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Study of Fungal Pathogens Causing Post-Harvest Fungal Fruit Diseases Found in Akola Region

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Abstract:

Plant diseases have a huge impact on agricultural productivity and food security, thus understanding them is crucial, particularly for angiospermic plants that yield fruit. Plant diseases are caused by pathogenic organisms that disturb normal physiological and metabolic processes, reducing function. Environmental variables and pathogens, such as bacteria, viruses, and fungi, can cause pre- and post-harvest diseases, resulting in losses along the food supply chain. Fungal infections are a prevalent cause of post-harvest illnesses, which damage fruits and vegetables during harvest, handling, and storage, resulting in both quality and quantity losses. These illnesses generate health difficulties because they produce harmful metabolites, lower market value, and have an economic impact, particularly in developing countries. The Akola region in Maharashtra, India, is a suitable place for researching these topics due to its distinct tropical climate. This study will look at fungal diseases on locally accessible fruits in Akola to determine risks, economic effects, and control measures. The goal of this research is to evaluate the prevalence and severity of fungal infections in this region in order to improve fruit quality, support food safety efforts, and develop sustainable agricultural methods.

Key words: *Plant diseases, Fungal infections, Postharvest losses, Food security, Sustainable agriculture.*

Introduction:

Plant diseases are detrimental deviations or changes from normal physiological and metabolic processes. In sick conditions, plant cells or perhaps the entire plant lose their capacity to perform these critical processes. It occurs as a result of the presence of pathogenic organisms, which disrupt the normal functioning of plants and modify the fundamental processes of host plants, causing the host plant to become ill. Hundreds, if not thousands, of plant diseases can harm all types of crops. Certain pathogenic organisms can only infect a single plant variety, whilst others can affect dozens or even hundreds of plant species.Plant diseases are classified based on the cause of the disease. Infectious plant diseases are caused by fungi, prokaryotes, parasitic higher and green algae, viruses, viroids, nematodes, and protozoa, whereas noninfectious plant diseases can be caused by too low or too high temperatures, soil moisture content, lack or excess of light, lack of oxygen, air pollution, nutrient deficiencies, soil acidity or alkalinity, and so on.Post-harvest infections are those that grow on harvested plant parts such as seeds or fruits. Pathogen attacks can occur during harvesting, following handling, storage, marketing, and after consumer purchase. Plant parts may become contaminated in the field, although symptoms may appear later, at any point before final ingestion. Postharvest infections that cause spoiling of both durable and perishable goods are common.Losses caused by pathogen-induced diseases across the supply chain account for the majority of food waste and can occur at any point from pre-harvest to consumption. The ability of a microbe to cause postharvest diseases, as well as the final outcome, are determined by a number of parameters that may be easily linked to the pathogen, the host, and the environment.

However, more than 10,000 fungal species can cause plant disease. All plants are infected by fungi, and each parasitic fungal develops a variety of structures on the host's surface, including mycelium, sclerotia, sporophores, fruiting bodies, and spores, which are collectively known as signs. Signs differ

from symptoms, which refer solely to the appearance of sick plants or plant tissues.The purpose of this study is to discover potential dangers associated with eating infected locally accessible fruits, which is critical for ensuring food safety, encouraging sustainable agriculture, and increasing consumer confidence in fruit products. Surveying fungal infections on locally available fruits is critical for public health because it identifies potential dangers connected with eating infected fruits. Such surveys help to preserve agricultural crops by providing information on the prevalence and varieties of fungal infections influencing fruit production.

Material and Method:

A regular survey was done for collection of infected fruits during January to February 2024 in various places in the Akola region. Collection of Samples was done from local markets such as Janata, Gorakshan Road, Sindhi Camp, and Kaulkhed. The infected fruits were collected in sterile polyethylene bags & brought to the lab.

Collection of infected fruits from different locality of Akola region.

Janata fruit market

Sindhi Camp fruit market

Kaulkhed fruit market.

Gorakshan road fruit market

Isolation of fungi:

After collection the fruit was wash with water to remove the dust particles from the surface. Symptoms of collected diseased fruit were recorded. Isolation was made by cutting small fragment of diseased spot along with healthy region of fruit. These pieces were surface sterilized with 90% alcohol & transferred aseptically to sterilized slants prepared from Potato Dextrose Agar in petri dishes incubated at 25–27°C (+ 2). Isolated fungi were purified with single spore method and then maintained in a refrigerator on PDA slants.

Identification of Fungi:

The morphological identification of the fungal strains is based on the morphology of the fungal culture colony, size, color, characteristics of the spores or hyphae and reproductive structure were examined critically with Refer toence to mycological texts (*Barnett et.al.,* 1972). In some cases the infected tissues were stained by cotton blue and Lactophenol (*Mc Lean et.al.,* 1965) and observed under the microscope. After 7 days fungal colonies were recognized according to microscopic features and classes on many keys and Refer toences.

Observation and Result:

1) ***Musa X paradisiaca* L.**
Musaceae

Symptoms observed:

- Brown-black spots within the flesh; soft and mushy in texture.
- Soft, mushy areas on the fruit. Small black lesions on the surface. Soft, discolored tissue inside the fruit.
- Black mold growth. Soft and mushy texture. Darkening of the fruit. Sunken Lesions.
- Small water-soaked lesions. Black discoloration. Sunken lesions. Soft tissue inside the fruit.

Fungi found: *Rhizopus sp.,Aspergillus sp.,Fusarium sp.,Phoma sp.*

1) ***Carica papaya* L.**
Caricaceae

Symptoms observed:

- Brown-black lesions on the surface. Fruit unevenly ripened.
- Soft areas on the fruit. Small black lesions on the surface.

- Grayish growth on the surface. Soft texture. Sunken lesions with a watery appearance.

Fungi found: *Fusarium sp.,Mucor sp.,Rhizopus sp.*

2) *Manilkara zapota* (L.) P.Royen
Sapotaceae

Symptoms observed:

- Soft texture. Darkening ,browning of the fruit.
- Softening and Decay of the fruit. Small black lesions on the surface. Soft, discolored tissue inside the fruit.
- Grayish growth on the surface. Sunken lesions with a watery appearance.

Fungi found : *Aspergillus sp., Mucor sp., Rhizopus sp.*

3) *Vitis vinifera* L.
Vitaceae

Symptoms observed:

- Greenish- gray or black mold growth on the fruit surface. Soft and mushy texture. Darkening or browning of the fruit.
- Small black lesions on the surface. Soft, discolored tissue inside the fruit.
- Soft, discolored tissue inside the fruit.

Fungi found : *Aspergillus sp.,Penicillium sp., Rhizopus sp.*

4) *Cucumis melo* L.
Cucurbitaceae

Symptoms observed:

- Development of small, dark brown to black spots on the fruit surface.
- White to grayish growth on the surface of the fruit. Soft, mushy areas on the fruit. Sunken lesions with a watery appearance.
- Development of dark brown to black spots on the fruit surface.
- Greenish mold growth on the surface of the fruit. Lesions appear water-soaked.

Fungi found: *Alternaria sp.,Mucor sp.,Curvularia sp.,Trichoderma sp.*

5) *Lamonia acidissima* L.
Rutaceae

Symptoms observed:

- Development of small, dark brown spots on the fruit surface.
- Gayish growth on the surface of the fruit. Soft, mushy areas on the fruit. Sunken lesions with a watery appearance.
- Bluish-green mold growth on the surface of the fruit. Soft and mushy texture. Soft, discolored tissue inside the fruit.
- Soft texture. Darkening of the fruit. Fruit ripens unevenly.

Fungi found: *Alternaria sp.Penicillium sp.,Aspergillus sp.,Fusarium sp.,Mucor sp.*

6) *Punica granatum* L.
Lythraceae

Symptoms observed:

- Development of small, dark brown spots on the fruit surface. Infected areas soft and mushy.
- Grayish growth on the surface of the fruit. Soft, mushy areas on the fruit. Sunken lesions with a watery appearance.
- Soft and mushy texture. Soft, discolored tissue inside the fruit.
- Darkening and browning of the fruit.

Fungi found: *Alternaria sp.,Penicillium sp.,Aspergillus sp.,Mucor sp.*

7) *Phyllanthus emblica* L.
Phyllanthaceae

Symptoms observed:

- The dark-colored spots on the surface of the fruit. Softening and a foul odor of fruit
- Development of dark brown to black lesions with a sunken appearance.
- Growth of blue-green mold on the surface of the fruit.

Fungi found: *Aspergillus sp.,Phoma sp.,Penicillium sp.,Mucor sp.*

8) *Malus pumila* Mill.
Rosaceae

Symptoms observed:

- Development of blue-green mold on the surface of the fruit.
- Formation of dark, sunken lesions on the surface of the fruit.

Fungi found: *Penicillium sp,.Mucor sp.,Alternaria sp.*

9) *Citrus X sinensis* (L.)Osbeck
Rutaceae

Symptoms observed:

- Fruit soft and decayed.
- Formation of black patches on the surface of the fruit.

Fungi found: *Mucor sp.,Penicillium sp.,Rhizopus sp*.

10) *Psidium guajava* L.
Myrtaceae

Symptoms observed:

- Formation of dark, sunken lesions on the surface.The fruit is soft and watery.
- Development of dark colored spots or lesions on the surface of the fruit.

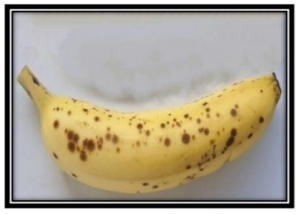
Fungi found: *Alternaria sp.,Aspergillus sp.,Mucor sp.*


Vitis vinifera L. .


Phyllanthus emblica L.


Malus pumila Mill.


Limonia acidissima L.


Musa X paradisiaca L.

Infected fruits showing various symptoms


Citrus X sinensis (L.) Osbeck


Cucumis melo L.

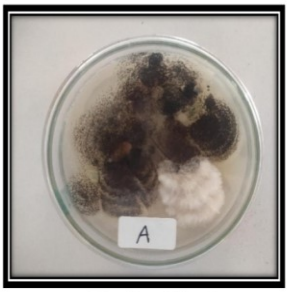

Punica granatum L.


Psidium guajava L

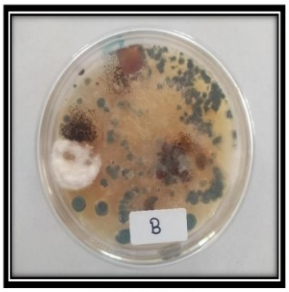

Carica papaya L..


Manilkara zapota (L.) P.Royen

Cultures of fungal colonies from infected fruits

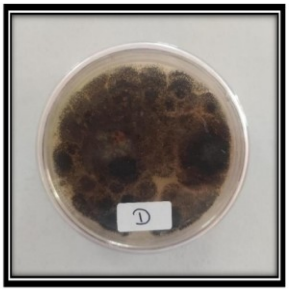


Musa X paradisiaca L.

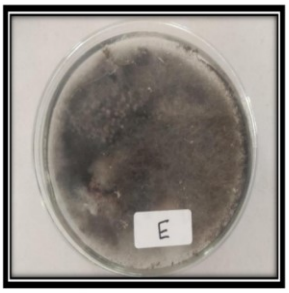


Vitis vinifera L.

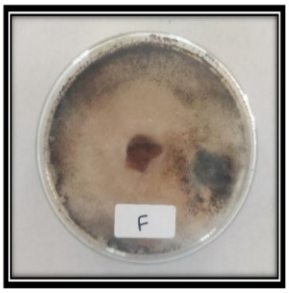
Carica papaya L.



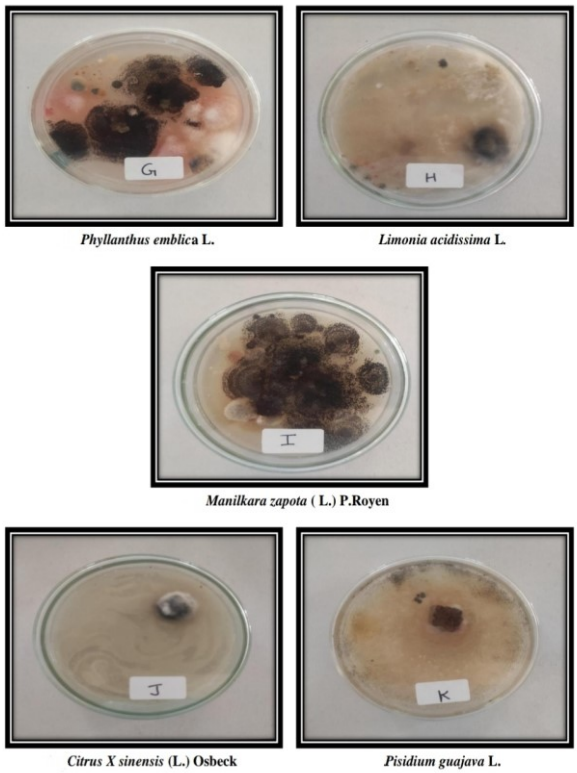
Punica granatum L.



Malus pumila Mill.



Cucumis melo L.



Phyllanthus emblica L. *Limonia acidissima* L.

Manilkara zapota (L.) P.Royen

Citrus X sinensis (L.) Osbeck *Pisidium guajava* L.

Taxonomical studies of the Isolates.

1)*Curvularia sp*. Boedijn

Morphology of isolate-

The mycelium branch, septate, subhyaline to light brown; colonies dark black; third cell is noticeably larger, broader, and darker than the other cells. The other cells curve slightly sub-hyaline with rounded apical cells somewhat obconical, basal cells that bear a scar indicating point of attachment to the conidiophores. Conidiophores are erect, slightly bent, dark brown, and branch; septate geniculate towards the apex, produced acrogenously at the tip of conidiophores

2) *Alternaria sp.* Nees

Morphology of isolate-

Usually, black hyphae with dark brown branches, the colonies are ellipsoidal, ovoid, obclavate, or obpyriform, and frequently have a short, conical or cylindrical beak. They can arise individually or in small groups. Septa can be up to eight transverse and typically several longitudinal or oblique.

3) *Penicillium sp*. Link

Morphology of isolate-

The colonies are velvety, widely spreading, densely sporulating, and produce submerged, septate, phialides-bearing terminal clusters of globular, elliptical, smooth conidia in a chain mycelium.

4) *Aspergillus sp.* Micheli exHaller

Morphology of isolate-

The colonies white at first, but hyaline, branch septate quickly turned black. The septate hyaline conidiophores unbranched and ended in globouse vesicles; sterigmata flask-shaped, that produce conidia in a chain in an acropetal succession.

5) *Phoma sp.* Saccardo

Morphology of isolate-

Light to dark brown hyphae; pycnidia are ostiolate, globose to subglobose, with a border of dark brown and immersed in the host tissue.

6) *Rhizopus sp.* Ehrenb.

Morphology of isolate-

As filamentous branching hyphae, body of branching mycelia composed of three types of hyphae; stolons, rhizoids & unbranching sporangiophores. colonies develop. The production of sporangiophores took place within a spherical structure called a sporangium, which is held up by a large apophyte columella at the top;

7) *Fusarium sp.* Link

Morphology of isolate-

Conidiophores vary in length and branching pattern, conidia are hyaline, microconidia are formed in simple, unbranched chains, and macroconidia are fragile, awle-shaped, and taper towards both ends. The mycelium is septate, cottony, and somewhat pink in culture.

8) *Mucor sp.* Fresen.

Morphology of isolate-

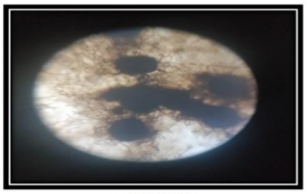
A column-shaped columella supports and elevates the apical, globular sporangia formed by simple or branching sporangiophores, which are fast-growing, usually white to beige or gray colonies.

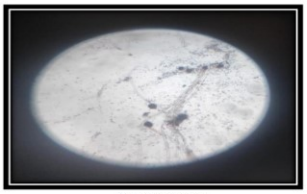
9) *Trichoderma sp*. Pers.

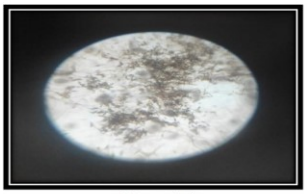
Morphology of isolate-

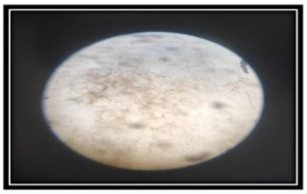
Hyaline conidia, which are ovoid, single-celled, and borne in small terminal clusters, are easily recognized by their quick growth and green patches or cushions of conidia. Hyaline conidiophores are highly branching and not verticillate, while phialides might be single or in groups.

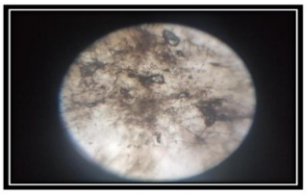
Microphotograph of the Isolated Fungi:


Phoma Sp.


Aspergillus Sp.

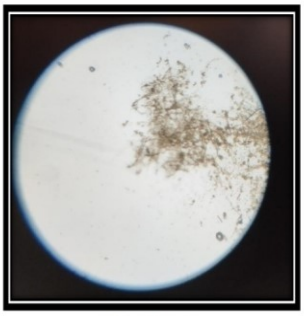

Alternaria Sp.


Fusarium Sp.


Curvularia Sp.


Trichoderma Sp.


Mucor Sp.


Penicillium Sp.


Rhizopus Sp.

Discussion:

According to a postharvest report of 2021, more significant postharvest losses occur with fruits and vegetables, with estimates of approx. 45%. One of the main causes of these losses is postharvest fruit rotting, which is predominantly brought on by fungal infections after the ripening phase.A regular survey was done for collection of infected fruits in various localities in Akola region. During collection common fruits such as Musa X paradisiaca L., Carica papaya L., Manilkara zapota (L.) P. Royen, Vitis vinifera L. Cucumis melo L., Lamonia acidissima L., Punica granatum L., Phyllanthus emblica L., Malus pumilaMil., Citrus X sinensis (L.) Osbeck., Psidium guajava L., were selected. During the investigation species of Mucorales such as Mucor & Rhizopus was found to be common & caused infections in most of the fruits. Ascomycetean members such as Aspergillus & Penicillium showed good growth on most of the fruits. Deuteromycetean fungi were found to cause severe diseases to fruits. Member from order Moniliales such as Alternaria showed good growth while Fusariumshowed moderate growth. Species of Trichoderma & Curvularia showed poor growth in Petri plates. Sphaeropsidalean members such as Phoma. also infected some of the common fruits.Presence of same fungi on different fruits shows the capacity of Deuteromycetean fungi to obtain food from different hosts. As a result of which these fungi have ability to cause infections in new hosts rapidly and also have higher chances of survival. These fungi are flexible regarding their nutritional requirements.Rhizopus species were discovered on Manilkara zapota (L.) P. Royen, Carica papaya L., and Musa X paradisiaca L. On Musa X paradisiaca L., Carica papaya L., and Lamonia acidissima L., Fusarium was discovered. Phyllanthus emblica L., Lamonia acidissima L., Manilkara zapota (L.)P. Royen, Citrus X sinensis (L.)Osbeck., Psidium guajava L., Carica papaya L., Punica granatum L., Malus pumila Mil., Cucumis melo L. On Cucumis melo L., the species of Trichoderma was discovered. Conversely, Aspergillus species were discovered on Malus pumila, Vitis vinifera, Phyllanthus emblica, Pinica granatum, Psidium guajava, and Lamonia acidissima. Penicillium species were discovered on Psidium guajava L., Lamonia acidissima L., Citrus X sinensis (L.)Osbeck., Malus pumila Mil., Phyllanthus emblicaL., and Vitis vinifera L. On Vitis vinifera L., Punica granatum L., Malus pumila Mil., Cucumis melo L., Psidium guajava L., and Lamonia acidissima L., the Alternariaspecies was discovered. While Phyllanthus emblica L. and Musa X paradisiaca L. were home to the Phoma species. Specifically, Curvularia sp. Was discovered on Cucumis melo L.

Conclusion:

Because of their high nutritional content, flavor, unique taste, and nutraceutical qualities, as well as their proven health-promoting effects, fruits are being consumed and accepted by more people. Fruit diseases brought on by fungus infestation leads to postharvest losses of fresh fruit. Approximately 30% of harvested fruits do not reach consumers plates due to postharvest losses. Fungal pathogens play a substantial part in those losses, as they cause the majority of fruit rots and consumer complaints.Understanding fungal pathogenic processes and control measures is crucial for developing disease prevention and treatment strategies. Fruits are perishable products.

Fruit's high-water content makes them particularly vulnerable to fungus attack. Additionally, fruits that are prone to mold contamination caused by fungal infection might release strange odors, such as moldy and earthy odors. The firmness of diseased fruits might range from mild to severe. Generally, fruit antioxidant activity decreases when pathogenic fungi are present. The fast physiological changes were brought by fungal decay in fruits, including color loss, weight loss, hastened softening of tissue and shorter storage life which considerably reduces the fruit's market value. In addition to such apparent quality attributes, a fungal infection changes the chemical composition and nutritional value of fruits.

The chemical alterations include the creation of acid, sugar breakdown, and microbial metabolites. Critically, increasing mycotoxin production often raises questions about food safety because these substances are harmful to human health. This work provided a comprehensive overview on diseases associated with common fruits and emphasized on the need for further research towards better production of fruits so that farmers can minimum fruit losses.

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