DISCUSSION

The present investigation deals with the aeromycological studies over wheat and groundnut fields in Karad region (Maharashtra). The investigation was carried out at Taluka seed farm, station road, Vidyanagar, Karad from 1st November 2007 to 15th June 2008. A total number of 19,75,553 biocomponents were identified from investigation. The biocomponents trapped were grouped into different categories viz. fungal spores, hyphal fragments, insect parts and scales, pollen grains and unidentified fungal spores.

During the investigation period, the fungal spores contribute highest percentage i.e. 75.84%to the total airspora and other group shows 24.16% to the total airspora. From fungal spore group, Deuteromycotina shows highest concentration 53.47% followed by Basidiomycotina 16.11%, Zygomycotina 4.41% and Ascomycotina 1.85% to the total airspora. From the other groups, Pollen grains recorded large number in the airspora i.e. 6.516% followed by hyphal fragments 6.105%, unidentified fungal spores 2.984% and Insect parts and scales 2.566%. During the investigation period a total number of 14,98,210/m^3 fungal spores were recorded. Highest total of fungal spores was observed in the month of November 2,55,164/m^3. These observations are in accordance with investigations of Padmanabhan (1953) from paddy fields at Cuttack, Cunningham (1873) from Calcutta, Tilak (1982) from Aurangabad, Sing et al. (1990) from Manipur, Nayar J. (1993) from Secundarabad, Khillare (1996) from Kolhapur, Ambore (2003) from Aurangabad, Khedkar (2005) from Kada, Beed and Hogale (2008) from Karad.

Airspora over wheat field:-

Present investigation over wheat field was carried out from 1st November 2007 to 28th February 2008. During the investigation period 56 different types of biocomponents were recorded. Out of these 52 named fungal spore types and 4 from other group were observed. Out of 52 types of spores, 2 belonged to Zygomycotina, 13 to Ascomycotina, 2 to Basidiomycotina and 35 to Deuteromycotina group. Deuteromycotina showed highest contribution 56.589%, followed by Basidiomycotina 19.022%; other types 18.293%, Zygomycotina 4.212% and Ascomycotina 1.884%.

The airspora showed dominance of *Nigrospora*, Smut spores and *Alternaria* while *Cladosporium*, Uredospores, *Sclerospora* (Oospores), *Curvularia*, *Epicoccum*, *Pithomyces*, *Helminthosporium*, *Aspergillus*, *Phaeotrichoconis* and *Dictyoarthrinium* were common in occurrence.

Airspora over groundnut field:-

During the investigation period (1st March 2008 to 15th June 2008), 49 different types of biocomponents were recorded over groundnut field. Out of these 45 named fungal spore types and 4 from other group were observed. Out of 45 types of spores, 2 belonged to Zygomycotina, 11 to Ascomycotina, 2 to Basidiomycotina and 30 to Deuteromycotina group. Deuteromycotina showing highest contribution 49.544% followed by other types 31.551%, Basidiomycotina 12.438%, Zygomycotina 4.668% and Ascomycotina 1.800%.

The airspora showed dominance of *Cladosporium, Alternaria* and *Nigrospora* while Smut spores, Uredospores, *Sclerospora* (Oospores), *Curvularia*, *Epicoccum*, *Pithomyces*, *Helminthosporium*, *Aspergillus*, *Phaeotrichoconis* and *Dictyoarthrinium* were common in occurrence.

From above record, the wheat airspora is rich in fungal spores than the groundnut airspora.

Groupwise concentration of different fungi:-

Out of 58 biocomponents recorded during the investigation period, 54 spore types belonged to fungi and remaining 4 to group others (In group others included pollen grains, hyphal fragments, Insect scales and parts and unidentified fungal spores).

Out of 54 fungal spores, 2 types belong to Zygomycotina, 14 to Ascomycotina, 2 to Basidiomycotina and 36 to Deuteromycotina group.

During the investigation period, Deuteromycotina group dominated the airspora contributing highest percentage 56.589% and 49.544% to the total airspora over wheat and groundnut fields respectively. This group was significant and dominant both qualitatively and quantitatively. It was followed by other group showing 18.293% and 31.551%, Basidiomycotina 19.022% and 12.438%, Zygomycotina 4.212% and 4.668%, Ascomycotina 1.884% and 1.800% and to the total airspora over wheat and groundnut fields respectively.

The concentration of Zygomycotina with respect to other groups was very low. From the Zygomycotina group only two spores types were recorded i.e. *Cunninghamella* and *Sclerospora. Cunninghamella* was contributing 0.049% and 0.069% to the total airspora over wheat and groundnut fields respectively. The highest concentration was 294spores/m^3 in the month of January when the average temperature was 29.85°C and average relative humidity 59.7% and rainfall was 6 mm.

Diurnal Periodicity studies (Tilak and Babu, 1981) in *Cunninghamella* indicate their maximum occurrence during rainy days. The high concentration of these spores is associated with low temperature (25°C) and high humidity (91%) (S.T. Tilak 2009).

Sclerospora oospores were showing 4.164% and 4.515% to the total airspora over wheat and groundnut fields respectively. These observations are in accordance with Mane (1978), who for the first time reported the presence of oospores of *Sclerospora* over the bajara field at Vaijapur, Tilak (1991) in his review article entitled "Aeromycology – aspects and prospects". Khilare (1996) from Kolhapur, Pawar (1997) from Aurangabad, Deshmukh (2000) from Jalgaon, Patel (2002) from Nasik, Kshirsagar (2006) from Aurangabad and Hogale (2008) recorded occurrence of these spores during their studies.

The group Ascomycotina was represented by 14 spore types during the period of investigation. Their percentage contribution was 1.884% and 1.800% to the total airspora over wheat and groundnut fields respectively. Occurrence of many ascospores in airspora revealed the abundance of parasitic and saprophytic Ascomycetes in wheat and groundnut fields and surrounding area. The rainfall has its immediate impact on the release of ascospores has been suggested by Meredith (1962). The temperature and rainfall are the two important factors which greatly affect the development of reproductive structures. Among other meteorological factors, temperature also plays an important role in release and subsequent occurrence of ascospores. (Tilak, 1988). Similar observations were recorded by Kulkarni (1971), Pande (1976), Miss Qudsia (1997) and Patel (2002).

Among the 14 ascospore types, the spores of genera recorded in high number are *Leptosphaeria* contributing 0.571% and 0.573%, *Teichospora* 0.368% and 0.344%, *Hysterium* 0.325% and 0.298%, *Chaetomium* 0.182% and 0.220%, *Bitrimonospora* 0.120% and 0.047%, *Melanospora* 0.092% and 0.060%, and *Sporormia* 0.069% and 0.061% to the total airspora over wheat and groundnut fields respectively. The spores of *Lophiostoma*, *Pleospora*, *Hypoxylon*, *Pleomassaria*, *Massaria*, *Emericella* and *Valsaria* were insignificant in concentration.

During the investigation period, it was found that the group Ascomycotina showed considerable monthly variation in spore concentration as November 2.01%, December 2.01%, January 1.81% and February 1.66% in rabbi season while in March 1.56%, April 1.49%, May 1.96% and June 2.17% in summer season to the total airspora. The low concentration in March and April was due to high temperature and

low humidity. These observations are in accordance with Khilare (1996) from Kolhapur city, Ambore (2003) over the wheat field at Kanchanwadi, Aurangabad, Khedkar (2005) from Kada, Beed, Chavan (2006) from Raigad, Konkan and Hogale (2008) from Karad.

The group Basidiomycotina was represented only by smut spores and Uredospores. This group ranks 3rd order of dominance. During the period of investigation group Basidiomycotina contributes 19.022% and 12.438% to the total airspora over wheat and groundnut fields respectively. Smut spores were recorded in high concentration showing 12.614% and 10.455% to the total airspora over wheat and groundnut fields respectively. The Uredospores of the rust fungi were recorded 6.408% and 5.864% to the total airspora over wheat and groundnut fields respectively.

In India and other countries the smut and rust spores are common in air from Basidiomycotina group. Uredopores and chlymadospores of smut are commonly encountered during winter season and being pathogenic or allergenic in nature. Sreeramulu and Vitthal (1969) while studying periodicities of Uredospores above and within sugarcane field recorded peak concentration in December and January. The smut spores are encountered during dry, gusty and sunny period especially in the afternoon. Maximum dispersal of spores occurs between 11hrs and 15 hrs with a peak 14 hrs.it has been noted that moderate temperature and high humidity favours the disease incidence and spread. Along with this growth and age of host plant also favours the disease incidence and spread. These observations are in accordance with Deshmukh (2000) over gram field at Jalgaon. Ambore (2003) and Khedkar (2005) over wheat field at Kanchanwadi, Aurangabad, Kshirsagar (2006) over the sunflower field at Aurangabad, Chavan (2006) over paddy field at Raigad, Konkan and Hogale (2008) from Karad city and adjoining area.

The Deuteromycotina group was showing highest concentration contributing 56.589% and 49.544% to the total airspora over wheat and groundnut fields respectively. Khillare (1996) recorded highest number of Deuteromycotina fungi in outdoor and indoor environment at Kolhapur city, Banswadekar (2002) recorded over sunflower field at Udgir, Chavan (2006) recorded over paddy field at Raigad, Konkan and Hogale recorded from Karad city.

The group of Deuteromycotina was represented by 36 different spore types. The spores of this group were recorded more or less throughout the investigation

period. Out of 36 spore types, Nigrospora recorded the highest concentration 2,35,770 spores/m3 to the total airspora and contributed 12.995% and 10.055% to the total airspora over wheat and groundnut fields respectively, followed by *Alternaria* 11.002% and 11.946%, Cladosporium 8.294% and 11.009%, *Curvularia* 3.459% and 2.683%, *Epicoccum* 2.855% and 3.655%, *Pithomyces* 2.687% and 3.715% and *Helminthosporium* 2.340% and 2.179% over wheat and groundnut fields respectively.

Monthly percentage contribution of Deuteromycotina shows variations as in November 57.01%, December 55.28%, January 58.68%, February 56.33%, March 45.69%, April 48.33%, May 52.52% and June 51.56% in both the seasons. Further it was noted that more spore catch was found in November and December due to wet period while less in March and April months due to dry period.

Alternaria shows high concentration 11.516% to the total airspora. It is a severe pathogen causing Early blight disease of Solanaceous vegetables leading to considerable damage to crop. The spores were trapped throughout the investigation period with large percentage contribution. As reported by Hirst (1953), Kramer et-al (1964), Mane (1978), Shastri (1981), Khot (1985), Qudsia (1997) Deshmukh (2000) and Patel (2002).

There was high concentration of *Cladosporium* 9.584% to the total airspora. It is one of the main component of air causing biopollution, spores of this genus constitutes predominant type in the airspora and have been reported throughout the world. While discussing spore dispersal Gregory (1973) suggested that the mixed pickup mechanism may play a part in the dispersal of *Cladosporium*. The high percentage 2.213% of *Aspergillus* in the present studies might be due to decaying of plant material in the vicinity of wheat and groundnut fields.

Airspora of wheat and groundnut fields in Karad region was very rich in fungal spores. The seasonal variation occurred may be due to the factors like temperature, rainfall and humidity. In present investigation, high concentration of fungal spores was recorded in the months of November and December due to low temperature and high humidity in the atmosphere which favours the fungal growth. The environmental factors are affecting occurrence of spores in the air, similar to Pawar (1997) from Aurangabad, Deshmukh (2000) from Jalgaon, Patel (2002) from Nasik, Khedkar (2005) from Aurangabad, Chavan (2006) from Raigad Konkan and Hogale (2008) from Karad.

In this investigation *Emericella*, *Lophiostoma*, *Valsaria*, *Massaria*, *Beltraniella*, *Pleospora* and *Brachysporium* were first time recorded in the atmosphere of Karad. These observations are in accordance with investigation of Patil (1988) from college library area at Karad and Hogale (2008) from aeromycological studies of Karad city and adjoining area.

Groupwise concentration of Other group:-

Present investigation also includes the study of hyphal fragments, pollen grains, insect parts and scales, and unidentified fungal spores included in the other groups. They were reported separately and this group shows 4,73,343 spores/ m3 to the total airspora contributing 18.293% and 31.551% to the total airspora over wheat and groundnut fields respectively. From other group, Pollen grains contributed high percentage 6.554% and 6.353% to the total airspora over wheat and groundnut fields respectively. It was followed by hyphal fragments 6.630% and 5.347%, unidentified fungal spores 2.679% and 3.308% and insect scales and parts 2.430% and 2.688% to the total airspora over wheat and groundnut fields respectively. These observations are in accordance with investigations of Patil (1981) from hospital airspora at Kolhapur, Patil (1988) from college library area at Karad, Khilare (1996) indoor and outdoor airspora from Kolhapur, Banswadekar (2002) over sunflower field at Udgir, Chavan (2006) over paddy field at Raigad, Konkan and Hogale (2008) from Karad city.

Maximum concentration 33.66% of unidentified spores was in the month of June. These spores could not be identified and classified because of their unsuitable orientation on the adhesive surface or because they were practically obscured by debris or other particles.

Hyphal fragments constitute an important contributor of airspora. It shows higher concentration 35.04% in the March. Many of hyphal fragments are capable of growth and thus act as 'reproductive propogules'. (S.T.Tilak, 2009). The role of hyphal fragments as pathogens and allergens has attracted the attention in recent years. Aeromycological survey by Pady and Karmer (1960) recorded 43% of hyphal fragments. Aeromycology of hyphal fragments at Aurangabad has been reviewed by Tilak and Bhalke (1978). The seasonal variation of the hyphal fragments clearly revealed its close correlation with meteorological factors like rainfall, temperature, relative humidity and wind velocity.

Pollen grains also contribute a major part of airspora. Pollen grains are transmitted by insects, human beings, animals and wind. The pollen grains show high percentage in dry and windy season. Pollen grains contribute high percentage 34.79% in the March. Tilak and Vishwe (1980), Tilak et.al (1999) recorded serious allergic disorders due to air borne pollen grains.

Insect scales and parts also show considerable concentration in the airspora. It constitutes maximum percentage 28.65% in March. Tilak and Bhalke (1978) presented a report on concentration of insect parts from Aurangabad. Further Tilak (1982) observed the abundance of insect parts is closely related with meteorological conditions, while high wind velocity also lifts the insect parts up in the air.

Monthly percentage of the other group showed variation as in November 17.50%, December 20.18%, January 17.21%, February 18.48%, March 32.35, April 33.15, May 28.45 and June 32.15% to the total airspora during the investigation period.

The present aeromycological studies on wheat exhibited certain characteristics during the investigation period. The temperature and humidity has profound effect on the growth and development of spores. This probably explains high concentration of spores during wet period and considerable low concentration in dry period.

Gregory (1961) noted that the atmospheric spore concentration fluctuates according to meteorological conditions; it also fluctuates for the growth and differentiation of spore producing organisms. Hirst (1953) has shown that pollen and spores of *Cladosporium*, *Alternaria*, rust and smut mostly removed by prolonged rain and are replaced by damp airspora.

Wind velocity also plays a significant role along with the humidity, temperature and rainfall in increasing the number of spores in the spore catch. High wind velocity carries more spores than air massed with low velocity. The present studies confirm this and shows considerable increase in the concentration of spores and other types in spore catches.

The disease development and spread does not occur unless certain requirements are fulfilled. Weather conditions play an important role in seasonal development of many plant diseases. Along with this the susceptible crops are also responsible for disease development. The relation between weather and disease development is the basis on which disease occurrence can be predicted. Meredith (1971) has suggested that in few cases knowledge of mechanism of spore release has

helped in devising an effective disease forecasting system which in turn has resulted in improved and cheaper control measures.

During the investigation period some allergic fungal spores are also recorded. As suggested by Chaubal and Deodikar (1964) that air borne pollen and spores of some species are known to cause many mild or serious allergic reactions in sensitive persons. The spores of *Cladosporium*, *Aspergillus*, *Alternaria, Helminthosporium, Epicoccum* and Uredospores of *Puccinia* recorded in this investigation are known to cause allergic reactions. (Tilak and Pande 2004). The percentage contribution of these allergic spores was 35.052% to the total airspora.

Many of the spores from studies are found to be responsible for biopollution in the air and biodeterioration. Biodeterioration includes rotting, mechanical damage, staining and spoilage of material. Rajan et.al (1952) were the first to introduce such type of investigation in India. The spores of *Cladosporium*, *Aspergillus* and *Alternaria* are responsible for biodeterioration and playing important role in microbial population which has resulted in destruction of cereal grains, vegetables in storage leading to incidence of many diseases.

Disease forecasting has become more important in India, due to large scale adaptation of new agricultural strategy for increasing food production. Development of effective forecasting system requires deep knowledge of interaction of pathogen population with various environmental factors including plant host. The information about environmental conditions which affect perpetuation of pathogen will enable the farmer to be alert with regards to incidence of diseases this will help in organizing preventive campaigns.

Considerable work has been done in this regard in India. Various methods of disease forecasting have been suggested by Indian workers such as Tilak (1984), Nagarjan and Singh (1976), Mallaiah (1989). The present work along with the work of Indian and Foreign scientists will definitely helpful in solving this problem. The result obtained and conclusion drawn would definitely enable to serve as the basis of devising disease forecasting system and will help in efficient control of diseases in the wheat and groundnut crops.