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Picking out of soil microbes for quality production of greater yam

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Abstract

Tuber crops are plants that store energy in their underground parts, typically in the form of starch. They are often high in carbohydrates and can be grown in diverse climates. Some like potato, yam, greater yam. Greater yam is a significant tuber crop cultivated in tropical and subtropical regions for its edible starchy tubers. Soil microbes play a role in decomposition, organic matter breakdown, and nutrient availability. It maintains soil health and plant growth. Soil microbes also play a role in disease resistance by outcompeting harmful pathogens and producing antimicrobial compounds. Soil microorganisms like bacteria and fungi, help decompose organic matter, releasing essential nutrients like nitrogen and phosphorus that are vital for yam development. Certain beneficial microbes can form symbiotic relationships with the plant roots, improving water uptake and disease resistance. The interactions between soil microbes and greater yam can lead to agricultural practices and higher yield improvement.

Keywords: - Soil microbes, Greater yam, Nitrogen fixation, antimicrobial compounds, Decompose Organic matter

Introduction

Greater yam (*Dioscorea alata*) is native to Southeast Asia and is widely grown in tropical and subtropical regions around the world. It is valued in traditional medicine for its potential health benefits. It contains compound such as diosgenin, which may have anti-inflammatory and antioxidant properties, contributing to overall health. Additionally, it is rich in carbohydrates, vitamins, and minerals making it a nutritious food source that can support energy levels and immune function (Baahet al.2009). It uses in herbal remedies often focuses on digestive health, hormonal balance and as a natural remedy for various ailments. Yam cultivation can improve soil health through crop rotation practices which can enhance overall agricultural productivity. It can contribute to sustainable agricultural practices by encouraging the use of organic farming methods and reducing the need for chemical inputs.

Soil microbes refer to the study and understanding of various microorganisms that inhabit the soil ecosystem. These microbes include bacteria, fungi, protozoa and nematodes which play crucial roles in soil health and fertility. They contribute to nutrient cycling, organic matter decomposition, and the formation of soil structure. Soil microbes also help in suppressing plant disease and enhancing plant growth by promoting nutrient availability. Research in this area often focuses on the diversity of microbial communities and their interactions with plants and other soil organisms. These dynamics is essential for sustainable agriculture and soil management practices. Beneficial microbes can be used in bioremediation efforts to restore contaminated soils. Soil microbes are vital for maintaining ecosystem balance and supporting agricultural productivity.

The concept of biofertilizers originated from the need to enhance soil fertility and promote sustainable agricultural practices. Historically, farmers have utilized natural processes, such as crop rotation and the use of legumes, to improve soil health. The modern understanding of biofertilizers began to take shape in the early 20th century which scientists started isolating beneficial microorganisms that could enhance nutrient availability in the soil. They also reduce the reliance on chemical fertilizers, minimizing the risk of soil and water pollution. Biofertilizers can help in the restoration of degraded soils making them more productive over time. The application of biofertilizers is often cost-effective, as they can reduce the need for synthetic inputs. Their use aligns with the principles of organic farming, appealing to consumers who prioritize environmentally friendly practices (Jain, 2019).

Types of soil microbes

Soil microbes include fungi, bacteria, actinomycetes, protozoa etc in the greater yam rhizosphere soil as depicted in the Figure 1.

- Fungi are particularly important in decomposing complex organic materials. They breakdown substances like lignin and cellulose found in plant cell walls, which are difficult for many organisms to digest. Fungi form mycorrhizal associations with plant roots, which enhance the plant ability to absorb water and essential nutrients such as phosphorus. This symbiotic relationship only benefits the plants but also helps fungi thrive by providing them with carbohydrates produced through photosynthesis.
- Bacteria it is the most abundant soil microbes, play diverse roles in the soil ecosystem. They are involved in nitrogen fixation, a process where atmospheric nitrogen is converted into forms usable by plants. This is crucial for plant growth, as nitrogen is a key nutrient. Bacteria also decompose organic matter, breaking it down into simpler compounds that can be utilized by other organisms in soil food web.

Actinomycetes, this is a unique group of bacteria, are known for their filamentous structure and ability to decompose tough organic materials, such as chitin from insect exoskeletons and cellulose from plant fibers. They are also significant producers of antibiotics, which can inhibit the growth of harmful soil-borne pathogens, thus promoting a healthier soil environment.

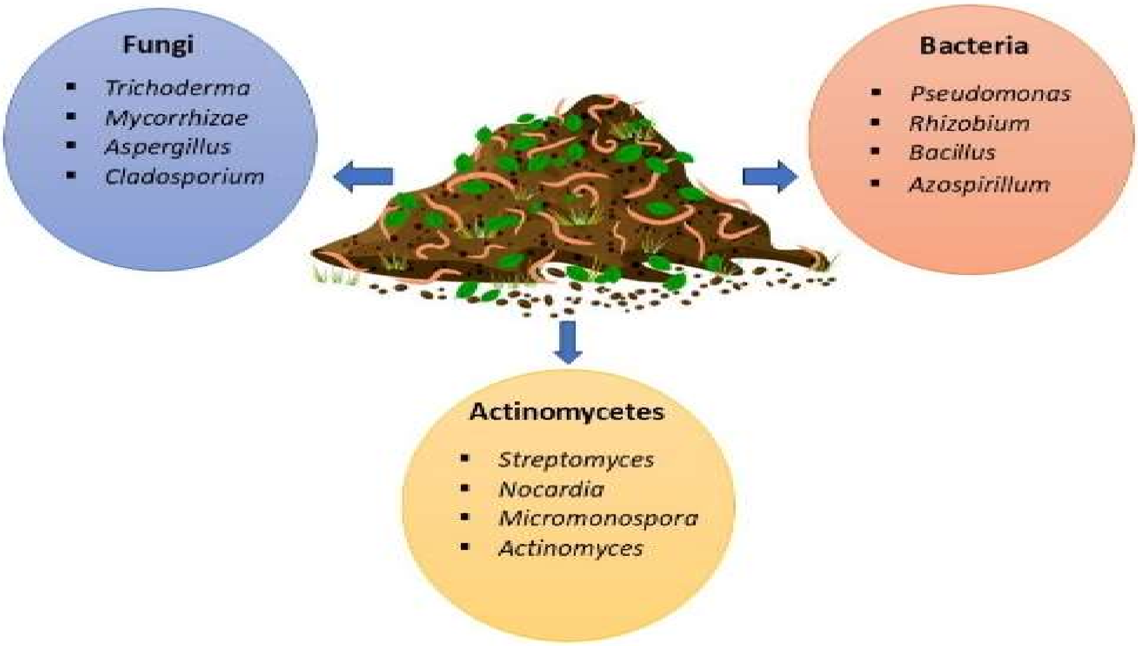

Figure 1: Types of soil microbes present in the Greater yam rhizosphere soil

Mechanism of soil microbes

1. Organic Matter Decomposition

-Bacteria & Fungi break down plant and animal residues into simpler compounds. Enzymatic Activity secretes enzymes like cellulase, ligninase, and protease to degrade complex organic molecules. Formation of Humus stabilized organic matter that improves soil structure and water retention.

2. Nutrient Cycling

- Nitrogen Cycle: Nitrogen fixation (e.g., *Rhizobium, Azotobacter*) Converts atmospheric nitrogen (N_2) into ammonium (NH_4^+) Nitrification (e.g., Nitrosomonas, Nitrobacter) converts NH_4^+ into nitrites (NO_2^-) and then nitrates (NO_3^-), making nitrogen available to plants. Denitrification (e.g., *Pseudomonas*, *Paracoccus*): Converts nitrates into gaseous nitrogen (N_2), returning it to the atmosphere. Phosphate-solubilizing bacteria (PSB) like *Pseudomonas* and *Bacillus* convert insoluble phosphorus into soluble forms for plant uptake. Microbes like Bacillus mucilaginosus break down potassium minerals into bioavailable forms. Methanotrophic Bacteria consume methane, reducing greenhouse gas emissions.

3. Carbon Fixation by Soil Algae & Cyanobacteria contribute to carbon sequestration.

Growth promotion of greater yam yield using soil microbes

Soil microbes play a crucial role in enhancing the growth and yield of greater by improving nutrient availability, suppressing soil-borne pathogens, and promoting plant health through symbiotic associations. Beneficial microbes such as *Trichoderma* spp., *Pseudomonas fluorescens*, and *Bacillus* spp. contribute to increased root development, higher nutrient uptake, and improved resistance to biotic and abiotic stresses (Shah et al.,2021). The application of microbial inoculants in yam cultivation has been reported to enhance tuber size, weight, and overall productivity by facilitating nitrogen fixation, phosphate solubilization, and phytohormone production. The following table 1 summarizes the impact of key microbial species on greater yam yield improvement. The integration of these beneficial microbes into sustainable agricultural practices can significantly enhance yam production while reducing dependency on chemical fertilizers.

Table 1: Effect of Soil Microbes on Growth and Yield of Greater Yam

Microbial Species	Mode of Action	Impact on Yield Improvement (%)
Trichoderma harzianum	Root growth promotion	20-25%
Pseudomonas fluorescens	Phosphorus solubilization	18-22%
Bacillus subtilis	Nitrogen fixation, growth hormones	15-20%
Azospirillum spp.	Nitrogen fixation, root elongation	12-18%
Mycorrhizal fungi	Phosphorus uptake, drought tolerance	22-28%

Conclusion and Future Prospects

Achieving quality production remains a challenge due to soil fertility depletion, pest and disease pressures, and inefficient farming practices. The integration of soil microbiome management into yam cultivation presents a promising avenue for improving yield, quality, and sustainability. Selecting beneficial soil microbes offers an eco-friendly approach to enhance soil health, nutrient uptake, and plant resilience. Beneficial soil microbes, including plant growth-promoting rhizobacteria (PGPR) and mycorrhizal fungi, play a crucial role in nutrient solubilization and uptake. Future research should focus on isolating and optimizing microbial strains that enhance phosphorus and nitrogen availability in yam fields. Strains of *Rhizobium*, *Bacillus*, *Azospirillum*, and *Trichoderma* have shown potential in improving root health and overall plant vigor. The application of microbial inoculants tailored for greater yam cultivation could reduce reliance on synthetic fertilizers and improve crop sustainability. Yam cultivation faces significant challenges from soil-borne pathogens such as *Fusarium oxysporum*, *Phytophthora*, and *Pythium* species. The selection and application of antagonistic microbes, such as *Pseudomonas fluorescens* and *Bacillus subtilis*, offer a biocontrol strategy to mitigate these pathogens. Future research should explore microbial consortia that can enhance disease resistance while maintaining soil microbial balance. The incorporation of microbial biofertilizers that enhance organic matter decomposition and soil aggregation can significantly improve soil fertility. Future innovations should focus on formulating multi-functional microbial consortia that optimize soil aeration, moisture retention, and organic matter decomposition in yam farms. Advances in metagenomics and synthetic biology offer new prospects in selecting and engineering soil microbes for greater yam production. Future research should also explore the potential of microbial probiotics that can be tailored to specific soil conditions and yam varieties. Advances in microbial selection, inoculant development, and biocontrol strategies present viable alternatives to conventional inputs. By integrating microbial solutions into yam farming practices, we can ensure increased productivity, environmental sustainability, and food security in yam.

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