Discussion
DISCUSSION

While no fungi are known to grow and reproduce in the air, the spore load of certain areas especially in relation to allergies and epiphytotics is usually considered a population. Most fungi with dry spores are transported by air and when spores of a certain species are released to the air in large enough number by explosive forces from asci and basidia, from conidiophores or by simple release from pressure of numbers or by air currents, they can result in serious infestations of material, crop plants, allergies of man, or even more serious diseases of man and animals. Splash dispersal can also release, especially those, which are produced in slime, into the air during periods of precipitation.

In the recent past several investigations on aeromycoflora at various places have indicated the implications as the source of inoculum in the incidence of plant diseases and human allergic disorders. Fungal spores constitute a significant fraction of air borne pollutants. Numerically they are more frequent in air.

The air we breathe is seldom free of fungus spores, but their number and type vary with the time of day, season, weather, geographical location, and nearness of large spore sources. Conidia make a large contribution in this air spora, mostly originating form living and dead vegetation out doors and from stored products indoors. The airspora comprises spores in the process of
dispersal following their liberation by means characteristic of each species and prior to deposition on new substrates either by physical process or by rain washing.

The study of Aeromycology is then important in understanding the distribution and ecology of fungi and also relates to their interactions with plants, with man and with their products. Many spores will be killed by exposure to the elements. Of those that survive, some may be harmless to other forms of life, others cause diseases of plants, humans and animals, and yet others cause deterioration of foodstuffs and manufactured products.

Much of our knowledge of the behaviour of air borne spores comes from the study of the epidemiology of plant diseases and of infectious disease and allergy in human. It has been stimulated during the last 25 years by the development of a new methods of trapping spores, by collaboration among Engineers, Physicists, Microbiologists, Hygienists, Allergists and Pathologists and by the synthesis made by P.H Gregory (1973) in his book 'Microbiology of Atmosphere'.

By keeping all these in view the researcher made an attempt to study the air borne fungi of Shimoga city which is one of the District place in Karnataka state and is situated roughly in the mid-south-western part of the state. Air sampling has been carried out in the 4 major places of Shimoga city viz.,
METHODS OF STUDY:

In order to study populations of airborne spores and their dispersal, they must first be trapped, classified and counted. These 3 processes provide a succession of problem that have long exercised the minds of Physicists, Engineers, Microbiologists and Allergists. The result has been a large number of devices, many developed for industrial hygienic use, each with its own characteristic but few well suited to trapping spores.

Different spore trapping techniques used a variety of processes. Sedimentation methods are widely employed by all mycologists, but recently the advantages of impaction techniques have been recognized. Sedimentation has been widely used to trap spores. Settle plates are inexpensive and easy to use but suffer from severe limitations. They are not volumetric and can only give qualitative results.

The rate of deposition of spores varies with their terminal velocities, which is a function of the square of their radius and causes large spores to be sampled, effectively from a greater volume of air than small ones.

Vertical cylinders 5mm in diameter, covered with cellophane dipped in glycerine or sugar jelly offer many of the advantages of sedimentation methods without some of the disadvantages. Trapping efficiency increases with
increasing wind speed and particle size. The choice of diameter is a compromise between efficiency of trapping small spores and losses from large spores blowing out (Ramalingam, 1968).

The use of impactor traps, particularly those that operate continuously has revolutionized the concept of the air spora. In principle, traps of this type are similar in that air is drawn through rectangular or circular jets and then deflected at right angles by the trapping surface behind. Particles with sufficient momentum are thrown out of the air stream and impact on the trapping surface. As jet velocity increases smaller particles will be impacted. Impactor traps allowing microscopic assessment include cascade impactors and various continuously operating traps which give time discrimination (Hirst, 1952; Kramer and Pady, 1966; Brown and Jackson, 1978), where as isolation culture is possible with a slit sampler (Bourdillon, 1941; Brown, 1970) and an Anderson sampler (Anderson, 1958). Trapping efficiencies up to 98% may be obtained in the slit sampler with a jet 0.3x28mm using unit destiny spheres 1μm in diameter.

**Isolation Media:**

The choice of culture media for spore trapping is wide and may depend in part on which organisms are of particular interest. The suitability of different media has been discussed by Rogerson (1958), Lacey and Dutkiewicz (1976) and Burge et.al. (1977b).
Area and Climate:

Shimoga is one of the District place of Karnataka state and is situated in the mid South-Western part of the state and consists of a striking transition from Malanad. The main characteristic feature of Malanad region is the presence of rich forest and more rainfall than in other regions. The climate of this district is cool because a greater part of this place has a hilly terrain. Four sites have been selected from Shimoga city for the analysis of air borne mycoflora viz. Meghan Hospital area, Shivappa Nayak market area, Bus stand area and Ashok nagar area.

Meghan Hospital area:

Air was sampled in the out door campuses of Hospital area with all three methods. A total of 96 species, Yeast colonies and Non-sporulating colonies have been isolated from the Meghan hospital area. Of these 8 species belonged to Zygomycotina, 4 species belonged to Ascomycotina and 84 species belonged to Deuteromycotina. Among these Aspergillus fumigatus Aspergillus niger, Aspergillus versicolor, Cladosporium cladosporoides, were most common in their percentage occurrence where as Aspergillus flavus was common. The species such as Rhizopus stolonifer, Cladosporium herbarum, and Cladosporium oxysporum, were frequent in their occurrence where as Absidia corymbifera, Rhizopus nigricans,Acremonium strictum, Alternaria alternata, Aspergillus candidus, Curvularia clavata, Curvularia lunata, Curvularia
*pallescens*, *Penicillium citrinum*, *Penicillium expansum*, and *Penicillium lanosum* were occasional. The rest of the organisms have shown sporadic in their percentage occurrence.

When results were compared with Alteras and Lehrer (1977), Solomon et al. (1978), Jayaprakash (1980) almost similar results were obtained. The predominance of species of *Aspergillus* and *Penicillium* were reported.

**Shivappa Nayak Market Area:**

A total of 85 species, Yeast colonies and Non-sporulating colonies have been isolated from Shivappa Market area of these 8 species belonged to Zygomycotina, 4 species belonged to Ascomycotina and 73 species belonged to Deuteromycotina. *Rhizopus stolonifer*, *Aspergillus flavus* and *Aspergillus niger* were most common in their occurrence where as the species such as *Cladosporium cladosporoides* was most common. *Syncephalastrum racemosum* and *Aspergillus fumigatus* were frequent where as *Mucor racemosus*, *Alternaria alternata*, *Cladosporium cucumerinum*, *Fusarium oxysporum*, *Gliocladium roseum*, *Monilia sitophila* and *Penicillium brefeldianum* were occasional. The rest of the organisms were sporadic in their occurrence.

When compared the results with Barkai and Golan (1966), Jayaprakash (1980), Meshram (1999) some what different results were obtained.
Aspergillus niger contributes maximum percentage of occurrence with 22.33%.
The same results were monitored by Shashidhar and Reddy(1989).

**Bus stand area:**

Studies on airborne mycoflora of Bus stand is new to the field of Aeromycology, even though the dust pollution is more. A total of 96 species, Yeast colonies and Non-sporulating colonies have been isolated from Bus stand area. Of these 8 species belonged to Zygomycotina, 3 species belonged to Ascomycotina and 85 species belonged to Deuteromycotina.

Among these *Aspergillus flavus* and *Aspergillus fumigatus*, *Aspergillus niger* were most common. The species such as *Rhizopus stolonifer* was common. *Mucor racemosus* and *Aspergillus japonicus* were frequent where as *Absidia corymbifera*, *Aspergillus nidulans*, *Aspergillus ochraceus*, *Cladosporium cladosporoides*, *Cladosporium herbarum*, and *Curvularia clavata*, were occasional. The rest of the organisms were sporadic in their occurrence.

Nearly 50% of total occurrence was with *Aspergillus* sp. which are very dangerous to inhale.

**Ashok Nagar Area:**

The area which is fully contaminated because of solid waste dumping has shown a maximum number of fungal spores when compared with other sites. A total of 95 species, Yeast colonies and Non-sporulating colonies have been isolated from Ashok nagar area. Of these 8 species belonged to
Zygomycotina, 6 species belonged to Ascomycotina and 81 species belonged to Deuteromycotina.

Among these *Aspergillus flavus* and *Aspergillus fumigatus*, *Aspergillus niger* were common. *Rhizopus stolonifer*, *Cladosporium chlorocephalum*, were frequent. *Absidia corymbifera*, *Mucor racemosus*, *Rhizopus nigricans*, *acreamonium strictum*, *Alternaria alternata*, *Aspergillus candidus*, *Aspergillus carbonarius*, *Aspergillus japonicus*, *Aspergillus nidulans*, *Aspergillus ochraceus*, *Aspergillus versicolor*, *Cladosporium cladosporides*, *Cladosporium herbarum*, *Cladosporium lignicola*, *Curvularia lunata*, *Fusarium oxysporium*, *Nigrospora sphaerica*, *Penicillium purpurogenum*, *Penicillium restrictum*, *Periconia cookei*, *Pithomyces atr-o-livaceous* and *Torula herbarum f. quaternella* were occasional whereas others were sporadic in their percentage occurrence.

When compared the work with Udayprakash and Vittal(1977), Reinthaler et.al.(1980), Fisher(1998) almost similar results were obtained.

The seasonal incidence and concentration of fungal spores varies both qualitatively and quantitatively from place to place depending on the local flora, topography of the landscape and Human interference. The knowledge on composition and seasonal periodicity of fungal spores in each location helps physicians to identify the cause of allergy. Fungal spores have little or no control over the temperature of the environment, and consequently over the
thermodynamics of their metabolism because temperature affects all the
chemical reaction rates. So temperature is an extremely important factor
regulating fungal life. Because of this reason during the course of study it was
observed that the number of fungi decreases with the increase in the
temperature of the environment. Maximum number of species percentage
occurrence was found in the season of winter when compared with the rainy
and summer seasons. Most of the Deuteromycotina were isolated in winter
season only. The occurrence and prevalence of these spores is related to their
production and meteorological parameters like rainfall, temperature, relative
humidity, wind velocity etc., and the available plants and plant debris, which
act as a host or substrate for the most commonly encountered fungi, e.g.,
Cercospore, Alternaria, Beltrania, Curvularia, Cladosporium, Fusarium;
usually during the rainy period. The atmospheric fungal population decreases
due to “washing off” by rain, however, it gradually increases summer months.
However, it can be said that there is no “spore free” season. During the clear
weather the fungal spores are carried to short or long distances the air currents
resulting in good quality and quantity. The low temperature of winter decreases
the fungal population in air but again optimum temperature favour
aeromicrobiota from January to April. Though most of the spore types exhibit
seasonal variation in the concentration spores of Alternaria, Cladosporium,
Curvularia do not exhibit marked seasonal variation may be due to their wide host range.

The effect of rainfall is very clearly evident in the release of ascospores and this may be immediate or delayed. A slide for analysis after rainfall shows the presence of several ascospores, which abound both in quality and quantity. A very useful comparison on the data of seasonal changes in the catches of total air spora recorded by Cunningham (1873) for Culcutta, Rajan et. Al., (1952) for Kanpur, Tilak and Kulkarni (1970) for Aurangabad and Sreeramulu and Ramalingam (1966) for Vishakapatnam has been plotted correlating with rainfall wherever data is available.

Similar results have been obtained by Lyon et.al. (1984) who worked on airspora and showed variations of airspora in the atmospheres due to weather conditions.

Vertical cylinder method is considered as the best method when compared with the rotorod method. Maximum number of fungal spores was isolated by vertical cylinder method. In vertical cylinder method the trapping efficiency increases with increasing wind speed and particle size. The choice of diameter is a compromise between efficiency of trapping small spores and losses from large spores blowing off.