Research Paper :

Aeromycoflora of store house and incidence of post-harvest diseases of mango (*Mangifera indica* L) at Udgir, Maharashtra

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International Journal of Plant Protection (April, 2010), Vol. 3 No. 1 : 94-98

SUMMARY

Aeromycoflora of mango store houses was studied by using Volumetric Tilak Air sampler for a period of two consecutive years. A total of 42 fungal spore types were identified. The predominant spore types included *Cladosporium, Penicillium, Pseudotorula, Rhizopus, Aspergillus, Alternaria, Nigrospora, Fusarium, Curvularia* and *Helminthospore*. Simultaneously, a systematic survey of post-harvest diseases of mango storehouses and fruit market was undertaken at weekly intervals for two consecutive years. The investigation showed that there were some relationship between the airspora of storage houses and the prevalence of fruit rots. Firstly there were some fungi, which were extensively prevalent both in the air and on spoiled fruits, e.g. *Cladosporium, Penicillium, Curvularia, Fusarium, Helminthosporium, Nigrospora* and *Aspergillus.* Secondly, those fungi which were more prevalent in the air but caused few rots e.g. *Alternaria, Fusarium, Pseudotorula* and *Curvularia.* Thirdly, the fungi that were less prevalent in the air but caused considerable fruit rot e.g. *Aspergillus niger, Colletotrichum gleosporioides, Botrydiplodia theobromae* and *Botrytis cinera*. Eleven fungi were isolated from spoiled mango fruits and found to be associated with post-harvest diseases of mango causing both quantitative and qualitative losses.

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Key words : Aeromycoflora, Mango, Storehouses and post-harvest, Diseases

Accepted :
March, 2010

Mango is one of the oldest and most important tropical fruits. Mango is called the king of fruits because of its delicious taste, richness in vitamins and rare sugars, and its relatively low cost, which the masses of India can offer. But mango like all other fruits is subjected to a number of diseases while they are in the field and the market. Ripened fruits are more suceseptible to attack by a variety of microorganisms. The fungi responsible for such post-harvest rots may originate within the enclosure of storage houses or they may be carried along with the packing materials like leaves, straw and baskets or may get associated with the surface of the fruits in the field (Meredith, 1961; Sullia and Khan, 1980; Panduranjan and Suryanarayanan, 1985).

In 1991, twelve retailers in a Mandi suffered a combined loss due to Rhizopus rot and Lasiodiplodia rot of Rs. 1,17,301 out of the total value of mangoes of Rs. 32,39,101 (Patil and Pathak, 1994). Johnson *et al.* (1993) have reported that the mango fruits are infected by *Lasiodiplodia theobromae* when fruits were inverted in soil after harvest to drain out the sap from the fruits. Keeping in view the significance of fruit rot problem, detail investigation was undertaken for a period of two consecutive years to determine the relationship between aeromycoflora of mango storehouses and incidence of post-harvest mango diseases.

MATERIALS AND METHODS

Air sampling by volumetric tilak air sampler:

Investigations on aeromycoflora of storage houses of mango fruits of Udgir city were carried out by operating Volumetric Tilak Airsampler. Volumetric Tilak Airsampler runs on an electric power supply (Ac 230 v.) and provides a continuous sampling for a weak. The air is sucked in through an exhaust tube at the rate of 5 liters per minute impinging on cellophane tape. A thin coating of white petroleum jelly was slightly coated on the cellophane tape. Cellophane tape was 1.5 cm in breadth and sticked on a slowly rotating drum. Thus, this coated tape, faced the orifice outward projecting tube 0.5 cm. away from it. The drum rotated continuously, slowly, when the sampler was operated. This was in a clockwise manner, which are continuous air sampling for eight days. The drum had markings

of day and night dividing it into 16 compartments. Thus, such each segment of cellophane tape was carefully removed from the drum and mounted on a clean glass slide with a glycerin jelly as mounting. The care was taken that the microorganisms deposited on the tape were not disturbed while handling.

The scanning of such prepared slides was regularly done. The identification of spore types on the exposed tape was done by direct microscopic observations of spores with reference to size, colour, shape and septation.

Survey of mango store houses and fruit market :

Regular survey of post-harvest diseases of mango store houses and fruit markets was under taken at weekly intervals for two consecutive years to compare yearly incidence of various diseases. Samples of diseased fruits were collected from storage houses and various fruit shops of Udgir city. As soon as the infected fruits were brought in the laboratory, symptoms of various diseases were critically studied. Various stages of disease development were noted down. The nature of spots, rots and extent of tissue damage in fruits were carefully studied and approximately estimated. The pathogens responsible for post-harvest rots were isolated within 8 hours of collection.

RESULTS AND DISCUSSION

The results obtained from the present investigation are summarized below :

Aeromycoflora of store house :

A total of 42 fungal spore types were identified, and among these trapped fungal species, *Botrydiplodia, Botrytis, Colletotrichum, Cladosporium, Rhizopus, Penicillium, Pseudotorula* and *Aspergillus* were recorded in maximum number throughout the year and they were most frequent pathogens causing rots of mangoes. Other fungal species like, *Alternaria, Fusarium, Curvularia* and *Geotrichum* were trapped from air of storage houses which also caused considerable damage to mango fruits (Table 1 and Plate 1). The fungi trapped from air of storage houses were categorized in four groups such as:

- Highly occurring fungi: This group includes the fungi like *Cladosporium, Curvularia, Helminthosporium, Melanospora, Nigrospora, Penicillium, Pseudotorula,* smut and rust spores. These fungi occurred in high concentration and moderately associated with post-harvest diseases of mango but did not cause any disease on mango fruit during storage.

- Moderately occurring fungi: *Alternaria, Aspergillus, Botrydiplodia, Botrytis, Diplodia, Colletotrichum, Fusarium, Phomopsis* and *Rhizopus* were found to be strongly associated with post-harvest diseases of mango.

Table 1 : Fungi trapped from mango store houses and fruit shops at Udgir

Fungi species trapped	Percentage frequency of occurrence	Associated risk
Alternaria	67.23	Moderate
Aspergillus	71.01	Strongly moderate
Bispora	11.67	No risk
Botrydiplodia	79.64	High
Botrytis	74.32	High
Brachysporium	7.62	No risk
Cephalospora,	14.25	No risk
Cercospora	37.25	Moderate
Colletotrichum	56.47	High
Cladosporium	94.28	Strongly moderate
Corynespora	5.32	No risk
Curvularia	45.11	Moderate
Didymosphaeria	7.22	No risk
Diplodia	73.21	High
Drescherlera	4.15	No risk
Epicocum	3.22	No risk
Exosporium	6.33	No risk
Fusariella	10.05	No risk
Fusarium	42.30	High
Geotrichum	9.44	No risk
Gloeosporium	49.06	No risk
Helminthosporium	63.33	Strongly moderate
Lacellina	24.17	No risk
Leptosphaeria	16.22	Moderate
Melanospora	30.55	No risk
Memnoniellia	41.33	No risk
Nigrospora	48.24	Moderate
Penicillium,	85.63	Strongly moderate
Pestalotia	69.31	High
Phaeotrichoconis	3.12	No risk
Phomopsis	23.20	High
Pithomyces	11.40	Moderate
Pleospora	4.57	No risk
Pseudotorula	92.31	Strongly moderate
Pyricularia	19.28	No risk
Rhizopu	95.26	High
Rosellinia	3.05	No risk
Sirodesmium	7.24	No risk
Sordaria,	9.13	No risk
Spegazzinia	5.66	No risk
Tetraploa	13.23	No risk
Trichothecium	7.05	No risk

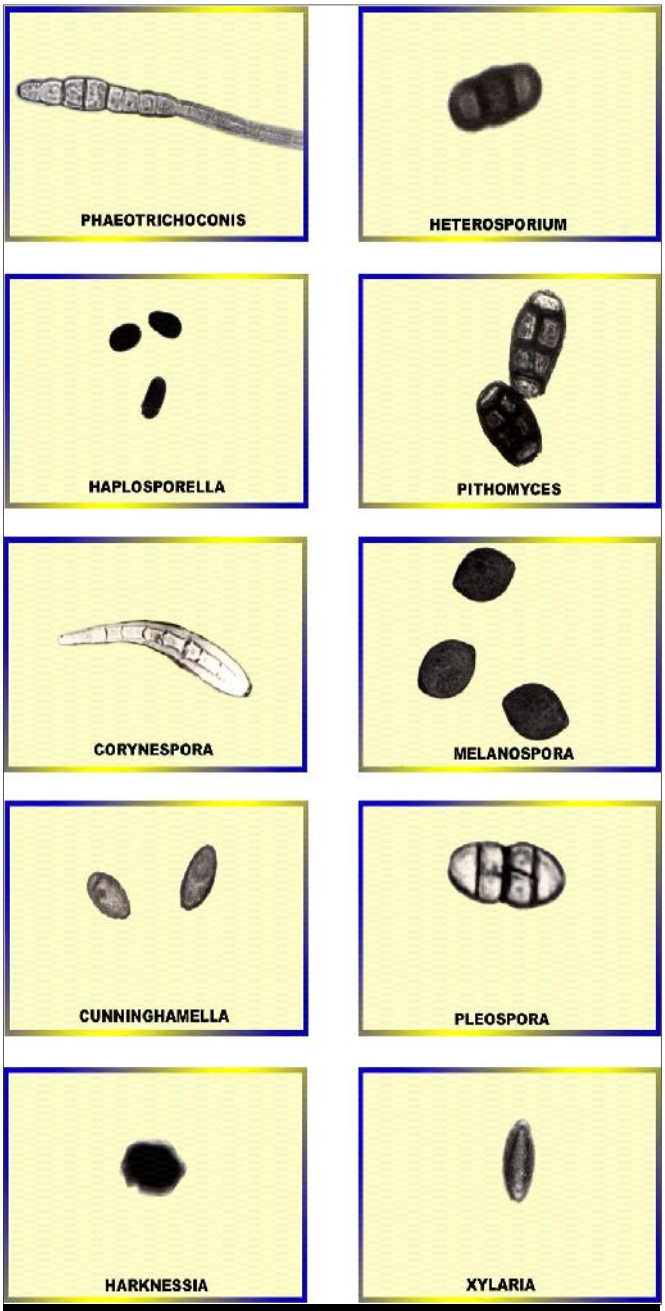

Plate 1: Fungal spores trapped in air of mango storehouses

- Weakly occurring fungi : *Memnoniellia, Chaetomium, Curvularia, Drescherlera, Gloeosporium* and *Pyricularia* were found to be weakly associated with post-harvest diseases of mango.

- Rarely occurring fungi : *Bispora, Brachysporium, Cephalospora, Cercospora, Corynespora, Didymosphaeria, Epicocum, Exosporium, Fusariella, Geotrichum, Lacellina, Leptosphaeria, Phaeotrichoconis, Pithomyces, Pleospora, Rosellinia, Sirodesmium, Sordaria, Spegazzinia, Tetraploa and Trichothecium.* These fungi were not associated with post-harvest diseases of mango.

Survey of mango store houses and fruit market :

Survey of post-harvest diseases of mango store houses and fruit market revealed that 11 fungi were found to be associated with post-harvest diseases of mango causing both qualitative and quantitative losses. These eleven fungi were isolated from decaying mango fruits during storage- *Botryodiplodia theobromae, Aspergillus niger, Rhizopus nigricans, Colletotrichum gloeosporioides, Botrytis cinera, Diplodia natalensis, Diplodia mangiferae, Alternaria solani, Phomopsis mangiferae, Fusarium oxysporum* and *Cladosporium oxysporium* (Table 2).

Table 2 : Fungi of species isolated from spoiled mango fruits collected from store houses and fruit shops at Udgir

Sr. No.	Fungal spp.	Percentage frequency of isolation	Associated risk
1.	*Alternaria solani*	37.25	Moderate
2.	*Aspergillus niger*	83.23	Strongly moderate
3.	*Botryodiplodia theobromae*	97.11	High
4.	*Botrytis cinera*	91.14	High
5.	*Cladosporium oxysporium*	85.32	Moderate
6.	*Colletotrichum gloeosporioides*	89.64	High
7.	*Diplodia mangiferae*	94.25	High
8.	*Diplodia natalensis*	77.62	High
9.	*Fusarium oxysporum*	44.28	Moderate
10.	*Phomopsis mangiferae*	56.47	High
11.	*Rhizopus nigricans*	11.67	Strongly moderate

More than 10 fungal diseases were recorded during survey of mango storehouses but three diseases like anthracnose (*Colletotrichum gleosporioides*), Aspergillus rot (*Aspergillus niger*) and Rhizopus rot (*Rhizopus arrhizus*) were more common causing considerable damage. These diseases were found on the fruits during storage and in fruit market. These diseases attacked Dashehari, Kesar, Hapus, Desi and Neelam verities.

Symptoms by Colletotrichum gleosporioides:

Due to anthracnose disease, the ripe fruits in storage become blemished and their market value is reduced. This disease usually appears on the fruit only as it ripens. The spots at first appear near the stem end as very small brown areas that enlarge rapidly and become black. Often the entire surface of fruit is covered by the coalescing of the spots. Under moist conditions pink spore masses appear

in the form of fruiting bodies scattered over the lesions.

Symptoms by Aspergillus niger:

Aspergillus rot was also a common disease in Udgir market and causes serious losses in storage. Almost all varieties of mango were found to be susceptible to this disease. The disease starts as a small circular pale area at the tip of the mango fruit and soon enlarges, becomes black and covers the tip of the mango completely. Some times a small spot also appears near the stem end and becomes larger and dark black when the fruits completely ripens. In Neelam variety of mango, entire surface of the fruit is covered by small black spots with black spore masses of *Aspergillus niger*. Due to these spots, the selling price of fruits is greatly reduced.

Symptoms by Rhizopus arrhizus :

Rhizopus rot was favoured due to injuries caused during harvesting, packing, transit and in storage. It is very serious and common disease in Udgir market causing considerable loss. It is observed that the healthy fruits are not infected by this fungus but only the injured fruits get spoiled. One spoiled fruit becomes source of infection for other fruits in storage and the healthy fruits also become infected by contact with decayed fruits in storage. Generally *Rhizopus* sp. infect the fruits at injuries. Under humid conditions, the typical cottony, coarse and stringly mycelium of *Rhizopus*, with characteristic black sporangia, covers the entire injured part of fruit. At severe stage of disease development, there is often a leakage of juices from the affected parts of fruit. The juice of such infected fruits contains large number of spores and hyphal fragments. Customers do not accept such fruits and there is a great loss to shopkeepers.

It is concluded from the present investigation that there are some relationship between the air spora of storage houses and the prevalence of fruit rots. Firstly there are some fungi, which are extensively prevalent both in the air and on spoiled fruits, e.g. *Cladosporium oxysporium, P. expansum, Curvularia, Fusarium, Helminthosporium, Nigrospora* and *A. flavus*. Secondly, those fungi which are more prevalent in the air but cause few rots e.g. *Alternaria alternata, Fusarium solani, Pseudotorula* and *Curvularia lunata*. Thirdly, the fungi that are less prevalent in the air but cause considerable fruit rot e.g. *Aspergillus niger*, *Colletotrichum gleosporioides*, *Botrydiplodia theobromae* and *Botrytis cinera*. Eleven fungi were isolated from spoiled mango fruits and found to be associated with post-harvest diseases of mango causing both quantitative and qualitative losses.

The findings of present investigation are similar to the work of Pathak and Srivastava (1967) and Tandon (1967). Arauz and Umana (1986) have isolated the species of *Colletotrichum, Lasiodiplodia, Pestalotia, Aspergillus, Macrophomina* and *Pseudomonas* from different mango cultivars and their pathogenicity was confirmed. Wagan (2001) surveyed different markets of Hyderabad, Mirpurkhas, Tandojam and Tando Allahyar and reported *B. theobromae* as predominantly associated with rotted mangoes followed by *A. niger, R. nigricans, R. stolonifer* and *Penicillium* spp. Singh (2003) also isolated *B. theobromae* and *A. niger* from rotten fruits causing spoilage up to 12 per cent. Krishnapillai (2004) reported that 20% of the mango fruits were rejected for marketing due to the stem end rot and anthracnose during ripening. Dhemre and Waskar (2004) reported mango fruit spoilage at room temperature by *A. niger, C. gloeosporioides, R. stolonifer* and *B. theobromae*

Conclusion :

The results of present study indicate that, storage houses are not only congenial for proliferation of fungal pathogens but also expose the fruits to adverse conditions. The fungi on the fruit surface may contribute to its spoilage at the post-harvest stage. Fungi responsible for post-harvest rots are carried either on the fruit surface or come in contact with the fruits during transit and storage and cause spoilage of fruits. For management of these diseases, it can be recommended that the injured fruits, which are more vulnerable to infection and the infected fruits, which are a source of inoculum, should be removed. Infection of fruits by post-harvest pathogens often occurs in the field prior to harvest and it would be advantageous to apply fungicides and biocontrol agents before harvest, which would reduce initial infection and then remain active and suppress the pathogens in storage. Similarly, careful harvesting, handling and transportation would help to control the post-harvest diseases. The fruit store houses and shops may also be fumigated twice or more in a year to reduce the air-borne fungal inoculum.

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