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Effect of Culture Filtrate of Fungiq on Seed Germination of Different Crops

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Abstract

The present study investigates the influence of culture filtrates of various pathogenic fungi on the seed germination of selected leguminous and oilseed crops. Seeds of cowpea, chickpea, green gram, green pea, and groundnut were treated with culture filtrates of ten fungal pathogens, including Rhizoctonia solani, Curvularia lunata, Aspergillus niger, Colletotrichum falcatum, Macrophomina phaseolina, Fusarium oxysporum, Sclerotium rolfsii, and others. The percent germination varied significantly, with some fungi such as Alternaria alternata and Aspergillus flavus showing strong inhibitory effects, while others like Rhizoctonia solani exhibited relatively lesser impact. These findings highlight the potential phytotoxicity of fungal metabolites and their implications in crop seedling vigor and plant health.

Keywords: Seed germination, fungal culture filtrate, phytotoxicity, legumes, Aspergillus niger, Fusarium oxysporum

I.INTRODUCTION

Seed germination is a critical phase in the life cycle of plants, directly affecting crop establishment and yield. Various biotic and abiotic factors influence germination, among which soil-borne pathogenic fungi pose significant threats. These fungi release secondary metabolites and enzymes into their surroundings, often causing phytotoxic effects on seed germination and early seedling development. Several studies have indicated that culture filtrates of pathogenic fungi can drastically inhibit seed germination and root elongation. However, the severity of inhibition is often species-specific, depending on the type of crop and fungus involved. This research aims to evaluate the effect of culture filtrates from ten fungal pathogens on the seed germination of cowpea, chickpea, green gram, green pea, and groundnut.

Selected crop plants is the most important crops in the world but its production does not meet the need. Shetty (1988) reported that fungi accounted for 75% of seed-borne pathogens which have been found to cause infectious diseases such as rot, discoloration, necrosis and blight. Fusarium spp. is reported to be the most important field fungi worldwide and produce over 100 secondary metabolites that are hazardous to the seed consumers (Owolade et al., 2005). Crop seeds and seedlings are susceptible to soil and seed-borne diseases as many seeds may decay before or after germination. Also, affected plants may suffer from stunted growth, reduced ear size and even in severe condition, may die as a result of poor root system (Vincelli, 2008). Fungi of the genera Aspergillus, Fusarium, Penicillium and Rhizoctonia are known to produce mycotoxins, toxic metabolites (Singh et al., 1991).

These mycotoxins had been reported to degrade seed quality and reduce their viability (Caster and Frederiksen, 1980; Gopinath and Shetty, 1988). Culture filtrates of Aspergillus spp. caused reduction in seed germination and root-shoot elongation and the filtrate of A. niger was found to be inhibitorier (Jalander and Gachande, 2012). Seed-born diseases play a significant role in the quantity and quality of agricultural produce. Seed rot, seedling blight, Bipolaris leaf spot and Cuvularia leaf spot are etiologically caused by Penicillium spp. and Fusarium oxysporium, Aspergillus spp., Bipolaris maydis and Curvularia lunata respectively (Debnath, 2012). Symptoms expressions are affected by plant age, plant species and environmental factors. The etiological agents of disease penetrate host plants by direct penetration using mechanical force or indirect penetration through wound and natural openings such as lenticels, hydathodes and stomata (Agrios, 2005). As alternative to direct penetration, fungi attack foliage and develop infectious structures that may consider stomata as their penetration route. The dysfunction of stomata affects host plants seedling physiological activities, include transpiration and respiration. The phyllosphere of terrestrial plants provides one of the most important niches for microbial inhabitation (Upper and Hirano, 1999; Lindow and Brandl, 2003).

The present study is to elucidate the effects of Aspergillus, Fusarium, Penicillium and Rhizoctonia species filtrates on seed germination of the selected plant seedling viz. Vigna unguiculata, Cicer arietinum, Vigna radiate, Pisum sativum, and Arachis hypogaea.

Materials and Methods

Test Crops

Cowpea (Vigna unguiculata)
Chickpea (Cicer arietinum)
Green gram (Vigna radiata)
Green pea (Pisum sativum)
Groundnut (Arachis hypogaea)

Fungal Isolates

Culture filtrates were prepared from the following fungi:

- F1: Alternaria alternate
- F2: Aspergillus flavus
- F3: Aspergillus niger
- F4: Curvularia lunata
- F5: Colletotrichum falcatum
- F6: Fusarium oxysporum
- F7: Macrophomina phaseolina
- F8: Penicillium citrinum
- F9: Rhizoctonia solani
- F10: Sclerotium rolfsii

Preparation of Culture Filtrates:

Each fungus was isolate on Potato Dextrose Media, and then cultured on Glucose Nitrate Agar (GNA) broth for 10–12 days at 25°C. The mycelial mats were filtered through muslin cloth and then Whatman No.1 filter paper to obtain the culture filtrate

Germination Test:

Surface-sterilized seeds of each crop were placed in sterile Petri dishes lined with filter paper. Each dish received 10 mL of culture filtrate (treatment) or sterile distilled water (control). The dishes were incubated at 25±2°C, and germination was recorded after 7 days. Each treatment was replicated thrice.

Results

Effect on Germination Percentage:

The percentage seed germination varied considerably among crops and fungal treatments. Table.1 summarizes the results:

Table 1: Effect of fungal culture filtrate on seed germination (%)

Sr. No.	Crop	Control (%)	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
1.	Cow pea	90	60	70	85	40	65	50	75	60	65	80
2.	Chick pea	92	45	60	80	40	50	55	70	65	70	75
3.	Green gram	97	35	65	75	60	45	40	65	55	85	80
4.	Green pea	95	30	50	85	35	40	45	80	50	70	75
5.	Groundnut	97	50	75	80	55	65	55	70	60	75	85

Photoplates clearly illustrate differences in seedling emergence and vigor under the influence of different fungal filtrates (Fig. 1).

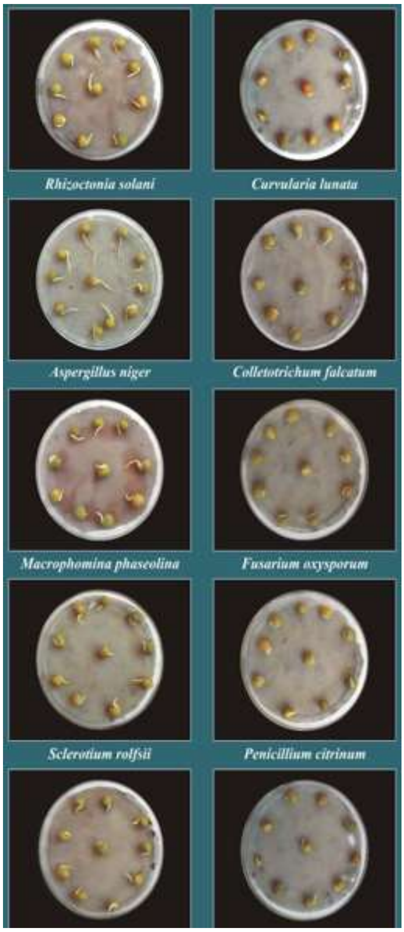

Fig.1: Effect of fungal culture filtrate on green pea seed germination

- The most inhibitory effects were observed with F1 (Alternaria alternata) and F2 (Aspergillus flavus) in all crops.
- Sclerotium rolfsii (F10) had relatively moderate inhibitory effects.
- Some fungi like Rhizoctonia solani (F9) and Penicillium citrinum (F8) allowed better germination compared to others.
- Control treatments showed the highest germination rates, confirming the inhibitory effect of fungal metabolites.

Discussion

The inhibitory effects on seed germination by fungal filtrates could be attributed to toxic secondary metabolites such as aflatoxins, oxalic acid, and phenolic compounds. Aspergillus niger, known to produce oxalic acid, showed high inhibition in most crops, similar to Curvularia lunata, which can secrete host-specific toxins. These phytotoxic compounds likely interfere with enzymatic or hormonal processes during germination. Previous studies, Pandey et al., (2020) and Sharma and Kumar (2019) have reported that culture filtrates from Fusarium, Macrophomina, and Alternaria species significantly reduce seedling growth by affecting cell division and elongation.

II. CONCLUSION

The present study emphasizes that culture filtrates of pathogenic fungi have variable effects on seed germination of different crops. The observed reduction in germination indicates that pre-sowing fungal contamination or infection could significantly affect crop establishment. Understanding these interactions can help in developing better disease management strategies for sustainable agriculture.

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