apple aroma between organic and conventional apples which were farmed in the southeast region of Tibet Plateau, China. Solid-phase microextraction-Gas Chromatography-Mass Spectrometry (SPME-GC-MS) analysis indicated that a total of 104 VOCs were detected in the apples, which were classified into 11 categories, i.e., olefins, esters, aldehydes, phenols, alcohols, aromatic hydrocarbons, ketones, acids, alkanes, ethers and heterocycles. Compared with conventional apple, organic production significantly increased the content of olefins (78.6%), esters (159%), aldehydes (87.5%), phenols (202%), alcohols (138%), acids (126%) and ethers (1750%). The Orthogonal Partial Least Squares Discriminant Analysis (OPLS-DA) model effectively distinguished the organic and conventional apples by relying on 104 VOCs. Total 31 and 28 VOCs were involved in the construction of apple aroma framework for organic and conventional apples, respectively. Primary aroma compounds in apples include butyl acetate, 2-methylbutyl acetate, butyl butyrate, ethyl caproate, hexyl alcohol, hexyl 2-methylbutyrate, trans-2-hexenal, α-farnesene, damascenone, hexyl acetate, hexanal, and ethyl butyrate. Odor activity value (OAV) of fruital, botanical, and floral fragrance of organic apples are 33914, 11025, and 5008 respectively, ca. 166%, 69.0%, and 69.0% higher than those of conventional apples. Organic apples also have much lower rotted index than conventional apples (7.10 vs. 40.8) after 100 days of storage experiment and the organic apples exhibited a longer shelf-life. The study highlights that organic farming practices improve the comprehensive sensory quality of apple and prolong the product's storage period.