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Efficacy of Soil Inhabiting Fungi/PGPF against *Fusarium oxysporum* f. Sp. *lycopersici* (Fol) causing Wilt of Tomato

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Fusarium wilt is regarded as one of the tomato plant diseases that cause the most damage. In this study, the antifungal and plant growth-promoting properties of some plant growth promoting fungi (PGPF) were investigated. Plant growth-promoting fungus (PGPF) reduced plant diseases and enhanced plant health.*Fusariumoxysporum* f. sp. *lycopersici* that causes *Fusarium* wilt in tomato plants (*Lycopersicum esculentum*), one of the most serious soil-borne diseases that causes the greatest yield loss in farmers' fields and causes excessive losses on tomato crops globally. The beneficial effects of soil inhabiting fungi are to suppress the growth of mycelia formation and germination of spore through induces systemic resistance. The potential of PGPF as an environmentally eco-friendly bio-control agent, that produced growth stimulant, antibiotics, biofertilizers and biopesticides for controlling the plant disease and for facilitating the quality product and to enhance the disease-free tomato cultivars.

Keywords: *Fusarium* wilt, Tomato, Plant growth promoting fungi, Sustainable agriculture, Bio-control.

Introduction

Tomato infections have a severe impact on the crop; they are regarded as having significant economic significance. Numerous detrimental diseases affect tomato output in terms of both quantity and quality. Increasing crop output while limiting the use of chemical pesticides, given the threat of climate change and disease spread, is a key concern for the agricultural sector. However, *Fusarium oxysporum* is the primary cause of *Fusarium* wilt disease, which severely damages plants at every stage of growth. An alternative to chemical management of *Fusarium* wilt illnesses is biological control, which uses antagonistic non pathogenic organisms that are powerful enough to lessen the detrimental effects of *Fusarium* wilt in a variety of crops (Mohammed and Toama, 2019). Plant Growth Promoting Fungi stimulate the root formation of plant or act as root proliferation and also produce the chemical substances i.e. antibiotics, growth hormones, nutrient solubilization (especially phosphorus), and inducing systemic resistance against pathogens. HCN was identified as a biocontrol agent among them due to its perceived toxicity to plant diseases (Attia *et al*., 2019).

Most of the soil inhabiting fungi such as *Aspergillus fumigatus* and *Rhizopus oryzae* both have a potential activity to reduce the mycelial growth formation of *F. oxysporum* through antagonistically. Hence, chemical fungicides are harmful to the environment and also human and animals; thus, traditional methods such as bio-control agents as PGPF may be applied to restrict their hazardous effects from environment as eco-friendly management. (Khalil *et al*., 2021).

Dual culture effect of PGPF against *F. Oxysporum* under *in vitro* condition

The antifungal activity of ethyl acetate fungal extracts of *Aspergillus fumigatus* and *Rhizopus oryzae* was studied using the agar well diffusion method (Plate. 1). After being inoculated on Potato Dextrose broth medium, *F. oxysporum* was incubated for three to five days at 28 ± 2°C. A thick layer of the *F. oxysporum* fungal inoculum was applied to the sterile, solidified potato dextrose agar (PDA) medium. 50µL of each fungal extract (4 mg/ml) were placed in 6-7 mm well zones. The zones of inhibition were measured and monitored after the culture plates were incubated for seven days at 25±1°C (Hashem *et al*., 2022).

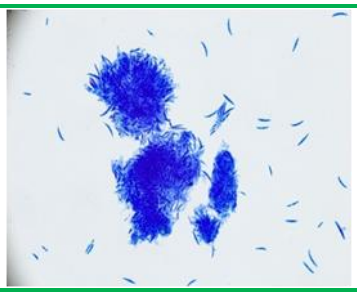
Inhibition zones of fungal pathogens

Effect of PGPF against *F. Oxysporum* under *in vivo* condition

The ability of fungal isolates to stimulate biochemical defense performance of tomato plants and to control wilt disease caused by *F. oxysporum* was demonstrated under net house conditions using plastic pots (25 × 20 cm). PGPF were applied one week before infection with *F. oxysporum*, and then the pathogen was inoculated into cultivation soil (Hashem *et al*., 2022).

Major symptoms of *Fusarium* wilt in tomato

- **Yellowing:** The leaves, especially the older, bottom leaves, turn yellow.
- **Wilting:** The plant wilts over several days.
- **Browning:** The leaves turn brown and fall off.
- **Stunted growth:** The plant's growth is stunted.
- **Little or no fruit:** The plant produces little or no fruit.
- **Brown vascular tissue:** When the stem is cut at its base, the vascular tissue is brown.
- **Early death:** The plant often dies before it matures

		
Macro and Micro Conidia under 40X	Chlamydospore	Vascular discolouration

to prevent tomato *Fusarium* wilt

***In vitro* Management Practices:**

- **Isolation and Screening of antagonistic fungi:** To screen and recover of plant growth promoting fungi such as *Trichoderma harzianum*, *Penicillium chrysogenum* from soil or Rhizosphere of plant. Dual culture provides a antagonistic activity which is against the Fusarium wilt by reducing its growth of the pathogen *F. oxysporum*.
- **Optimization of growth conditions:** Improve the pH, culture media, temperature and nutrient supply to supply the growth of fungus and production of metabolite.
- **Pathogen Suppression Analysis:** Microscope identifies the pathogen *F. oxysporum* lysed and degraded by the PGPF.

***In vivo* Management Practices:**

- **Soil and Seed treatment:** Incorporating the PGPF into the soil and on seed coat before planting seedling to establish protective colonization.
- **Net house diseases trials:** Estimate the disease inhibition by inoculating the tomato plant with *F. oxysporum* by applying PGPF on it. Measure the disease severity and yield improvement.

- **Enhance the plant defense mechanism system:** Observe the plant defense enzyme activity such as peroxidase, polyphenol oxidase to confirm induced system resistance (ISR) in treated plant.

Conclusion

A destructive soil-borne disease that affects tomatoes all around the world, *Fusarium* wilt results in large crop losses and financial losses. *Fusarium oxysporum* f. sp. *lycopersici* is the pathogen that causes the illness, and it infects tomato plants through their roots. Cultural, chemical, and biological controls must all be used in a complete strategy to effectively manage *Fusarium* wilt. To lower the danger of disease outbreaks, integrated pest management techniques, crop rotation, resistant cultivars, and cleanliness are crucial. Tomato producers may reduce the effects of *Fusarium* wilt and guarantee a healthy, fruitful crop by being aware of the disease's causes, symptoms, and management choices.

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