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## Circadian periodicity studies of some important fungal spores over guava orchard in Nashik Maharashtra

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**ABSTRACT :** Circadian periodicity studies of the fungal spore types like *Colletotrichum*, *Fusarium* and *Albugo* were conducted during the aerobiological sampling by using volumetric Tilak air Sampler from 1<sup>st</sup> January 2013 to 31<sup>st</sup> December 2014. In the present investigation, fungal spore trapping was done by operating continuously Tilak air Sampler (Tilak and Kulkarni; 1970). During this period; consecutive meteorological parameters such as temperature, relative humidity and rainfall were monitored. Circadian periodicity studies of the fungal spore types like *Colletotrichum*, *Fusarium* and *Albugo* in the present investigation clearly indicated that these spore types belong to nightspora. The maximum concentration of *Colletotrichum* and *Albugo* was recorded in the months of July and August; whereas *Fusarium* was recorded maximum in the month of June. There exist some rhythms in fungal components of the airspora and these are correlated to the periodicity of environmental factors.

**Key Words :** Circadian periodicity, guava, Tilak air sampler.

The airspora of a region is influenced by topography and meteorological parameters of the concerned area. Aerobiology is a scientific discipline that, deals with the transport of organisms and biologically significant materials through the atmosphere (Gage and Isard, 2000). The availability and concentration of airspora totally depend on weather conditions and climatic factors. The dispersion of pollutants as well as aerobiological agents is studied in environmental science which becomes a newly emerging interdisciplinary branch (Tilak and Babu, 1983; Subba Reddy and Janakibai, 1977). Guava (*Psidium guajava* Linn.) is an important fruit crop of several tropical and sub-tropical countries, is facing several agronomic and horticultural problems such as susceptibility to many pathogens (Rai *et al.*, 2009).

In the present investigation; it was observed that there was a temporary decrease of dry spore fungi at the onset of summer season. Later, however, rain markedly increased the concentration of spore content of the air. The rapid changes in humidity, during early morning hours and early night hours probably play the significant role in releasing new conidia into the air as has been found by Gre-

gory (1961) and Meredith (1962). Gregory (1961) suggested that, in the cooler, non-tropical area where the rainfall is more or less evenly distributed, throughout the year, seasonal variation in the spore numbers are related more to changes in temperature than to any other single factor. (Gregory, 1961; Di Menna, 1955).

The temperature and rainfall, are the two external factors which greatly affects the development of reproductive structures. (Bauer, 2008; Ball and Ketterson, 2008). Abu-Dieyh and Barham (2014) studied concentration and dynamics of fungal spore populations in the air of Zarqa, Jordan. Thakur and Jite (2015) studied the circadian periodicity of fungal spores like *Didymospaheria* and *Leptosphaeria*. Baraskar and Patil (2016) conducted circadian studies of *Alternaria*, *Cladosporium* and *Cercospora* during aerobiological studies over Jowar crop field at Jamkhed, Ahmednagar, Maharashtra.

### Materials and Method

The Tilak air sampler was installed at Gauva orchard in Kakad farm near Gangapur region, Nashik. Orchard selected for aerobiological study is



situated in the Gangapur region 10 km away from Nashik city. The aerobiological studies were conducted continuously for two years i.e. from 01.01.2013 to 31.12.2014.

The volumetric Tilak air sampler (Tilak and Kulkarni, 1970) was used for the aerobiological studies. It consists cubical tin box, runs on electric power supply and it provides continuous sampling of air for 8 days. Air is sucked in (5 liters/minute) and impinged on the transparent cello tape of the rotating drum coated with thin layer of petroleum jelly; thus the bioparticles from the air were entrapped. The exposed cello tape was changed every 8 days and was cut into 16 equal parts; each representing 12 hours trace area, of a day and night accordingly. At the end of 8 days, it was divided into 16 equal parts as marked on the drum, each part measuring 4.2 cm in length. Each piece of the cello tape now obtained; represented the 12 hrs sampling for a day or night accordingly. The cello tape for 12 hrs is mounted on clean slide in a glycerine jelly. Also, scanning was done by dividing this cello tape further, into 6 equal parts, each part representing 2 hrs trace area. The pieces of cello tape were mounted on microscopic slides using glycerine jelly as a mount. The prepared microscopic slides were used for scanning purpose. Total 9600 sq. micron of the area was obtained during daily scan by using 10x and 45x eye piece of the microscope. Scanning of prepared glass slides was done regularly and identification of bioparticles was based on microscopic diagnostic features, reference slides and available literature. During this period, consecutive daily meteorological parameters such as temperature, relative humidity and rainfall were monitored. The meteorological data was obtained from Hydrological project, water resources Department, Maharashtra Engineering Research Institute (M.E.R.I.), Nashik, the Government of Maharashtra.

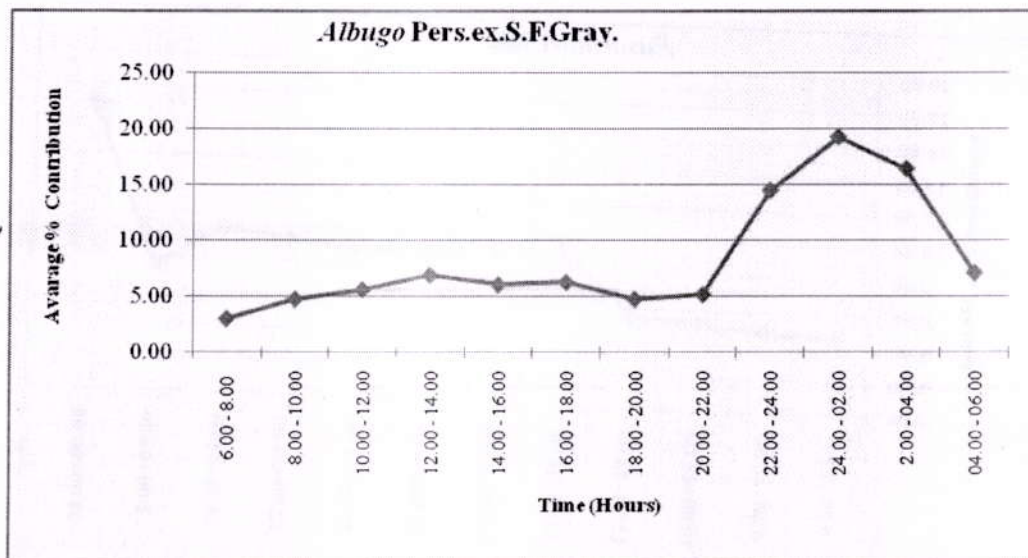
### Results and Discussion

The fungal spore types *Colletotrichum*, *Fusarium* and *Albugo* contributed significantly to

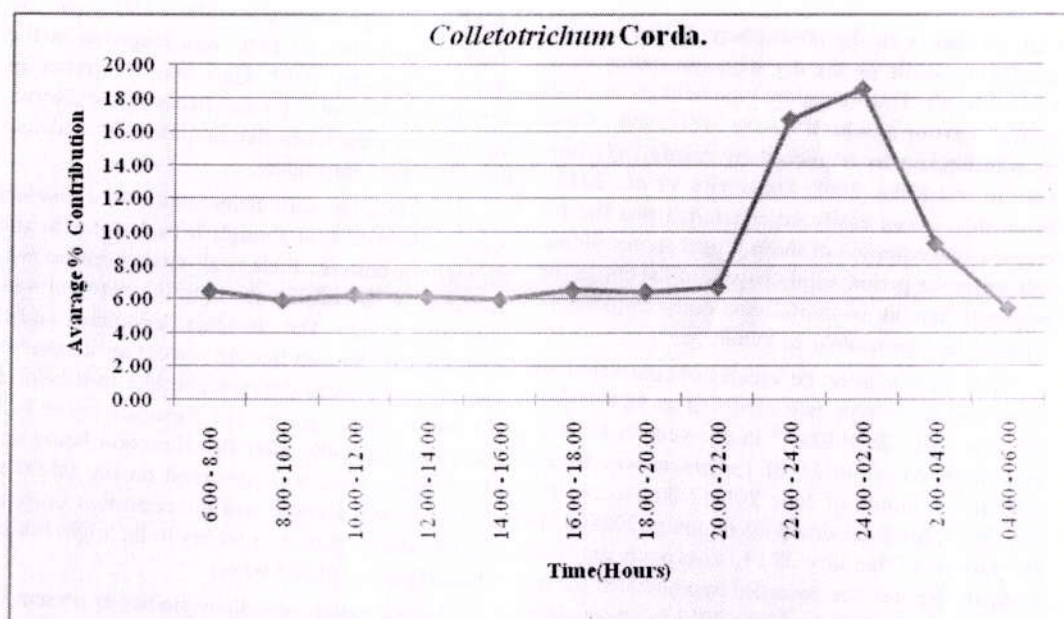
the total airspora, throughout the rainy season. The percentage contribution of these spores has been calculated on the basis of bihourly catches of each spore type for 24 hour period. Accordingly, the mean circadian periodicity curves for *Colletotrichum*, *Fusarium* and *Albugo* were prepared. The circadian periodicity studies of *Colletotrichum*, *Fusarium* and *Albugo* showed that they belong to the nightspora pattern. The circadian periodicity studies of *Colletotrichum*, *Albugo* spores showed that their concentration reaching the peak during 24.00 hrs. to 2.00 hrs. whereas the circadian periodicity studies of *Fusarium* spores showed that their peak concentration was found to be at early in the morning between 4.00 hrs. to 6.00 hrs. (Fig. 1,2&3).

The maximum concentration of spore type *Colletotrichum* was found 10686/m<sup>3</sup> in the month of July 2013 whereas in the year 2014, it was recorded maximum as 12221/m<sup>3</sup> in the month of August. Circadian periodicity curve study showed that during the night time spore concentration was high, during day time it decreases in number, so it was a "Night Spora" group. The circadian periodicity studies of *Colletotrichum* spores showed that they belong to the nightspora pattern; with their concentration reaching the peak during 24.00 a.m to 2.00 a.m. The concentration of this spore type showed remained steady from 06.00 to 20.00 hrs. and showed a sudden increase from 20.00hrs to 2.00hrs reaching its peak at 24.00 to 2.00hrs. It again decreases during 24.00 to 06.00 hrs. This indicated that concentration was highest during night time and started to decline after night hours.

Occurrences of *Colletotrichum* and *Albugo* were noted maximum in the atmosphere in the months of July 2013 and August 2014. An average value of rainfall was 116.4 mm and 84.8 mm, relative humidity 82.30% and 79.48% whereas average temperature was 24.78°C and 26.78°C for July 2013 and August 2014 was recorded. These environmental factors were responsible for favorable for the discharge of spores and increased concentra-



**Fig.-1 :** Circadian Periodicity curve of average percentage contribution of *Albugo*.



**Fig.-2 :** Circadian Periodicity curve of average percentage contribution of *Colletotrichum*.



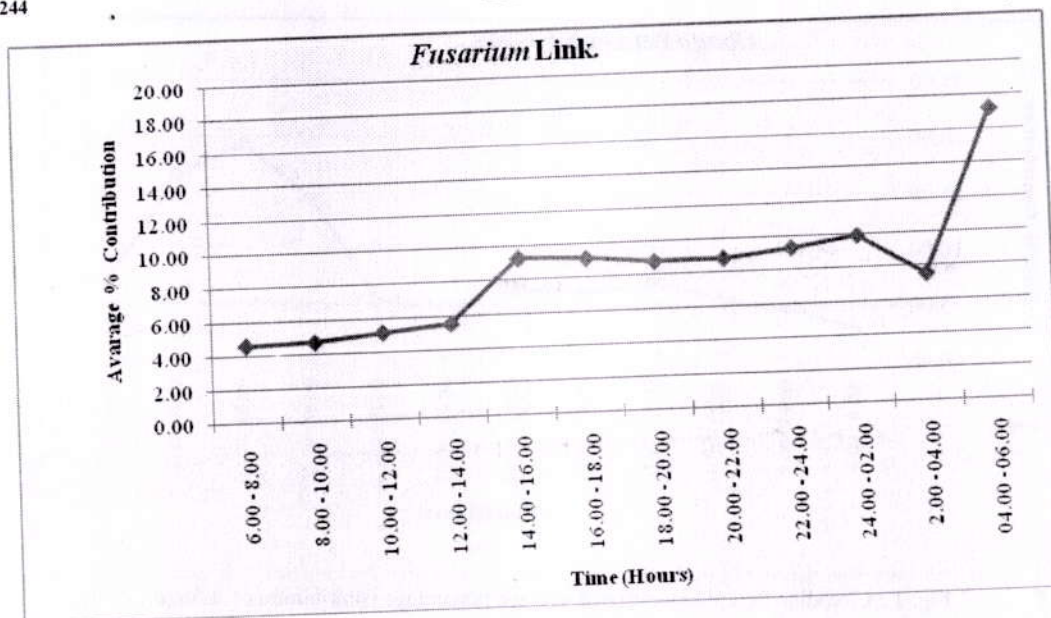


Fig.-3 : Circadian Periodicity curve of average percentage contribution of *Fusarium*.

tions of spores in the atmosphere at high humid conditions, while on the dry days the spores were less in the air. Thus the spore type belongs to "Wet spora" group, which were released from pseudothecia was triggered by rainfall (Grinn-Gofron and Mika, 2008; Dawidziuk *et al.*, 2012). From this, it can easily be concluded that the increased concentration of these fungal spores during this particular period; might have resulted due to the moderate amount of rainfall and daily temperature with the high percentage of humidity.

The yearly average mean concentration of *Fusarium* spore type was recorded as 1841/m<sup>3</sup> in the year 2013 & 2003/m<sup>3</sup> in the year 2014. The maximum contribution of *Fusarium* was found 3646/m<sup>3</sup> in month of June 2013. Likewise; in the year 2014, it was recorded maximum as 2785/m<sup>3</sup> in the month of January 2014. The occurrence of *Fusarium* spores was recorded maximum in the atmosphere in the month of June 2013 in relevance to total rainfall 116.4 mm, the average relative humidity 70.35% and average temperature 28.98°C. Like-

wise, the average relative humidity 61.42% and average temperature 27.11°C was recorded in the month of January 2014. Thus, the occurrence of this spore type could be correlated with the prevailing weather parameters like rainfall with moderate humidity and temperature.

The circadian periodicity studies of *Fusarium* spores showed that though they belong to the nightspora pattern; their peak concentration was found to be at early in the morning between 4.00 a.m. to 6.00 a.m. The circadian periodicity studies of *Fusarium* showed that the maximum number of spores were present during night time so it belongs to "Night spora" group. The *Fusarium* spore type increases gradually after the afternoon hours and the highest peak was observed during 04.00 to 06.00 hrs and showed that concentration dropped slightly during 2.00 to 4.00 hrs in the night but increased rapidly after 4.00 hrs.

The circadian periodicity studies at present investigation are in relevance with the studies of Sreeramulu and Ramlingam (1964). Mishra and



Srivastava (1969) found that the population of *Fusarium* spores varied at different sampling periods in the different months and was governed by atmospheric conditions.

According to Ingold (1965), the hygroscopic movements of the conidiophores releases spores from organic contact. Also, it was found that on increase in wind velocity and temperature in the forenoon hours favored decreased fungal spore concentration incidence while increase in relative humidity or dew formation or cloudiness increased it. In the month of July 2013; increased rainfall and relative humidity also showed a marked seasonal periodicity, related to fungal spore types *Colletotrichum*, *Albugo*. Some researchers observed that during the high temperature and low humidity; the fungal spore discharge is comparatively slowed down or retarded in case of spore type *Colletotrichum*, *Fusarium* and *Albugo*. Tilak (1982) reported *Albugo*, *Colletotrichum* and *Fusarium* spores incidence and concentration with the increased humid conditions at Aurangabad city. Similar findings have been recorded by Sreeramulu and Ramlingam (1964), Tilak and Babu (1983). Though there has been a slight variation of peak concentration timings but all three spore types have occurred maximum in number during night time. *Colletotrichum*, *Fusarium* and *Albugo* were contributing significantly to the total airspora, present throughout the investigation period over Guava orchard.

The present circadian periodicity studies of *Colletotrichum*, *Fusarium* and *Albugo* during the present investigation; clearly exhibited that, some circadian rhythms in the elements of the airspora are closely related to periodicity of environmental factors. In the present investigation of airborne *Albugo*, *Colletotrichum* and *Fusarium* fungal spore types in the atmosphere of Guava orchard in Nasik; were generally affected by weather, especially rain fall, moderate temperature and high relative humidity seems to increase the spore concentration. The spores concentration were highest during the night time and lowest during the day time.

Weather conditions play an important role in

the seasonal development of many plant diseases. The general prevalence of particular fungal spore types and the occurrence of particular disease may be influenced to a great extent by the characteristics climate variation. Variation from the characteristic climate conditions; may be responsible for the sporadic outbreaks of certain plant disease, which normally do not occur. Therefore, the climate of a region not only determine the crop that can be grown profitably; but also, influence the dangers of disease to which crop are susceptible.

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