GENERAL INTRODUCTION
Ever since the introduction of the term "phyllosphere" independently by Last (1955a,b) and Ruinen (1961) and subsequently by Dickinson (1965) using the term "phylloplane" for phyllosphere of Last, the study of leaf surface microflora has attracted the attention of different workers (Lamb and Brown, 1970; Sinha, 1971; Dickinson, 1971, 1976; Mishra and Srivastava, 1971b, 1974; Mishra and Tewari, 1976b; Sharma and Mukerji, 1976; Gupta and Mukerji, 1982; Gupta and Dixit, 1983).

Leaf surface holds a fascination especially for microbial ecologists because of its complex nutrient spectrum which supports a rich microflora. The study of the qualitative and quantitative composition of the epiphytic micro-organisms on leaf surface as well as the investigation of their activities constitutes an important problem concerning the inter-relations between plants and micro-organisms.

Considerable interest has developed recently (Narula and Mehrotra, 1981; Khara and Singh, 1981; Rao and Manoharasahary, 1981; Pennycook and Newhook, 1981; Ahuja and Payak, 1981; Kumar and Singh, 1981; Miller and Roy, 1982, Gupta and Mukerji, 1982) in investigating the various types of micro-organisms which occur on leaf surface at various stages of plant growth and also during the changing environments.

An understanding of the nature, periodicity and density of the fungal propagules in the air is much helpful in making a
forecast regarding the occurrence of fungal diseases and the quantum of viable pathogenic propagules likely to cause infection. Very little work has been done on this aspect in India (Mishra and Srivastava, 1970b, 1971a, 1972; Mishra, 1972; Mishra and Tewari, 1976a; Kumar and Gupta, 1976, 1980; Dixit and Gupta, 1980). The effect of air fungal population over different fields in relation to the leaf surface fungi has not been studied in detail excepting a few workers (Mishra and Tewari, 1976a; Kumar and Gupta, 1980). By understanding a survey of the aero-mycocflora of different regions, some knowledge about the various human pathogens which are responsible for allergenic diseases may be obtained since 80% of them are caused by fungal spores (Agarwal et al., 1968).

Leaf surface is well known to harbour a definite microbial community by virtue of the presence of leachates (Godfrey, 1976; Irvine et al., 1978). The different microbial populations in such a community interact with one another by competing for space and nutrients, by production of secondary metabolites and also the antibiotics (Fokkema, 1973; Hudson, 1978). Earlier workers (Last, 1955a; Ruinen, 1956, 1961; Dickinson, 1965, 1967) studied the microflora of different plant species without laying much emphasis on the mutual interaction of the micro-organisms associated with leaf surfaces. Studies relating to mutual antagonism of the micro-organisms and the possibilities of biological control of
some pathogens opened a new field of investigation to the
pathologists (Fokkema, 1973, 1978; Mishra and Tewari, 1976c;
Sharma and Gupta, 1978, 1980; Rao et al., 1978; Tsuneda and
Skoropad, 1980; Rai and Singh, 1980; Purkayastha and
Bhattacharya, 1982; Papavizas et al., 1982). Thus the role
of phylloplane saprophytic fungi in biological control in
certain epidemic diseases may be important and if properly
exploited it may offer an alternative to the synthetic
fungicides (Srivastava et al., 1981; Purkayastha and
Bhattacharya, 1982; Gupta and Dixit, 1982; Trutman et al.,
1982; AbdElmoity et al., 1982; Elad et al., 1983).

In addition, a large number of nitrogen fixing
organisms are present on the leaves of plants growing on
nitrogen deficient soil (Pilla! and Sen, 1966). Supplied
with moisture from the atmosphere and nutrients in the form
of leaf exudates, such organisms may fix considerable amount
of nitrogen. Recently, considerable interest has developed
on this aspect and many workers are trying out different
micro-organisms which might play a role in the growth and
nitrogen nutrition of host plants and in turn may increase
the yield of plants (Kvasnikov et al., 1974; Blasco and
Jordan, 1976; Remacle, 1977; Capone and Taylor, 1977;
Banerjee and Chandra, 1978; Sadykov and Umarov, 1980a, b;
Nandi and Sen, 1981, 1982; Sadykov, 1981; Sengupta et al.,
1981; Nandi et al., 1982a, b).
Further, the studies on leaf surface mycoflora are also helpful in screening out the decomposers which are responsible for active turnover of minerals from leaf litter (Gupta, 1982). The potentialities of organic plant residues as fertilizers is well recognized (Whitehead, 1963; Chatterjee et al., 1979). However, the suitability of the organic material as fertilizer depends to a great extent on its rapidity of mineralization and quick liberation of the nutrients (Goluke et al., 1954). Much work has already been done on this aspect (Garrett, 1963, 1980; Harley, 1971; Kalekar et al., 1976; Wani and Shinde, 1980; Bhardwaj, 1980).

The excretion of nutrients by leaves has now been an established fact (Sinha, 1965; Godfrey, 1976; Irvine et al., 1978). The leaf leachates or exudates greatly influence the quality and quantity of micro-organisms occurring on the leaf surfaces (Tukey, 1971; Tyagi and Chauhan, 1982). Very little work has been done to study the biochemistry of the leaf leachates at various stages of growth of the plants (Tewari, 1973; Mishra and Tewari, 1976b, 1978; Tyagi and Chauhan, 1982). For explaining the population dynamics of the phylloplane mycoflora physico-chemical characteristics of the leaf surface environment should be properly understood (Mishra and Tewari, 1976b).

Further, stimulatory effect of leaf surface nutrients on the microflora has been reported by Brown (1922) and Mishra
and Srivastava (1970a), whereas Purkayastha and Deverall (1965) found that growth of Botrytis cinerea was inhibited by substances arising from the leaf cells. Detailed study on the overall effect of the leaf and leaf surface nutrients on the phylloplane fungi is, however, not available for most of the plants excepting a few reports in the literature (Mishra and Tewari, 1978; Tyagi and Chauhan, 1982). Thus an investigation of the spectrum of chemical compounds (aminoacids, sugars, organic acids and phenols) available on the leaves of different plants in relation to their effect on the spore germination of phylloplane fungi is warranted (Tyagi and Chauhan, 1982).

Also, the effect of pollen on the saprophytic mycoflora of the phylloplane has not been studied in detail. It has been observed by some workers (Ogawa and English, 1960; Bachelder and Orton, 1963; Chu-chou and Preece, 1968; Chu-chou, 1970; Fokkema, 1968, 1971; Warren, 1972, 1976; Garg and Sharma, 1982) that presence of pollen grains affects the establishment and infection of leaf-pathogens by changing the saprophytic mycoflora of the phylloplane. Any factor which might alter the balance between phylloplane micro-organisms and pathogens on leaf surface may be of significance in the understanding of disease-development (Garg and Sharma, 1982).

Relatively little work has been done to understand the ecology and role of naturally occurring microbes on the leaf
surface. Considering the significant role played by the phylloplane fungi in controlling diseases on crop plants, the present investigation was undertaken to study the various ecological aspects of the phylloplane fungi. The work was undertaken to find out the extent of host influence on building up of microbial communities under similar climatic conditions.

In North-Eastern part of India where rice is the staple food for the people, paddy constitutes one of the most important crop. Many epidemic diseases are reported on paddy from this region. Considerable loss in yield was noted during the great famine of Bengal, in 1942-1943 caused by brown spot disease of rice. There was almost failure of the paddy crop and the losses in yield upto 90% in Bengal (Ghose et al., 1960) and in weight of grains ranging from 4.6 to 29% in Punjab (Bedi and Gill, 1960) were recorded due to infection by *H. oryzae*.

The present study was undertaken on three varieties of paddy which are commonly grown in North-Eastern region of India. The three varieties exhibit different degree of response in relation to *Helminthosporium oryzae*: Khonorullo is a disease resistant variety; Ngoba, a local variety is moderately resistant and Mirikrak, is a disease susceptible variety.

Therefore, work was taken up to screen different saprophytic fungi which may be exploited for the biological control of the pathogen *H. oryzae* which causes brown spot
disease of rice. The present study was designed to follow the pattern of fungal colonization on paddy leaves from initial expansion stage through maturity and up to senescence.

It is now well recognized that studies on ecology of micro-organisms depend on the careful selection and application of proper techniques of isolation (Dickinson, 1971). For proper studies of phylloplane, simultaneous use of several techniques have been strongly recommended for getting a complete spectrum of the fungal flora (Sharma et al., 1974; Dickinson and Wallace, 1976; Gupta, 1982). Therefore, several complementary techniques, viz., direct observation (Edward and Hartman, 1952; Masurovsky and Jordon, 1960), moist chamber (Keyworth, 1951), leaf impression plate (Potter, 1910), dilution plate (Dickinson, 1971) and washed leaves plating (Macauley and Thrower, 1966) were used simultaneously. Further, nutrient medium used also influences the isolation of different fungi (Tsao, 1970). Hence several media viz., Czapek's Dox agar, Potato dextrose agar and cellulose agar were tried to find out best combination of media on which maximum number of fungi could be isolated.

Most of the earlier studies on biological control have been done in vitro, adopting dual culture method by observing the inhibition potentiality of the pathogen by different test fungi. These studies often ended with doubts about their success in controlling the pathogens in vivo as a result, there is a lot of discrepancy between laboratory and field studies.
(Heuvel, 1970; Roy, 1977; Rai and Singh, 1980; Purkayastha and Bhattacharyya, 1982). Thus in the present studies, after screening the potential antagonists of the pathogen, **H. oryzae** in *vitro* their success in controlling the brown spot disease of paddy in pot experiments were also tried.

There is still ample scope for further research on this important field of microbial ecology which may open up many unexplored vistas which will in turn help in solving the various ecological problems.

The studies during the present investigation has been classified into following 7 chapters and each aspect will be discussed separately.

I. Assessment of the fungal flora from the phylloplane regions at different developmental stages of the plant.

II. Survey of air fungi of the site where the three varieties of paddy were growing and the evaluation of their impact on the leaf surface mycoflora.

III. Screening and isolation of the pathogen from the leaf surface and the studies on the role of different factors which control the occurrence of the pathogen (**H. oryzae**).

IV. Interaction studies in *vitro* and in *vivo* between certain epiphytic fungi and the pathogen obtained from the phylloplane of paddy plants and also the exploitation of the effective epiphytes in the biological control of the pathogen.
V. Competitive ability of the phylloplane fungi on the leaf surface and their germination in leachates obtained from different ages of the three varieties of paddy plants.

VI. Biochemical analysis of the leaf leachates and leaf extracts and their role on the colonization of the phylloplane fungi.

VII. Effect of pollen on the saprophytic and pathogenic mycoflora of the phylloplane.