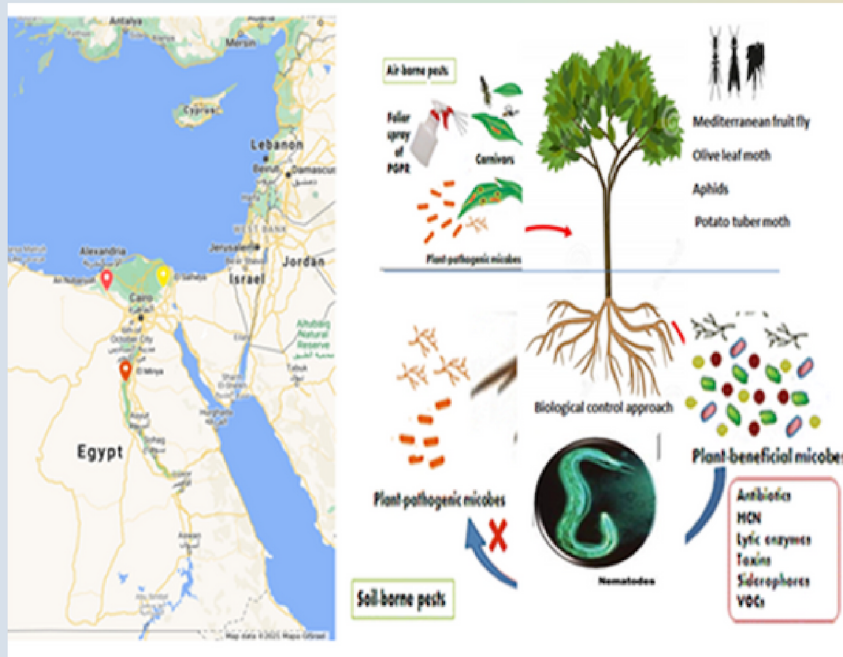


Case Study 4:

Al Minya, An Nubariyah and Salheya regions, Egypt.

ORGANIC AGRICULTURE FARM

Context and background



Modern agricultural practices are being introduced to cultivate new reclaimed lands; such practices include modern irrigation systems, organic farming and integrated pest management. Due to the shortage of fertilizers and other agricultural chemicals, farmers usually produce agricultural commodities organically, which are exported. Water resources such as ground and surface water are being used for irrigation purposes in the new lands in Egypt Al Minya, An Nubariyah and Salheya regions. Al Minya Governorate is one of the governorates of Upper Egypt.

An Nubariyah is a region in El Beheira which is a coastal governorate, located in the northern part of the country in the Nile Delta. Moreover, Salheya is a city in the Sharqia governorate, which is located in the northern part of the country. All three regions have a good potential to produce field crops such as wheat, maize, citrus, potato, sugar beet, cotton, soybean, sunflower, alfalfa, peach, olive and watermelon under irrigation with providing the water requirements but they are also affected by climatic factors as well as both biotic (pathogens and pests) and abiotic (drought, salinity) stresses.

Objectives

The main objectives of this case study are to develop a system for delivering healthy protected plants following enhancement of *Trichoderma* spp. for biological pest control, formulation, application techniques for mentioned microorganisms and recyclable biomasses with finding sustainable alternatives to chemical pesticides. This study focuses on:

- 1- **Ecofriendly approaches for plant parasitic nematodes diseases management.**
- 2- **Formulation and tailoring of regenerative agriculture solutions.**
- 3- **Novel biopesticides to enhance beneficial microorganism communities and minimize losses.**

Experimental design

The study is divided into two specific challenges:

1. Ecofriendly approaches for plant parasitic nematodes diseases management.

This research aims to find an ecofriendly approach for management plant parasitic nematodes (PPN), *Meloidogyne* spp. The study focus on the combination with bio-amendments (compost) and beneficial microorganisms (*Trichoderma* spp.) for their nematocidal effects on potato, citrus and olive under *in vitro* and *in vivo* conditions.



2. Formulation and tailoring of regenerative agriculture solutions.

Alternative treatments produced according to farmers' local practice (compost) usually applied to avoid or reduce nematodes attack, was tested to establish potential synergistic (or antagonistic) effects on the susceptible plant crops used above. This will include testing compost act as carriers/co-formulates of *Trichoderma* spp. As well as new formulation of *Trichoderma* spp using Rice bran. Application and dosage will mimic those applied by farmers and the experiment will be carried out under An Nubariyah and Salheya field conditions. The damage to plants, pathogen reproduction and *Trichoderma* spp colonization will be assessed. At the end of the assays, plant growth parameters will be assessed to determine the improvement of root colonization and plant growth by biocontrol of nematodes (*Meloidogyne* spp.).



3. Novel biopesticides to enhance beneficial microorganism communities and minimize losses.

Contribution to zero waste farming system, local biomasses are recycled as soil amendments and not wasted. Leaching of N to groundwater is reduced by using N-fixing microorganisms. Therefore, fertilization strategies based on compost and /or beneficial microorganisms to increase N-use efficiency and minimize N losses including N₂O emissions will be performed in field studies. The ability of the selected strategies to enhance resilience regarding the biotic and/or abiotic stresses will be studied. In particular, their ability to Induced Systemic Resistance (ISR) against the main potatoes, citrus and olive diseases phytonematodes will be considered.

Key Innovations

Integration of Novel Preventive Strategies: Implementation of newly screened PGPF fungi to suppress potato, citrus and olive nematodes diseases in Nubariyah and Salheya regions.

Bioeconomy approaches: Recycling and valorizing waste biomasses to restore soil organic matter and provide bio-stimulant properties.

Formulation and tailoring of regenerative agriculture solutions: To design formulations of solid microbial cultures, microbe-biomass formulates.

Preliminary results

Lab experiments

Screening and selection of beneficial microorganisms.

- Out of 48 microbial isolates, 11 have siderophore production, 19 have phosphate solubilization,
- 14 have a cellolytic activity and 18 produced indole-3-acetic acid (IAA).
- 28 gave a nematicidal effect, while 5 showed the highest effect in juveniles' mortality; three of them were related to *Trichoderma* spp.

Design of microbe- biomasses formulates.

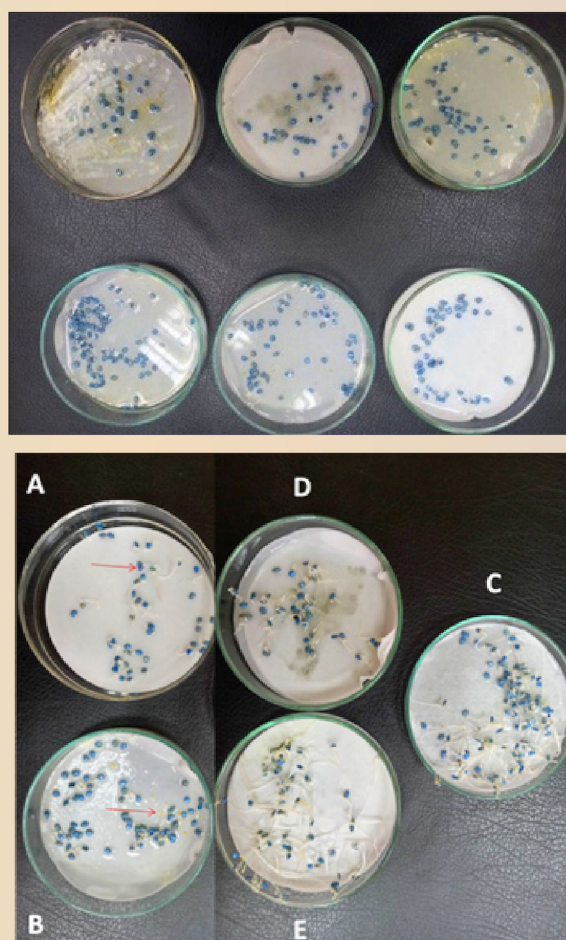
Effect of fungal inoculation on vigor index and root parameters of seedlings

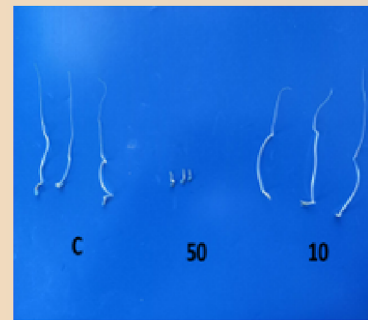
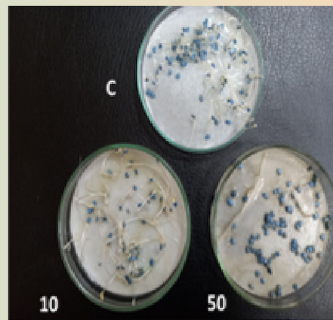
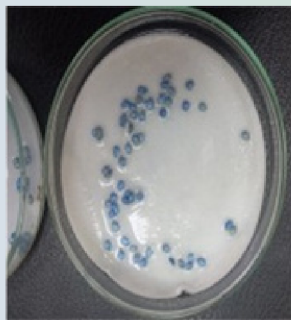
Irrespective to tested microorganisms, most isolates showed moderate increase in germination % and germination tube exceeded that of untreated inoculated plants with various degrees. However, a positive correlation between tested fungal isolates and tomato germination % were recorded in most treatments. However, after 6 days of germination the fungal isolates ARC_Tri1 and Tri_5 (*Trichoderma* sp.) showed better results than did control as showed. Also the seedling's vigor index was increased to 3400 and 5400 respectively.

Effect of compost on vigor index and root parameters of seedlings.

This study summarized the effect of compost applied at two concentrations viz. 50 and 25 ppm on the germination % and growth parameters of tomato under in vitro conditions.

It is worth to note that asinificant differences noticed in plant vigor index within the two concentrations of compost. Meanwhile, at concentration of 25 x103ppm was the most effective in improving tomato plant length with percentage of germination amounted to 60%.





Preparation of rice bran formulation of fungi:

For mass production of *Trichoderma* spp., they were grown in vermiculate, rice brain and Cz medium (Cz Difco), and autoclaved for 20 min at 121°C, on two consecutive days. After 6 months, the assessments of shelf-life properties were recorded.



Greenhouse experiments

Testing results of combining Regenerative solutions together at the pot level.

Pot experiment was conducted with collaboration of UC and ARC and performed at ARC under controlled conditions in greenhouse to elicit induced systemic resistances towards plant parasitic nematode (Root-knot nematodes 1000 j2/ pot).



Sequence the sRNA libraries colonized or not colonized by nematodes and/or beneficial microorganism (*Trichoderma* spp. from ARC & *Pseudomonas* sp and *Bacillus* sp. from UC) and identify potential miRNAs, both in plants and nematodes by UBFC.



Field experiments

Testing results of combining Regenerative solutions together at the pot level.

The experimental field began on the mid of June, 2024, so results will be available only by the end of December 2024. In the field experiment in particular these conditions will be tested:

- The use of compost as alternative strategy in fertilization
- The applications of the formulations of *Trichoderma* spp./rice bran and *Trichoderma* spp./compost to enhance yield, crop nutrition and nematodes management.