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Antifungal Activity of Cinnamon Oil against *Macrophominaphaseolina* by Poisoned Food Technique

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Abstract

Macrophominaphaseolina is a devastating soil-borne fungal pathogen that causes severe diseases in various crops, leading to significant economic losses worldwide. With the growing concern over the indiscriminate use of synthetic fungicides and their adverse effects on the environment and human health, there is a pressing need to explore alternative and sustainable approaches for controlling fungal pathogens. This research paper investigates the antifungal potential of cinnamon oil against *M. phaseolina* using the Poisoned Food Technique. The study employed different concentrations of cinnamon oil viz., 20%, 40%, 60%, 80% and 100% to determine its inhibitory effect on fungal growth and development. The findings reveal that cinnamon oil exhibits significant antifungal activity against *Macrophominaphaseolina*, with higher concentrations resulting in greater inhibition. These results suggest that cinnamon oil holds promise as a potential natural fungicide for managing *M. phaseolina* and could contribute to the development of eco-friendly and sustainable disease management strategies in agriculture.

Keywords: Antifungal activity, Cinnamon oil, *Macrophominaphaseolina*, Poisoned Food Technique, Natural fungicide, Disease management, Sustainable agriculture.

Introduction

Macrophominaphaseolina, commonly known as charcoal rot, is a destructive fungal pathogen that affects a wide range of plants, including crops, ornamentals, and weeds. This soil-borne fungus thrives in hot and dry conditions, making it a significant threat in arid and semi-arid regions.Once introduced into the soil, *M. phaseolina* infects plant roots, colonizing and spreading through the vascular system. The infection disrupts water and nutrient uptake, leading to wilting, yellowing, and premature senescence of leaves. The disease progresses rapidly, often leading to the plant's death.Charcoal rot primarily targets legumes, such as soybeans, mung beans, and cowpeas, but can also impact other important crops like sunflowers, sorghum, and cotton. Crop losses due to *M. phaseolina* can be devastating, causing significant economic consequences for farmers and agricultural industries.Management strategies for charcoal rot include crop rotation, using resistant

varieties, practicing proper irrigation, and adopting good agronomic practices. Fungicides have limited effectiveness against the disease, and integrated approaches are essential for sustainable control.Understanding the ecology and epidemiology of *M. phaseolina* is crucial to developing effective control measures and minimizing the impact of this destructive fungal pathogen on agriculture and ecosystems. In the present study we investigated the effect of cinnamon oil against *Macrophominaphaseolina* by poisoned food technique.[1,2,3]

Cinnamon oil is derived from the bark or leaves of the *Cinnamomum* tree species. Its main components include cinnamaldehyde (60-80%), eugenol (4-10%), and other minor constituents like linalool, benzaldehyde, and coumarin. The oil is prepared through steam distillation or solvent extraction methods. During steam distillation, the bark or leaves are heated, and the vapour is collected and condensed to yield the essential oil. The resulting oil possesses a warm, spicy aroma and is commonly used in aromatherapy, culinary applications, and traditional medicine for its potential antimicrobial, anti-inflammatory, and digestive benefits.Cinnamon oil has demonstrated potent antifungal activity against plant fungi, making it a promising natural alternative for plant disease management. Studies have shown that the oil contains active compounds such as cinnamaldehyde and eugenol, which exhibit strong fungicidal properties. When applied to infected plants or as a preventive measure, cinnamon oil effectively inhibits the growth and development of various plant fungal pathogens, including common species like *Fusarium*, *Botrytis*and *Alternaria*. The antifungal mechanism of cinnamon oil involves disrupting fungal cell membranes, inhibiting spore germination, and interfering with vital metabolic processes. Its mode of action is environmentally friendly, reducing the reliance on synthetic fungicides that may have adverse effects on the ecosystem. Moreover, cinnamon oil's antifungal properties can contribute to improved crop yields and reduced economic losses due to fungal infections. However, further research is needed to optimize application methods and concentrations for safe and effective utilization in agricultural practices.[4,5,6,7,8,9]

Materials and methods

Fungal strain

Macrophominaphaseolina was isolated from watermelon seeds by agar plate method.

Antifungal assay

Potato dextrose agar media was prepared and different concentrations of cinnamon oil viz., 20%, 40%, 60%, 80% and 100% was incorporated in the media at 1000 ppm. After preparing agar plates, *Macrophominaphaseolina* was inoculated and plates were incubated at 27°C for seven days. Control plates without cinnamon oil were also prepared. Experiments were performed in triplicates.

Results

The results revealed that cinnamon oil exhibits significant antifungal activity against *Macrophominaphaseolina*. At 40%, 60%, 80% and 100% complete inhibition of *Macrophominaphaseolina* was observed and at 20% colony of 48.3 was observed. Maximum growth was observed in the control plates.

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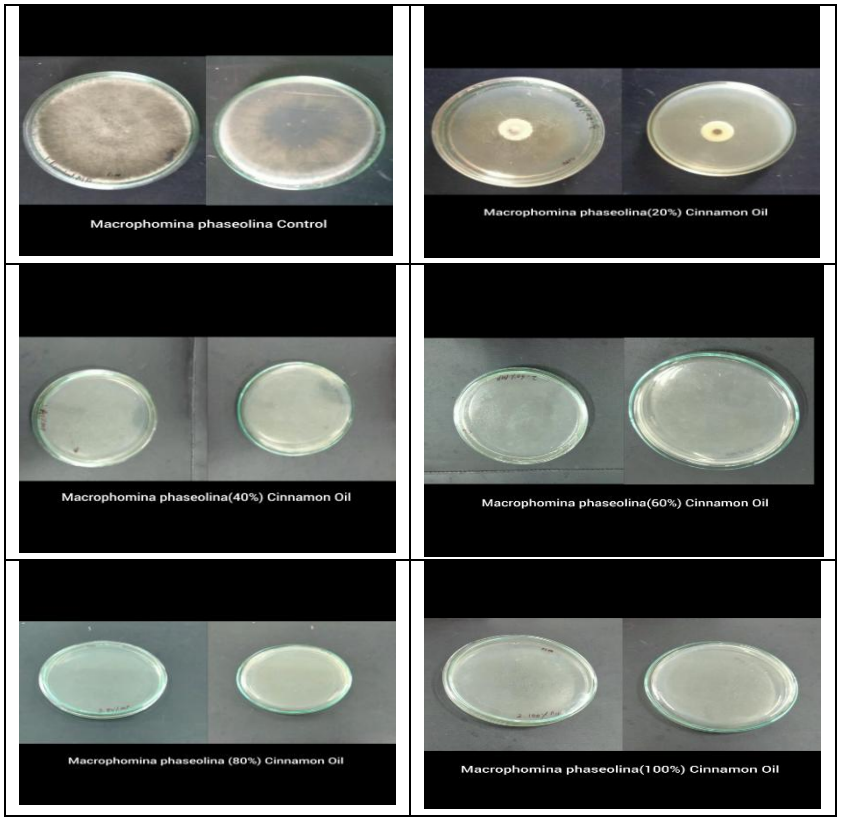

Fig 1: Antifungal activity of Cinnamon oil against *Macrophominaphaseolina*

Table 1: Antifungal activity of Cinnamon oil against *Macrophominaphaseolina*

Essential oil	Concentration	Mean colony diameter (mm)	Percentage of inhibition (5%)
Control	0%	90	00
Cinnamon oil	20%	48.3	53.66
Cinnamon oil	40%	00	100
Cinnamon oil	60%	00	100
Cinnamon oil	80%	00	100
Cinnamon oil	100%	00	100

Discussion

From the study of Šernaitė et al., antifungal activity of cinnamon oil against *Botrytis cinerea* was revealed.[10] Similarly, in the present study antifungal activity of cinnamon oil against *Macrophominaphaseolina* was observed. From the study of Liu Y et al., antifungal activity of cinnamon-litsea combined essential oil against *Aspergillus flavus* was revealed.[11] Similarly, in the present study strong antifungal activity of Cinnamon Oil against *Macrophominaphaseolina* was observed. From the study of HeJingliu et al., antifungal activity of cinnamon oil against *Colletotrichum* was revealed.[12] Similarly, in the present study strong antifungal activity of cinnamon oil against *Macrophominaphaseolina* was observed.

The present study investigates the effectiveness of cinnamon oil as an antifungal agent against *Macrophominaphaseolina*, a pathogenic fungus causing plant diseases. The study

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employs the poisoned food technique to evaluate the inhibitory properties of cinnamon oil on the growth of the fungus.Cinnamon oil, derived from the bark of Cinnamomum trees, is known for its diverse bioactive compounds, including cinnamaldehyde, which possess antimicrobial properties. In this study, various concentrations of cinnamon oil were incorporated into the culture medium to observe its impact on the fungal growth.The results of the study suggest that cinnamon oil exhibits antifungal activity against *Macrophominaphaseolina*, effectively inhibiting its growth. The antifungal efficacy may be attributed to the presence of cinnamaldehyde and other compounds that disrupt the fungal cell membrane or interfere with essential metabolic processes.The findings from this study contribute to the understanding of natural alternatives for controlling plant pathogens, potentially offering a sustainable and eco-friendly approach to manage fungal diseases in agriculture. Further exploration of cinnamon oil's mechanisms of action and its application in real-world settings could open up new avenues for plant disease management and contribute to the development of safer and more environmentally friendly fungicides.

Conclusion

In conclusion, the research paper demonstrates that cinnamon oil possesses significant antifungal activity against *Macrophominaphaseolina*, as evidenced by the results obtained through the Poisoned Food Technique. The study provides valuable insights into the potential of cinnamon oil as a natural fungicide for managing fungal infections in agricultural settings. Further exploration and application of cinnamon oil in real-world scenarios could hold promising prospects for sustainable and eco-friendly approaches to combat fungal diseases.

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