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Organic Management of Strawberry Diseases using Cow Urine and Plant Extracts for Improved Soil Health

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Abstract
Strawberry (Fragaria × ananassa) is a high-value horticultural crop cultivated in diverse agro-climatic regions of India, including the plains of Maharashtra. Despite its economic and nutritional importance, strawberry production is severely constrained by post-harvest fungal diseases that lead to significant quality deterioration and economic losses. Excessive dependence on chemical fungicides for disease control has raised serious concerns regarding soil health, environmental safety and sustainability. The present study was undertaken to identify the fungal pathogen associated with strawberry fruit decay and to evaluate eco-friendly organic disease management strategies.
Diseased fruits of two commercially cultivated strawberry varieties, Winter Down and Sweet Sensation, were collected from farmers' fields in Satara district, Maharashtra. The fungal pathogen was isolated using Sabouraud Dextrose Agar and identified based on colony morphology and microscopic characteristics following Lactophenol Cotton Blue staining. The isolate was identified as Aspergillus niger, a common post-harvest fungal pathogen of strawberries. Antifungal activity of cow urine was evaluated alone and in combination with garlic and ginger extracts using the agar well diffusion method on Potato Dextrose Agar.
Cow urine exhibited clear zones of inhibition against A. niger, indicating strong antifungal activity. Enhanced inhibition was observed when cow urine was combined with garlic and ginger extracts. These findings suggest the presence of bioactive compounds in cow urine capable of suppressing fungal growth. The use of indigenous organic inputs such as cow urine reduces dependency on chemical fungicides, supports soil microbial diversity and promotes sustainable agriculture.
The study highlights the potential of cow urine-based organic formulations as effective, low-cost and environmentally safe alternatives for managing post-harvest fungal decay in strawberries while contributing to improved soil health.

Keywords: Strawberry; Aspergillus niger; Cow urine; Organic farming; Fungal decay; Soil health

Introduction

Strawberry (*Fragaria* × *ananassa*) is one of the most widely cultivated small fruit crops worldwide and is grown under diverse climatic conditions (Hancock, 1999). In India, strawberry cultivation is traditionally confined to hilly regions such as Mahabaleshwar, Nainital, Dehradun and the Kashmir Valley. In recent years, cultivation has expanded into the plains of Maharashtra due to favourable agro-climatic conditions and increasing consumer demand.

Strawberries are consumed fresh and processed into jams, frozen products and desserts owing to their appealing flavour and high vitamin C content. However, the fruit is soft, delicate and highly perishable, making it susceptible to post-harvest fungal infections during harvesting, storage and transportation (Sharma and Singh, 2009). Among the commonly cultivated varieties, Winter Down and Sweet Sensation are preferred for their yield and fruit quality but remain vulnerable to fungal pathogens. Post-harvest fungal diseases account for significant losses in strawberry production, particularly under warm and humid conditions. *Aspergillus niger* is one of the dominant pathogens responsible for black mould rot of strawberries, leading to reduced marketability and shelf life (Pitt and Hocking, 2009). Conventional disease management relies heavily on chemical fungicides, which adversely affect soil microbial diversity, environmental quality and long-term agricultural sustainability (Lampkin, 2002).

Organic farming emphasizes the use of natural inputs to manage plant diseases while maintaining soil health and ecological balance. Cow urine is a traditional organic input widely used in Indian agriculture and is known for its antimicrobial properties. The present study aimed to identify the fungal pathogen associated with strawberry fruit

decay and to evaluate cow urine and plant extract-based organic formulations as eco-friendly alternatives for disease management.

Materials and Methods

Sample collection

Diseased and healthy strawberry fruits of Winter Down and Sweet Sensation cultivars were collected from the farm of a local grower in Jalgaon village, Satara district, Maharashtra. Samples were collected aseptically and transported to the laboratory for further analysis.

Fig. 1. Healthy Strawberry

Fig. 2. Diseased Strawberry

Isolation of fungal pathogen

Fungal isolation was carried out using Sabouraud Dextrose Agar. Diseased fruit tissues were processed aseptically and saline washings were spread onto agar plates. Plates were incubated at room temperature for 5–7 days and observed for fungal growth.

Morphological and microscopic identification

Colony morphology was recorded based on colour, texture and growth pattern. Microscopic identification was performed using Lactophenol Cotton Blue staining to observe hyphae, conidiophores and conidia under a compound microscope.

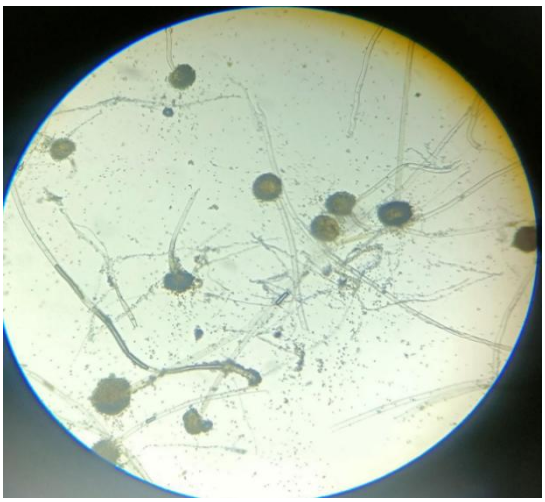

Fig. 3. Fungal Mycelium stained with lactophenol blue

Fig. 4 Fungal Growth on SDA

Identification of fungal species

Based on macroscopic and microscopic characteristics, the fungal isolate was identified as *Aspergillus niger*.

Preparation of organic antifungal agents

Fresh cow urine was collected aseptically from local and Gir cow varieties, filtered and stored in sterile containers. For combination treatments, crushed garlic and ginger were added separately to cow urine and incubated for 4–5 days at room temperature.

Antifungal activity assay

Antifungal activity was assessed using the agar well diffusion method on Potato Dextrose Agar. Plates were inoculated with *A. niger* spore suspension, wells of 6 mm diameter were prepared and 50 µl, 100 µl and 150 µl of

treatments were added. Plates were incubated at 25°C for 3–5 days. All experiments were performed in triplicate and zones of inhibition were recorded.

Fig.5. Ginger & Local Cow Urine **Fig. 6.** Garlic & Local Cow Urine

Results

Fungal colonies isolated from diseased strawberry fruits showed cottony growth, initially white to yellow, later turning black due to conidial formation. Microscopic examination revealed smooth conidiophores and black conidia characteristic of *Aspergillus niger*.

Cow urine exhibited clear zones of inhibition against *A. niger* at all tested concentrations. Enhanced antifungal activity was observed when cow urine was combined with garlic and ginger extracts. One-month-old Gir cow urine also demonstrated effective inhibition of fungal growth compared to fresh samples.

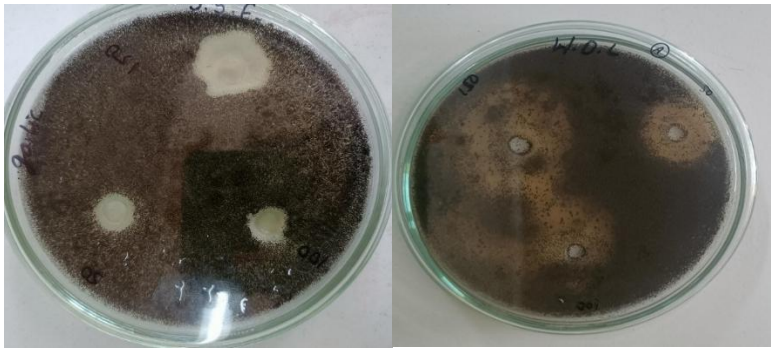

Fig. 7. Cow urine exhibited clear zones of inhibition against *A. niger*

Discussion

Aspergillus niger is a major post-harvest pathogen of strawberries, particularly under warm and humid conditions prevalent in Maharashtra. Rapid colonization of damaged fruit tissues by this pathogen results in black mould rot and substantial post-harvest losses (Barkai-Golan, 2001). The present study confirms the antifungal potential of cow urine against *A. niger*. Cow urine contains bioactive compounds with antimicrobial properties and has been widely recognized in organic farming systems. The enhanced efficacy observed with garlic and ginger combinations may be attributed to sulfur-containing and phenolic compounds present in these plant extracts (Singh et al., 2005). The adoption of organic disease management strategies reduces dependence on synthetic fungicides, preserves soil microbial diversity and improves soil health. Utilization of locally available organic resources such as cow urine aligns with sustainable agricultural practices and environmental safety.

Conclusion

The study identified *Aspergillus niger* as the primary fungal pathogen responsible for strawberry fruit decay in the study area. Cow urine-based organic formulations demonstrated effective antifungal activity against the pathogen, particularly when combined with garlic and ginger extracts. These findings suggest that cow urine can serve as a sustainable, low-cost and environmentally safe alternative to chemical fungicides. Adoption of such organic practices contributes to improved soil health, reduced environmental pollution and sustainable strawberry production.

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PMS, SPP, SP and MT conceived the concept, wrote and approved the manuscript.

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Competing interest
The authors declare no competing interests.

Ethics approval
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