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STUDIES ON SOME PATHOGENIC FUNGAL SPORES AND DISEASE INCIDENCE OVER GUAVA FRUIT ORCHARD AT NASIK, M.S.

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Abstract

The present research work deals with an aeromycological survey and monitoring of prominent pathogenic fungal spores carried out by using Volumetric Tilak air sampler. This study was conducted on Guava (*Psidium guajava*) fruit plant which is one of the major cultivated and increasingly popularized tropical fruit plant from Nasik region and also, a little aeromycological data of Guava fruit crop is found to be available in comparison to other fruit crops of Nasik region. The present studies have been conducted during the period from January 2018 to December 2018 and continuous monitoring of air mycoflora surrounding to the guava orchard was carried out, which involved air sampling of prominent pathogenic fungal spores belonging to different classes like Deuteromycetes, Ascomycestes, Phycomycetes and Basidiomycetes. Also, an attempt has been made to study occurrence of pathogenic fungal spores associated with the changing climatic conditions, responsible for the particular disease incidence on Guava fruit plant at Nasik. The prominent pathogenic fungal spores like *Colletotrichum gloeosporoides* (Anthracnose disease), *Fusarium* (Guava wilt disease), *Cercospora sps.* (Cercospora leaf spot disease) and *Phomopsis psidii* (styler end rot disease) etc. were found to be observed during the study period.

Keywords: Fungal spores, Guava, Nasik.

Introduction

The presence of microbes is a chief attribute of an environment which generally migrate through one place to another by air current. Of these, presence of fungus and their propagation, dispersal, through the formation of different fungal spores, disease incidence on variety of agricultural crops, is a well-known and studied phenomena. The aerobiological study is interdisciplinary and it incorporates external ambient air quality. It is significantly influenced and interacted by abiotic factors and meteorological parameters. (Tilak *et al.,* 2009; Subba reddy and Janakibai, 1970). Aeromycological investigations take into account the identification of source, mode of release, dispersal, deposition, impaction and effects of impaction of fungal spores on various living systems. Many of the fungal spores are endowed with unique structures and capacity to survive under unfavourable environmental conditions and these probably account for their predominance in the air. (Mishra and Deshmukh, 2009).

Thus the airspora totally depends on the availability of substrate as well as on the climatic factors like temperature, humidity, rainfall, wind velocity. It is well established fact that the disease incidence caused due to an outbreak of fungal spores on fruit orchards like Guava, is stimulated due to the moderate amount of rainfall and daily temperature variations associated with high percentage of humidity. The relation between the disease development and weather, is the basis on which, occurrence of disease can be predicted. The fungal spores have a wide range of spore dispersal mechanism. Low temperature and a slight rainfall with high humidity favours the occurrence of most of the fungal spores. (Mohture and Koprenwar, 2015). A change in temperature may influence the colonization and growth of fungi directly through the physiology of individual organisms, or indirectly through physiological effects on their host plants or substrates. (Charlotte Sindt *et al*., 2016).

Aeromycology involves study of airborne fungal spores which is influenced by topography and meteorological parameters of the concerned area. It is specifically concerned with a scientific discipline *i.e*. Aerobiology that, deals with the transport of organisms and biologically significant materials through the atmosphere. (Isard and Gage, 2000). Guava (*Psidium*

guajava) fruit plant belonging to family Myrtaceae, is one of the major cultivated and increasingly popularized tropical fruit plant from Nasik region. Nasik is one of the leading horticultural district in Maharashtra state. The climate of the Nasik district is very pleasant for the cultivation of various horticultural crops and this makes Nasik rich in horticultural crops due to diverse agro-climatic condition. Guava is an important, irrigated horticultural crop of Nashik district and is rich source of vitamin C and mineral elements. (Shinde and Ahire, 2017). This is hardy crop, can be cultivated successfully even in neglected soils and it is attacked by large number of pathogens mainly fungi. (Gupta *et al.,* 2010). Guava fruit contains phenolic compounds that are helpful for skin and diseases like cancer, it possesses anti-viral, anti-inflammatory activities (Naseer and Hussain *et al*., 2018).

It has been estimated that, over 30% of fruit and vegetable produce is wasted during harvest, grading, packing, transport, marketing and storage. Identification and analysis pathogenic airborne fungi is essential to reduce incidence of post-harvest diseases of fruits. It is crucial for the post-harvest quality management of a wide range of high value fruit crops. (Vermani *et al*., 2014). The airborne pathogenic fungal spores may germinate due to the influence of favourable weather conditions and cause post-harvest diseases before reaching the consumers. (Surendranathan, 2005; Zhu, 2006). Presently, fungal diseases like Guava wilt and Anthracnose disease are found to be relatively common and re-emerging diseases worldwide. Freeman *et al.,* (1998). Diseases like Anthracnose caused by *Colletotrichum* and black spot caused by *Guignardia psidii* are the prominent post-harvest diseases affecting the quality of guava fruit. Little is known about the field epidemiology of guava diseases and importance of early disease detection in disease management. (Fischer *et al*., 2011, 2017).

Due to such losses in yield, there occurs less availability of good quality Guava fruits associated with the high market price and even some times the price goes beyond the production cost invested by farmers or owner of Guava orchards. Anup Kumar Sarkar, (2016). As a result, the farmers tend to become less interested about the cultivation of such commercially and medicinally beneficial fruit crop. The incidence of pathogenic fungal spores on the selected guava orchard, may provide an idea to the guava producing farmers and other horticultural farm owners, about likely occurrence of diseases so as to implement proper preventive measures well in time, thereby avoiding huge economic losses. Keeping in view these points, Guava fruit orchards need to be protected in order to minimize the disease incidence during growing as well as during post-harvest period.

Materials and Methods

Aeromycological investigations were carried out at Nashik (Maharashtra) by using the volumetric Tilak air sampler (Tilak and Kulkarni, 1970) that was installed at selected Guava orchards in Nashik city. Tilak air sampler consists cubical tin box, runs on electric power supply that provides continuous sampling of air for 8 days. Air was sucked in (5 liters/minute) and impinges on the transparent cellotape of the rotating drum coated with thin layer of petroleum jelly, thus the airborne fungal spores from the air were entrapped. The exposed cellotape was changed after every 8 days and cut into 16 equal parts, each representing 12 hours traces area, of a day and night accordingly. The pieces of cellotape were mounted on microscopic slides using glycerine jelly as a mount. Scanning of prepared glass slides was done regularly and identification of entrapped fungal spores was done based on microscopic observations and available literature

Data on climatic conditions has been collected during the study period so as to trace out the relationship between the occurrence of pathogenic air borne fungal spores and disease incidence. During the period of investigation, the observations on the pathogenicity of identified fungal spores, the prominent fungal diseases occurred on guava plants, were recorded during the study period.

Table 1: The average and Percent mean contribution of prominent pathogenic fungal spore types during January 2018 to December 2018.

Sr. No.	Spore Types	Conc. no. of spores/M^3	% mean contribution
	ASCOMYCOTINA		
1.	*Phomopsis psidi* Sacc.Roum.	626	1.83
2.	*Claviceps* (Fr.) Tul.	110	0.32
3.	*Melanospora* Corda.	135	0.39
	BASIDIOMYCOTINA		
4.	Basidiospores	304	0.89
5.	Smut spores	595	1.76
	DEUTEROMYCOTINA		
6.	*Alternaria* Nees.	1648	4.81
7.	*Cercospora* Fr.	1982	5.79
8.	*Cladosporium* Link.	2058	5.89
	DEUTEROMYCOTINA		
9	*Colletotrichum* Corda	2099	6.11
10	*Fusarium* Link.	1922	5.61
11	*Helminthosporium* Link. Ex Fries.	1188	3.62
12	*Nigrospora* Zimm.	1716	5.22
	PHYCOMYCOTINA		
13	*Albugo* Pers.Ex. S. F.Gray	280	0.83
14	*Phytophthora* (Mont.) De Bary	349	0.89
15	*Rhizopus* Chrenb.	588	1.73

Results and Discussion

Fungi and plants have a long history of opportunities for co-evolution and exert reciprocal evolutionary effects on one another. In guava fruits, fungi are the causal agents of anthracnose, light blight, stem rot and crown rot. (Valentino *et al*., 2015). During infection, the pathogens grow, multiply, establish contact within the plant tissues and procure nutrients from them (Streets, 1969).

During the present studies, total 15 airborne pathogenic fungal spore types were identified. Among these, Deuteromycotina contributed the highest and the percent mean contribution of *Colletotrichum* was highest (6.11%) followed by *Cladosporium and Cercospora* among Deuteromycotina spore group. Similarly, *Phomopsis psidi* among Ascomycotina was found to be highest (1.83%) followed by Smut spores (1.76%) from Basidiomycotina and *Rhizopus* (1.73%) from Phycomycotina spore groups. (Table 1).

Fungal spores like *Colletotrichum gloeosporoides* (Anthracnose disease), *Fusarium* (Guava wilt disease), *Cercospora sps*. (Cercospora leaf spot disease) and *Phomopsis psidi* (styler end rot disease) etc. were found to be observed during the study period. (Shinde and Ahire, 2017). The pathogenic fungal spore types like *Cercospora, Colletotrichum* are causing fungal diseases on guava plant and also on other fruit crops like pomegranate. (Aher *et al*., 2015).

The prominent pathogenic air borne fungal spores that were entrapped and their average mean percentage contribution was estimated during the study period. These are *Phomopsis psidii*, *Claviceps* and *Melanospora* are belonging to Ascomycetes while *Cladosporium, Alternaria, Cercospora, Colletotrichum, Fusarium, Helminthosporium, Nigrospora* are belonging to class Deuteromycetes. Similarly, spores like *Albugo, Phytophtora* and *Rhizopus* are belonging to Phycomycetes while Basidiospores and Smut spores were reported from Basidiomycetes.

Although a diverse group of fungal spores are known to be disease causing agents to a wide range of horticultural crops, the most prominent pathogenic fungal spores are *Alternaria, Aspergillus, Fusarium, Rhizopus*

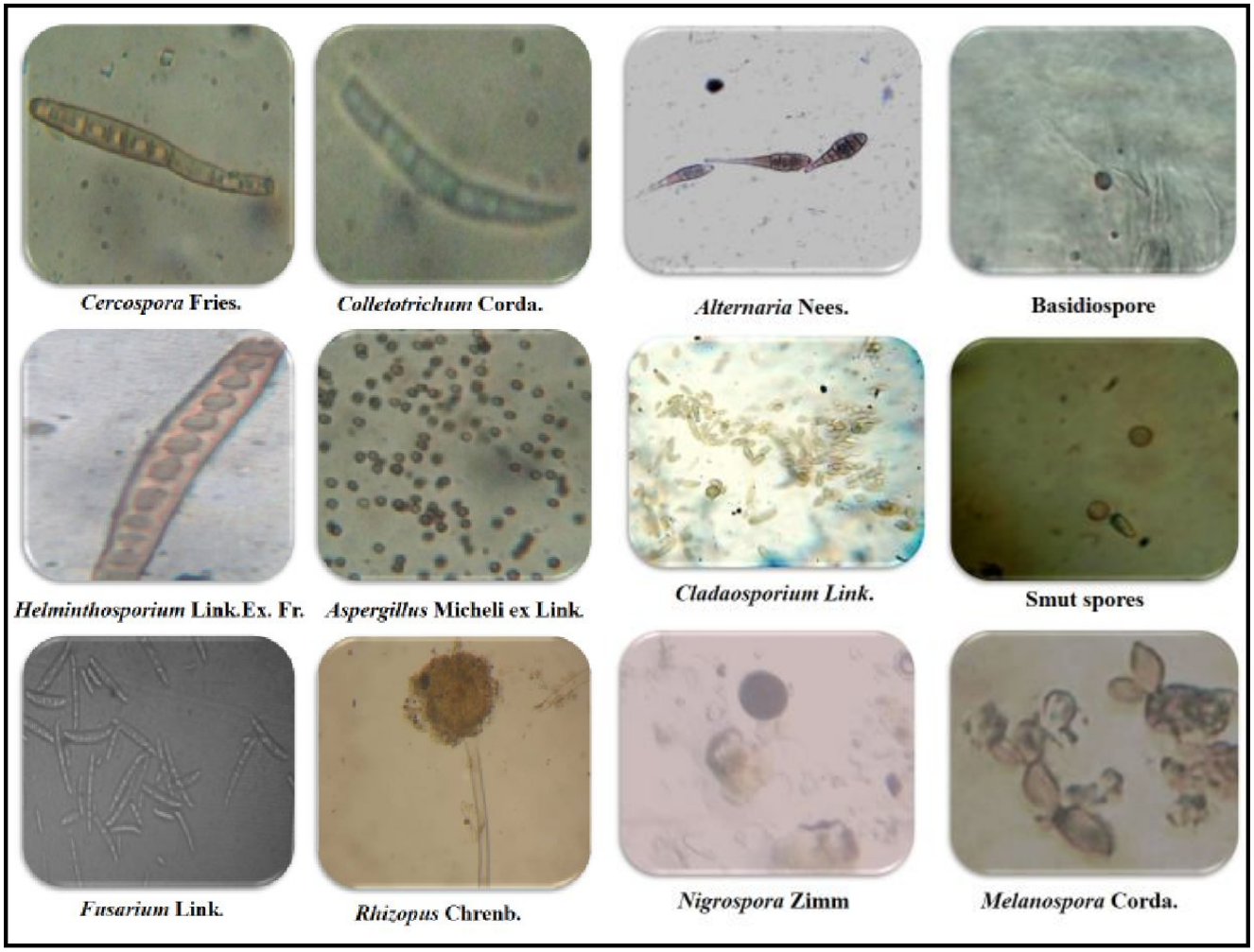

Fig. 1: Photographs of identified pathogenic fungal spore types from guava orchard.

Fig. 2. Photographs of fungal diseases on guava plant.

etc. (Ogawa *et al*., 1995). The different strains of *Aspergillus* like *A. flavus, A. flumigatus* and *A. niger* are causal agents of postharvest spoilage in fruits including guava and tomatoes. Mathew, (2010), Akinmusire, (2011) and Amadi *et al*., (2014). These are known to be producing aflatoxin and carcinogenic compounds that may lead to serious health implications, thus making fruits unfit for human and animals (Shenasi *et al*., 2002).

The fungal spores like of *Fusarium, Colletotrichum, Cladosporium, Cercospora* and *Helminthosporium* are belonging to Deuteromycotina and are observed to be major cause of damage in Guava fruits. Of these, many strains of *Fusarium* were reported by Misra and Pandey, (1999) causing wilt to guava plants. Guava wilt disease is characterised by yellow to reddish colouration leaves and their and subsequent premature defoliation. Fruits remain underdeveloped, hard and stony. In addition, *Fusarium* are fumonisin producers, which are phytotoxic, damaging a wide variety of crops. Likewise, fungal spores like *Colletotrichum psidii* known to be causing anthracnose disease in guava in which entire plant may drop down *i.e*. die back of shoots. Symptoms include typical dark brown, pin-head spots on fruit skin which on severity developed into bigger lesions. Similarly, leaves of the guava plant are affected by different strains of fungal spores of *Cercospora* in the form of water soaked, brown irregular patches on the lower surface and yellowish colour on the upper surface of the leaves. (Fig. 1).

Also, during the study period; though there is no sharp seasonal variation in the occurrence of airborne fungal spores like *Aspergillus, Cladosporium, Penicillium*, *Helminthosporium* and *Alternaria*, slight fluctuations were observed due to the sudden changing environmental factors such as temperature, rainfall and humidity. It has been observed that the higher concentration of fungal spores like *Cladosporium, Alternaria, Cercospora, Fusarium, Colletotrichum, Rhizopus* were recorded during prolonged rainy and dry periods. Generally, temperature and relative humidity have a pronounced effect on spore productivity which probably explains high spore incidence in the rainy season and low in dry periods (Shrivastava, 2007). Thus it was found that the temperature and rainfall are the two external factors which greatly affects the development of reproductive structures. (Ball and Ketterson, 2008; Shinde and Ahire, 2017).

The present study revealed that, the increased concentration of identified pathogenic fungal spores during the period of study; is due to the moderate amount of rainfall and daily temperature with high percentage of humidity. Also, the recorded fungal spore types are said to be responsible for the prevalent diseases like Wilt disease, Anthracnose disease, Cercospora leaf spot disease and styler end rot disease that were observed during the period of investigation, in guava orchard selected for the study. Further, the results of the present study will contribute towards the identification, determination and monitoring prominent fungal spores causing diseases in guava fruits. There is a further scope for studies on utilization of the non-pathogenic fungi as biological control agents to numerous phytopathogens infecting various horticultural crops worldwide.

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