

Postharvest Diseases and Pathogens Associated with Major Fruits Crops in Dharwad, Karnataka Region

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ABSTRACT

Studies were taken up on different postharvest diseases of major fruits like mango, banana, citrus, grapes and pomegranate in markets of Dharwad, Karnataka, India. Postharvest diseases of mango observed are Anthracnose, Stem end rot, Aspergillus rot and Rhizopus rot. The diseases observed in banana are Anthracnose, Crown rot, Finger rot and Black tip. In citrus, Anthracnose, Black core rot, Stem end rot, Fusarium rot, Aspergillus rot and Sour rot are the major diseases. In grapes, Aspergillus rot and Rhizopus rot were observed and in pomegranate, Aspergillus rot, Penicillium rot and Colletotrichum rot were observed. Pathogens were isolated, pathogenicity was proved and the pathogens were identified by studying the morphological characters.

Key words: Postharvest diseases - Mango - Banana - Citrus - Grapes - Pomegranate - Symptoms and Pathogens

INTRODUCTION

Fruits are of immense significance to human beings as they are highly nutritious and play a vital role in balanced diet. Fruits are rightly called as 'protective foods' as they are rich sources of carbohydrates, minerals, vitamins and dietary fibres, provides energy to the body and also gives protection against various diseases. Fruits are living entities and are highly perishable commodities that are affected by a number of factors leading to post harvest losses and postharvest diseases caused by various fungi are a major cause of postharvest losses. Considering the importance

of postharvest diseases studies were taken up on different postharvest diseases of major fruits like mango, banana, citrus, grapes and pomegranate in markets of Dharwad, Karnataka, India.

MATERIALS AND METHODS

Fruits of mango, banana, citrus, grapes and pomegranate affected by different postharvest pathogens showing symptoms were collected from the markets and nearby orchards. Typical symptoms of the postharvest diseases were recorded.

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Isolation of the fungi responsible for postharvest diseases was made following standard isolation technique. Infected fruit bits along with some healthy portion was surface sterilized with 1:1000 mercuric chloride for 30 seconds followed by rinsing with sterile water and isolated in PDA slants. Isolated fungi were purified by single spore isolation and pathogenicity was proved on apparently healthy and uninjured fruits. Koch's postulates were proved by reisolation and comparing with the original cultures. Pathogens were identified based on morphological characters as described in CMI descriptions.

RESULTS AND DISCUSSION

The results pertaining to the present investigations made on postharvest diseases and the pathogens associated with them are presented below:

A. Symptoms of various postharvest diseases.

The symptoms of different postharvest diseases recorded on mango, banana, citrus, grapes and pomegranate from the fruits collected from the markets and nearby orchards are described as below.

I. Mango:

a) **Anthraco-nose:** Caused by *Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc.

On ripe fruits symptoms appeared as small round depressed spots, which later coalesced to cover large area of rotten patches. Produced pinkish sporemasses under humid conditions representing the acervuli of the pathogen. (Plate 1)

b) **Stem end rot:** Caused by *Botryodiplodia theobromae* Pat.

Small, soft, dark brown lesion on the fruits near the stem end region which later extended downwards and entire fruit is converted into black rotten mass emitting foul smell within 2-3 days. (Plate 2)

c) **Aspergillus rot:** Caused by *Aspergillus niger* v. Teighem

Symptoms started as water soaked spots which did not differ initially from the colour of the fruit and later covered with sooty mass of black spores. Formation of sclerotial bodies which were initially white and later turned dark brown was also observed. (Plate 3)

d) **Rhizopus rot: Rhizopus sp.**

Appeared as blackish discolouration on the outer rind and the internal pulp of the affected fruit turned brown and emitted fermentative odour. (Plate 4)

II. Banana:

a) **Anthraco-nose:** Caused by *Colletotrichum musae* (Berk & Curt) v. Arx

Symptoms appeared in two types. In one case, small circular brown spots looking like cultivar character rather than due to disease. Spots later enlarged and became sunken. Symptoms were also observed as black lesions or patches on the bruised areas of the fruits. On both the spots pinkish spore masses appeared. (Plate 5)

b) **Crown mould or Crown rot or Finger stalk rot:** Caused by *Colletotrichum musae* (Berk & Curt) v. Arx and/or *Fusarium moniliforme* Sheldon

Rotting started from the cut surface of the crown and late spread downwards into the fingers. Pinkish mycelial growth was observed on the crown portion. Fingers of such crown dropped off readily while handling and sometimes only finger stalks got rotted leaving the crown uninfected. (Plate 6)

c) **Finger rot:** Caused by *Botryodiplodia theobromae* Pat.

Brownish water soaked discoloration at the finger tip and later spreading upwards and within 3-4 days entire fruit was rotten with very soft semi liquid like pulp. (Plate 7)

d) **Black tip:** Caused by *Deightoniella torulosa* (Sydow) M.B. Elliss.

Black discoloration at the perianth end of the fruits and advanced along with the fruit

with irregular outline surrounded by a narrow grey or yellowish margin. (Plate 8)

III. Citrus:

a) Anthracnose: Caused by *Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc.

Symptoms appeared at the stem end shoulders as small dark brown discoloration and later spread downwards. Pinkish spore masses appeared. (Plate 9)

b) Black core rot: Caused by *Alternaria alternata* (Fr.) Keissler and/or *Alternaria citri* Ell. & Pierce Brownish discoloration on the rind at the stem end region and when the affected fruit was split open, the axis of the fruit was found to be black with fungal growth. (Plate 10)

c) Black mould rot: Caused by *Aspergillus niger* v. Teighem Infection started as a very soft, sunken, water soaked spot in the peel which later on gave rise to black sporulation resembling soot accompanied by fermentative odour. (Plate 11)

d) Fusarium rot: Caused by *Fusarium sp.* Affected fruit tissue is leathery, light or dark brown in colour and sunken. Under humid conditions, white surface mycelium appears. Core of the infected fruits appears with white or pink depending up on the *Fusarium sp.* involved. (Plate 12)

e) Stem end rot: Caused by *Botryodiplodia theobromae* Pat. Started as slight softening of the tissue around the stem end. it progressed rapidly and became brown. Decay spread rapidly down and became visible at the stylar end of the fruit. (Plate 13)

f) Sour rot: Caused by *Geotrichum candidum* Link Affected fruits were found to be extremely soft and slippery. Fruits were later covered with whitish growth which was full of abundant sporulation. Spore laden juice from the infected fruits contaminated and infected the healthy fruits. (Plate 14).

IV. Grapes:

a) Aspergillus rot: Caused by *Aspergillus niger* v. Teighem Affected fruits became soft and appearance of black heads of fungus was observed. Rot usually started at

a point of injury or sometimes as water soaked spot at the pedicel end of berry. (Plate 15)

b) Rhizopus rot: Caused by *Rhizopus sp.*

Infection usually started in one of the berries and the profuse mycelial growth consisting of sporangia and sporangiophores covered the adjacent berries also. (Plate 16)

V. Pomegranate:

a) Aspergillus rot: Caused by *Aspergillus niger* v. Teighem Brownish discoloration on the outer rind and black spore head of the fungus were produced on affected areas. Severely affected fruits became depressed, slimy and rotten and emitted fermentative odour. (Plate 17)

b) Penicillium rot: Caused by *Penicillium sp.* Dark brown irregular patches appeared on the outer rind and as the disease progressed, inner core and the rils became soft. Later entire rotted fruit surface was covered with bluish growth of the fungus. (Plate 18)

c) Colletotrichum rot: Caused by *Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc. Spherical and depressed scattered spots appear on the outer rind of the fruit and the spots later coalesced to form necrotic patches leading to complete rotting of fruit and arils. (Plate 19)

B. Morphological characters of various postharvest pathogens. The morphological characters of various postharvest pathogens isolated are presented below.

a) *Alternaria alternata* (Fr.) Keissler

Black or olivaceous black colonies. Conidiophores single or in groups, golden brown in colour. conidia often in chains, obclavate, often with conical or cylindrical beak with up to 8 transverse and several longitudinal or oblique septa measuring 20-63 x 9-18 µm.

b) *Alternaria citri* Ell. & Pierce

Colonies effuse, olivaceous to black. Conidiophores simple or branched, straight or flexuous, septate. Conidia are in simple or branched chains of 2-7 straight or slightly curved, variously shaped but commonly obclavate or oval, smooth or verrucose with up to 8 transverse and numerous longitudinal or oblique septa, measuring 8-60 x 6-24 μm .

c) *Aspergillus niger* v. Teighem

Colonies dark brown to black felty and slightly zonate. Conidial head dark brown to carbon black, globose. Vesicles hyaline to brown, globose, thick walled, which measure 30.2-70.5 μm . Sterigmata hyaline to brown, typically in two series. Conidia in long chains, dark brown, globose, spinulose, which measured 3.5-5.0 μm .

d) *Botryodiplodia theobromae* Pat.

Colonies whitish in the beginning and turns blackish later. It is very fast growing and it covers the 90 mm petriplate in 3 days. Pycnidia are subglobose to globose, 300-700 μm in diameter, single or grouped in stroma, papillate bearing spores measuring 17-43 x 10-18 μm . Young spores are hyaline, non septate and granular and mature spores are one septate and striated.

e) *Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc.

Colonies are with abundant whitish aerial mycelium, slimy pinkish spore masses, acervulate. Conidia were oblong or oval or cylindrical, straight, hyaline, non septate with rounded ends, thin walled having oil globules in the centre. Conidia measure 10.39-19.05 x 4.33 x 10.32 μm .

f) *Colletotrichum musae* (Berk & Curt) v. Arx

Colonies abundant, with white aerial mycelium become grey with age, producing ochraceous cinnamon colored conidial mass. Conidia are straight, cylindrical, obtuse at the apices 12-17 x 4.5-5.5 μm .

g) *Deightonella torulosa* (Sydow) M.B. Elliss.

Colonies effuse, grey, brown or black, often hairy. conidiophores macronematous, mononematous, torsive or flexuous, unbranched. Conidia solitary, acrogenous, simple commonly with more than 3 septa or pseudosepta, obpyriform or obclavate, measuring 35-70 x 13-25 μm .

h) *Fusarium moniliforme* Sheldon

Mycelial growth initially colourless and rapid and become powdery appearance due to formation of abundant microconidia and macroconidia. micro conidia were fusiform to clavate, single celled and colourless measuring 5-12 x 1.5-2.5 μm . Macroconidia, rather few, fusoid, delicate, thin walled, sharply curved, pedicellate basal cell, colourless and 3-7 septate measuring 20-25 x 3.5 μm .

i) *Geotrichum candidum* Link

Mycelium is hyaline and septate and is specialized into broad radiating vegetative hyphae which branch dichotomously and narrower lateral sporulating hyphae. Conidia are formed by segmentation of the hyphae. Conidia are 3-6 x 6-12 μm .

j) *Rhizopus* spp.

Colonies whitish with sterile aerial mycelium and black spots or sporangia and dark sporangiophores. Rhizoids well developed, sporangiophores on stolons up to 2000 x 20 μm brown in groups of 1-3, sporangia blackish powdery in appearance, up to 275 μm in diameter, sporangiospores angular-globose-ellipsoidal up to 13 μm in length, distinctly striate.

k) *Penicillium* spp.

Mycelium is hyaline, septate, conidiophore hyaline, short, septate, straight, branched like broom, phialides or sterigmata on each branched hyphae, few to many conidia in chains on sterigmata which measured 3.0-3.85 μm .

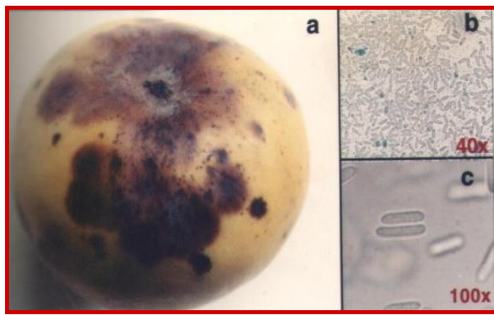


Plate 1: Mango Anthracnose

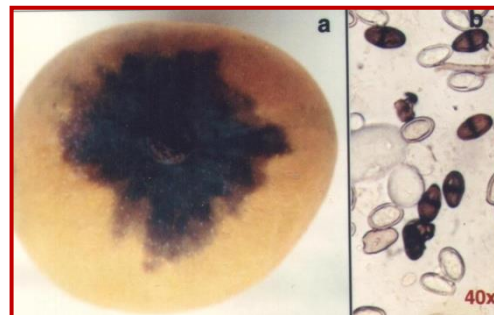


Plate 2: Mango Stem End Rot

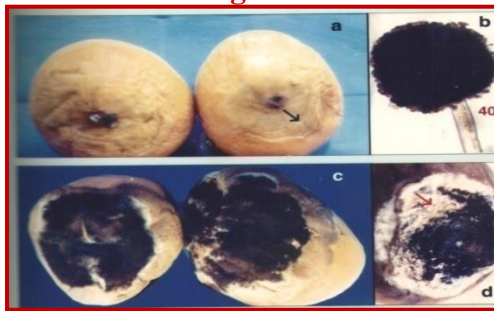


Plate 3: Mango Aspergillus Rot



Plate 4: Mango Rhizopus Rot

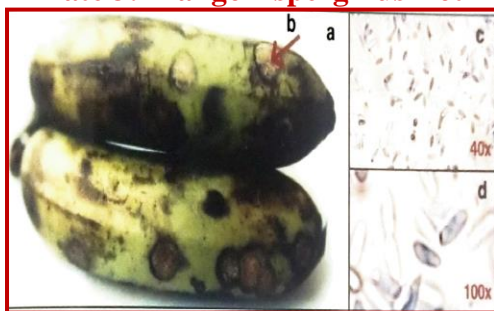


Plate 5: Banana Anthracnose

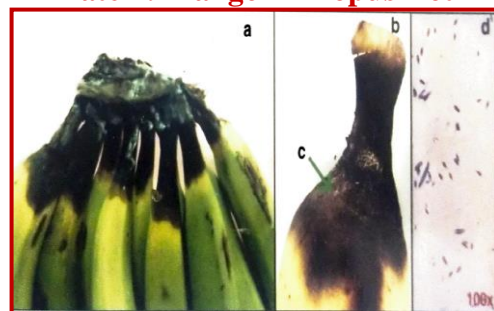


Plate 6: Banana Crown Rot

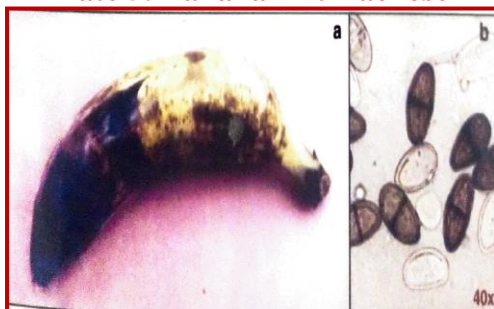


Plate 7: Banana Finger Rot

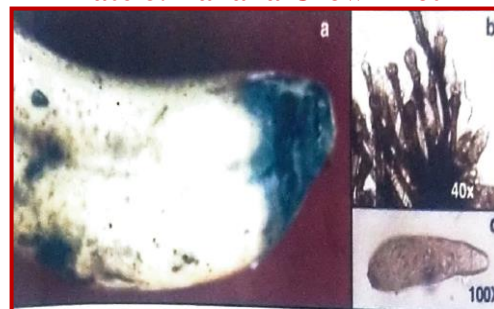


Plate 8: Banana Black Tip

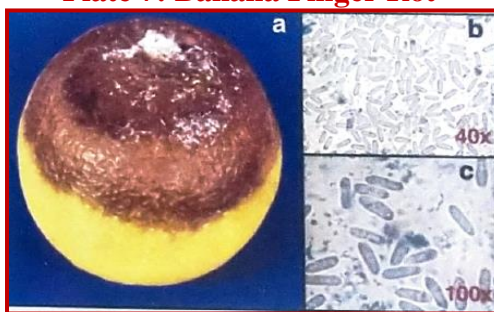


Plate 9: Citrus Anthracnose



Plate 10: Citrus Black Core Rot



Plate 11: Citrus Black mold Rot

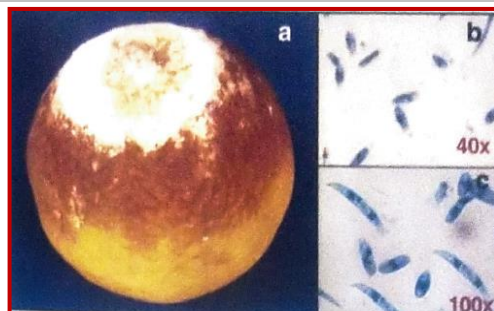


Plate 12: Citrus Fusarium Rot

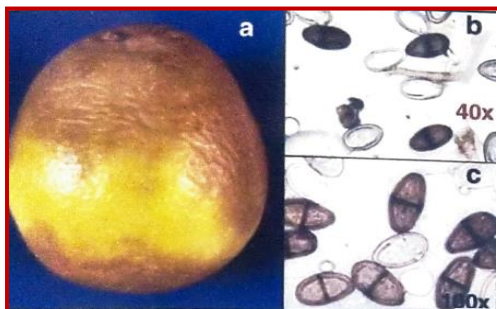


Plate 13: Citrus Stem End Rot

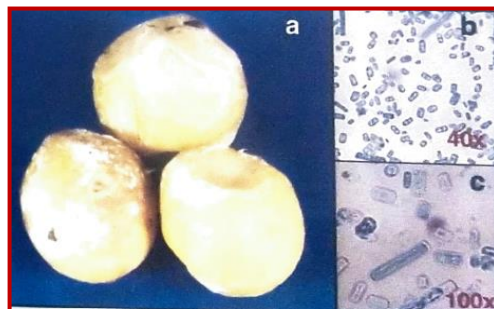


Plate 14: Citrus Sour Rot

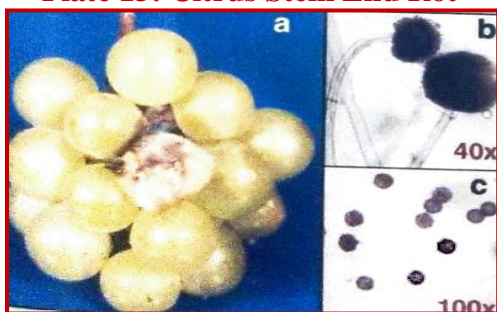


Plate 15: Grapes Aspergillus Rot

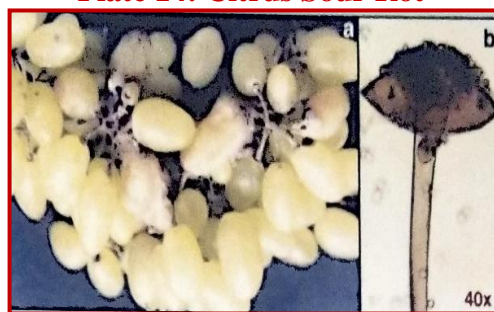


Plate 16: Grapes Rhizopus Rot

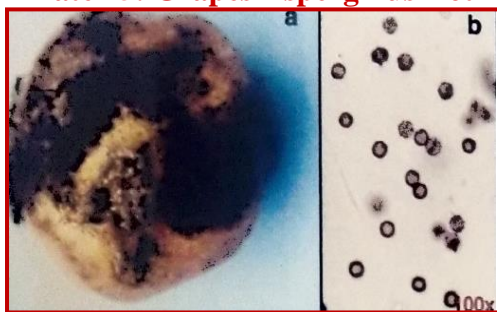


Plate 17: Pomegranate Aspergillus Rot



Plate 18: Pomegranate Anthracnose

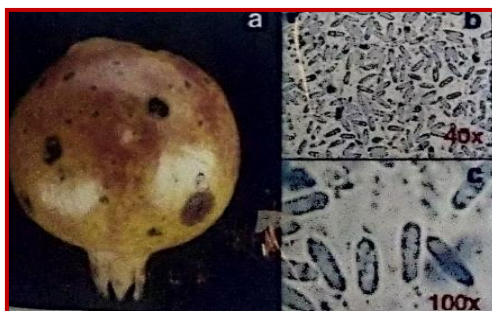


Plate 19: Pomegranate Colletotrichum Rot or Anthracnose

CONCLUSION

In the present investigations, four postharvest diseases of mango viz., Anthracnose, Stem end rot, Aspergillus rot and Rhizopus rot were encountered. Similar reports of postharvest diseases and symptoms were reported earlier by various workers (Bhuvanewari, 1999; Shirshikar, 2002; Hasabnis, 1984; Bhargava and Singh, 1975; Snowdon, 1990). In banana, the diseases observed are Anthracnose, Crown rot, Finger rot and Black tip. The symptoms observed are resembling those described by Muirhead and Deverall (1981), Meredith (1971), Sharma and Rana (1999). In citrus, Anthracnose, Black core rot, Stem end rot, Fusarium rot, Aspergillus rot and Sour rot were observed. Various earlier workers described similar symptoms of postharvest diseases of citrus (Snowdon, 1990; Singh and Khanna, 1966; Bhargava, 1972). In grapes, Aspergillus rot and Rhizopus rot were observed with symptoms similar to those reported by Sharma and Kaul (1999). In pomegranate, Aspergillus rot, Penicillium rot and Colletotrichum rot were observed with symptoms similar to those reported by Srinivasulu (2001).

During the present investigations, the pathogens associated with the postharvest diseases were isolated and were identified based on their colony and spore morphology. The characters observed were compared and found similar to the descriptions of different postharvest pathogens given by earlier workers, Thom and Raper (1945), Ellis (1971), Biradar (1997), Bhat (1991), Joffe (1986). These studies establish the various postharvest diseases and their pathogens prevalent in Dharwad region of Karnataka and the information can be used for understanding the pathogens prevailing in the region and devising the management strategies.

REFERENCES

Bhargava, S.N and Singh, A.P. Aspergillus rot of mango and its control. *Indian journal of Horticulture*. 32: 190 (1975).

Bhargava, S.N. Aspergillus rot on *Citrus aurantifolia* fruits in the market. *Plant Disease Reporter*. 56: 64 (1972).

Bhat, N. M. *Aspergillus niger* V. Teigh. and *Colletotrichum gloeosporioides* (Penz.) Penz and Sacc. *M.Sc. (Agri.) Thesis*. University of Agricultural Sciences, Dharwad (1991).

Bhuvanewari, V. Studies on postharvest diseases of mango. *M.Sc. (Agri.) Thesis*. Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad (1999).

Birdar, B.M. Studies on postharvest diseases of vegetables in parts of northern Karnataka. *M.Sc. (Agri.) Thesis*. University of Agricultural Sciences, Dharwad (1997).

Ellis, M.B. *Dematiaceous Hyphomycetes*. Commonwealth Mycological Institute, Kew Surrey, U.K. pp. 164-165 (1971).

Hasabnis, S.N. Studies on storage rot of mango (*Mangifera indica* L.) fruits caused by *Colletotrichum gloeosporioides* Penz. and *Botryodiplodia theobromae* Pat. *M.Sc. (Agri.) Thesis*. Konkan Krishi Vidyapeeth, Dapoli, Maharashtra (1984).

Joffe, A.Z. *Fusarium species-Their Biology and Toxicology*. John Wiley & Sons, New York. p.403 (1986).

Meredith, D.S.. Transport and storage diseases of bananas: Biological and control. *Tropical Agriculture*. 48: 35-50 (1971).

Muirhead, I.F and Deverall, B.J. Role of appressoria in latent infection of banana fruits by *Colletotrichum musae*. *Physiological Plant Pathology*. 19: 77-84 (1981).

Sharma, R.C and Kaul, J.L. *Postharvest diseases of fruits and their management*. In *Diseases of horticultural crops - Fruits*. Ed. Verma L.R. and Sharma, R.C., Indus Publishing Company, New Delhi. pp. 582-623 (1999).

Sharma, R.L and Rana, N. Postharvest diseases of tropical and subtropical fruits. In *Diseases of Horticultural Crops - Fruits*. Ed. Verma L.R. and Sharma, R.C., Indus

- Publishing Company, New Delhi. pp. 624-667 (1999).
- Shirshikar, G.S. Studies on fruit rots of mango (*Mangifera indica* L.) caused by *Botryodiplodia theobromae* Pat. and *Colletotrichum gloeosporioides* Penz. and their management. *M. Sc. (Ag.) Thesis*. Konkan Krishi Vidyapeeth, Dapoli, Maharashtra (2002).
- Singh, R.S and Khanna, R.N. Black core rot of mandarin oranges caused by *Alternaria tenuis* Nees. *Plant Disease Reporter*. 50: 127-131 (1966).
- Snowdon, A. *Color atlas of postharvest diseases and disorders of fruits and vegetables*” Vol. 1: *General Introduction and Fruits*. CRC Press, Boca Raton, FL, USA (1990).
- Srinivasulu, P. Studies on postharvest diseases of pomegranate. *M. Sc (Ag) Thesis*. Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad (2001).
- Thom, C and Raper, N.N. A manual of *Aspergillus*. Williams and Wilkins Co, Baltimore. p.373 (1945).