X International Symposium on SOIL AND SUBSTRATE DISINFESTATION

June 6th | 8th, 2023
Almería (Spain)

Book of abstracts

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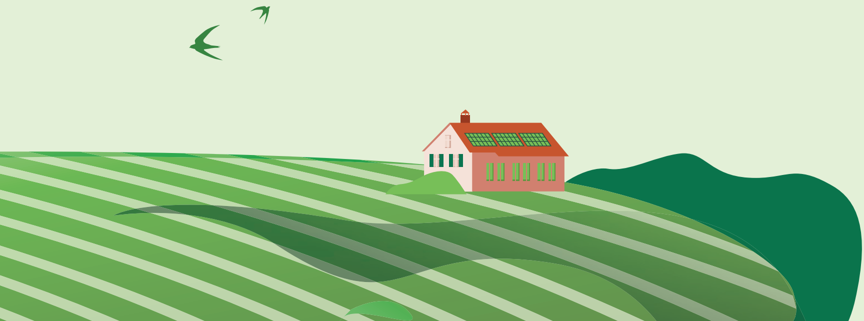
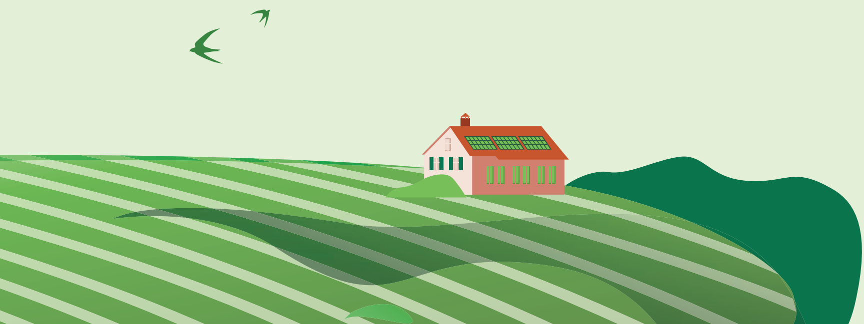
BOOK OF ABSTRACTS

JUNE 2023



01. Welcome



Dear colleagues,

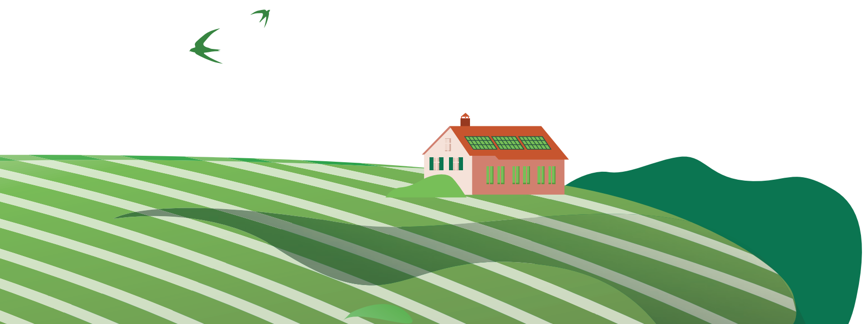
It is our pleasure to announce the upcoming X International Symposium on Soil and Substrate Disinfestation, a unique opportunity to exchange with the scientific and stakeholder communities, the latest advances on control of soilborne diseases and nematodes. It has passed four years since our last symposium and many changes have arisen in relation to the topic. Next year we will have a chance to know how to face these changes and how to cope with the challenges of the new production requirements in terms of sustainability and profitability.

The symposium involves the ISHS Division Protected Cultivation and Soilless Culture, the ISHS Division Vegetables, Roots and Tubers, and the ISHS Working Group Soil Borne Pathogens, and will be held in Almería (Spain) from June 6th to 8th 2023.

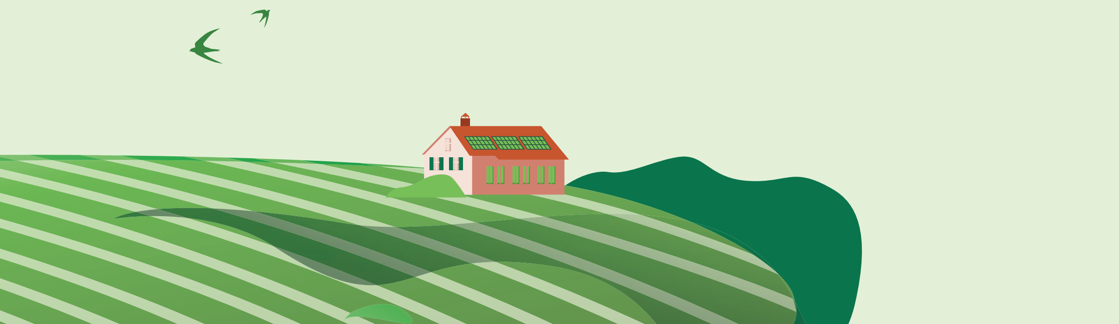
The scientific sessions will include hot current topics based on research and application around the Globe: Anaerobic soil disinfestation; Soil disinfestation and beneficial microorganisms; Disinfestation against nematodes; Soil solarization, biosolarization, biofumigation and nonfumigant soil disinfestation technologies; Soil disinfection technologies; Cultural practices and Combined Control Measures; and Resistant Cultivars and Grafting for Soil-Borne Disease Management.

We look forward to seeing you all during the next X International Symposium on Soil and Substrate Disinfestation in 2023.

Organizing Committee



02. Committees



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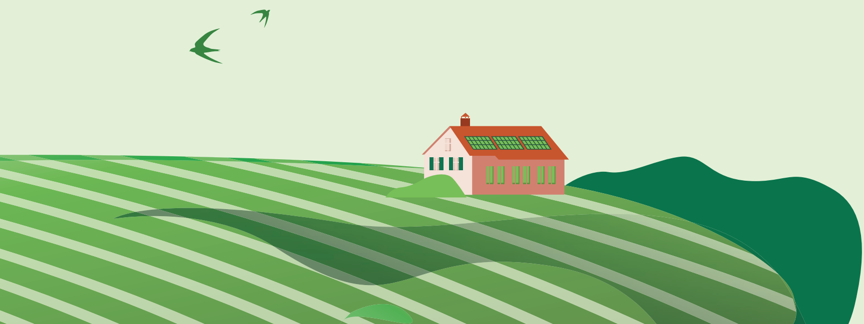
03. Program



TUESDAY 06/06/2023

08:00 - 09:00 Registration

09:00 - 09:20 Welcome: Institutional presentation

09:20 - 10:00 Keynote Speech 1: Advancing Organic Amendment-based Soil Management Approaches: A Paradigm Shift from Soil Disinfestation to Nourishing Soil Health.

Dr. Francesco Di Gioia. *College of Agricultural Sciences. Penn State University, U.S.A.*

10:00 - 10:20 Oral 1.1: Seasonal differences influence the efficacy of soil biosolarisation with plant debris on the presence of *Fusarium* spp. and *Pythium* spp. in soil.

Dr. J. Ignacio Marín-Guirao. *IFAPA, Spain*

10:20 - 10:40 Oral 1.2: Yellow nutsedge *(Cyperus esculentus)* management in Southern California strawberry.

Dr. Oleg Daugovish. *University of California, U.S.A.*

10:40 - 11:20 Poster Session/Break: Poster session 01

11:20 - 11:40 Oral 1.3: Effect of compost and biocontrol agents on lettuce and tomato Fusarium wilts and on rhizosphere microbiome.

Dr. Massimo Pugliese. *University of Torino, Italy*

11:40 - 12:00 Oral 1.4: Vegetative and Reproductive, quality and quantity characteristics of strawberry cv. Camarosa in response to new soilless medium.

Prof. Bijan Kavoosi. *Fars Agricultural Research, Iran*

12:00 - 12:20 Oral 1.5: Disinfection of used sawdust and its effect on yield of hydroponically grown tomatoes.

Dr. Nadia Araya. *Agricultural Research Council, South Africa*

12:20 – 13:40 LUNCH

13:40 - 14:20 Keynote Speech 2: Response of Soil Nitrogen Cycle and Functional Microbes after Soil Disinfestation.

Dr. Dongdong Yan. *Institute of Plant Protection. Chinese Academy of Agricultural Sciences Beijing, China*

14:20 - 14:40 Oral 2.1: Seed germination and seedling development of selected vegetables and herbs grown in used disinfected substrates.*

Ms. Johleen Malaka. *Agricultural Research Council, South Africa.*

14:40 - 15:00 Oral 2.2: Fresh chicken manure fumigation reduces the inhibition time of chloropicrin on soil bacteria and fungi and increases beneficial microorganisms.*

Ms. Daqi Zhang. *Institute of Plant Protection, Chinese Academy of Agricultural Sciences, China*

15:00 - 15:40 Poster Session/Break: Poster session 02

15:40 - 16:00 Oral 2.3: The dynamic change of soil K following soil fumigation.*

Dr. Wensheng Fang. *Institute of Plant Protection, Chinese Academy of Agricultural Sciences, China.*

16:00 - 16:20 Oral 2.4: Environmental Fate of Soil Fumigant—Allyl Isothiocyanate.*

Ms. Yi Zhang. *Plant Protection Institute, Chinese Academy of Agricultural Sciences, China.*

16:20 - 16:40 Oral 2.5: Combined silica with copper-based sodium alginate/chitosan multicomponent hybrid hydrogels to synergistically control fumigants release, reduce emission and enhance bioactivity.*

Dr. Lirui Ren. *Institute of Plant Protection, Chinese Academy of Agricultural Sciences, China.*

16:40 - 17:00 Oral 2.6: Enhanced Efficacy and Economic Feasibility of Anaerobic Soil Disinfestation Combined with Carbon Source and Cover Tarps in Controlling Strawberry Soil-borne Diseases.

Mr. Zhaoxin Song. *Institute of Plant Protection, Chinese Academy of Agricultural Sciences, China. China*

* Candidate for the 'Young Mind Awards'

WEDNESDAY 07/06/2023

9:00 - 09:40 Keynote Speech 3: Valorization of Biomasses and Biowastes into Suppressive Biofertilizers.
Dr. Massimo Pugliese. *University of Torino, Italy*

09:40 - 10:00 Oral 3.1: Exploring novel soil organic amendments to implement suppressive soils against *Fusarium oxysporum* fs.p. *lactucae*.
Dr. Jesús Fernández-Bayo. *University of Granada, Spain*

10:00 - 10:20 Oral 3.2: Agronomic viability of species of the Brassicaceae family with biofumigant potential in central Spain.
Prof. Daniel Palmero. *Polytechnic University of Madrid, Spain.*

10:20 - 11:00 Poster Session/Break: Poster session 03

11:00 - 11:20 Oral 3.3: Factors that promote dimethyl disulfide fumigant desorption from soil and reduce the risk of phytotoxicity to newly-planted seedlings.
Quiuxia Wang. *Institute of Plant Protection, Chinese Academy of Agricultural Sciences, China.*

11:20 - 11:40 Oral 3.4: Evaluation of different peats for the suppression of damping-off in cucumbers.
Prof. Ana Pastrana. *University of Sevilla, Spain*

11:40 - 12:00 Oral 3.5: Control of soil-borne tobacco diseases by low dose dazomet combined with mustard biofumigation.
Dr. Qingli Han. *College of Biodiversity Conservation, Southwest Foresty University, China*

12:00 - 12:20 Oral 3.6: An innovation machine for dazomet application in strawberry.
Prof. Aocheng Cao. *Institute of Plant Protection, Chinese Academy of Agricultural Sciencies, China.*

12:20 - 13:40 LUNCH

13:40 - 14:20 Keynote Speech 4: Integration of biosolarisation in Mediterranean greenhouse systems.
Dr. Miguel de Cara. *IFAPA, Centro La Mojonera, Almería, Spain*

14:20 - 14:40 Oral 4.1: Evaluation of rhizome treatment combined with preplant fumigation in ginger field.
Dr. Dongdong Yan. *Institute of Plant Protection, Chinese Academy of Agricultural Sciences, China.*

14:40 - 15:00 Oral 4.2: Optimizing the Application of Anaerobic Soil Disinfestation to High Tunnel Vegetable Production Systems in the U.S. MidAtlantic Region.
Dr. Francesco Di Gioia. *Penn State University, U.S.A.*

15:00 - 15:40 Poster Session/Break1: Poster session 04

15:40 - 16:00 Oral 4.3: Use of plastic films in soil treatments beyond TIF.
Mr. Javier Pery. *Grupo Armando Álvarez, Spain*

16:00 - 16:20 Oral 4.4: Efficacy of Biofumigation with Brassica carinata Commercial Pellets (BioFence) to Control Rhizoctonia solani and Sclerotinia sclerotiorum.
Ms. An Decombel. *Inagro, Belgium.*

16:20 - 16:40 Oral 4.5: Sustainable use of soil fumigant Nemasol® (Metam Sodium 510): Stewardship and mitigation measures as key success factors.
Dr. Emanuele Medico. *EASTMAN, Italy*

16:40 - 17:00 Oral 4.6: Efficacy of Dimethyl Disulfide (DMDS) for *Orobanche* spp. control in Turkey.
Mr. Thierry Fouillet. *Arkema, France*

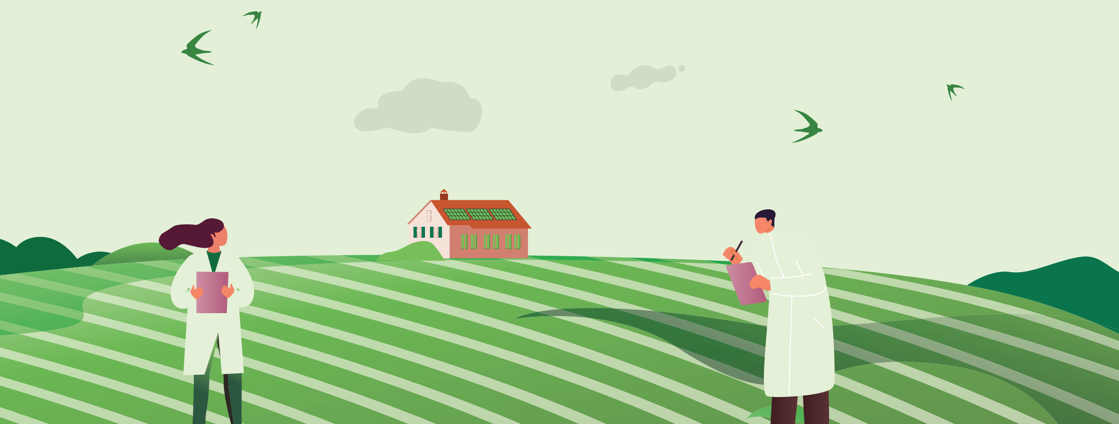
17:00 - 17:40 Young Mind Awards and Concluding Session

21:00 - 22:00 Social Dinner

THURSDAY 08/06/2023

08:30 - 15:00 Technical Visit

04. Abstracts



TITLE:

Oral 1.1 Seasonal differences influence the efficacy of soil biosolarisation with plant debris on the presence of Fusarium spp. and *Pythium* spp. in soil

AUTHOR(S):

J.I. Marín-Guirao*, M.A. Gómez-Tenorio, F.J. Castillo-Díaz, J.C. Tello-Marquina
University of Almería
*jignaciomarin@gmail.es

ABSTRACT:

The effect of soil biosolarisation treatments on *Fusarium* spp. and *Pythium* spp. populations was evaluated for two consecutive years in two commercial greenhouses located in Almería, Spain. Four rates of fresh plant debris (2.5, 5.0, 7.5, and 10.0 kg/m^2), a treatment with 5 kg/m^2 of fresh sheep manure, and a solarisation treatment with no incorporation of organic amendment as a control treatment were tested. The treatment dates differed between the two greenhouses: i) March-May in Greenhouse 1 and ii) May-August in Greenhouse 2. Following treatments, pepper and cucumber crops were grown in Greenhouse 1 and Greenhouse 2, respectively. In both greenhouses, soil sampling was conducted to determine the initial state, as well as after the treatments and at the end of the crops in both years. Complementary bioassays with tomato and cucumber plants were conducted to evaluate the impact of the soil samples on plant growth.

Initially, the presence of *Fusarium* and *Pythium* in the two greenhouses were quite similar. In Greenhouse 1, biosolarisation treatments with plant debris increased *Fusarium* populations, mainly *F. solani*, and *Pythium* was present in all evaluated soil samples. In Greenhouse 2, all treatments significantly reduced both *Fusarium* and *Pythium* populations in the first year and throughout the second year, making them undetectable by the analytical technique used. In any case, no pathogenicity was detected in the pepper and cucumber crops or in tomato and cucumber seedlings grown in the bioassays. The values of three out of four growth-related variables (roots dry weight, aerial dry weight and leaf area, but not height) in cucumber seedlings showed a positive relation with *F.solani* population.

The application of fresh plant debris to the soil through biosolarization is postulated as an alternative for the management of crop residues in accordance with the principles of the circular economy.

Keywords: biodisinfestation, circular economy, greenhouse, horticultural crops, solarisation.

TITLE:

Oral 1.2 Yellow nutsedge *(Cyperus esculentus)* management in Southern California strawberry

AUTHOR(S):

O. Daugovish[1*], S. Fennimore[2]

[1]University of California Cooperative Extens, 669 County Square Drive, Suite 100, Ventura, CA 93003-5401, United States of America

[2]University of California Davis, 1636 East Alisal St, Salinas California, United States of America

[*]odaugovish@ucanr.edu

ABSTRACT:

Coastal California remains one of the world's primary strawberry growing regions with an annual fruit production on 15, 000 ha and value of more than $2.2 bln. In addition to soil-borne pathogens, a very competitive perennial weed *Cyperus esculentus* became increasingly difficult to manage in strawberry since the phase-out of methyl bromide. In a series of replicated trials we evaluated end-season bed fumigation, pre-plant application of *S*-metolachlor, shoot germination barriers, steam and anaerobic soil disinfestation as management tools for yellow nutsedge. End-season bed fumigation via two drip lines with metam sodium at 280 L/ha reduced nutsedge shoot germination from tubers 100% under the drip lines, but only 67-75% in-between drip lines. *S*-metolachlor at 0.36 and 0.72 kg/ha applied to beds immediately before plastic tarp installation and 30-35 days before strawberry transplanting provided 80-100% control of nutsedge shoots. Both herbicide rates was slightly phytotoxic to strawberry, but the plants outgrew injury and yielded similar to untreated. Application of superheated steam to maintain soil temperature at 70 C for 20 minutes reduced nutsedge germination 84%, while barrier fabric and a combination of paper with plastic on bed tops provided 95-100% germination reduction. Due to $2,000-3,200/ha cost of the barriers for nutsedge control they have only been adopted in organic strawberries with heavy infestations. Maintaining anaerobic conditions under plastic mulch for three weeks after an addition of 9.2 t/ha of labile carbon sources and irrigation provided an environment that reduced shoot germination of yellow nutsedge tubers 38-63%. Yellow nutsedge remains a challenging weed that interferes with strawberry production. Multiple management approaches are necessary to prevent yield losses in strawberry production in California.

Keywords: weed control, plasticulture, strawberry

TITLE:

Oral 1.3 Effect of compost and biocontrol agents on lettuce and tomato Fusarium wilts and on rhizosphere microbiome

AUTHOR(S):

M. Pugliese*, G. Gilardi, M.A. Cucu, A. Bellini, M.L. Gullino, A. Garibaldi
University of Torino
*massimo.pugliese@unito.it

ABSTRACT:

Suppressive composts and biocontrol agents are considered among the alternatives to soil and substrate disinfestation for controlling soil-borne pathogens. Different mechanisms of action are involved, including competition for space and nutrients, plant resistance induction, bioactive compounds, and direct parasitism. The objective of the present work is to summarize the results achieved by evaluating green composts and biocontrol agents (*Trichoderma* spp., *Bacillus amyloliquefaciens*, *Pseudomonas* sp.) efficacy against *Fusarium oxysporum* on lettuce and tomato, as well as the effect on the rhizosphere microbiome. Experimental trials were carried out in field conditions, by transplanting plants previously grown using potting substrate containing compost or applying the biocontrol agents in nursery. Quantitative Polymerase Chain Reaction - qPCR and the next generation amplicon sequencing technologies were applied on rhizosphere samples. Composts and biocontrol agents reduced the diseases by 50-70%, compared to the untreated controls. Moreover, a reduction of the abundance of the soil-borne pathogens up to 100 folds was observed in the soils where compost and biocontrol agents were applied. The abundance of beneficial microorganisms, such as *Bacillus* and *Trichoderma,* increased in the rhizosphere of plants treated. However, treatments did not affect the microbial diversity observed applying NGS. These findings suggest that compost and biocontrol agents can be used to reduce plant diseases caused by soil-borne pathogens, most probably improving the abundance of beneficial microorganisms and reducing that of pathogens.

Keywords: *Fusarium oxysporum* f. sp. *lactucae*; *Fusarium oxysporum* f. sp. *lycopersici; Trichoderma* spp.; qPCR; NGS.

TITLE:

Oral 1.4 Vegetative and Reproductive, quality and quantity characteristics of strawberry cv. Camarosa in response to new soilless medium

AUTHOR(S):

B. Kavoosi[1*], A. Ziyaian[2], D. Mohammad[2]

[1]Horticulture Crops Research Departement, Fars Agricultural Research, Natural Resources, Shiraz, Iran

[2]Fars Agricultural Research Center, Shiraz, Iran

[*]kavoosi696@yahoo.com

ABSTRACT:

Due to the scarcity of water resources, especially in arid and semi-arid regions, the use of this vital resource has been limited. Growing in greenhouses and indoors as an effective way to increase production, with less water consumption is expanding. Due to the serious drought crisis in Fars province, it is planned to increase the area of greenhouses in the province to 7000 hectares. Therefore, a large volume of culture media is needed, some of which are currently imported from abroad. This study was conducted to investigate the effect of different planting medium combinations (70% Cocopeat + 30% Perlite (control), 50% Licorice Root waste + 50% Rice bran, 25% Licorice Root waste + 75% Rice bran, 75% Licorice Root waste + 25% Rice bran, 100% Rice bran, 100% sawdust, 100 Licorice Root waste, 50% Rice bran + 50% sawdust, 50% Rice bran + 50% cocopeat) in a completely randomized design in three replications was conducted in 2019-2020. Number of leaves, leaf area, number of fruits, yield and qualitative indices such as TSS, TA, TA/TSS ratio and reproductive index included flower size and number of days to flowering were measured the results showed that the effect of planting composition on all vegetative, reproductive and quantitative characteristics of strawberry fruit except the number of days to flowering was significant but not on the quality traits of strawberry juice. Based on the results of this study, different indices of strawberry were reduced in the composition of pure Rice bran (100%) and compounds containing more than 50% of Rice bran. The most economically beneficial treatment in strawberry production was (Licorice Root waste (75%) + Rice bran (25%).

Keywords: Licorice Root waste, Rice bran, Strawberry, Vegetative, Yield

TITLE:

Oral 1.5 Disinfection of used sawdust and its effect on yield of hydroponically grown tomatoes

AUTHOR(S):

N. Araya*, R. Mahlangu, H. Araya, R. Sutherland, M. Truter, C. du Plooy

Agricultural Research Council , Vegetable, Industrial and Medicinal Plants, Pretoria, South Africa

*ibraimon@arc.agric.za

ABSTRACT:

Sawdust is readily available in South Africa, making it more affordable to growers than imported substrates. In addition, sawdust has favourable physical properties for plant growth, such as high porosity, while maintaining a good water retention capacity. Emerging hydroponic farmers find it challenging to obtain new sawdust every season due to limited affordability; as a result, there is a need to explore the potential of reusing it. With this intention, four disinfection methods were evaluated in terms of their restriction to pathogen infestation and yield of tomatoes grown in an open-bag hydroponic system, operating under a non-temperature-controlled plastic tunnel: (1) solarization; (2) soaking in water; (3) soaking in sporekill (1L /1000L) and (4) soaking in 50% hydrogen peroxide (1L /1000L) for 24 hours, followed by sun-drying for two weeks before their reuse to grow tomatoes hydroponically. The microbial analysis of the disinfected sawdust showed that the colony-forming units (cfu) of bacteria decreased with treatments sun-drying ($4.1x10^{11}$ cfu/g), water ($7.0x10^{11}$ cfu/g) and sporekill ($1.3x10^{12}$ cfu/g), while hydrogen peroxide increased detectable levels to $4.6x10^{13}$ cfu/g, compared to before treatment ($4.4x10^{12}$ cfu/g). In contrast, the fungal colonies were reduced the most by hydrogen peroxide ($2.0x10^{5}$ cfu/g), followed by sporekill ($3.5x10^{5}$ cfu/g) and water ($3.7x10^{5}$ cfu/g), while increased with sun-drying ($7.3x10^{5}$ cfu/g), compared to before treatment ($4.3x10^{5}$ cfu/g). The resultant marketable yield was significantly higher under the solarization method (3.91 kg/plant), followed by soaking in sporekill (3.4 kg/plant) and water (3.29 kg/plant), while the lowest yield was observed with the hydrogen peroxide disinfection method (2.68 kg/plant) which was not significantly different from the new sawdust (2.86 kg/plant). These findings demonstrate that disinfected old sawdust can potentially be reused in hydroponics, as no major disease incidence was observed. This can contribute to reduced input costs and increased profitability for hydroponic farmers.

Keywords: Organic growth media, non-temperature-controlled plastic tunnel, solarization, hydrogen peroxide.

TITLE:

Oral 2.1 Seed germination and seedling development of selected vegetables and herbs grown in used disinfected substrates

AUTHOR(S):

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*malakaj@arc.agric.za

ABSTRACT:

Seedling production is an important aspect in crop production that has a direct influence on crops' yield and overall production value chain. However, affordability and accessibility of seedling growth substrates has become a challenge for resource-poor growers. Therefore, the aim of the study was to assess the response of used, disinfected substrates of selected vegetable and herb crops on seed germination and seedling development. The experiment was conducted in a temperature-controlled glasshouse that ranged from 16-24ºC, during December 2022. The study treatments were one–season-used cocopeat, sawdust and perlite substrates. The treatments were tested on sweet basil, coriander, lettuce and spring onion. Prior to their reuse, the various substrates were disinfected with hydrogen peroxide at an application rate of 1L/1000L. Cocopeat revealed the best performance, as it resulted in germination percentages of 100% for coriander and sweet basil, 98% for lettuce and 35% for spring onion. In contrast, sawdust and perlite had significantly lower and comparable germination percentage for most crops, except for spring onion which yielded 60%. The seedlings in cocopeat had improved seedling development in terms development and stimulating growth of true leaves within 7 days after planting. The finding of this study suggest that substrate that is one-season-used could be disinfected and reused in an effort to reduce input costs without compromising seedling development and overall quality of leafy vegetable and herb crops. This helps to improve food production and sustainability of income generation for resource-poor growers.

Keywords: Germination percentage, Growth media, Seedling emergence, soilless production.

TITLE:

Oral 2.2 Fresh chicken manure fumigation shortened the inhibition time of soil bacteria and fungi and increases beneficial microorganisms

AUTHOR(S):

D. Zhang*

No.2 West Yuanmingyuan Road, Beijing, China, Beijing, China

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ABSTRACT:

Chloropicrin (CP) controls soil-borne plant diseases caused by pathogens, increases crop yield, but has a long-term inhibitory effect on beneficial soil microorganisms. Therefore, we evaluated the effects of biofumigation material fresh chicken manure (FCM) on soil bacteria and fungi and nitrogen cycle functional genes, and the duration of those effects in this experiment. Our results showed that in the laboratory, FCM and CP increased NH_4^+-N concentration within 40 days which then returned to the control level. FCM increased NO_3^--N by 2.82–5.78 times by 80 days, compared with the control, while the concentration of NO_3^--N in the CP treatment was not significantly different from the control at the 80 day. Although in the laboratory FCM inhibited the relative abundance of 16 S rRNA and the nitrogen cycle functional genes archaeal *amo*A (AOA *amo*A), bacterial *amo*A (AOB *amo*A), *nir*K and *nos*Z over a 40-day period, the taxonomic diversity of soil bacteria and fungi in the FCM treatment were restored to unfumigated level within 90 days in the field. However, CP treatment has a strong inhibitory effect on soil microorganisms after 90 days. Importantly, the relative abundance of some beneficial microorganisms that control soil-borne pathogenic microbes or degrade pollutants increased significantly in FCM, including *Bacillus*, *Pseudomonas* and *Streptomyces* bacterial genera and *Chaetomium* and *Mycothermus* fungal genera. Noteworthy, like CP, FCM still had a strong inhibitory effect on *Fusarium* at 90 d. Our results indicated that FCM not only increased the content of inorganic nitrogen and improved the respiration rate of soil microorganisms, but it also shortened the recovery time of beneficial soil microorganisms and increased taxonomic diversity. we believe that FCM has the potential to replace CP, which would eliminate CP's detrimental environmental impact, improve farmer safety and promote sustainable crop production.

Keywords: Soil fumigation, Fresh chicken manure, N-cycling genes, Soil bacteria and fungi, Beneficial microorganisms

TITLE:

Oral 2.3 The dynamic change of soil K following soil fumigation

AUTHOR(S):

W. Fang*, A. Cao, Q. Wang, Y. Li, D. Yan
No.2 Yuanmingyuan West Road, Beijing Haidia, YuanMingYuan West Road 2, Beijing,China
*fws0128@163.com

ABSTRACT:

The dynamic change of soil K following soil fumigation was not clear. To determine the effect of soil fumigation on different soil forms of K, five commonly used fumigants (chloropicrin, 1, 3-dichloropropene, dazomet, dimethyl disulfide and allyl isothiocyanate) were used to investigate the effects of soil fumigation on the content of three forms of potassium (NH_4OAc extracted potassium, HNO_3 extracted potassium and slow-available potassium) in soils in China. Our results showed that none of the five fumigants had any significant effect on the K content of the three forms during short-term fumigation (1-7 days). However, chloropicrin fumigated soils showed rapid reductions of NH_4OAc extracted K (16%-24%) and HNO_3 extracted K (17%~23%) 28 d after tomato was planted, compared with the control soils. Moreover, the K content of tomato plants after chloropicrin fumigation was significantly higher than that without fumigation (30.3 vs 21.9 mg K/g plant dry weight, respectively), indicating that the latter stage of fumigation (28 – 70 d) significantly promoted the uptake of soil K by tomato. Correlation analysis showed significant, negative correlations between soil K plant height, stem diameter and dry weight of tomato. Soil fumigation did not affect the content of NH_4OAc extracted K, HNO_3 extracted K and slow available K in the short term (7 d), but significant promote the absorption of K by tomatoes which decreased the content of available K and available K in the later stage of fumigation. Our results provide a new perspective for understanding the “ fertilizer effect “ of soil fumigation.

Keywords: Fumigant; Soil potassium; Potassium uptake; Tomato

TITLE:

Oral 2.4 Environmental Fate of Soil Fumigant——Allyl Isothiocyanate

AUTHOR(S):

Y. Zhang*, Q. Wang

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ABSTRACT:

Allyl isothiocyanate (AITC) is a soil fumigant used for controlling soil-borne pests that reduce the growth, quality and yield of food crops. Its effectiveness against pathogens depends largely on its environmental fate like distribution and degradation in soil. The degradation and distribution of AITC under different soil textures and application methods were compared. Our results showed that the degradation half-life of AITC were 24.4 and 35.4 h in Fangshan and Yongzhou soils, respectively, without any added fertilizer or soil amendment. Nitrogen and organic fertilizer accelerated the degradation rate of AITC, while phosphorus fertilizer had the opposite effect. Inorganic and organic fertilizers affected the degradation of AITC by affecting soil microbial activity on the basis of the CO_2 cumulative release. The degradation rate of AITC increased more than 0.4 times in response to zeolite, but this was independent of particle size; and increased 1.0 - 2.6 and 0.3 - 9.7 times in response to biochar made from corn stalk and pine wood, respectively. AITC applied by drip irrigation at 7.5 g m^{-2} and covered with PE film for 5 d provided a more satisfactory efficacy against soil-borne pathogens and weeds without any phytotoxicity than that was injected at 50 g m^{-2}. AITC applied by drip irrigation at 7.5 g m^{-2} diffused 15 cm laterally and 30 cm deep where it reached concentrations of 0.022 ug cm^{-3} and 0.035 ug g^{-1}, respectively. While the gas AITC peak concentration was 0.64 μg cm^{-3} at 5% moisture content when was injected. Our results indicated that AITC applied by drip irrigation was more effective than injected. The improvement of application methods and effective addition of substances will guide applicators on methods to optimize the application of AITC for efficient control of key pests and weeds.

Keywords: Distribution, degradation, shank injection, drip irrigation, control effect

TITLE:

Oral 2.5 Combined silica with copper-based sodium alginate/chitosan multicomponent hybrid hydrogels to synergistically control fumigants release, reduce emission and enhance bioactivity

AUTHOR(S):

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ABSTRACT:

Soil fumigants—the most effective agrochemicals for managing soil-borne diseases—have been used extensively. However, high volatility, moderate toxicity and insufficient effective duration considerably limit their application. In the present study, combined silica with copper-based sodium alginate/chitosan multicomponent hybrid hydrogels was constructed to encapsulate dimethyl disulfide (DMDS), developing a model fumigant for controlled release (SIL/Cu/DMDS). The chemical properties and morphological features of the hybrid hydrogels characterized by integrated methods revealed successful preparation. Compared with monolayer (SIL/DMDS, Cu/DMDS), SIL/Cu/DMDS could significantly delay DMDS release and emission owing to the composite obstruction effect. Moreover, the hydrogels endowed the cargo molecules with a pH-responsive release property. Additionally, this composite showed a longer persistent duration by prolonging DMDS degradation half-life, which was 4.29 times greater than that of the DMDS technical concentrate in the soil. Finally, the control efficacy of the SIL/Cu/DMDS against pathogens was significantly enhanced at the same dose, but the composite did not inhibit seed germination and growth after 7 days when fumigated soil was aerated. Construction of a composite encapsulation system enhanced pesticide efficacy, reduced dose via controlled release and delayed fumigant degradation in soil, indicating the great potential of this strategy for developing an effective and environmentally friendly fumigant formulation.

Keywords: Soil fumigant, pH-triggered release, Controlled release formulations, Biosafety, Hydrogels

TITLE:

Oral 2.6 Enhanced Efficacy and Economic Feasibility of Anaerobic Soil Disinfestation Combined with Carbon Source and Cover Tarps in Controlling Strawberry Soil-borne Diseases

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ABSTRACT:

Pre-planting soil fumigation is a common practice for controlling strawberries (*Fragaria×ananassa* Duchesne) soil-borne diseases worldwide. Anaerobic soil disinfestation (ASD) is widely evaluated to suppress soil-borne diseases economically in numerous crops. The efficacy of the ASD technique varies with the form of the carbon source and its quantity, the soil properties, the temperature, and the cover tarps. The influence of different tarps on ASD efficacy is not documented.

In laboratory experiments, we evaluated the efficacy of three films used for ASD.The result indicated that the combined factors of organic ammendment maltose, 28ºC temperature, and 30% of soil moisture carried out for ASD were more efficient than the other conditions by orthogonal experimental studies. Also, ASD using maltose and sealing with TIF, obtained the higher suppression against *Fusarium* spp. (> 99.5%) and *Phytophthora* spp. (> 99.3%). High throughput gene sequencing showed TIF significantly increased the fungal taxonomic diversity. However, TIF and PE significantly reduced bacterial diversity and richness. PE and TIF significantly reduced Ascomycota abundance and significantly increased Firmicutes. *Sporolactobacillus* increased in dominance to comprise about 50% of the bacterial genera in response to both films, while the abundance of *Dongia* and *Nitrospira* were significantly reduced.

In the field trials, the efficacy of ASD using 6 and 9 t/ha maltose and sealing with TIF was evaluated. Compared with the untreated soil, ASD treatments highly reduced the colony number of *Fusarium* spp. and *Phytophthora* spp., and successfully controlled the damage caused by root rot wilt disease. ASD significantly increased the soil's nutrition which promoted plant growth. Also, it significantly increased strawberry yield.

Keywords: *Fusarium, Phytophthora,* Soil-borne diseases

TITLE:

Oral 3.1 Exploring novel soil organic amendments to implement suppressive soils against Fusarium oxysporum fs.p. lactucae

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ABSTRACT:

Plant diseases caused by soil-borne pathogens have become a major problem since the implementation of restrictions on the use of chemical fumigants. This has created the need to look for novel sustainable alternatives to control soil-borne pathogens such as *Fusarium oxysporum* f.sp. *lactucae* (Fol). The objective was to assess the potential of microbial communities from different soil amendments to develop suppressive soils as an alternative to chemical fumigation. Four different amendments, three of them chitin-rich, were tested: frass from black soldier fly larvae (BSFL, *Hermetia illucens*); commercial chitin; commercial compost, and commercial chitin + compost. To stablish the microbial communities in the soil, amended soils were incubated for four months before the experiment in a greenhouse (humidity set at 60% of the field capacity and it was corrected every two weeks by weight). After the incubation time, soils were inoculated with *Fol race 1* (the estimated initial Fol rate in the soil was 4.53×10^5 colony forming units/g of dry soil). A non-amended soil was used as control. Lettuce plants were grown in the resulting soil and periodically monitored for foliar severity. The experimental design included five treatments, three blocks and three randomised replicates per block and treatment (9 plants per treatment). Foliar severity of FOL observed on lettuce plants was significantly reduced (~45%) in the soils amended with commercial chitin and BSFL frass when compared to the control ($P < 0.05$). This indicates that these amendments may be promoting the development of soil microbial communities responsible for natural soil suppressiveness of FOL. The soil microbial community structure of each treatment will be characterized to identify potential microorganisms responsible of the suppressiveness.

Keywords: soil-borne pathogens; chitin; black soldier fly

TITLE:

Oral 3.2 Agronomic viability of species of the *Brassicaceae* family with biofumigant potential in central Spain

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ABSTRACT:

Biofumigation has been proposed as a strategy for the control of soil-borne diseases in horticultural crops. This cultural practice implies the cultivation of biofumigant species in the affected field, followed by the chopping of the plant tissue and its rapid incorporation into the soil. Volatile inhibitory substances, in particular isothiocyanates (ITCs), are produced after the hydrolysis of glucosinolates (GSLs) by the enzyme myrosinase released after alteration of plant tissue. The choice of the biofumigant species is a key aspect. However, very little information is available on the brassica species best adapted to outdoor cultivation under continental climate conditions. This work presents the results of a field trial carried out with 5 fast-growing species (*Brassica napus, B. juncea, B. carinata, Raphanus sativus* and *Sinapis alba*), with high biofumigant potential and isothiocyanate producers. Monitoring of phenological development and control of growth throughout the crop cycle has been carried out, through the periodic determination of chlorophyll vegetative development indicators (NDVI, GNDVI), (SPAD, NDRE) and combined chlorophyll-vegetative development indices (TCARI/ OSAVI) obtained by near sensors (portable reflectometer) and remote sensors (multispectral camera coupled to a drone). In addition, a PAR radiation balance has been carried out, in order to determine, together with the total accumulated biomass (roots, aerial part and composition) at the time of its incorporation into the soil (flowering), the efficiency values in the use of radiation PAR (RUE) of each of the species. On the other hand, the relationships between all these indicators have been analyzed to detect those that are most suitable for evaluating the agronomic viability of species with a potential biofumigant effect, identifying the most promising ones that can be inter-croped or cultivated in rotation as part of cultural management against edaphic diseases of semi-extensive horticultural species.

Keywords: Biofumigation, *Brassica napus, Brassica juncea, Brassica carinata, Raphanus sativum, Sinapis alba*, NDVI, GNDVI, SPAD, NDRE, TCARI, OSAVI.

TITLE:

Oral 3.3 Factors that promote dimethyl disulfide fumigant desorption from soil and reduce the risk of phytotoxicity to newly-planted seedlings

AUTHOR(S):

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ABSTRACT:

Dimethyl disulfide (DMDS) is a relatively new soil fumigant used in agro-industrial crop production to control soil-borne pests that damage crops and reduce yield. DMDS emissions after fumigation reduce soil concentrations thereby reducing the risk of phytotoxicity to newly planted crops. In our study, the desorption characteristics of DMDS from soil were measured in response to continuous ventilation. We examined DMDS degradation by thermal incubation. We determined the phytotoxic response of newly-planted cucumber seedlings to different concentrations of DMDS residues. We showed DMDS desorption and degradation rates fitted a first order model; that 92% of the DMDS desorption occurred in the first hour after fumigant application; and that residue concentrations in the soil at the end of the ventilation period were unlikely to be phytotoxic to newly planted crops. DMDS was desorbed faster from Wenshan soil than from Shunyi and Suihua soils. DMDS desorption was slowed more by high soil moisture content than increased soil bulk density. DMDS degradation, however, was mostly influenced by soil type and moisture content. A slow degradation rate resulted in a high initial desorption concentration of DMDS in soil. Our results indicated that DMDS desorption from soil in response to continuous ventilation was affected by the soil's key characteristics. The rapid decline in DMDS concentrations over time rendered the soil safe for newly-planted crops. Rapid degradation of DMDS in soil will lower the risk of phytotoxic residues remaining in the soil and reduce emissions during the waiting period. Acceleration of emissions early in the waiting period by regulating soil moisture content or increasing soil porosity may shorten the duration of emissions. Alternatively, soil extraction technology may be designed and developed to recover and reduce fumigant emissions.

Keywords: Volatilization

TITLE:

Oral 3.4 Evaluation of different peats for the suppression of damping-off in cucumbers

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ABSTRACT:

Pythium aphanidermatum causes damping-off and root rot in a wide range of plant species. In cucumbers, it is a recurrent problem for growers in Almeria, the main production area in Spain. Plant production companies mainly use peat as a substrate for seedbeds. It has been described that the incidence of damping-off by *Pythium* spp. increases as the degree of peat humification (decomposition) increases. Therefore, this study aimed to evaluate peats with different degrees of humification, according to the von Post scale, and their microbial activity against the severity of damping-off in cucumbers. Seven different peats, differing in their von Post scale, were used. A randomized block trial with five replicates was conducted under controlled conditions. Each replicate consisted of a 300 cm^3 pot with ten seedlings of cucumber cv. 'Hyclos Mix'. For pathogenicity tests, a known pathogenic isolate of *P. aphanidermatum* was grown on a soil-potato substrate and three grams per pot was used as inoculum. The disease severity was assessed after 14 days. The betaglucosidase activity was measured for each peat before the trial. The results showed no relationship between disease incidence and the von Post scale. Similarly, there was not a clear decreasing pattern of microbial activity with the degree of humification, as would be expected. However, a negative and significant correlation ($P < 0.05$; $R^2 = 59.5\%$) was observed between the microbial activity of the peats and the severity of damping-off recorded. In conclusion, microbial activity predicts the conductivity/suppressiveness of the peats better than the degree of humification by van Post

Keywords: Pythium aphanidermatum, Von Post scale, humification, decomposition, microbial activity

TITLE:

Oral 3.5 Control of soil-borne tobacco diseases by low dose dazomet combined with mustard biofumigation

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ABSTRACT:

Flue-cured tobacco has the characteristics of continuous cropping obstacle. Continuous cropping on a plot leads to occur soil-borne diseases such as root knot nematode disease, black shank and root black rot seriously, and these diseases cause heavy losses to flue-cured tobacco. Soil fumigation treatment kills a large number of harmful organisms in soil before planting, which is the most direct and effective measure to control soil-borne diseases. Stud y showed that soil fumigant dazomet with 375 kg/ha could effectively control soil-borne tobacco diseases, but it cost a lot and is difficult to popularize in flue-cured tobacco planting. Based on the traditional planting pattern of flue-cured tobacco in Yunnan province, combination fumigation was carried out by combining mustard, rape and white radish with different doses of dazomet. The results showed that mustard combined with 225 kg/ha dazomet can effectively kill root knot nematodes, *Phytophthora nicotianae* and *Fusarium* in soil, and in the growing period of flue-cured tobacco, the control rate of root knot nematodes was more than 80%, black shank was more than 85%, and black root rot was more than 90%. At the same time, the tobacco quality can be guaranteed, average yield per plant increased by 30%, the proportion of superior tobacco also be increased. The technology of chemical fumigation with of low dose dazomet combined with biological fumigation with mustard can be widely used in continuous cropping tobacco fields.

Keywords: Flue-cured tobacco, Soil-borne disease, Biological fumigation, Chemical fumigation

TITLE:

Oral 3.6 An innovation of a machine for dazomet application in strawberry fields

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ABSTRACT:

Soil compaction and the deficiency of the organic matter are the important factors in the occurrence of soil-borne diseases. Returning straw to the field can increase soil organic matter and reduce the compaction. A machine was innovated by using eccentric rotary tillage axis, combined with high-speed reversal knife roller and hydraulic cylinder The tillage can reach the depth of 30-40 cm soil layer. This allows the integration of returning straw to the fields, deep ploughing, and applying dazomet and solves the problem of uneven application. The conventional dazoment application is to spread dazomet to soil surface with hand, and then incorporate the soil with small rotary tiller. The most of dazomet granuales are distributed into the 15 cm soil layer on the top and the application is not even. The effect of using this all-in-one machine was compared in two experimental sites where the soil-borne disease was sever on strawberry in Mancheng, Hebei Province, China. The results indicated that by applying 40 g/m^2 of dazomet, an average yield of 28,509 kg/ha for strawberry was obtained by using this all-in-one machine while the average yield with conventional application was 17,775 kg/ha. The yield in the untreated control was 12,631 kg/ha. The yield of strawberry was increased by 60.4% when the application using the all-in-one machine was compared to the conventional measure.

Keywords: Soil fumigation, yield, soil-borne diseases

TITLE:

Oral 4.1 Evaluation of rhizome treatment combined with preplant fumigation in ginger field

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ABSTRACT:

Ginger (*Zingiber officinale*) is widely planted around the world. Due to monoculture, the incidence of soilborne diseases of ginger has dramatically increased. Ginger bacterial wilt caused by *Ralstonia solanacearum*, rhizome rot caused by *Pythium* spp. and *Phytophthora* spp., and nematode disease caused by *Meloidogyne* spp. are the main problems restricting the development of ginger. The objective of our research was to compare the comprehensive control effect of different soil fumigants and seed rhizome treatments on ginger soilborne diseases, by monitoring the ginger growth, yield and evaluation of economic benefits. Soil fumigation with dazomet and chloropicrin effectively reduces the population of soilborne pathogens, and chloropicrin had better control effect than dazomet. Two chemical pesticides and two biological control agents were used for rhizome treatment in the present study. Avermectin and metalaxyl-M are the traditional pesticides for controlling root-knot nematodes and oomycetes, respectively. *Trichoderma* spp. and *B. subtilis* are also used by seed treatment to control root and soilborne disease caused by *Pythium* spp., *F. oxysporum*, and *Sclerotinia sclerotiorum* in many crops. Preplant soil fumigation and seed treatment not only provide good control of soilborne disease, but also reduced the incidence of plant foliar pest and disease. Average yield increase rate of seed rhizome treatment was 12.0%, the highest yield increase was 24.4%. The average cost of seed rhizome treatment only increased by about 2.86%, but the net revenue increase rate of seed rhizome treatment reached up to 19.1%. Therefore, the seed rhizome treatment is a very cost-effective soilborne disease control technology. In the management of soilborne diseases, the combined application of soil fumigation and seed rhizome treatment, based on prevention strategy, can ensure that crops are not infected by soilborne diseases, and ensure high and stable crop yields.

Keywords: soil fumigation, seed rhizome treatment, ginger, control effect, economic benefit

TITLE:

Oral 4.2 Optimizing the Application of Anaerobic Soil Disinfestation to High Tunnel Vegetable Production Systems in the U.S. Mid-Atlantic Region

AUTHOR(S):

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ABSTRACT:

The increasing adoption of high tunnel production systems is often associated with intensive cultivation practices. In the case of high tunnel tomato monoculture, the emergence of several soilborne pests and pathogens has become a common issue in the U.S. Mid-Atlantic region. High tunnel tomato growers operating in this region have very limited options to manage soilborne diseases, especially, considering that consumers increasingly demand the adoption of chemical-free production practices. In this scenario, Anaerobic Soil Disinfestation (ASD) has been considered an effective biological option to manage soilborne disease and improve soil health. The implementation of ASD in this region requires several adaptations given significant differences in climate (in particular temperature) when compared to recommendations previously developed in warmer regions. As such, two main challenges can be enumerated: (*i*) the short window of time available to apply the ASD treatment, since warmer months are reserved to crop production; and (*ii*) the availability of low-cost carbon substrates. Therefore, a series of field trials were conducted to (*1*) test the application of ASD at relatively low temperatures either in the fall (after an early high tunnel tomato crop) or in the spring (before a late high tunnel tomato planting); and (*2*) evaluate diverse carbon substrates, including cover crops and by-products generated by the local agrifood industry, to test their differential efficacies in establishing anaerobic conditions during the initial stages of ASD. We also measured their impacts on soil nutrient availability over time, and the post-ASD crop performance. In brief, our results revealed the feasibility and efficacy to apply ASD even in presence of suboptimal soil temperatures. However, we observed the efficacy of the treatment to be variable across the distinct carbon substrates used. In addition, variations in carbon substrates have also significantly impacted the soil nutrient availability post-ASD, and the crop yield performance.

Keywords: biological soil disinfestation, soilborne pests, soilborne pathogens, organic amendments, cover crops, carbon, nitrogen

TITLE:

Oral 4.3 Use of plastic films in soil treatments beyond TIF

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ABSTRACT:

Plasticulture is the use of plastic materials in agriculture, primarily for crop production. It involves the use of plastic mulch film, drip irrigation systems, and other plastic-based products to enhance the growing conditions and yield of crops.

One of the main advantages of plasticulture is its ability to conserve soil moisture and reduce weed growth. Plastic mulch film is laid over the soil before planting, creating a barrier that helps to retain moisture and prevent weed growth, thus reducing the need for herbicides and manual weeding. This results in improved crop yields and reduced labor costs. In addition to weed suppression, plasticulture also helps to regulate soil temperature, especially in areas with extreme weather conditions. The plastic mulch film helps to maintain a stable temperature and prevent soil erosion, thus protecting crops from environmental stress.Another advantage of plasticulture is the ability to control the application of water and fertilizers through the use of drip irrigation systems. These systems deliver water and nutrients directly to the plant roots, reducing water and nutrient loss through evaporation or runoff.

This article details the application of different films for soil treatments such as Chemical Soil Disinfestation (CSD) Solarization (SOL) and Anaerobic Soil Disinfestation (ASD) focused on:

- Evolution of the barrier films from VIF (Very Impermeable Film) to TIF (Total Impermeable Film) from the raw materials to the multiple layer blow machines.
- Permeability tests for different gases. Method for film permeability determination using a static technique.
- International regulations review on TIF use in agriculture. The US EPA (Enviromental Protection Agency) example.

Keywords: plasticulture, mulch, plastic mulch, mulching, solarization, ASD, Biofumigation

TITLE:

Oral 4.4 Efficacy of Biofumigation with *Brassica carinata* Commercial Pellets (BioFence) to Control *Rhizoctonia solani* and *Sclerotinia sclerotiorum*

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ABSTRACT:

Due to the withdrawal and restricted use of agrochemicals, other means of desinfestation, such as biofumigation, are needed to safeguard in soil production. The efficacy of biofumigation with *Brassica carinata* pellets (BioFence®) to control pathogens was investigated in pots and in field experiments. Inoculum of *Rhizoctonia solani* (AG4 HGI) and *Sclerotinia sclerotiorum* was buried in mesh bags prior to the treatments. After biofumigation, the bags were retrieved from the soil and the viability of the inoculum was tested by plating on semi-selective media. In 2021 soil from a lettuce grower (sandy loam, pH 5.9) was tested in lid-sealed pots with 10.5 L soil in a growing chamber at 24°C. For both pathogens a 100% mortality was achieved with 2 and 3 g L^{-1} BioFence®. In 2022, field experiments were conducted in a greenhouse (sandy loam, pH 6.9) and in chicory forcing ground (sandy loam, pH 6.6). In the greenhouse biofumigation with four weeks coverage with TIF at a concentration of 3 g L^{-1} was 100% effective in killing the two soilborne pathogens. However, in the chicory forcing ground no significant difference in pathogen viability was observed between the untreated control and biofumigation with two weeks coverage. To investigate the reason for this difference in mortality the soil of the chicory forcing ground was used to set up an experiment with *R. solani* in 10.5 L soil in lid-sealed pots in a growing chamber at a concentration of 3 g L^{-1} BioFence®. Different exposure time for the biofumigation (2,3, 4 and 6 weeks), temperature (18°C, 24°C and 30°C) and water content of the soil (16%, 24% and 28%) were used. The *R. solani* viability showed no significant difference between the treatments and the control. The reason for this is still unclear.

Keywords: Chicory, leafy vegetables

TITLE:

Oral 4.5 Sustainable use of soil fumigant Nemasol® (Metam Sodium 510): Stewardship and mitigation measures as key success factors

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ABSTRACT:

Sustainable fumigation is an innovative approach developed for helping farmers to reduce crop protection inputs while maintaining efficacy standards in respect of the user, the consumer, and the environment. Soil is a limited resource and a sustainable approach is needed to guarantee a healthy and fertile soil over the years. Sustainable fumigation requires, stewardship and mitigation measures to increase efficiency and safety. The key factors include primarily an appropriate use of PPE (personal protection equipment), the use of specific gas tight film - TIF (total impermeable film) and the implementation of the stewardship guidelines to perform a precision application by drip irrigation. These measures will increase product efficiency directly enhancing the level of efficacy in controlling soil borne diseases, weeds, and nematodes at a reduced dose rate of 300 L/ha per hectare. Stewardship and mitigation measures are key success factors which allow the respect of the environment with no unacceptable risk and no residues in the crops. After application, Nemasol® quickly breaks down to methyl isothiocyanate (MITC) which in its turn breaks down further in the soil, allowing soil resilience with a reestablishment of the natural equilibrium of the native microbiome. The chemistry of the active ingredient is “Inspired by Nature” as MITC is a compound normally present in nature. Thanks to the key success factors fumigation with Nemasol® is proven to be sustainable and can be considered a foundation for building IPM programs.

Keywords: Sustainability, Fumigation, TIF

TITLE:

Oral 4.6 Efficacy of Dimethyl Disulfide (DMDS) for Orobanche spp. control in Turkey

AUTHOR(S):

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ABSTRACT:

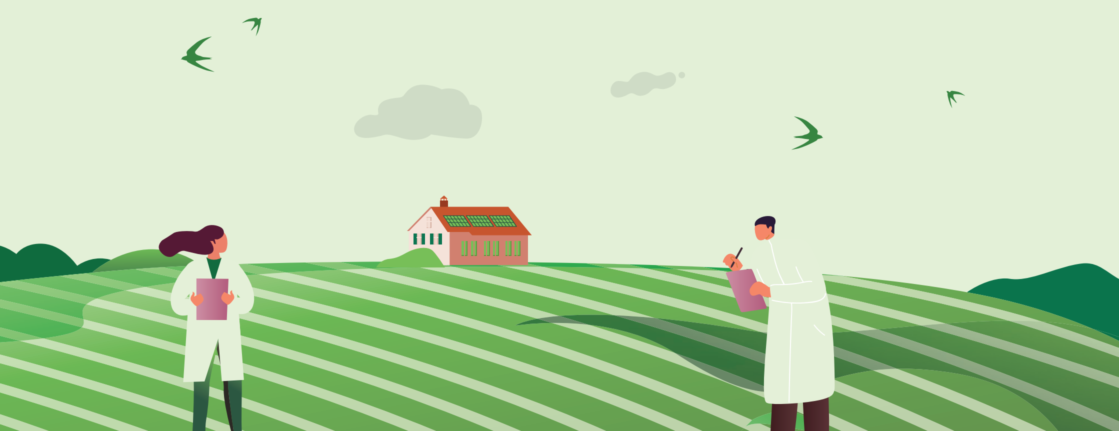
Broomrapes (*Orobanche* spp.) which belong to the family Orobanchaceae are obligate parasitic flowering plants. Some particularly damaging *Orobanche* species occur in the Antalya Highlands region in Turkey causing important damages in tomato.

Control of these parasitic plants is difficult because broomrapes produce hundreds of thousands of minute seeds that are highly persistent in the soil and can easily spread to new areas. Moreover, due to the intimate connection between these holoparasitic weeds and their hosts, no economically viable and effective control system against the parasites were developed in tomatoes, which contributes to the continuously increasing importance of these weeds in agricultural areas. The soil treatment, dimethyl disulfide, DMDS, has been successful to control nematodes, and other soil-borne pathogens occurring along with nematodes in different crops, and a number of weed species, in particular *Cyperus* spp. DMDS, has been recently approved in Turkey for *Orobanche* spp. control.

One study was carried out under compliance with good experimental practices with randomized plots and 4 replicates. DMDS was applied by drip irrigation under barrier film in protected tomatoes at three doses in comparison with untreated plot and local reference. Assessments showed a broomrape infestation of 100% in untreated and reference plots, the infestation was nil in plots treated with the highest dose of DMDS.

Keywords: Soil treatment, Broomrape, Tomato, Antalya

05. Posters



TITLE:

P01 Effect of soil biosolarization with different amendments during high temperature conditions on greenhouse pepper yield in Southeastern Spain

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ABSTRACT:

In this study, the effect of soil biosolarization with different organic amendments was evaluated on the yield of a greenhouse pepper crop. It was carried out throughout the hot summer season in the cultivation area of Campo de Cartagena field (Southeastern Spain). The biosolarization was carried out in August. The amendments used for soil biosolarization were: T1: wheat husk + semicomposted sheep manure 3.5 kg m^{-2} (1+2.5); T2: sunflower pellets (Alimer SCoop) 3.5 kg m^{-2}; T3: semi-composted sheep manure 3.5 kg m^{-2}; and T4: control (non-amendment and non-plastic). Treatments consisted of different amendments used for soil biololarization were arranged in a randomized complete block design with two replicates. Each experimental unit consisted of a 60 m^2 plot. Pepper cultivar Beniel was planted in December at the common density of the zone: 1 m separation between rows and 0.4 m between plants in the same row (2.5 plants m^{-2}). At 15 cm and 30 cm soil depth, soil temperatures above 42ºC were reached in all the biosolarization treatments, for more than 300 hours, while in the control treatment only 60 hours above this temperature were reached. No differences in yield were observed among the three amendments. Pepper yield was greater in all the biosolarization treatments when compared to the control treatment. The amendments with manure did not produce an improvement in yield when compared to the amendment without manure, an interesting fact for areas vulnerable to groundwater contamination due to nitrate leaching, such as Campo de Cartagena.

Keywords: *Capsicum annuum*, solarization, groundwater, lixiviation, crop yield

TITLE:

P02 Efficacy of microorganisms against Fusarium wilt on tomato in greenhouse

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ABSTRACT:

Fusarium wilt, caused by *Fusarium oxysporum* f. sp. *lycopersici* (Fol), results in considerable yield losses for tomato crops throughout the world. The application of microbial biocontrol agents, physical methods, genetic resistance and grafting are the most applied alternatives to soil and substrate disinfestation for controlling Fol. Experimental trials have been carried out on potted tomato plants cv Cuor di Bue in greenhouse with the aim to evaluate the efficacy of 12 experimental antagonistic strains of *Fusarium* spp., *Trichoderma* spp. and *Pseudomonas* sp., obtained from suppressive soils, substrates and compost, to control Fol. Tomato plants were grown using a commercial peat substrate and five replicates of 6 plants each were considered for each treatment. Biocontrol agents were applied in nursery, 15 days after sowing, and at transplanting and were compared to a commercial formulation of *Trichoderma* spp., to the chemical fungicide tiophanate-methyl and to the untreated control. Results showed a good efficacy of some microorganisms such as *F. oxysporum* MSA35 and *T. asperellum* FC80, that significantly reduced Fol (50-70% disease reduction efficacy), while all remaining tested microorganisms provided similar protection to the commercial mixture of *T. asperellum* and *T. gamsii* (30-50% disease reduction efficacy). The application of biocontrol agents starting from nursery is a promising solution to control Fol on tomato and should be further investigated under field conditions.

Keywords: *Fusarium oxysporum* f. sp. *lycopersici; Trichoderma* spp.; *Pseudomonas* sp.; biocontrol.

TITLE:

PO3 Interaction between soil pathogenic fungi and nematodes in strawberry soil borne diseases in South Spain

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ABSTRACT:

Strawberry is a high value crop in Spain, where fruits for fresh consumption are produced off season and exported to central and northern European countries. Soil-borne pathogens (SBP) as *Macrophomina phaseolina*, *Fusarium oxysporum* f. sp. *fragariae* and *Meloidogyne hapla* are widely spread in strawberry crops in Spain and constitute a key limiting factor to achieve strawberry premium quality and economically sustainable yields, since they frequently occur together. Soil disinfestation is the main SBP control method for strawberry crops in Southern Spain. Interactions between soil pathogenic fungi and nematodes were analysed in pot experiments on strawberry plants ‘Rociera’ in controlled conditions, growth chambers. Development of strawberry SBP diseases were estimated by weekly observations of the disease incidence (percentage of dead plants over the total), and severity on a scale of 0 (healthy plant) to 5 (dead plant). At the end of the trial, severity of root-knot nematode nodulation symptoms in the root system, rate of nematode reproduction (Pf/Pi) and different plant growth parameters were also estimated. There was an increase in disease symptoms in joint inoculations of phytoparasitic nematodes and soil pathogenic fungi, suggesting a synergistic interaction between them in strawberry SBP caused disease. Specifically, significant differences were observed with respect to the untreated controls in the interactions *M. hapla* + *Fusarium* and *M. hapla* + *M. phaseolina*. At the end of the trial, most of the isolates from strawberry tissues in plants co-inoculated with *M. phaseolina* and *F. oxysporum* were *M. phaseolina* which suggests that *M. phaseolina* has the capacity to displace *Fusarium* species in strawberry, when occurring together.

Keywords: Interactions, *Fusarium, Meloidogyne, Macrophomina*, Strawberry

TITLE:

P04 Biofumigation, a soil disinfestation technic alternative to chemical soil disinfestation before replanting in asparagus crop

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ABSTRACT:

Among the key diseases affecting asparagus crop (*Asparagus officinalis* L.), vascular wilting of asparagus caused by *Fusarium oxysporum* f. sp. *asparagi* stands out worldwide. Asparagus cultivation can be in the field for up to 10 years and the amount of pathogen propagules increases preventing replanting the same crop in the field. This work aims to study the efficacy of biofumigation with species of the Brassicaceae family to prevent Asparagus Decline Syndrome (ADS) and presents the experimental results of a greenhouse trial carried out with three biofumigant species (*Brassica napus*, *Sinapis alba*, and *Camelina sativa*), and two control treatments one with asparagus and another without crop (fallow). After 4 moths from showing on naturally infected soil from a producing area from a plot with an 8-year history of growing asparagus and upon reaching flowering, the biomass produced as well as the glucosinolate content was determined. Each specie was chopped and crushed in a mortar, and then incorporated into the pots for 40 days at controlled temperature (20-27°C). After the treatment, asparagus was transplanted. After three weeks, the dry weight of the plants, the disease index and the amount of fungal inoculum in the soil was measured. Both control treatments without biofumigation showed the highest levels of disease in the pots after replanting and the lowest dry weight of the plants. Biofumigation treatments showed a decrease in the amount of pathogen present in the soil. Rapeseed presented the lowest disease severity index (p=0,000) and highest growth of asparagus plants, followed by *Sinapis alba*, however biodisinfestation with *C. sativa* failed to stop the expression of the disease. Selection of the biofumigant species is a key factor, but soil biofumigation with Brassicas can be a viable alternative in the cultivation of asparagus against ADS.

Keywords: *Fusarium oxysporum* f. sp. *asparagi*, biodisinfection, Asparagus Decline Syndrome, *Brassica napus, Sinapis alba*, and *Camelina sativa*

TITLE:

P05 Efficacy of Nemasol® (Metam sodium 510) applied by drip irrigation at low dose to control Soil diseases and Nematodes on protected crops in Southern Europe

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ABSTRACT:

Eastman is committed to a constant innovation in the use of Nemasol® (*Metam sodium 510*) towards higher sustainability. The implementation of stewardship programs and precision application have been key achievements so far. Efforts are now directed at reducing the dose of application for meeting the most recent regulations and aligning closer to the goals of the European Green Deal.
Nemasol® applied at reduced rate of 300 L/ha (153 kg a.s./ha) through drip-irrigation under Totally Impermeable Film (TIF) was tested over 4 growing seasons in 2019-2022 on tomato, cucumber, zucchini, melon, and watermelon grown under protected conditions. A total of 20 representative and statistically significant Good Experimental Practice (GEP) trials were selected from Southern Europe (Italy, Spain, Portugal, Greece). TIF was placed just before the application and kept on site for 6 weeks. The efficacy of the treatment was assessed on the roots after digging out the plants, at several time points during the crop cycle. Marketable yield and total harvest were assessed during the trials.
Nemasol® provided in all crops a significant control of Nematodes (*Meloidogyne spp*.), expressed as percentage of efficacy on severity of root galling in comparison to untreated plants. The efficacy ranged from 55% to 100% on tomato and 75% to 90% on cucurbits (cucumber and zucchini). The control of the nematodes led to a significant increase of harvest in the Nemasol® treated plots compared to the untreated plots. The marketable yield following Nemasol® treatment was 15%-40% higher in tomato and 35%-90% higher in cucurbits.
In trials where soil diseases were present due to fungi of the Fusarium group (*F. oxysporum - F. sambucinum*), Nemasol® provided a significant efficacy ranging from 50% to 100% on both tomato and cucurbits. The control of the soil diseases with metam sodium translated in an average of 50% of yield increase over the untreated plots.
Nemasol® applied at 300L/ha through drip-irrigation under TIF proves to be an efficient tool for controlling soil diseases and nematodes. Nemasol® can be considered as a foundation for building an IPM program in line with the principles of sustainability.

Keywords: Sustainable agriculture, TIF, fumigation, soil borne disease.

TITLE:

P06 European Project "VIRTIGATION"- Emerging viral diseases in tomatoes and cucurbits: implementation of mitigation strategies for durable disease management

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ABSTRACT:

FAO estimates that annually up to 40 percent of global crop production is lost to pests. In Europe, crop losses caused by viral diseases have reached an estimated annual value of 34.5 billion EUR. Virus symptoms could be difficult to identify by the farmers. These cases are intensified when the virus is an emergent new virus. Moreover, some plants viruses need a biological vector to spread its disease, farmers have been forced to increases the use of chemical treatments, although this has resulted an increase in costs for the farmers and a higher exposing to pesticide residues for the consumers. The European project VIRTIGATION has the main goal of developing rapid and lasting solutions to emerging viral diseases caused by begomoviruses (whitefly-transmitted) and tobamoviruses (mechanically transmitted) on cucurbits and tomato in Northern Europe and the Mediterranean Basin as well as at increasing knowledge to better control and manage the viral diseases. Within the VIRTIGATION project, Fundation TECNOVA (TEC, Almería, Spain) and Landwirtschaftskammer Nordrhein-Westfalen (LNW, Germany) work together in the task "Optimization of eradication methods after tobamovirus outbreaks". Institutes are working on the validation of solarisation and steaming methods to eradicate tobamoviruses in contaminated cocopeat bags by TMV (Tobacco mosaic virus). TEC is using the special temperature conditions of the months of September to November in Almería, with temperatures similar to north and centre of Europe in summer. LNW is using steaming with temperatures of minimum 90ºC. In addition, it tries to discern if the substrate must necessarily be free of crop residues or not. This poster will summarize the details of each used protocol and, the encouraging results that we expect to obtain in the coming months, with the goal to spread validated methods for virus eradication in Europe with zero waste. "VIRTIGATION" is funded by HORIZON 2020 (Award #101000570).

Keywords: Solarization, Steaming, tobamoviruses, TMV, disease-management, contaminated-substrate, virus-eradication.

TITLE:

P07 Training in disinfection of horticultural soils in greenhouses

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ABSTRACT:

The IFAPA is committed to the knowledge of good agricultural practices for the maintenance and improvement of the health of agricultural soils through various training and knowledge transfer projects.

According to official data, the area of protected horticultural crops in the province of Almeria in the 2021/2022 campaign reached 32,500 hectares, where approximately 26,000 have followed integrated control strategies, giving great importance to respect for the environment, restrictions on the use of chemical products, and specifically soil management and soil disinfection.

At La Mojonera facilities, IFAPA promotes the training of farmers and advisors in subjects related to the knowledge of soil microbiology, soil diseases and pathogens, the different cultural, chemical and biological alternatives for soil disinfection and the protocols for integrated control. In addition, technical visits are organised to experimental farms and practical work is carried out both in the laboratory (microbiological analysis) and in the Information and communiaction technology (ICT) classroom (use of the IFAPA Fungi Guide App and the tools for the control of soil pathogens available on the Best4soil website).

This study analyses the evolution of training activities on soil disinfection in protected horticulture in the last 5 years, at IFAPA La Mojonera.

This work is part of the projects "Integrated Production and IPM" (PR.FAI.FAI202200.003) and "Incorporation of Young People to the Agricultural Enterprise" (PR.FAI.FAI202200.005), 90% co-financed by FEADER, Andalusian RDP 2014-2020.

Keywords: soil health, IPM, protected crops

TITLE:

P08 Evaluation of totally impermeable film and fumigants for management of clubroot of *Brassica* crops

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ABSTRACT:

Clubroot is caused by the soil borne pathogen *Plasmodiophora brassicae*. Management of the disease is difficult due to the longevity of resting spores in soil. Field trials were conducted in early summer (early July) each year to test the efficacy of fumigants covered with totally impermeable film for clubroot management. In 2019, chloropicrin (Pic Plus; 164 and 280 kg/ha) and metam sodium (Busan 1236; 150 and 300 kg/ha) were applied to high organic matter soil (~70% organic matter) naturally infested with *P. brassicae*. After application, all treated plots were covered with totally impermeable film (TIF). In 2021, an experimental product was applied at two rates, 50 and 200 L/ha and compared to metam sodium (Vapam; 70 L/ha). Both trials included a covered and uncovered control. The TIF was left on for two weeks, removed, and plots were seeded with a clubroot-susceptible Brassica. Clubroot severity was assessed based on root symptoms, six weeks after seeding using the standard 0 – 3 scale. In 2019, all fumigants decreased clubroot severity compared to the uncovered control. The covered control had low severity, similar to the fumigants. In 2021, plots treated with the experimental product or metam sodium and covered with TIF had lower severity than the uncovered control. Soil temperatures under the covered and uncovered controls averaged 29.4 °C and 22.7 °C in 2019, and 25.5°C and 20.8 °C 2021, respectively. The maximum temperatures for TIF-covered plots were approximately 10 °C higher than the uncovered control in both years. Covering soil with TIF can be used to reduce the severity of clubroot. As the soil temperatures and duration of heating in the TIF treatments were lower than reported for effective solarization to reduce clubroot, anaerobic conditions may contribute to the reduction in clubroot severity. More research is needed to confirm this hypothesis.

Keywords: totally impermeable film, anaerobic soil disinfestation, *Plasmodiophora brassicae*, clubroot

TITLE:

P09 Integrating Anaerobic Soil Disinfestation in Organic Small Fruit and Vegetable Production Systems

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ABSTRACT:

The expansion of the organic small fruit and vegetable industries is often limited by the lack of viable and effective practices for managing soilborne pests and pathogens. Anaerobic Soil Disinfestation (ASD) is a pre-plant soil treatment increasingly recognized as a biological approach for building a healthy soil system. However, the proper implementation of ASD in organic production systems requires (i) its integration with other organic crop management practices, (ii) the definition of optimal carbon sources, and (iii) application rates for specific crops and growing systems. Although the suppression of soilborne pests and pathogens is the primary goal of the ASD application, the proper implementation into organic production systems must consider the short- and long-term effects of ASD on soil nutrient dynamics and soil health. From an application standpoint, it is important to evaluate the economic viability of this technology and identify obstacles to adoption. To address these research themes and advance the integration of ASD in organic specialty crop production systems, we established a multi-regional project encompassing a multidisciplinary team of researchers from Florida and Pennsylvania, two states representative of the Southeastern and Mid-Atlantic U.S. regions, respectively. Using strawberries and fresh-market tomatoes as target crops, a set of ASD trials have been conducted and are ongoing to evaluate the effects of alternative application protocols and carbon sources on ASD efficiency. In brief, parameters

such as pest and pathogen control, nutrient dynamics, shifts in soil microbiome, crop yield, and quality performance have been measured pre- and post-ASD. Overall, the results show that the C:N ratio of the carbon source is a critical factor determining the efficacy of the ASD treatment further influencing crop performance post-ASD. While evaluating the economic viability of ASD in organic production systems, the team is engaging with industry stakeholders to transfer knowledge and identify obstacles to adoption.

Keywords: biological soil disinfestation, soilborne pests, soilborne pathogens, organic amendments, cover crops, carbon, nitrogen, strawberry, tomato

TITLE:

P10 Mitigation effect of soil coverage to reduce MITC (methyl isothiocyanate) emission after application of the soil fumigant Nemasol® (Metam sodium 510)

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ABSTRACT:

A study was set-up for experimental determination of the mitigation effect of soil coverage to reduce the emission of MITC (*methyl isothiocyanate*) after application of the soil fumigant Nemasol® (*Metam sodium 510*) to bare soil. The test system consisted of gas-tight volatilization chambers with a diameter of about 10 cm each. The lower part of the chambers was filled with test soil and the upper parts consisted of dome covers with connections for air inlet and outlet. Air streams through the chambers and connected trapping systems for MITC and CO_2 with flow rates of 250 mL/min were established. Between the lower and the upper part of the chambers, one of three different types of plastic film was fixed before clamping both parts together. Control variants without soil cover were also established. A total of 16 chambers were set-up in parallel (two replicates for each variant) at 25°C in the dark, and air sampling was continued for up to 21 days.

This study successfully determined the mitigation effect of soil coverage to reduce MITC emission after application of the soil fumigant Nemasol® to bare soil at an application rate corresponding to 300 L/ha. Only a minor reduction of MITC emission was achieved using PE film. However, the use of totally impermeable films (TIF) led to a reduction factor of up to 500-fold compared to the uncovered control variant, with only 0.15 to 0.18% of the applied MITC passing through the TIF in 21 days.

TIF is a tool contributing to sustainable fumigation by mitigating the risk for operators, workers, bystanders, residents and the environment and by allowing the use of a lower dose rate maintaining the same level of efficacy.

Keywords: Sustainable fumigation, metam-sodium, TIF, PE

TITLE:

P11 Efficacy of microorganisms against Rhizoctonia crown and root rot on strawberry in greenhouse

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ABSTRACT:

Several soil-borne pathogens affect strawberry crops, such as *Verticillium, Pythium, Phytophthora, Neopestalotiopsis* and *Rhizoctonia*, which can cause significant losses in crop yields. Microbial biocontrol agents are known to be effective in controlling soil-borne pathogens on strawberry, although results may vary. The purpose of this study was to evaluate the efficacy of 12 antagonistic strains of *Fusarium* spp., *Trichoderma* spp. and *Pseudomonas* sp., obtained from suppressive soils, substrates or compost, in the control of *Rhizoctonia solani*. Experimental trials have been carried out on potted strawberry plants cvs Olimpia, Portola and Clery, in greenhouse. Plants were grown using a commercial peat substrate and five replicates of 6 plants each were considered for each treatment. Biocontrol agents were applied by root dipping at transplanting and 7 days before transplanting and were compared to a commercial mixture of *T. asperellum* and *T. gamsii,* to the chemical fungicide tolclofos-methyl and to the untreated control. Results showed a good efficacy of some microorganisms such as *Fusarium oxysporum* 257/8 that significantly reduced *R. solani* on the cv Olympia (91% disease reduction efficacy), while all remaining tested microorganisms provided similar protection to the commercial formulation of *Trichoderma* spp. (64-75% disease reduction efficacy). However, the differences in efficacy varied according to the strawberry cultivar used in the study.

Keywords: *Rhizoctonia solani; Trichoderma spp.; Pseudomonas* sp.; biocontrol.

TITLE:

P12 Overview of dimethyl disulfide (DMDS) soil treatment at global level, an innovative and modern technology

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ABSTRACT:

Dimethyl disulfide, DMDS, is a naturally occurring compound and a major component of the sulfur cycle. DMDS belongs to a new chemical family in soil treatments, resulting in a different and unique mode of action compared to other existing soil treatments.

DMDS has been successful to control nematodes, other soil-borne pathogens occurring along with nematodes in different crops, and a number of weed species in particular *Cyperus* spp. In addition to its technical efficacy, with its unique mode of action, compatible profile with IPM programs, limited persistence in the environment, no long-term toxicological effects and no adverse effect on the ozone layer, DMDS is an innovative and modern technology.

DMDS has shown high effectiveness across a wide spectrum in many efficacy studies and commercial applications in Europe, Africa, Middle East, Asia, Australia and America.

A large number of results have been published in conferences and symposia, a synthesis of these results has been carried out in order to update the profile of this substance.

Keywords: PALADIN, ACCOLADE, Natural occurrence

TITLE:
P13 Trends in soil disinfection in greenhouses in Southeastern Spain

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ABSTRACT:

Almeria and Granada have 37,534 ha of protected vegetable crops, and soil disinfection is a widespread practice. Due to the importance of this cultural technique, soil disinfection is included as one of the items evaluated in the studies carried out by IFAPA and CAJAMAR Foundation on the characterisation of greenhouses. This studies comprises a total of 4 surveys, initiated in year 1999.

The latest study was carried out in the spatio-temporal framework of the provinces of Almeria and Granada, 2019-2020 campaign, with 541 questionnaires carried out on the farm to obtain primary information on greenhouse vegetable growers.

Solarisation is a technique for soil disinfection that uses the energy of solar radiation. It consists of mulching the moist soil for 4-6 weeks with plastic films during the period of the highest solar radiation. It can be done with water alone or in combination with chemicals (mixed solarisation) or organic products (biosolarisation). Solarisation is currently the main soil disinfection technique used in south-eastern Spain, covered by more than 90% of farms.

Trends in soil disinfection are changing, such as the increase in solarisation only with water compared to combined with chemical products, the reduction in the use of certain active disinfectant materials, the variation in the frequency of the application of this practice, the increase of biosolarisation, and the irruption in the use of new and specific plastics for solarisation.

Keywords: solarisation, biosolarisation, solar radiation, protected cultivation, vegetables, plastics

TITLE:

P14 Alternative carbon sources for anaerobic soil disinfestation in California strawberry

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ABSTRACT:

Anaerobic soil disinfestation (ASD) has been adopted in over 1,000 ha in California strawberry production as an alternative to chemical fumigation. Rice bran, the predominant carbon source for ASD, has become increasingly expensive. In 2021-2023 field studies we evaluated 20-30% lower-priced wheat middlings (Midds) and dried distiller's grain (DDG) at 6 and 7 t/acre as alternative carbon sources to rice bran. The study was placed at Santa Paula, California in September of each season in preparation for strawberry planting in October. Soil and air temperatures were 18-26 C during that time. After incorporation of carbon sources into the top 30 cm of bed soil, beds were reshaped, irrigation drip lines installed and covered with totally impermeable film (TIF) to prevent gas exchange. Beds were irrigated to full capacity within 24 hours after TIF installation. Anaerobic conditions were measured with a soil redox potential (Eh) sensors placed at 15 cm depth in all plots. Both DDG and Midds plots maintained Eh at -180 to 0 mV during the two ASD weeks, while untreated soil was aerobic at 200 to 400 mV. Permeable bags with inoculum of *Macrophomina phaseolina*, a key soil borne pathogen of strawberry, and tubers of *Cyperus esculentus*, a primary weed, were placed 15 cm deep in soil in all plots at ASD initiation and retrieved two weeks later for analyses. Two weeks after that, holes were cut to aerate beds and 'Victor' or 'Fronteras' bare-root strawberry were transplanted into them. ASD with Midds reduced viable microsclerotia of *M. phaseolina* 50% in one season and 75 to 85% with both carbon sources in the second season. Both ASD treatments reduced tuber germination of *C. esculentus* 29-76% compared to untreated soil. Additionally, Midds and DDG provided greater sufficiency of plant-available nitrogen and phosphorus compared to untreated soil with synthetic pre-plant fertilizer and improved fruit yields 40 and 30%, respectively. ASD with these carbon sources can suppress soil pathogens and weeds and help sustain organic strawberry production in California.

Keywords: soil microbiology, soil-borne pathogens

TITLE:

P15 Profitability of soil disinfestation methods against Root-knot nematodes in Mediterranean intensive strawberry crops

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ABSTRACT:

Losses caused by phytoparasitic nematodes depend directly on their soil densities at the start of the crop, so reducing their populations before planting is the main aim of nematological control. Efficacies in reducing *Meloidogyne hapla* populations in strawberry fields by different soil disinfestation methods, as agrochemicals, botanicals, or biosolarization were estimated on multiple field trials conducted during fourteen years on intensive horticultural crops. Soil nematode populations were reduced by 87 to 78% after fumigation with 1.3-dichloropropene + chloropicrin and dimethyl-disulphide, respectively. Other agrochemical nematicides showed efficacies ranging from 51 to 64%, while natural products as botanicals reduced nematode populations by 41 to 48%. The combination of solarization with organic manure (biosolarization) reduced soil nematode populations by 73%. An economical cost-benefit study of soil disinfestation methods in Mediterranean intensive horticulture was performed for the pathosystem strawberry-*M. hapla*. The range of *M. hapla* field soil densities (P0) that the fumigant 1,3-dichloropropene+chloropicrin can manage, keeping profitability in strawberry intensive crops, was 165-1289 J2/100 cm^3 of soil. Biosolarization with chicken manure (0.270 €/m^2) with efficacies (72-73%), was profitable in the range 301-1115 J2/100 cm^3 of soil. For less efficient nematicidal treatments (50-65%) with a cost below 0.100 €/m^2 (0.016-0.097 €/m^2) the ranges in which the nematicidal treatment would be profitable varied between 30-238 J2/100 cm^3 of soil. Fumigation with 1.3-dichloropropene + chloropicrin and biosolarization with chicken manure were the only treatments able to reduce high RKN soil populations down to levels that reduce yield under the nematode economic damage threshold levels, keeping profitability. Other nematicidal treatments were not able to reduce high RKN soil infestations (above 200-300 J2/100 cm^3 of soil) down to nematode economic thresholds but were profitable when RKN soil densities were below the limits of 200-300 J2/100 cm^3 of soil.

Keywords: Biosolarization, Cost-Benefit, Nematicide

TITLE:

P16 Decline of charcoal rot in strawberry by anaerobic soil disinfestation: reduction of propagules and/or induction of soil suppressiveness

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ABSTRACT:

In previous work, anaerobic soil disinfestation using agro-industrial residues, such as rice bran and residual strawberry extrudate, was able to reduce the charcoal rot disease in strawberry plants growing in soil previously infected with *Macrophomina phaseolina*. The objective of this work was to elucidate if the disease severity decline was due to a reduction of propagules of *M. phaseolina* and/or to a possible induction of soil suppressiveness. Four trials were conducted in a growth chamber with a totally randomized experimental design with three repetitions per treatment. Three different amendments were used: rice bran (13,5 t/ha), residual strawberry extrudate (16,89 t/ha), and fish meal (2.78 t/ha). The doses were adjusted to be equivalent to the rice bran contribution, taking as reference the oxidizable carbon for the extrudate and the total nitrogen for the fish meal. A control soil exposed to anaerobiosis but without organic amendment and an untreated control soil were added. The duration of the treatments was 25 days. The redox potential was measured as an indicator that anaerobiosis was occurring. After the treatments, strawberry plants were grown on these soils and inoculated with *M. phaseolina* propagules by irrigation. Measurements of disease severity were made from symptom onset until the mortality reached 100% in a treatment. Although anaerobiosis was well developed, no effect of treatment on disease severity was observed. The results seem to indicate that anaerobic soil disinfestation owes its efficacy against charcoal rot disease of strawberry to the reduction of fungal propagules and not to the induction of soil suppressiveness.

Keywords: ASD, Macrophomina phaseolina, soil inoculum

TITLE:

P17 Ozone treatments for the management of Meloidogyne spp. in tomato crops under protect

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ABSTRACT:

Meloidogyne spp. is a soil pathogen that affects numerous horticultural crops, being a limiting factor in protected tomato crops in south-eastern Spain. Soil disinfection before transplanting has been applied for years in order to maintain crop health and productivity. 1,3-dichloropropene has been widely used under exceptional use restrictions, however, its use is currently not allowed. Biosolarisation is an environmentally friendly alternative to chemical fumigant, although it shows very variable nematode control from one year to the next. This paper evaluates the efficacy of ozone treatments for nematode control compared to 1,3-dichloropropene and biosolarisation. Two trials were carried out in two tomato greenhouses, one experimental and one commercial, both infested with *Meloidogyne spp*. In the experimental greenhouse we tested: i) 1,3-dichloropropene + fluopyram, ii) pre-plant ozone gas + ozonised water in 2 irrigations during crop season, iii) pre-plant ozone gas + ozonised water in all irrigations during crop season, iv) control. Population density and incidence of nematodes and crop yield were measured. The population density of the nematode at the end of the crop was similar in pre-plant ozone gas + ozonised water in all irrigations during crop season and in 1,3-dichloropropene + Velum. The application of ozone gas + ozonised water at all irrigations reduced the root gall index and the percentage of affected plants by 61.9 and 42.4 %, respectively, compared to the control, and yield showed no significant differences. In the commercial greenhouse, comparisons were made between: i) pre-plant ozone gas + ozonised irrigation water each two weeks, ii) pre-plant ozone gas and iii) biosolarisation. Yield was not measured in this greenhouse. No significant differences were found between the three treatments in terms of nematode incidence and population density. These results show that the applied ozone treatments do not significantly improve nematode control by chemical disinfection or biosolarisation.

Keywords: Root-knot nematodes, *Solanum lycopersicum*, soil disinfection, ozone gas, ozonised water

TITLE:

P18 Best4Soil tools to improve soil health

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ABSTRACT:

Best4Soil is a European network created for the promotion and dissemination of existing knowledge ready-for-practice, about the best practices for maintaining soil health, which include crop rotation, compost and vermicompost, green manures and cover crop, biofumigation, (bio)solarization, and anaerobic soil disinfestation.
To this end, a series of freely accessible materials published in 22 European languages have been produced and are available on the website www.best4soil.eu. Among these materials are included open access video tutorials, factsheets, pictures and blogs. Also, two online innovative decision support tools have been developed, based on two specific databases for plant parasitic nematodes and soilborne pathogens. These tools provide information on the host status and damage sensitivity of 70 crops for 32 nematode species and 138 soilborne pathogens. Based on this information, these tools make it easy to determine the optimal sequence to grow the different crops. The tools are currently available in 22 languages. Each nematode - crop and pathogen-crop combination will get a background page (WIKI) with additional information, including control measures. The working method for the nematode scheme and the pathogen scheme is the same, and it is based on the concept of Wageningen UR | Field crops – www.aaltjesschema.nl
For three years, more than 250 informative and training activities dealing with the promoted practices, as well as with the correct use of the databases tools, have been carried out in 20 European countries, with the participation of advisors, growers, researchers, educators, and students, interested on soil health and plant protection.
‘Best4Soil’ project has received funding from the European Union’s Horizon 2020 research and innovation program under grant agreement No 817696.

Keywords: Databases, green manure, biofumigation, biosolarization, compost, anaerobic soil disinfestation, crop rotation

TITLE:

P19 Volatil fatty acids released during soil biodisinfestation with agri-food by-products in a greenhouse lettuce crop with limited solar radiation

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ABSTRACT:

Several mechanisms occur during soil biodisinfestation (BD) with organic amendments (OA) for the control of soil-borne diseases in intensive greenhouse horticultural crops. In areas and/or seasons with limited solar radiation, it is interesting to reinforce the anaerobic component of those mechanisms. In anaerobic soil disinfestation (ASD), volatile fatty acids (VFAs) are produced and can exert a biocidal effect against soil-borne pathogens. This study was carried out in a commercial lettuce greenhouse of the Basque Atlantic area (Northern Spain) that was affected by the root-knot nematode *Meloidogyne incognita*. The effect of four BD treatments with OA mixtures of various agri-food by-products (fresh cattle manure, sunflower seed husks, wheat bran, beer bagasse and rapeseed cake) was determined. For that, the content of various VFAs (acetic, lactic and formic) and sugars-alcohol (glucose, maltose, xylose and ethanol) were measured at different times (8-14-20-27-42 days from treatment onset) and at two soil depths (0-15 and 15-30 cm). In addition, a control treatment (non-amended and non-plastic-mulched soil) was considered. BD treatment was applied during 6 weeks starting on July-18-2019 with a 45 micron thick transparent total impermeable film (TIF) of polyethylene plastic. For each time and depth, soil samples were taken, and the liquid phase obtained after extraction was analyzed by High Performance Liquid Chromatography (HPLC) with a chromatograph equipped with a refractive index detector. No significant differences were observed in the content of VFAs and sugars-alcohol among different BD treatments. On the contrary, BD treatments did differ significantly from the control treatment. An increase between 11 and 105% for the total content of VFA and between 9 and 86% for the total sugars-alcohol content was observed when compared to the control treatment. These results show the potential of the anaerobic component of BD treatments with OA in areas and/or seasons with limited solar radiation.

Keywords: biofumigation, total impermeable film (TIF), biosolarization, organic amendment, anaerobic soil disinfestation (ASD), *Lactuca sativa*

TITLE:

P20 Efficacy of ethanedinitrile for use in high-value crop production

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ABSTRACT:

The commercial production of high-value fruit, vegetable, and turfgrass crops throughout the world relies upon the use of pre-plant soil fumigants. Due to heavy restrictions and bans on many soil fumigant chemistries, the incidence and severity of many pests, such as plant pathogens, parasitic nematodes, and weed species can increase, resulting in decreased yields and crop quality. Extensive examination of several soil fumigants has resulted since the ban on methyl bromide however, these alternatives are often more costly and provide insufficient control of key pests. A recent restriction of chloropicrin in Spain intensifies the concern for food security. A highly volatile compound, ethanedinitrile (EDN), has shown promising results in several countries including Australia, Israel, Turkey, and the United States. Experimental trials conducted in Australia and the United States have demonstrated that EDN is highly efficacious against a wide range of soilborne plant pathogens, plant parasitic nematodes, and recalcitrant weeds. Natural by-products of EDN reduce the need for pre-plant fertilizer, and it can be applied either through traditional shank, chemigation, or cold gassing. In addition, current soil fumigants require a lengthy plant-back interval prior to planting of the crop to reduce the risk of phytotoxicity due to low volatility of these compounds. Recent studies with EDN have suggested that the plant-back interval can be substantially decreased in some crops without sacrificing efficacy or crop health.

Keywords: Methyl bromide alternative; Soil disinfestation

TITLE:

P21 Greenhouse soil fertility improvement through soil biosolarisation with fresh plant debris

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ABSTRACT:

This study was conducted over a two-year period in two commercial greenhouses in Almería, Spain. The effect of soil biosolarisation with fresh plant debris (FPD) on physical and chemical soil parameters, as well as on culturable soil fungi and bacteria was assessed. Four rates of FPD (2.5, 5.0, 7.5, and 10.0 kg/m^2), a treatment with 5 kg/m^2 of fresh sheep manure (FSM), and a non-amended solarisation treatment were tested. The treatment dates differed between the two greenhouses: 1) March-May in Greenhouse 1 and 2) May-August in Greenhouse 2. After treatments, pepper and cucumber crops were grown without fertilizer input in Greenhouse 1 and Greenhouse 2, respectively. Soil samples were taken before and after treatments, as well as at the end of the crops in both years. Complementary pot experiments were conducted to evaluate the impact of the soil samples on the growth of tomato and cucumber plants.

Overall, physical and chemical variables in soils that received at least 5 kg/m^2 of FPD did not differ from those treated with FSM, but increased assimilable potassium was detected based on the amount of FPD incorporated. Soils treated with FSM showed the highest levels of assimilable phosphorus. The type and amount of organic amendment influenced the fungal community composition. Fungal density and diversity decreased only when treatments were performed in warmer months (Greenhouse 2). At the end of the crops, fungal population tended to reach or even increase the initial levels, especially when FPD was used. Thus, at the end of the study, the soils that received the highest amounts of FPD had higher fungal populations. Likewise, FPD led to an increase in bacterial populations.

Incorporating plant debris through biosolarization is a practice aligned with the circular economy that improves soil fertility in greenhouses.

Keywords: circular economy, physical and chemical soil variables, soil fungi and bacteria, waste management.

TITLE:

P22 Planting-hole steam application for pathogen and weed control in organic strawberry in Southern California

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ABSTRACT:

Organic strawberry production has been expanding in California, but opportunities for crop rotation are limited due to lack of organically certified fields. Continuous strawberry production promoted soil-borne pathogens; a problem exacerbated by lack of effective management tools. At Oxnard, CA we evaluated steam injection to raise soil temperature to 70 C or above for at least two minutes. Steam generated on-site was injected via 25 cm long spikes to planting holes in the white plastic-covered raised beds. Five days later, bare-root strawberry plants were placed in six steamed and six untreated plots and their performance and fruit production assessed. Additionally, we collected soil at 0-25 cm for analyses of resident *Macrophomina phaseolina* and *Fusarium oxysporum* f. sp. *fragariae* before and after treatment and evaluated weed densities in planting holes. Steam application reduced *F. oxysporum*, sp. *fragariae* survivorship in soil 78% and *M. phaseolina* 80%. Steaming provided 100% weed control of species germinated from soil seed bank, but had no effect on germination of wind-dispersed weeds deposited to holes during production season. Strawberry mortality due to soil-borne pathogens was 12-18% in steamed plots and 70-75% in untreated soil. Due loss of plants, marketable fruit yields in untreated plots were reduced 95% compared to steam treatment.

Keywords: soil disinfestation, soil-borne pathogens

TITLE:

P23 Is soil amendment a safe practice to recycle end-of-life organic substrates from soilless cultures? *

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ABSTRACT:

Soilless cultivation of horticultural crops is increasing world-wide, leading to high volumes of end-of-life substrates. Applying the used organic substrates as soil amendment has been a common recycling practice due to its potential to increase soil organic matter (SOM) and thus soil fertility. A few studies were conducted to evaluate the safety of this practice, however integrated ecotoxicological assessments addressing possible effects on soil functions are still scarce. Furthermore, different crop requirements and horticultural practices can originate different hazard levels of these residues, making it important to explore different scenarios. In this work, three end-of-life organic substrates' from tomato, strawberry and rose cultivation were applied independently as soil amendments at different rates (2.5, 5 and 10% dw) to assess their potential toxicological effects. To that end, it was evaluated the seed germination and plantlet growth (using two monocotyledonous and two dicotyledonous species), as well as soil enzyme activity and important soil processes, as proxy of soil production and soil nutrient's recycling functions. Overall, the obtained results demonstrated a high potential to recycle these materials through soil incorporation. However, more studies are needed with different trophic level organisms, since some of the results suggested that the detected beneficial effects may depend on the balance between the improvement of soil physicochemical parameters and the chemical residues (PPPs and fertilizers) present in these substrates.

Keywords: ecotoxicological evaluation, growing media, rose, strawberry, tomato, waste

* Candidate for the 'Young Mind Awards'

TITLE:

P24 The biocontrol agent *Trichoderma asperellum* T34 is tolerant to biofumigation by defatted *Brassica carinata* seed meal

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ABSTRACT:

The project ALTCHEM* (Sustainable alternatives for chemical soil disinfestation) has been exploring sustainable strategies to manage soil-borne pathogens in leafy vegetables greenhouses in Belgium. Biofumigation by defatted Brassica carinata seed meal (BCSM) has shown potential in experiments and it is an interesting technique for further development in Belgium. The use of biocontrol agents is another key tool to increase soil resilience and plant health. To integrate strategies in practice, in collaboration with the project partners, we investigated the effect of BCSM on the commercial beneficial fungus *Trichoderma asperellum* T34. In vitro, two doses of BCSM were tested (Biofence® pellets were used, 33 mg and 66 mg per Petri dish; doses were chosen based on publications). We kept the plates in darkness at 20°C. Daily evaluation of the development of *T. asperellum* T34 on PDA medium showed a small dose-response effect on the mycelium growth. After six days, in all plates, the colonies reached the plate edges. To test the effect in soil, the commercial product Asperello® T34 Biocontrol® was applied (10 g/m^3 soil that corresponds to approximately 6,6E+03 cfu/g soil) in a soil collected from a greenhouse (sandy loam, pH 6.6, TOC 4.2%, moisture of 20%). Inoculated and non-inoculated soils were stored in plastic containers for four weeks at 20°C before Biofence®pellets were applied or not (3 g/L soil). The containers were tightly closed and stored at 24°C. Just before BCSM application and after four weeks of biofumigation, soil samples were taken and plated on Trichoderma semi-selective medium. *T. asperellum* T34 established (5.0E+03 cfu/g DW soil) and persisted stably in the soil. Currently, we are investigating the effect of combined application of BCSM and *T. asperellum* T34 on soil-borne pathogens.
*ALTCHEM is financed by the Flemish government (VLAIO: HBC.2019.2884). The project partners are Inagro, PSKW, PCG, Praktijkpunt Landbouw Vlaams-Brabant and ILVO. Biobest is member of the user group.

Keywords: biological control, integrated disease management

TITLE:

P25 Biosolarisation with by-products of winemaking for the management of *Meloidogyne* incognita in pepper crops under greenhouse

AUTHOR(S):

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ABSTRACT:

The pepper crop is compromised by *Meloidogyne incognita* which affects numerous greenhouses located in the production area of Campo de Cartagena (Spain). Chemical disinfestation of soil with 1,3 dichloropropene is currently not permitted and biosolarisation carried out in August shortens crop production by two months. In order to find an eco-friendly disinfestation practice compatible with the crop cycle, a trial of two consecutive years was proposed in which grape pomace (GP) (skin + seed) were evaluated as an organic amendment for biosolarisation (BS) in October (Oct). The experiment was carried out in an experimental greenhouse and the following treatments were compared: i) BS GP (Oct) dose 1, ii) BS GP (Oct) + composted sheep manure (CSM), iii) BS GP (Oct) dose 2, iv) BS fresh sheep manure (FSM) in August, v) untreated control. Each treatment contained one row of nematode susceptible plants and one row grafted onto resistant rootstock. The BS GP in October and CSM and BS GP Oct dose 2 showed a similar incidence to the BS in August, but was not significantly different from the untreated control. In the first year, the nematode population density of the plots with treatment iv) (BS FSM in August) was significantly lower than the BS plots in October,howerver, this difference was diluted in the second. In terms of yield, the BS GP plots in October showed a reduction in yield compared to the BS FSM in August. The use of grafted plants reduced the population density of the nematode as well as its incidence and severity, improving yield. The results show that BS in October with GP alone were not efficient to control the nematode and therefore the use of resistant rootstocks or varieties is required to reduce the initial population density.

Keywords: Nematode, *Capsicum annuum*, eco-friendly disinfestation

TITLE:

P26 Date palm fiber as an organic substrate for vegetable production in hydroponics

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ABSTRACT:

The demand for local organic fresh produce is increasing around the world as it is gaining a high reputation in terms of health and safety. Despite the fact that hydroponic is commonly used in vegetable production, growers are looking for sustainable cultivation systems. Therefore, the objective of this study was to establish a sustainable hydroponic system to produce vegetable crops utilizing strategies for replacing synthetic nutrient solutions (NS) with natural organic sources, and the synthetic substrate with organic one. For this purpose, liquid organic fertilizers derived from four different organic sources were used as nutrient solutions, and date palm leaf fiber as a substrate in auto-pot hydroponic system, to grow lettuce plants. The vegetative growth, yield production, and nutrient content parameters of these lettuce plants were determined in comparison to the standard inorganic NS. The results revealed that organic hydroponic performance was sufficient to produce lettuce crop comparable to inorganic in the first four weeks. At harvest, growth of organic lettuce leaves had lower plant height, leaf number, area, and fresh and dry biomass compared to the inorganic lettuce leaves. However, the organic lettuce growth showed higher chlorophyll, carotene contents, and stomatal density than inorganic plants. Leaf nutrient content at harvest was significantly impacted by the type of used fertilizers (plant/animal) source. It is suggested that using organic liquid fertilizer and date palm fiber are potential alternatives from natural organic source to develop a sustainable hydroponic for growing safe and nutritious healthy vegetables crops for better health, environment.

Keywords: Organic nutrient; sustainable; lettuce; antioxidants

TITLE:

P27 Efficacy of Nemasol® (Metam sodium 510) applied by drip irrigation at low dose to control Weeds on protected crops in Southern Europe

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ABSTRACT:

Eastman is committed to a constant innovation in the use of Nemasol® towards higher sustainability. The implementation of stewardship programs and precision application have been key achievements so far. Efforts are now directed at reducing the dose of application for meeting the most recent regulations and aligning closer to the goals of the European Green Deal.

Nemasol® applied at reduced rate of 300 L/ha (153 kg as/ha) through drip-irrigation under Totally Impermeable Film (TIF) was tested over 4 growing seasons in 2019-2022 on lettuce, baby leaf crops (rocket, lamb's lettuce, spinach), cucurbits (melon and zucchini) and ornamentals (chrysanthemum and lilium) grown under protected conditions. A total of 22 representative and statistically significant Good Experimental Practice (GEP) trials were selected from Southern Europe (Italy, Spain, Greece). TIF was placed just before the application and kept on site for 6 weeks. The efficacy of the treatment in weed control compared to the untreated check was assessed just after the TIF cover removal and at several time points during the crop cycle. Marketable yield and total harvest were assessed during the trials.

Nemasol® applied with TIF, provided in all crops a significant control (between 80% and 100%) against both dicots (*Amaranthus* sp., *Chenopodium* sp., *Portulaca* sp., *Lamium* sp., *Convolvulus* sp., *Solanum* sp.) and monocots (*Poa* sp., *Setaria* sp., *Cyperus* sp.).

The control of the weeds led to a significant increase of harvest in the Nemasol® treated plots compared to the untreated plots. The marketable yield after Nemasol® was 20%-30% higher in lettuce and baby leaf crops, 40%-90% higher in cucurbits and 40-80% higher in ornamentals.

Nemasol® applied at 300 L/ha through drip-irrigation under TIF proves to be an efficient tool for controlling weeds in line with the principles of sustainability.

Keywords: Sustainable agriculture, TIF, fumigation

TITLE:

P28 *Fusarium*-infested cucumber plant debris are a suitable material for biosolarisation to control *Fusarium oxysporum* f.sp. *radicis-cucumerinum* in Almería (southeast Spain)

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ABSTRACT:

The use of plant debris in biosolarisation treatments can be an effective method for controlling soil pathogens and improving soil fertility. However, using infested plant tissues by soil pathogens may pose a risk.

This study shows the results of two greenhouse experiments conducted in Almería, Spain, during the summer of 2022. The experimental unit consisted of 30-liter containers that were filled with greenhouse soil, and inoculated with *Fusarium oxysporum* f. sp. *radicis-cucumerinum* (*FORC*) propagules to reach an inoculum density greater than $1x10^4$ CFU/g_{soil}. Three treatments were evaluated: (i) soil amended with crushed cucumber plants, including FORC-infected tissues, and sprayed with a commercial microbial product, (ii): (i) + soil covered with transparent polyethylene film (biosolarisation); (iii): non-amended soil covered with transparent polyethylene film (solarisation). The treatments lasted 30 days. The experiment had a randomized block design with four replicates.

In the non-solarized treatment, the average, maximum, and minimum soil temperatures at 20 cm depth were 38.8, 48.9, and 29.0, respectively. The average temperature was approximately 5ºC higher in both the biosolarised and solarised treatments, with maximum and minimum temperatures reaching close to 55ºC and 32ºC, respectively. The number of hours where temperatures reached or exceeded 45ºC were 320, 305, and 125 for the biosolarised, solarised, and non-solarised treatments, respectively. *FORC* populations were eliminated in the solarised and biosolarised treatments (mortality equal to or greater than 99.99%), while in the amended but not solarized treatment, a decrease of one fold in the *FORC* population was observed. As a result, damage to cucumber plants grown after the treatments was always lower and, in some cases, non-existent in the solarised and biosolarised soils.

The incorporation of *Fusarium*-infested cucumber plant debris to soil and solarisation for 30 days was effective in controlling *FORC* and provides a viable alternative for the management of infarm plant debris.

Keywords: greenhouse, solarisation, root and stem rot

TITLE:

P29 Evaluating the reuse of disinfected organic growth media for the production of hydroponically grown tomatoes

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ABSTRACT:

Organic growth media, such as sawdust and cocopeat, is the most common type of substrate used in open-bag hydroponic systems in South Africa. However, its acquisition cost remains a challenge for most hydroponic farmers. This is particularly true for imported organic growth media such as cocopeat. In spite of this challenge, farmers often make an effort to purchase new organic growth media every season, as opposed to reusing the old form. This is often due to the rising concern of substrate-borne disease development, such as *Pythium* diseases, which can be detrimental to commercial farming productivity and profitability. To limit the incidence of diseases in old organic growth medium, this study aimed to evaluate the reuse of old disinfected organic growth media for the production of hydroponically grown tomatoes. One-season-old sawdust and cocopeat growth media were derooted and disinfected using 50% strength hydrogen peroxide applied at a rate of 1L/1000L, prior to their reuse for tomato production in the open-bag hydroponic system, operating under a non-temperature-controlled plastic tunnel. The trial was conducted during two consecutive seasons (2021 – 2023) in the Tshwane region of Gauteng Province, which experiences a mild subtropical highland climate that is neither humid nor too hot. The tested application rate of hydrogen peroxide was non-lethal for bacteria (bacterial count increased from 4.4 x 10^12 to 4.6 x 10^13 cfu/g), but reduced the total Fusarium sp. fungal count from 4.3 x 10^5 to 2.0 x 10^5 cfu/g. Statistical analysis results of fruit marketable yield revealed the significantly better performance of reused sawdust (56.7 marketable tomato “cultivar Renka” fruits per plant) compared to its new form (42.1 fruits per plant). After sawdust, cocopeat ranked the second best, as there were no significant differences between its old and new forms (42.1 – 49.0 marketable fruits per plant). Such findings demonstrate that disinfected one-season-old organic growth media can be reused in hydroponics. The hydrogen peroxide application rate of 1L/1000 L should be increased for better results in terms of total bacterial and fungal reduction counts on the disinfected growth media. This will assist farmers in making more rational decisions regarding the reuse of organic growth media in hydroponics, which will ultimately contribute to improved farming productivity, profitability and sustainability.

Keywords: Sawdust, cocopeat, non-temperature-controlled plastic tunnel, hydrogen peroxide.

TITLE:

P30 Resistance genes to reduce the impact of soilborne diseases on tomato cultivars in UE

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ABSTRACT:

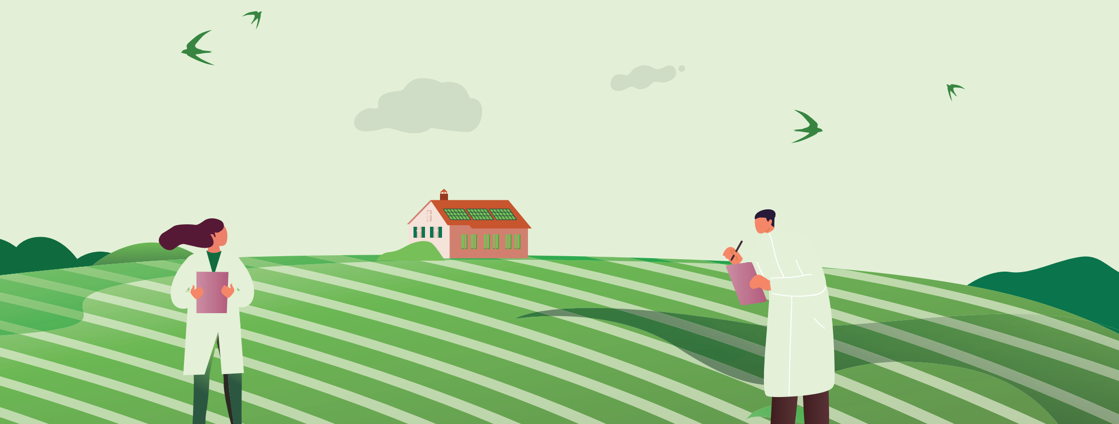
Tomato (*Solanum lycopersicum*) is the second most significant vegetable crop worldwide, following potato. Current world production is approximately 100 million tons of fresh fruit and its area covers 3.7 million hectares.

Considering that sustainable development requires a holistic approach that takes into consideration environmental concerns along with economic development, varietal innovation meets these requirements, helping the horticultural sector to reduce the use of phytosanitary products while achieving adequate yields through the application of plant breeding.

Plant resistance to soilborne diseases is a main tool for horticulturalists, who can include it in their integrated pest management programs. Resistance genes for soilborne fungi (*Fusarium oxysporum* f. sp. *lycopersici*, *F. oxysporum* f. sp. *radicis-lycopersici*, *Verticillium dahliae*), nematodes (*Meloidogyne* spp.) and viruses (TMV, ToMV), can be found in the tomato cultivars and rootstocks commercially available, but there are differences among types of tomato (beef, long-life, cherry, cocktail, oxheart, pear, vine, indeterminate), and between cultivars in the same type. Choosing the right tomato cultivar to avoid losses by soilborne diseases is possible with the information provided by the seed companies (*Portagrano, 2023*) in the European Union.

The increase of types and number of cultivars and rootstocks available for tomato growers in the last years, aimed this work, where the information regarding the presence of resistance genes to control soilborne diseases in tomato cultivars has been compiled and classified according to tomato types.

Keywords: IPM, breeding, hybrids, rootstock, fungus, virus, nematodes



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