



Research Article

Aerobiological studies with special reference to airborne basidiospores of *Ganoderma* Karst. at Pune, Maharashtra, India.

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Abstract: The basidiospores of *Ganoderma* were trapped in abundance during the aerobiological studies at Pune, during the year 2012. The sampling was conducted during the rainy months from 18th June to 10th September. Volumetric continuous Tilak Air sampler was used for sampling. Maximum number of spores was observed in the month of August (25760/m³ of air), followed by September (16548/m³ of air). The total spore number was 47460/m³ of air. The highest spore catch (3472/m³ of air) was recorded on 1st September. The relationship between the airborne concentration of *Ganoderma* spore count and meteorological factors are discussed in the paper. This information could be important for the sensitive individuals as *Ganoderma* spores are known to be allergic.

Keywords: Airspora, *Ganoderma*, Meteorological factors, Pune, Rainy months, Tilak air sampler.

Introduction

In rainy months, many types of basidiospores varying from hyaline to coloured and small to large in size have been reported during aerobiological sampling. In earlier aerobiological studies the emphasis was given to the spores of hyphomycetes and ascomycetes. In many aerobiological studies all the basidiospores were kept under the common group 'basidiospores' due to difficulty in identification at genus level. Among such basidiospores, spores of *Ganoderma* were trapped in large quantity.

Basidiospores of *Ganoderma*, a member of class basidiomycotina usually known as bracket fungus or wood decay fungus (Horner *et al.*, 1992). It is reported as an important and prevalent genus of fungal airspora throughout the world (Levetin 1990, 1991; Hasnain 1993; Halwagy 1994; Li & Kendrick 1994, 1995). The allergenic significance of basidiospores and basidiospores of *Ganoderma* was recorded throughout the globe. Gregory & Hirst (1952) first time reported the rapid fluctuation in hyaline basidiospores concentration and suggested that basidiospores might be associated with respiratory allergy. Various studies established the environmental prevalence and allergenicity of basidiospores (Lopez *et al.*, 1976; Santilli *et al.*, 1985; Lehrer & Horner 1990; O'Neil *et al.*, 1990; Hasnain *et al.*, 2005).

Studies all over the world have clearly shown *Ganoderma* spores as dominant fungal air spores and aeroallergens (Tarlo *et al.*, 1979; Hasnain *et al.*, 1984; Craig and Levetin, 2000; Hasnain *et al.*, 2004). Allergenic components of *Ganoderma applanatum* have been reported by Vijay *et al.*, (1991). Singh *et al.*, (1994) reported sensitization to *Ganoderma lucidum* in

the atopic population in India. The entire aerobiological study related to group basidiomycetes has been reviewed by Tilak and his colleagues at Aurangabad, India (Tilak *et al.*, 1981).

There are various other reports like this on the airborne nature, diurnal patterns and allergenic significance of basidiospores from European and other countries but very few from India. In most of the reports all types of basidiospores were grouped under common class 'basidiospores'. Therefore, in present study spores of *Ganoderma* were identified and counted separately. This aerobiological study was carried out with special reference to airborne basidiospores of *Ganoderma* count, its circadian periodicity and its relation to meteorological factors during rainy season of 2012 at Pune.

Materials and Methods

The aerobiological study was carried out with the help of volumetric continuous Tilak Air sampler (Tilak & Kulkarni, 1970). The sampling was carried from 18th June to 10th September 2012 (Rainy season) at Pune. The relationship between the meteorological factors and spore count in the atmosphere was studied.

Results and Discussion

The basidiospores of *Ganoderma* are easily recognizable, one celled oval to ellipsoid brown, apex truncate, apiculate, slightly rough, size is about 9-18 x 6-8 µm. Spores are double walled with inner golden-brown wall bearing an ornamentation this pierces the outer transparent wall, so the spores appear to have a spiny surface.

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Ganoderma, a perennial form belonging to Hymenomycetes is cosmopolitan in occurrence. It has been estimated that a large specimen of *Ganoderma* may liberate 20 million spores per minute and this great rate may be maintained for the five or six months from May to September (Buller 1992).

The basidiospores of *Ganoderma* were recorded regularly and occur abundantly throughout the study period. Their total spore count was 47460/m³ to the total airspora, whereas, the percentage contribution to the total airspora was 7.44. The spore count was maximum in the month of August (25760/m³ of air) followed by September also in considerable amount (16548/m³ of air). The analysis of the meteorological factors during these two months showed 26.3°C average mean temperature, 80.4% average relative humidity, 204.6 mm rainfall and 1.68 m/s average wind velocity in August and 24.8°C average mean temperature, 84.5% average relative humidity, 42.4 mm rainfall and 1.1 m/s average wind velocity in September (Table 1, Figure. 1A. and 1 B).

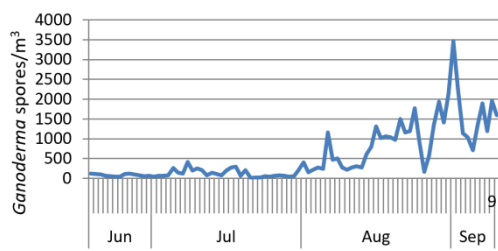


Fig. 1. A

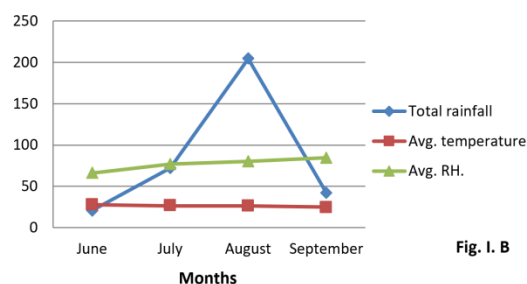


Fig. 1. B

Figure 1. A: Day to day variation in *Ganoderma* spore count **B:** Month wise meteorological factors (Temperature, Relative humidity and Rainfall) from 18th June to 10th September 2012 at Pune.

It clearly shows from the present observation that the rainfall or water is a pre-requisite for this fungus to liberate *Ganoderma* spores into the atmosphere. High relative humidity about 80% associated with high rainfall appeared to be suitable for this fungus for the production and liberation of the spores in high number into the air. This is somewhat in agreement with the reports of McCracken (1987) and Hasnain *et al.*, (2004) where humidity levels of about 70% are associated with increased concentrations of *Ganoderma* spores. Calderon *et al.*, (1995) observed the largest concentrations of *Ganoderma* spores due to 70–80% of relative humidity in Mexico City. Lacey (1990) showed an abundance of *Ganoderma* spores

during the rainy period in tropical countries. The rainy period accelerate development of sporocarps and release more spores because of high humidity and water availability.

The highest spore count (3472/m³ of air) was recorded on 1st September 2012 when there was a record of 26°C mean temperature, 78.5% of relative humidity, 17 mm rainfall and 0.8 m/s wind velocity on that day. The total rainfall of 38 mm was observed on prior two days i.e. 30th and 31st August. It clearly indicates that the rainfall on these prior days helped the fungus to liberate the spores. The relative humidity of 86.5% was of highest incidence which favored the fungus to release the spores in abundance. The day to day variation in the *Ganoderma* spore count and the meteorological factors are presented in Figure 1A and 1B.

The spore liberation and concentration of *Ganoderma* in the atmosphere is increased gradually from June to August as the rainfall progressed and later on started decreasing may be due to low rainfall. The highest spore count in August can be correlated with highest total rainfall associated with high relative humidity and average wind velocity might be responsible for the significant number of *Ganoderma* spores in the airspora. A clear correlation between the spore liberation, ultimate count in the atmosphere and the meteorological factors had been observed. This observation is more or less similar with the observation of Tilak and Ramchander Rao (1988) who recorded maximum *Ganoderma* spores in September followed August in rainy season. Singh reported that the maximum *Ganoderma* spore release occurred during the late summer and autumn, the rainy season in Delhi (Singh *et al.*, 1995).

The mean circadian periodicity curve of basidiospores of *Ganoderma* has been expressed as the percentage derived from the bihourly catches for 24-hour periods (Figure 2). The circadian periodicity studies have indicated that the spore belongs to “Wet spora” and “Night spora” group with a main peak between 2.00 - 4.00 hrs. with subsidiary peaks between 22 to 24 hrs. The spore count fluctuated with respect to time and showed gradual decrease and increase in peaks. Then after the main peak there is gradual decrease upto 12 hrs followed by gradual increase upto 24 hrs. (Figure 2). Similar findings have been recorded by Tilak (1989) with its peak at 4.00 hrs. Vittal and Krishnamoorthi (1989) recorded it to night pattern. Craig and Levetin (2000) they recorded diurnal rhythm in *Ganoderma* spore release with peak at 4.00 hrs. and lowest levels at 16 hrs. at Tulsa, Oklahoma. Hasnain *et al.*, 2004 also showed nocturnal pattern of *Ganoderma* spores in desert environment of Saudi Arabia.

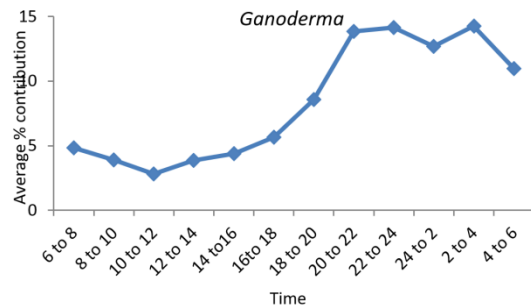


Figure 2. Mean circadian periodicity curve of *Ganoderma* expressed as the percentage derived from the bihourly catches for 24-hour periods.

The presence of high number of basidiospores of *Ganoderma* may be important for understanding allergic reactions (Grinn-Gofron & Strzelczak, 2011). Such aerobiological studies help for understanding of allergic manifestations caused by basidiospores of *Ganoderma*. Therefore, there is need of continuous study of occurrence of *Ganoderma* spores in relation to meteorological factors in Pune.

In conclusion, this study showed that airborne basidiospores of *Ganoderma* spores release depends on high relative humidity associated with rainfall. Hence, we can infer that it belongs to wet spora and showed night pattern. Further annual research data could provide a more accurate variation in spore count over time.

Table I. Month wise count of basidiospores of *Ganoderma* Karst. in the atmosphere and meteorological factors from 18th June to 10th September 2012.

Month	Total number of spores/ m ³ of air	Meteorological factors			
		Average mean temp.(°C)	Average relative Humidity (%)	Total rainfall (mm)	Wind velocity (m/sec.)
June	1092	27.9	66.1	20.6	3.31
Jul	4060	26.5	77.1	72.2	2.03
Aug	25760	26.3	80.4	204.6	1.68
September	16548	24.8	84.5	42.4	1.1

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