SOME STUDIES ON THE AEROBIOLOGY OF SHILLONG

(MEGHALAYA)

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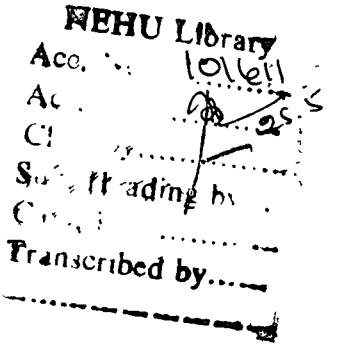

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CERTIFICATE

We certify that the thesis entitled "SOME STUDIES ON THE AEROBIOLOGY OF SHILLONG" submitted by Miss Mangla Satpute for the degree of DOCTOR OF PHILOSOPHY of the North-Eastern Hill University embodies the record of the original investigation carried out by her under our joint supervision. She has been duly registered, and the thesis presented is worthy of being considered for the award of the Ph.D. Degree. This work has not been submitted for any degree of any other University.

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SECTION I

General Introduction

General Introduction

Aerobiology is an interdisciplinary science which deals with the study of transport of organisms and biologically significant materials in the atmosphere. The biological components follow a definite aerobiological pathway i.e. source of organisms or a materials release, dispersion, deposition and impact on animal, plant or human systems. Environmental features affect each stage. Atmospheric pollen grains and fungal spores surveys carried out in many parts of the world provide valuable data on the pollen and spore types and their frequency in the air during various seasons of the year. This information is a must for forecasting any disease in plants or human beings.

Researches on aerobiology are now gaining momentum in India with the advancement of the knowledge on the air borne agents like spores, pollen grains, fragments of different plants etc., which are responsible as the causal agents of certain types of human allergic and plant diseases. Thus, works on aerobiology have been initiated at few centres like Delhi, Mysore, Waltair, Jaipur, Calcatta, Aurangabad, Lucknow, Nagpur, Banglore and Gauhati. However, no such studies have so far been conducted in mountain or hilly regions such as Shillong, except for a few scattered accounts(Singh and Baruah, 1979).Keeping the importance of such studies in view, the present study has been conducted.

The present study has been carried out under the seven sections.

First section deals with the climate, geography and vegetation of this area, as these are of prime importance for Aerobiological studies.

The study of pollen grains and spores are covered by the term palynology. Therefore, aerobiological studies when confined to pollen, spores and associated plant materials are known by the term "Aero-palynology" (Erdtman, 1952). The pollen flora and pollen morphology is taken into consideration in the third and fourth section respectively.

The need for intensive aerobiological studies has been emphasized by both clinicians and botanists during recent years. A knowledge of diurnal and seasonal fluctuations in the concentration of atmospheric pollen and fungal spores is of paramount value in the diagnosis and therapeutic treatment of human allergic and plant diseases. In an attempt to understand how the atmospheric content of pollen grains and fungal spores vary with weather, Aerobiological studies have been conducted in two parts, (1) seasonal variation and (2) diurnal variation in the fifth section.

Sixth section deals with the comparative study of air, leaf surface and soil mycoflora at different altitudes with different crop plants. Attempts have been made to compare the air, leaf surface and soil mycoflora to investigate the origin of spores. Further, the seasonal variation of air,

leaf surface, and soil mycoflora has also been studied.

ENVIRONMENTAL FEATURES

Location and Physiography

Shillong, the capital city of Meghalaya and one of the beautiful hill stations in India lies between $23^{0}54'$ N latitude and $91^{0}56'$ E longitude in the North-Eastern India. The altitude of the place varies from 1080 m to 1990 m, with the highest peak lying in Shillong Peak.

Physiographically the area is hilly with steep escarpments having shallow or deep valleys with swift flowing rivers and streams. These flow either northwards to the plains of Assam or southwards to the plains of Bangladesh. The physiography of Shillong consists of a big block of open high land at the centre with series of smaller ranges of hills and hillocks clothed with a luxuriant vegetation.

The area may be divided into 3 main physiographic units namely:

(i) The low hills of the northern belt: This comprises of the northern part of Shillong, ascending upwards from Barapani to Mawlai with an elevation below 1200 m. Here no steep escarpments are found. The river Umtrew takes its origin from the foot of Sohpetbneng peak by the

side of Barapani area.

(ii) The central upland zone: This unit comprises of central Shillong from Mawlai eastwards to Mawpat; southwards to Nongthymmai, Happy valley; and then westwards to Upper Shillong, Shillong Peak and Laitkor Peak. Many of these peaks are above 1500 m. A number of small rivers like Umiam, Umkhen and Umngot arises from this zone.

(iii) The hills and valleys of southern belt: This zone comprises of southern Shillong (below 1350 m). The hills in this belt show north-south alignment, and in many places they slope steeply and abruptly. The rivers Kynshiang, Umiew and Umngi flow towards south only cutting deep valleys through the cretaceous sandstones on their way and in many places the archaean shields have been exposed.

Constant erosion of the face of the escarps by wind and rain waters have led to the formation of many structural platforms here and there.

Climate

Shillong is one of the healthy hill stations of India with a cool climate. Based on climatic factors, although 4 seasons are recognised only 2 seasons are evident. The 4 seasons are:

1. Spring season (From March-April)
2. Summer season (including rainy season; May-September)
3. Autumn season (From October-November)
4. Winter season (From December-February).

Temperature

There is gradual increase in temperature from March. The average maximum temperature recorded at Shillong for two years is 23°C and average minimum is 7°C. There is gradual decline in temperature from November onwards, reaching its minimum during December-January, when it comes down to as low as 5°C. Sometimes during nights the temperature goes down to even below 0°C. Though snowfall is not experienced, there is heavy frost during early mornings, and this kills most of the herbaceous vegetation and the area looks dry and barren. Depression are frequent during this period when the cyclone occurs over the Bay of Bengal.

Rainfall

Rainfall is spread over throughout the year except during November-January. But heavy precipitation occurs from middle of May to end of September with June and July receiving the highest downpour. Though Shillong is situated just 40 Km north of Cherrapunjee and Mawsynram which receive an annual

rainfall of 12000 mm, the rainfall in Shillong is considerably less. The reason is that its higher hills act as barriers and lessen the intensity of rain bearing clouds. The least rainfall recorded was in 1980 (32.5 mm) and 1981 (13.6 mm) and the highest rainfall recorded was in 1980 (408.90 mm) and in 1981 (586.1 mm). The direction of the monsoon in Shillong is mostly south-westerly.

Humidity

The relative humidity is constant throughout the year owing to its experience of heavy rainfall. The weather does not become dry except during the winter months when very low humidities are recorded (Table 1).

GENERAL VEGETATION OF SHILLONG

A knowledge of the ground vegetation and the factors that influence the vegetation is of prime importance for Aerobiological studies, specially for Aeropalynology. Therefore, a brief vegetational account of the area is given below.

The vegetation of Shillong can broadly be studied under (a) sub-tropical pine forests, (b) the rolling grasslands, (c) mixed evergreen forests and (d) temperate forests.

Sub-tropical pine forests:- These forests are

Table 1. Meteorological data of Shillong (1980-1981).

Month	Temperature (Monthly average) Max °C		Min °C		Humidity (Monthly average in %)		Rainfall (Monthly total in mm)		Duration of sunshine (monthly average in hrs.)		Wind velocity (Monthly average in Km/hrs)	
	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981
January	14.2	14.3	06.9	05.9	64	65	000	34.5	7.18	6.5	3.26	3.16
February	17.8	17.2	7.48	07.4	62.99	69	32.5	20	7.55	7.9	5.32	5.28
March	20.18	20.0	11.24	10.7	60.13	63	34.7	45.9	8.96	6.3	7.29	6.51
April	25.11	20.5	15.16	12.0	66	68.5	80.40	192.0	9.29	6.2	10.1	6.88
May	22.62	18.9	14.55	14.4	79.5	84.5	261.80	401.0	4.38	5.2	6.22	4.29
June	23.64	23.4	17.41	17.1	88	85	408.90	263.4	3.24	4.3	8.55	3.3
July	23.74	23.1	18.91	17.7	87	88	312.9	586.1	4.08	3.1	1.77	3.41
August	24.21	23.8	17.59	17.6	86	86.5	218.5	539.4	4.19	4.4	3.25	2.6
September	22.55	23.5	16.71	16.3	88	84.5	315.9	239.4	3.2	4.1	12.33	11.36
October	20.5	22.0	13.6	13.7	82	80	224.3	13.4	6.0	7.4	2.12	1.87
November	10.7	19.9	10.3	10.8	74	72.5	000	000	8.3	8.2	3.56	3.7
December	13.70	15.4	7.98	07.0	78	78	7.5	87.2	7.5	7.6	2.87	3.83

confined to elevations upto 1800 m in Shillong and are the most dominant type of forests, although these forests do not represent a climax type. The predominent pine species here is Pinus kesiya Royl. ex Gordon.

Ascended upwards from Barapani, the broad-leaved forests are gradually replaced by these pine forests. These pine forests in many places harbour some angiospermic trees also, but their number and density is very negligible. Some of the common trees belong to Schima wallichii (DC.) Choisy, Schima khasiana Dyer., Acacia mollissima, Engelhardtia Willd., spicata Bl., Rhododendron arboreum Sm., Alnus nepalensis D. Don, Rhus semi-alata Murr., Quercus spp., and Symplocos spp. Among the shrubby species Lantana camara Linn., Eupatorium spp., and Pieris ovalifolia D. Don are common. The floor underneath is covered with a thick carpet of pine needles and support very little of herbaceous flora. The dominant ones are Eupatorium spp., Anaphalis spp., Artemisia parviflora Cav., Cardamine hirsuta Linn. and members of Rosaceae and Ranunculaceae. Aeginetia indica Linn., a curious member of Orobanchaceae makes its appearance in some forests among pine litters during August-October. Often the humus cover by pine needles underneath is checked by artificial burning and this has a devasting affect on herbaceous flora.

Moderately shaded areas support grass-legume

association which are subjected to grazing and scrapping in some places. The common leguminous species are Trifolium repens Linn., Desmodium heterocarpon (Linn.) DC., Crotalaria ferruginea Grah. ex Benth. and Smithia spp. These are associated with grasses like Panicum spp., Eragrostis nutans Nees, Sporobolus fertilis, etc.

Association of several terrestrial fern species make the ground vegetation markedly significant. Species like Pteridium aquilinum (Linn.) Kuhn, Pteris quadriaurita Retz., P. wallichiana Ag., Dicranopteris linearis (Burm.) Underw., Onychium japonicum (Thunb.) Kurz and several species of Thelypteris and Cyclosorus form a close association with grasses and leguminous species. Epiphytic flora is very poor in these forests due to lack of mossy habitat. However, certain xerophytic species belonging to Polypodiaceae do occur here and there. Lepisorus excavatus (Bory) Ching, Pleopeltis kashyapii (Mehra) Alston & Bonner, P. loniformis (Wall. ex Mett.) Moore, P. thunbergiana Kaulf., Pyrrosia manii (Gies.) Ching, P. mollis (Kuntze) Ching, etc. are some such species.

During peak winter much of the herbaceous flora is killed and only the hardier species manage to thrive. But those species which grow near ravines and streams however remain evergreen throughout the year. The common such species

are Lindsaya spp., Dryopteris spp., Lygodium spp., Onycnium japonicum (Thunb.) Kuntze, Pteris spp., Selaginella spp., and a few others.

The rolling grasslands:- The grasslands in Shillong represent only a seral condition and can be seen around Barapani and above, Golflink, Laitkor peak, etc. The dominant grasses in these grasslands belong to Eragrostis tonella (Linn.) P. Beauv., E. coaractata Stapf., E. unioloides (Retz.) Nees, Chrysopogon aciculatus (Retz.) Trin., Echinochloa colonum (Linn.) Link., Sacciolepsis indica (Linn.) A. Chase, Paspalum distichum Linn., Oplismenus burmanni (Retz.) P. Beauv. and Panicum spp. These grasses are associated with sedges like Cyperus haspan Linn., C. difformis Linn., C. rotundus Linn., Fimbristyl is tetragona Br. and F. aestivalis Vahl.

Apart from giving a green look to these barren hills, they also support other Angiospermic plants like Trifolium repens Linn., Hypochaeris radicata Linn., Sonchus oleraceus Linn., Anaphalis spp., and Chrysanthemum spp.

Besides these angiospermic plants one can also observe the scattered patches in these open grasslands formed by various fern species. There are associations of Pteridium aquilinum (Linn.) Kuhn and Dicranopteris linearis

(Burm.) Underw. in open places. Along the road cuttings Gleichenia longissima Bl. and G. volubilis Jungh are very common and these two species are closely associated with Brainea insignis (Hook.f.) Sm., Blechnum orientale Linn., Lindsaya cultrata (Willd.) Sw., Sphenomeris chinensis (Linn.) Max. and in some places Osmunda regalis Linn.

Much of these herbaceous species are either killed or lie dormant during the severe winter months and this coupled with grazing by animals and recurring annual fires favour the growth of many grass species and checks the growth of other plants.

Mixed evergreen forests:- These forests are confined to very much restricted areas and are much disturbed. The forests here are dominated by Schima wallichii (DC.) Choisy, Alnus nepalensis D. Don, Quercus spp., and members of Rosaceae.

The fern flora is quite diverse in species composition. There are scattered thickets of Gleichenia - Dicranopteris evecta (Forst.) Hoffm., Crypsinus hastatus (Thunb) Copel., Arthromeris wallichiana (Spr.) Ching., Athyrium spp., Polystichum spp., Pteris biaurita Linn., P. cretica Linn., and among the fern allies Selaginella spp. are some of the dominant terrestrial species which cover the

rich humus floor of these forests. Among the epiphytic species members of Polypodiaceae and Aspleniaceae top the list.

Along the freshly turned cut slopes and road cuttings Lindsaya cultrata (Willd.) Sw., Sphenomeris chinensis (Linn.) Max., are the two important early colonizers, which are gradually replaced by Dicranopteris linearis (Burm.) Underw., Brainea insignis (Hook.) Sm., and Blechnum orientale Linn.

Temperate forests:- These are confined to elevations from 1800 m and above, chiefly in Upper Shillong and Shillong Peak. The 'Sacred grooves' in Shillong represent the true temperate vegetation. These sacred grooves are the virgin forests and are untouched due to religious beliefs of the local people, and thus represent the 'relict' flora and gives us an indication of the type of vegetation that must have prevailed in these areas.

These forests are very dense and show clear stratification. The branches and trunks of trees are heavily plastered with epiphytic growth of lichens, mosses, ferns and orchids. The common epiphytic ferns are Asplenium nidus Linn., A. normale Don, Davallia spp., Drynaria propinqua J. Sm., Loxogramme involuta (Don) Presl., Pleopeltis spp.,

Pyrrosia spp., Polypodium argutum Wall. ex Hook.f, P. subauriculatum Bl., Vittaria elongata Sw., Lepisorus spp., and among the fern allies Lycopodium setaceum Buch.-Ham., L. hamiltonii Spr., L. squarrosum Forst. form the striking feature of the vegetation. In general the polypodiaceous members top the list of epiphytic ferns. These ferns have seasonal growth, flourishing mainly during rainy months (June-October) and undergo a period of dormancy during the severe winter months (November-January).

Some of the rocks lying deep inside the forests along the water course, are densly clothed with mosses and provide a suitable habitat for the free growth of a few ferns (lithophytes?) chief among which are Egenolfia appendiculata (Willd.) J. Sm., Elaphoglossum yunnanense (Bak.) C. Chr., Humata repens (Linn.) Diels, Mecodium spp., and Selaginella repanda (Desv.) Spr. On some of the comparatively drier rock surfaces species like Aleuritopteris spp., Cheilanthes spp., Adiantum venustum Don, Asplenium cheilosorum Kuntze ex Mett., Diplazium lanceum (Thunb.) Pr., Pteris vittata Linn., and Vandenboschia auriculata (Bl.) Copel. are very common.

The forest floor is covered with a dense mat of litter as there is no disturbance by way of forest fires, etc. Some of the shade loving angiospermic species like Anemone sp., Potentilla mooniana Wt., Impatiens spp., etc.

are closely associated with a large number of fern species chief among which are *Dryopteris paleacea* Hand-Maz., *D. nigra* Ching, *Diacalpe aspidioides* Bl., *Leptogramma pilosinscula* (Wikstr.) Alst., *Asplenium tenuifolium* Don, *Polystichum lobatum* (Huds.) Pr., *Rumohra aristata* Ching, *Coniogramme fraxinea* (Don) Diels and species of *Athyrium*, *Microlepia* and *Lycopodium* on the humus covered forest floor.

SECTION II

Review of Literature

Review of Literature

The word 'Aerobiology' was introduced by Fred C. Meier of the United States department of Agriculture to describe the microbial life in the upper air. The committee on Apparatus in Aerobiology (1941), has made a remarkable review of our early knowledge of aerobiology, from which it is known that Micheli observed clouds of fungal spores in the air, as early as 1729, and it was Micheli (1737) who first illustrated in 'seeds' of many fungi including mushrooms, cup fungi, moulds and slime. Further by sowing spores on fresh cut pieces of Melon and Pear, and reproducing the parent mould for generations, he could show that the spores of some common moulds were indeed seeds of the fungi. He noted, however, that some of his control slices also become contaminated, and he concluded that the spores of moulds are distributed through the air.

The minute growth of fungi noticed for centuries on mildewed or rusted plants were believed to be a consequence of the diseases. Perhaps the first to give reasonably affirmative evidence was Fontuna (1767), who examined and described wheat rust with his microscope. He saw them as a grove of parasitic plants nourishing themselves at the expense of the grain. Large (1940) reported that in some cases infection is acquired by planting in contaminated soil,

while others are carried on seed, and still others are spread in the wind by airborne fungus spores.

The discovery that microbes can cause diseases in human beings and animals came somewhat later, and the first animal pathogens to be recognized as such were again fungi. The idea that man, other animals and plants could become infected by microbes which set up pathological changes had been made acceptable by the analogy of sterile organic infusions that become seeded with putrefying microbes. The observation made by Blackley (1873), is of particular significance in the present context of aerobiology in relation to allergy. He proved by inhalation experiments on himself and others that this guess was correct, and demonstrated by trapping methods that pollen was at times present in the atmosphere in large quantities. He also showed by means of his sticky slides that air contains enough pollen during the grass-flowering season, for large quantities of pollen deposited on exposed surfaces.

After Blackley's pioneering work no progress was made in this field until 1910-1916, when fresh interest was aroused by the discovery of the fact that injections of pollen extracts can be used to desensitize patients who are allergic to pollen. Inhaled fungus spores were recognized

as allergens following the work of Cadham (1924) and Feinberg (1935) in North America.

Salisbury (1866) invented some form of the aeroconiscope, but were developed and modified fully by Maddox (1870); Cunningham (1773) in India and by Airy (1874) in England. The word 'aeroscope' has been used with some ambiquity, referring either to this type of instrument or to bubbles of the type described by Rettger (1910).

The various sampling techniques have different advantages and limitations. Scheppegrell (1922) used ordinary microscopic slides exposed without protection from rain. Blackley (1873); Wode-house (1945); Durham (1946); Hyde and Williams (1950) and Hyre (1950), have advocated the use of horizontal exposure of slide with the sticky surface, facing upwards in some form of shelter, open to the wind, but giving protection from rain.

A few workers have exposed petridishes horizontally to provide pollen deposits for visual examination (Hesselman, 1919; Ludi and Vareschi, 1937). Gravity sedimentation methods have been developed by Alvarez and Castro (1952) for the study of air borne fungi.

Vertical slide traps have also been sent fixed to kites, first apparently by Blackley (1873). A variety of

such devices were used by Mehta (1933) in his extensive studies of rust dissemination in India.

The slit sampler was designed primarily for indoor studies of bacteria by Bourdillon, Lidwell and Thomas (1941). The cascade impactor devised by May (1945), is a highly efficient suction trap. The automatic volumetric spore trap or Hirst trap devised by Hirst (1952), is a power-driven trap designed for operating continuously in the field. The Andersen sampler can be regarded as derived from the so-called 'sieve device' of duBuy and Crisp (1944) and the cascade impactor (Anderson, 1958).

From the results of the extensive aerobiological surveys conducted in U.K. and U.S.A., specially by workers interested in studies on respiratory allergy, dissemination of plant pathogens and quaternary palynology. However, it is clear that the patterns in the incidence of air-borne allergens differ considerably from place to place and season to season. In their intensive studies, Hirst (1952); and Richards (1954); Gregory and Hirst (1957); Hamilton (1959); Lacey (1962), and Davies (1963), they have discussed the seasonal and diurnal periodicity of spores of some plant pathogens and concluded that the air-spora of any locality may come from local sources, Gordon (1957) has provided ample evidence indicating the influence of locality on the

variations in pollen and spore content of the atmosphere which are of interest from an allergological point of view. Harvey (1970), Walkey and Harvey (1968), Hodgkiss and Harvey (1969, 1972), Harvey, Hodgkiss and Lewis (1969), in their intensive studies they have shown the diurnal and seasonal variation of air-spora in relation to climatic factors. McDonald (1979), has studied the effect of metereological conditions on the concentration of air borne pollen, and he has shown that the mechanism of pollen liberation depends on meteorological conditions; and that high rainfall depressed pollen dispersal. Further he has also shown that most species of fungi release their spores only at certain temperature, humidity and light conditions.

Markgraf (1980), has reported that the pollen production decreased quantitatively with increasing elevation.

Pollen statistics, pollen analysis, and more recently palynology (a term introduced by Hyde and Williams, 1944), are names given to a group of studies, including investigation of the ecology, vegetation and pre-history of quaternary period by examining pollens preserved in peat and other deposits. This is possible by virtue of the highly resistant sporopolenin of the pollen exine (Brooks et al, 1971). Aeropalynology is reviewed by Hyde (1969), and palynologists have contributed much to the development of aerobiology,

being well aware of the complications introduced by the occurrence of wind blown pollen from distant sources (Buell, 1947, Potter and Rowley, 1960).

Studies on pollen morphology virtually started with the work of Pro. R.P. Wode-house of U.S.A. and as embodied in his book 'Pollen grains' published in 1935. His work on pollen morphology was mainly a part of his aerobiological investigation and thus he placed concentrated attention on plants contributing to the air pollen flora. In India the Aeropalynological studies can be said to date by the work of Cunningham (1873).

Several decades after the momentous findings made by Cunningham, Mehta (1933), recovered fungal spores from the air on adhesive coated cellophane slips, attached to kites at Agra. His findings on the incidence of the spores of Puccinia, and of the transport of the respective spore from the infected crop plants growing in Himalayan hills to the wheat crops of the Gangetic plains has tremendous importance in relation to rust disease in India. Within the life cycle of the fungus have provided a permanent warning to cultivators and agricultural scientists in other part of the country, regarding the incidence and spread of the fungal disease. Later some medical scientists led by Kasliwal et al at Jodhpur, (1955) and Kalra et al at Pune (1957) made aerobiological investi-

gations with particular reference to pollen allergens.

A new decade of aerobiological research in India started with the studies made by Lokhanpal and Nair (1958) at Lucknow and at Almora in 1958 and 1960. Following the above studies elaborated investigation on the air born microflora, and its relation to allergy have been made by Shivpuri (1964) and his school in Delhi. Singh and Shivpuri (1968); Singh and Babu (1980) have studied the pollen allergy in Delhi. They have shown the seasonal variation in the pollen frequency of grasses in the atmosphere of Delhi area.

During the last 1-2 decade aerobiological studies in India have been conducted at different places such as Pune by Kalra and Dumbrey (1957), Jaipur by Sanghvi et al (1957), and Kasliwal et al (1959), Pondicherry by Saha and Kalyanasundaram (1962), Pune by Pushpa and Deodikar (1964), Gauhati by Baruah and Bora (1965, 1967), Mysore by Ramalingam (1971), , Aurangabad by Tilak and Srinivasulu (1971), Nagpur by Chitaley and Bajaj (1975), Bangalore by Agashe and Vinay (1975).

In Eastern India systematic aerobiological studies were initiated by Chanda and his co-workers (Chanda and Nandi, 1971; Chanda and Sarkar, 1972; Chanda, 1973; Chanda

and Mandal, 1976; Mandal, Chanda and Mukerjee, 1977). Pollination calender for Calcutta, Falta and Kalyani were published (Chanda, 1973; Mandal, Chanda and Mukerjee, 1977). Chanda and Sarkar (1972) have reported the incidence of air borne pollen in Greater Calcutta.

Similarly Gupta et al. (1960) have reported the fungal spores from the atmosphere of Jaipur. The spores of Alternaria, Fusarium and Helminthosporium were the common spores. Chitaley and Bajaj (1973,1974,1975) carried out aerobiological studies at high altitudes in Nagpur. According to Tilak (1974), Curvularia contributed 40% of the total air spora in Aurangabad. Vishnu-Mittre and Khandelwal (1973), reported the occurrence of 18 types of fungal spores in the air of Lucknow. Agarwal and Shivpuri (1974), reported that the atmosphere of Delhi was never free from fungal spores but their prevalence varied from hour to hour, day to day and month to month.

The contributions of Sreeramulu (1964), and his group in this field is quite significant. Their studies mainly deal with fungal aerospora in relation to plant pathology at Waltair. Sreeramulu (1967), stressed the need for existensive studies on air spora of out-door atmosphere which provides useful information regarding the dispersal of plant pathogens, allergens etc. Following this the air spora of crop fields

like rice, wheat, barley, sugarcane, groundnut, potato have been reported from various places (Konger and Baruah, 1958; Sreeramulu and Ramalingam, 1966; Rajkumar and Gupta, 1976; Dixit and Gupta, 1980; Mallaiah and Rao, 1981).

Some interesting studies on aerobiology in India were done by Sreeramulu and Ramalingam (1966). They reported on the seasonal quantitative and qualitative changes in the air-spora of a paddy field near Vishakhapatanam. They further reported on the four types of diurnal periodicity patterns of the fungal spore available in the atmosphere.

Ramalingam (1966-67) has reported on the atmospheric pollen over paddy fields. According to him an increase in temperature and wind velocity in the forenoon hours favoured high pollen incidence while increase in relative humidity or dew formation or cloudiness decreased it. Similar results were also reported earlier by Sreeramulu and Ramalingam (1964).

Sreeramulu and Ramalingam (1963), had worked out on the diurnal and seasonal periodicities in the air-borne spores. Diurnal and seasonal periodicities of some dominant constitutes of the air spora in India have been described by Sreeramulu and Seshavataram (1962), and Sreeramulu and Ramalingam (1961).

In the western countries normally an expensive

instrument is used i.e. Hirst spore trap, cascade impactor ext. To suit the Indian conditions, Ramalingam (1968) had derived an air sampler for routine aerobiological survey and reported his work done with this sampler; he recorded the visual and colony counts and estimated them to a number per cubic meter of air using the wind run recorded by an anemometer. Further to this Tilak (1970) also had developed a cheaper sampler to suit the conditions in India.

It has been suggested by different workers that an active population of fungi exists on the surface of physiologically active green leaves (Kerling, 1958; Ruinen 1961; Kendrick and Burges, 1962; Dickinson, 1965, 1966). Information of these mycoflora during plant growth, senescence and death is important because of the role they play in leaf decomposition in plant and animal disease, in causing allergies, and in antagonism, to cite a few reasons. Detailed information on the phylloplane is however, lacking (Dickinson, 1966).

Reports of the extensive investigations on the leaf surface mycoflora are given by Voznyakovskaya and Khudyakof (1960); Lesan (1961); Ruinen (1961); Last and Deighton, (1965); Sinha, (1965), Dickinson (1971). The population of saprophytic leaf surface propagules has drawn considerable attention, it is also known that these organisms play a significant role in the resistance mechanisms of

plants from air borne plant pathogens. The air spora of the different crops, and phylloplane flora of potatoes and paddy field has been studied by various workers (Gregory and Hirst, 1957; Ramalingam, 1971; Mishra and Srivastava, 1971; Rajkumar and Gupta, 1976). Studies on the interaction between various economically important plant pathogens and associated saprophytic microbes have also been done by different workers (Aka and Kuramato, 1968; Kapooria and Sinha, 1969; Mishra and Tewari, 1976) but the exact mechanisms involved in such saprophytic/pathogen interaction has rarely been elucidated. Although Bhatt and Vanghan (1962) reported that Cladosporium herbarum controlled Bortrytis cinerea disease of stroberries by increasing the pH of the substrate, by mycelial growth and by colonizing the available infection sites. The qualitative and quantitative estimation of the total population of the mycoflora in the soil and their seasonal variation have been worked out by different workers (Dixon, 1928; Waksman, 1944; Waid, 1962; Rama Rao, 1970).

Although the air-spora in phylloplane flora and soil mycoflora of different field has been studied by various workers (Gregory and Hirst, 1957; Rajkumar and Gupta, 1976; Ramalingam, 1966; Rama Rao, 1970) a comparative study of air leaf surface and soil mycoflora is lacking and therefore needs attention.

SECTION III

Flowering and Pollen Phenology

FLOWERING AND POLLEN PHENOLOGY

Introduction

Pollen grains constitute an important fraction of the atmospheric biopullutants, and a majority of them are responsible for causing various respiratory diseases in human beings. Practical palynology in the form of pollen calender is therefore, of prime importance to physicians, allergologists and others interested in the study of pollinosis.

A review of aerobiological studies in Shillong (Section 3) reveals a conspicuous lack of work on pollen and flowering phenology. Nevertheless, the area being a part of one of the richest Botanical region in the country with a dense and varied forest types ranging from broad leaved evergreen forests to narrow leaved pine forests, makes the study all the more necessary and important. Therefore, in the present section, flowering phenology of the most important

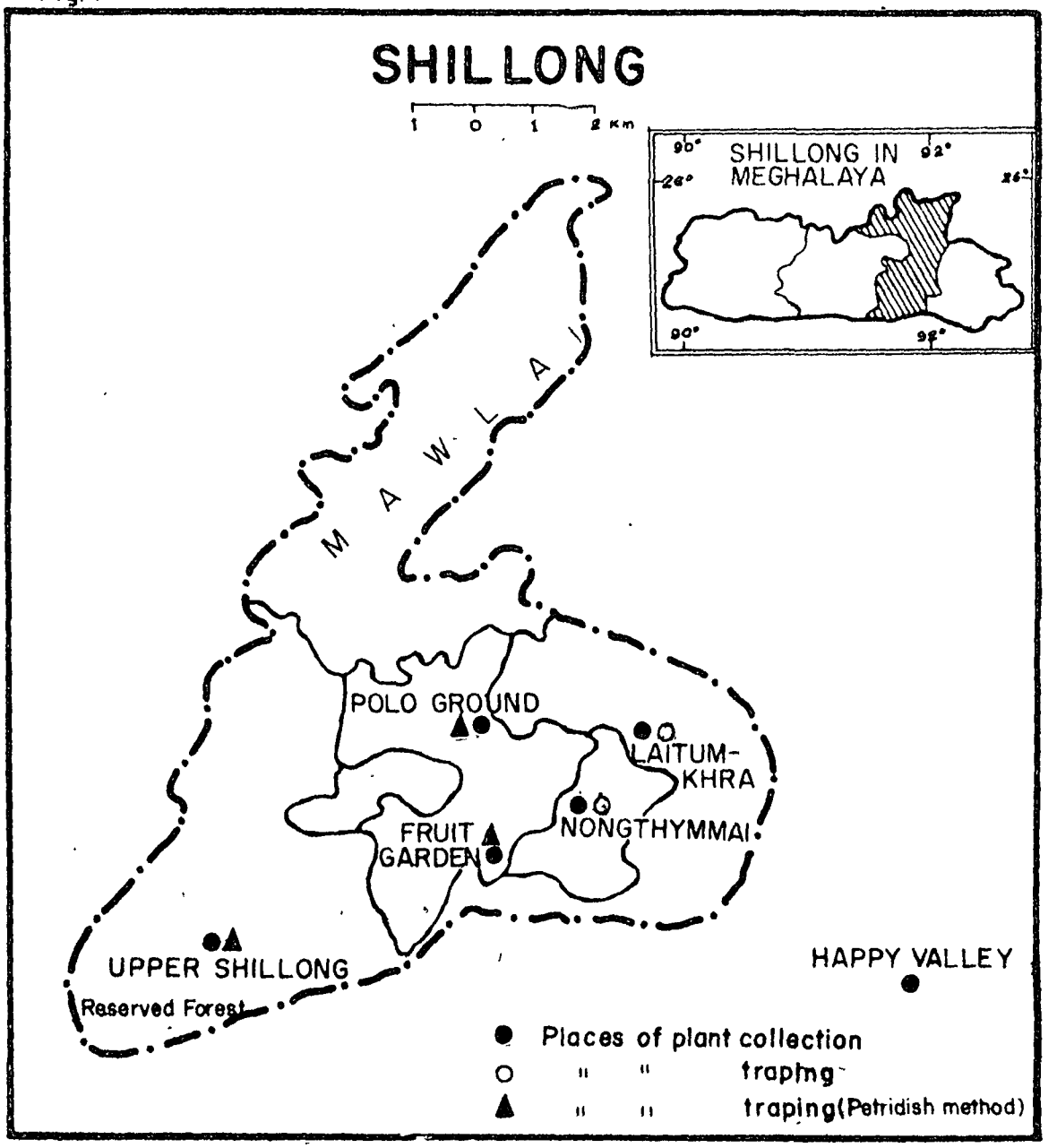
species has been attempted and this is based on regular vegetation studies in the area (Fig 2.1).

Materials and Methods

A knowledge of the ground flora is very important for any study conducted with Aeropalynology, specially for preparing pollen calenders. Therefore, regular field surveys (from November 1979 to November 1981) were conducted in and immediate vicinity of Shillong (± 14 Km.), for collection of flora and pollen of the plant species. Observation on flowering phenology were studied at fortnightly intervals. The plants collected were preserved in the Herbarium of North-Eastern Hill University following routine herbarium methods (Jain and Rao, 1978), and correct identification of the species were made with the help of available floras (Kanjilal et al., 1934-40, Hooker, 1872-97) and with the help of the Herbarium of the Botanical Survey of India at Shillong (ASSAM). Different sites representing different altitude and forest types were selected for field study and collection. These are Upper Shillong (2000 m), Pologround (1300m) and Happy Valley (1600 m) (Fig 1).

FIG. 1 MAP OF SHILLONG SHOWING DIFFERENT FIELDS AND SITES OF SAMPLING

Fig. 1


SHILLONG
1 0 1 2 Km
SHILLONG IN MEGHALAYA
90°
92°
26°
25°
M A W L A I
POLO GROUND
LAITUM-KHRA
NONGTHYMMAI
FRUIT GARDEN
UPPER SHILLONG
Reserved Forest
HAPPY VALLEY
Places of plant collection
" " trapping
" " traping(Petridish method)

For collection of pollen and later preparation of reference pollen slides, flowers and flower buds were collected in 70% alcohol in field along with collection of the plant species. The reference pollen slides were prepared following Wodehouse (1935) method and maintained in glycerine jelly, as described in section four.

For phenology 3 distinct stages were marked for each species i.e. beginning of flowering (bud stage), peak of flowering and late flowering stage or end of flowering (after fertilization) [Fig. 2.2]. However for Gymnosperm viz. Cedrus, Cryptomeria, Cupressus and Pinus observations on initiation and maturation of male cone were marked.

Results and Discussion

Pollen concentration in any atmosphere is naturally dependent on the local vegetation, specially of the anemophilous plants. The area being a part of one of the richest floristic province in the country, with a record of as many as 1000 flowering plant species alone, in which about 40% belong to monocots, predominantly by grasses. However, the anemophilous species in dicotyledons flora is meagre, except a few families such as Betulaceae, Fagaceae, Juglandeaceae, etc.

It has been noted that certain entomophilous plants also release sufficient amount of pollen in the atmosphere and thus qualify themselves being included in the list of pollen suspected for allergenicity.

Insect and wind are the chief agents for cross pollination of flowering plants. Other pollinating agents that are effective in a far smaller number of species include water currents and humming birds. The characteristics of wind borne pollen become clear when contrasted with insect borne pollen. Both anemophilous and entomophilous plants often protect their pollen from rain, and many store them within their flowers for some time after shedding from the anthers. Anemophilous pollen is not generally shed during very calm or very damp air.

In case of gymnosperms, the pollen, instead of being formed in stalked anthers like that of angiosperms, is produced in two or more pollen sacs on the lower side of the male cone scales.

In pinus the erect male cone scale gets separated as it is mature and pollens shed from the pair of sacs fall into small hollows on the upper surface of the cone scales below. From these hollows the pollen is blown away when the wind reaches at sufficient velocity. Here the pollen grains

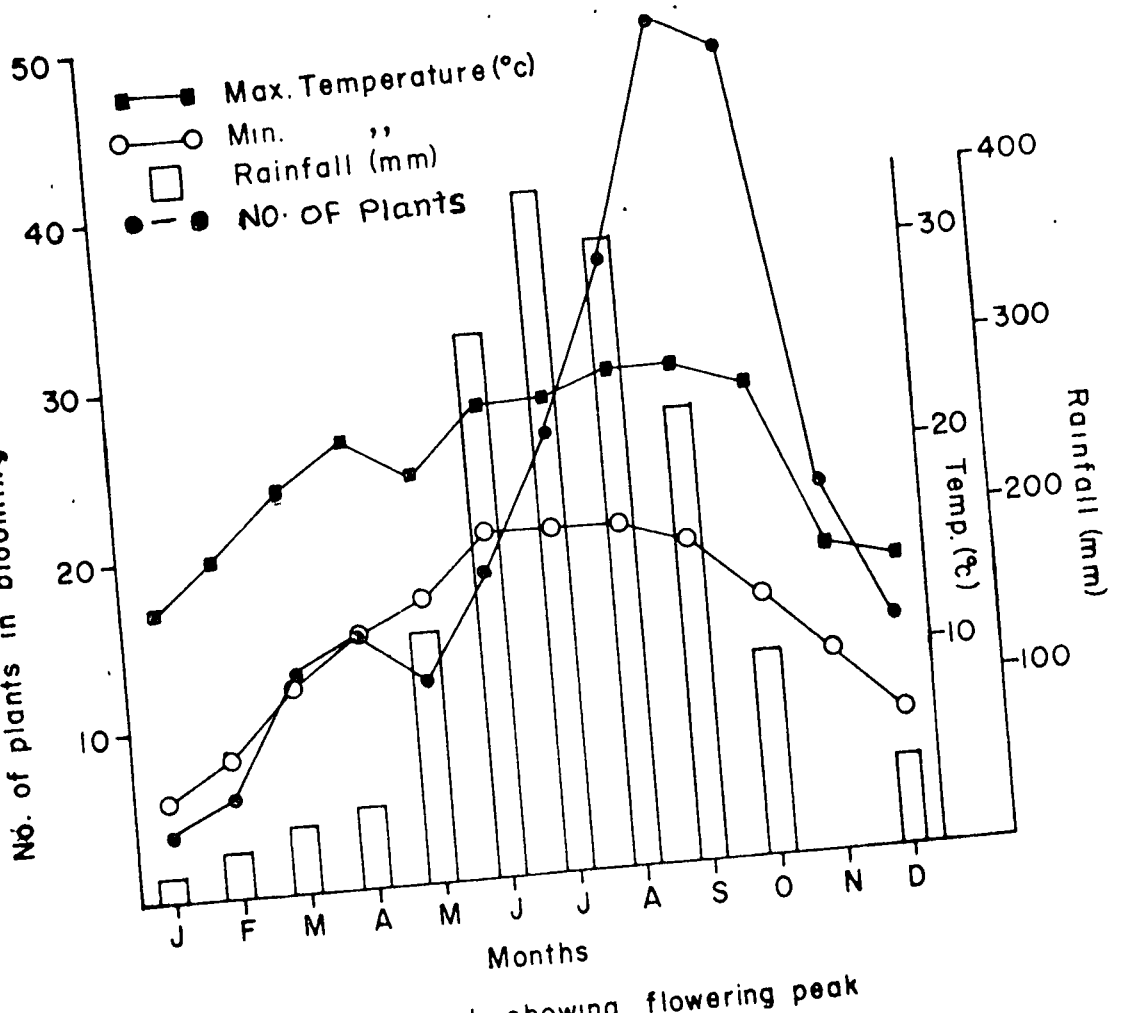
are large and often bear two conspicuous air filled bladders which decrease the density of the particle and retard its fall under the influence of gravity. But in case of Cupressus where the pollen is not winged, the expanded ends of the cone scales interlock closely in damp weather and separate again in dry air, allowing pollen to be blown out.

In case of angiosperms details of the pollen dehiscence mechanisms are given by Marloth (1895); Erdtman (1943,1952,1957), Wodehouse (1945). While Gregory (1973) outlined the characteristics of anemophilous and entomophilous pollens (Table 2). The Gramineae and Cyperaceae are typically wind pollinated. From the raised inflorescences of grasses and sedges, the anthers are extruded on long filaments to which they are so lightly attached that they vibrate in the slightest wind (versatile anthers).

Entomophilous herbs and low shrubs include some species in which a phase of insect visitation is followed by an opportunity for wind pollination. In case of Urtica, the anthers dry as they mature, tensions are set up, and suddenly, as the pollen sacs burst, the filaments uncoil, throwing pollen into the air. In species of Plantago, Rumex, and Thallictrum the anthers which are exposed in cups, close their slit in moist weather but shed their pollen in dry weather. Other conspicuous pollen shedders occur in

FIG. 2.1 PHENOLOGY GRAPH WITH METEOROLOGICAL DATA

Fig. 2.1



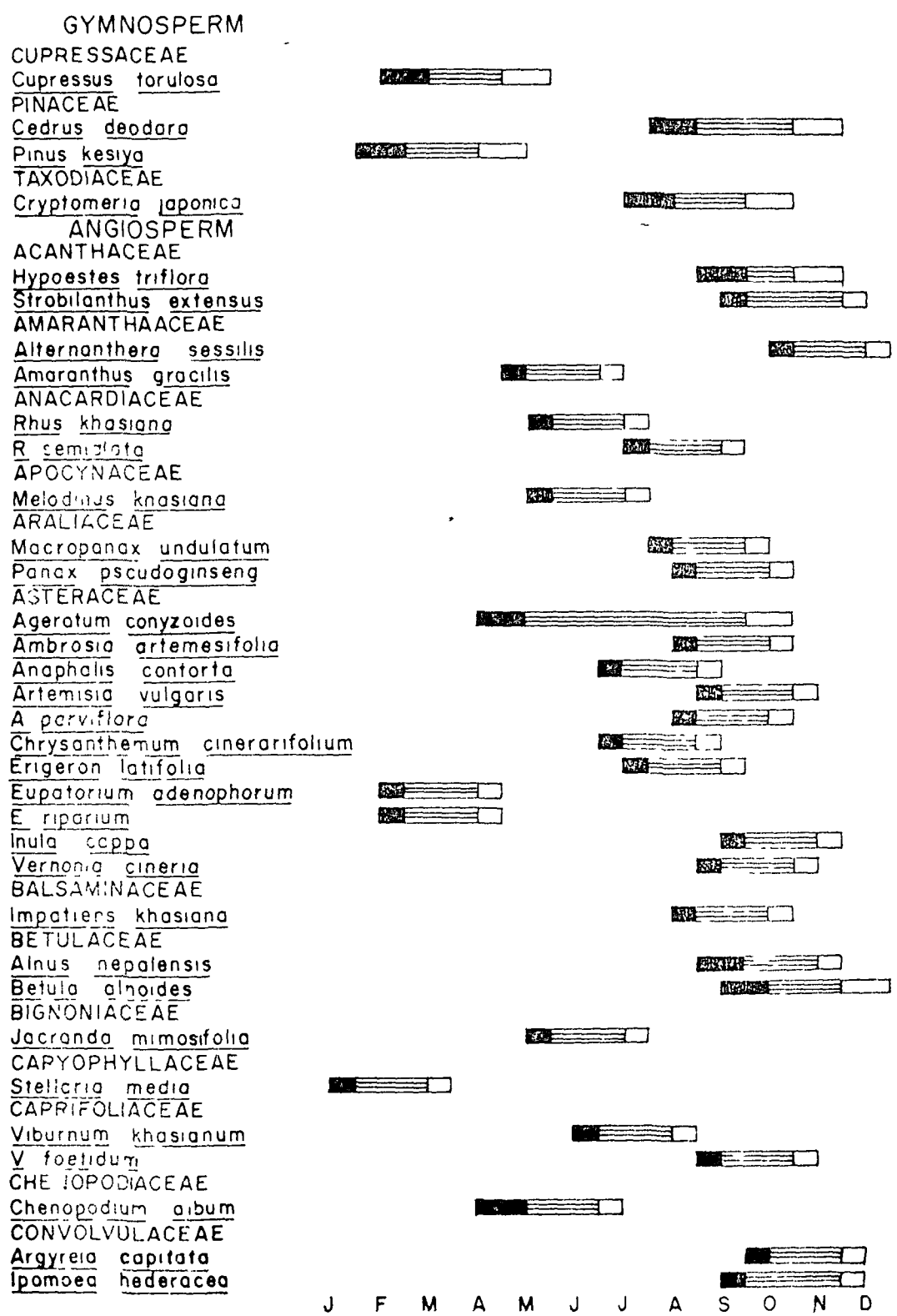
Phenology graph showing flowering peak

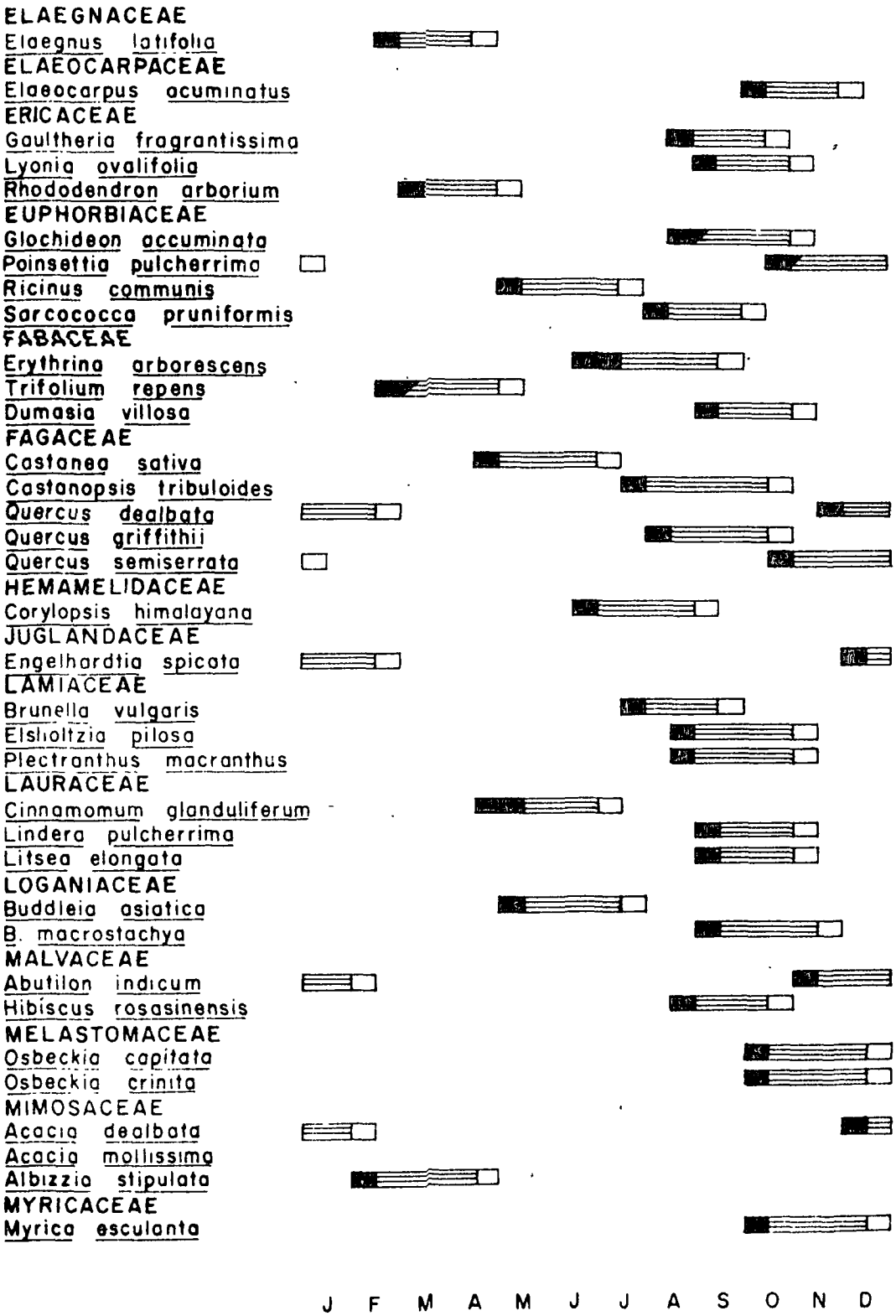
FIG. 2.2 PHENOLOGY CHART OF SOME DOMINANT SPECIES OF SHILLONG

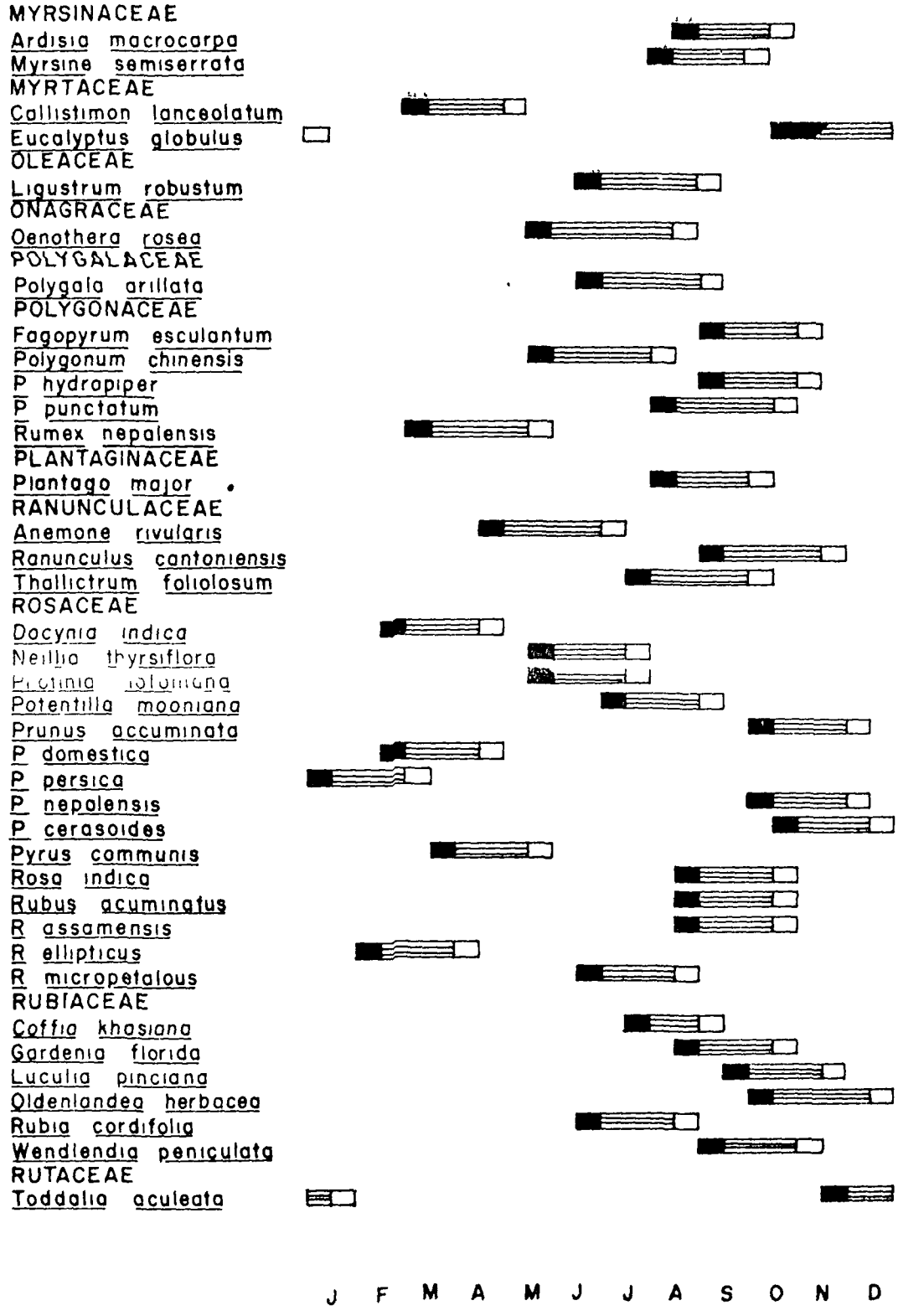
Fig 2 2

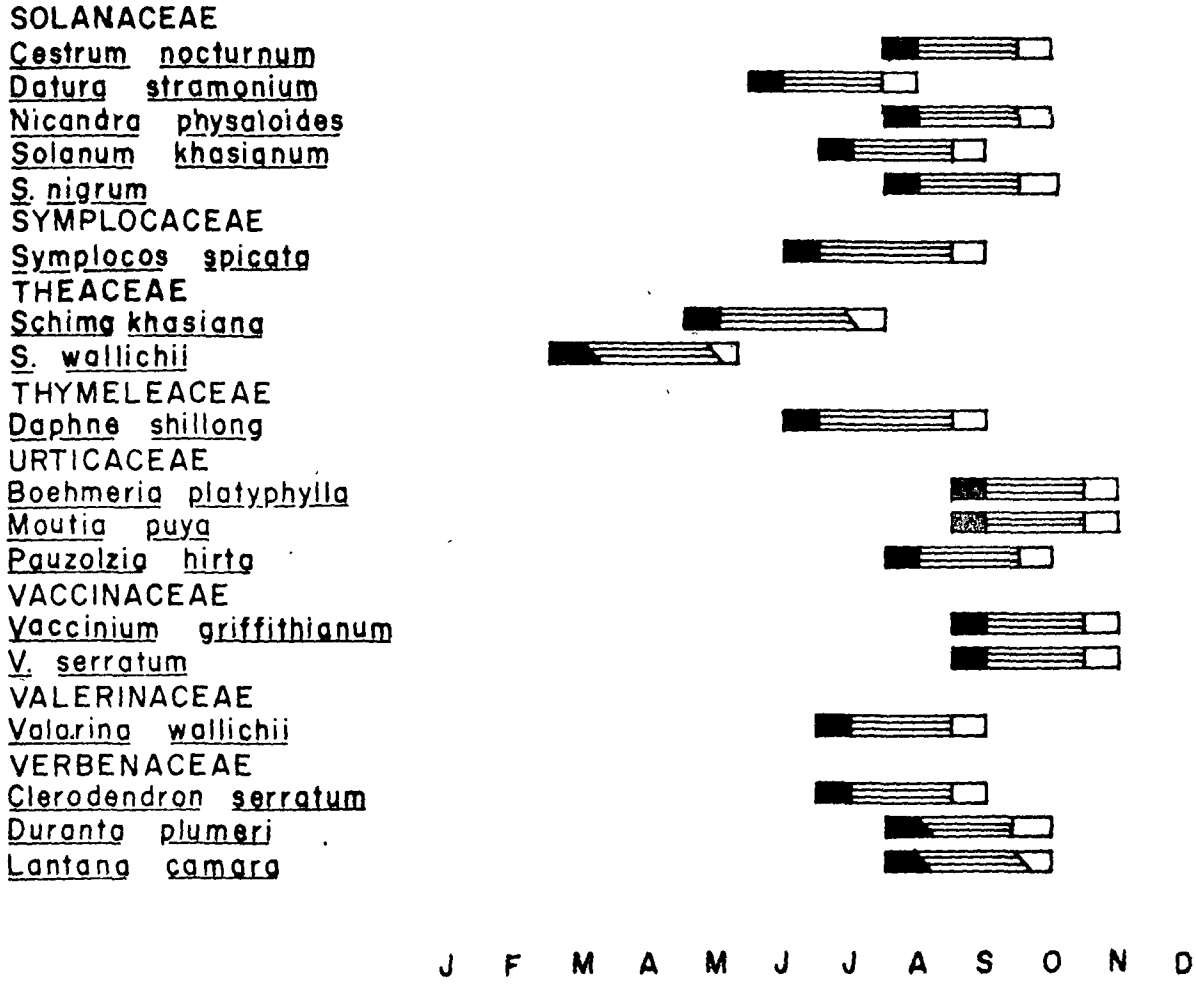
PHENOLOGY CHART

Begining, Peak, End of flowering




ELAEGNACEAE
Elaegnus latifolia
ELAEOCARPACEAE
Elaeocarpus acuminatus
ERICACEAE
Gaultheria fragrantissima
Lyonia ovalifolia
Rhododendron arborium
EUPHORBIACEAE
Glochideon accuminata
Poinsettia pulcherrima
Ricinus communis
Sarcococca pruniformis
FABACEAE
Erythrina arborescens
Trifolium repens
Dumasia villosa
FAGACEAE
Castanea sativa
Castanopsis tribuloides
Quercus dealbata
Quercus griffithii
Quercus semiserrata
HEMAMELIDACEAE
Corylopsis himalayana
JUGLANDACEAE
Engelhardtia spicata
LAMIACEAE
Brunella vulgaris
Elsholtzia pilosa
Plectranthus macranthus
LAURACEAE
Cinnamomum glanduliferum
Lindera pulcherrima
Litsea elongata
LOGANIACEAE
Buddleia asiatica
B. macrostachya
MALVACEAE
Abutilon indicum
Hibiscus rosasinensis
MELASTOMACEAE
Osbeckia capitata
Osbeckia crinita
MIMOSACEAE
Acacia dealbata
Acacia mollissima
Albizzia stipulata
MYRICACEAE
Myrica esculanta
J F M A M J J A S O N D


MYRSINACEAE
Ardisia macrocarpa
Myrsine semiserrata
MYRTACEAE
Callistimon lanceolatum
Eucalyptus globulus
OLEACEAE
Ligustrum robustum
ONAGRACEAE
Oenothera rosea
POLYGALACEAE
Polygala arillata
POLYGONACEAE
Fagopyrum esculantum
Polygonum chinensis
P hydropiper
P punctatum
Rumex nepalensis
PLANTAGINACEAE
Plantago major
RANUNCULACEAE
Anemone rivularis
Ranunculus cantoniensis
Thallictrum foliolosum
ROSACEAE
Docynia indica
Neillia thyrsiflora
Potentilla mooniana
Prunus accuminata
P domestica
P persica
P nepalensis
P cerasoides
Pyrus communis
Rosa indica
Rubus acuminatus
R assamensis
R ellipticus
R micropetalous
RUBIACEAE
Coffia khasiana
Gardenia florida
Luculia pinciana
Oldenlandea herbacea
Rubia cordifolia
Wendlendia peniculata
RUTACEAE
Toddalia aculeata
J F M A M J J A S O N D


SOLANACEAE
Cestrum nocturnum
Datura stramonium
Nicandra physaloides
Solanum khasianum
S. nigrum
SYMPLOCACEAE
Symplocos spicata
THEACEAE
Schima khasiana
S. wallichii
THYMELEACEAE
Daphne shillong
URTICACEAE
Boehmeria platyphylla
Moutia puya
Pauzolzia hirta
VACCINACEAE
Vaccinium griffithianum
V. serratum
VALERINACEAE
Valarina wallichii
VERBENACEAE
Clerodendron serratum
Duranta plumeri
Lantana camara
J F M A M J J A S O N D

Chenopodiaceae, Amaranthaceae and also in some groups within the Compositae, especially Ambrosia and Artemisia which are quite common in the ground vegetation.

In case of Alnus, Betula, Castanea, and Quercus, the male flowers are aggregated into pendulous catkins, usually appearing shortly before the leaves expand, and the pollen is protected from rain after shedding, while temporarily stored on the upper scales of the flower standing underneath until it is blown away.

The interaction between weather conditions in the external environment and the libration mechanisms results into great fluctuation in the abundance of pollen of any species at different times, and at different places.

The flowering phenology of the species are directly dependent on the seasons and weather conditions of the area and are more or less constant for individual species. Therefore, the atmosphere during different seasons is polluted by pollen of specific species depending upon the ground flora of the region. It has been possible in this study to correlate the prevalence of a specific pollen in the atmosphere to the flowering period of that particular species in the ground flora. For example, Pinus, Betula sp., Alnus sp., Cedrus sp. which have a peak flowering period during the

month of March, September, November, respectively, have also been recorded maximum in the atmosphere during these months. Similarly no pollen of these species were trapped during December and January when there was no flowering. The three stages of flowering, namely, the beginning, the peak and the end of the flowering are given in Fig. 2.1. It is evident from this Fig. 2.1 that most of the species in Shillong flower during March to September when the temperature is very high and the flowering of the species comes down during December to February, which are the winter months with least temperature. However, grasses and sedges which flower most part of the year follow an altogether different pattern of phenology.

Table 2. Typical characteristics of Anemophilous and Entomophilous Plants:

	Wind pollinated	Insect pollinated
Flowers	Lack conspicuous and attractive petals, scent and necter.	Often with bright colours scent; necter attractive to insects.
Flower position	Projecting into air: hainging from bare branches before leaves open (Catkins); on erect stalks (grasses, etc) or at ends of branches (conifers)	Tend to be exposed to view, but not exposing anthers to wind. Flowers usually maturing when plant in full growth and insects abundant
Prevention of self fertilization	Male and Female organs often in separate flowers or inflorescence, or on separate plants. If flowers hermaphrodite, one sex commonly matures before the other, or if sexes are in separate inflorescences, the female is often above the male.	Flowers usually hermophrodite, with structural or genetic barriers to selfing.
Pollen	Often shed into the air in vast quantities. Shape rounded, often nearly spherical or ellipsoidal. Size range narrower than entomophilous pollen and seldom less than 15 µm. Surface typically smooth non sticky, easily separating into single grain in air.	Usually restricted pollen production little shedding. Shape very variable 300 350 u but often less than 15 µm. Surface typically rough, spiny or warted, often oily or sticky, tending to adhere in clumps.

SECTION IV

Pollen Morphology

POLLEN MORPHOLOGY

Introduction

Palynology the science of pollen and spores has virtually started with the work of Prof. R.P. Wodehouse of U.S.A. In his book Pollen Grains (Wodehouse, 1935) he has outlined the history of pollen morphology. Since then significant contributions have been made in this field mainly by Erdtman (1943, 1952), Ikuse (1950); Selling (1946); Baker, (1954); Cranwell, (1942, 1952) and in India by Nair, (1960a, b); Rao, (1975); Thanikaimoni, (1966) and Vasanthy (1976). Thanikaimoni (1969) and Nair (1960) have given a detailed account of early history of pollen in India and a bibliographic account of Palynology. However, so far there are no published account on pollen morphology of plants of North-East India in general and - Shillong in particular. Further, a knowledge of pollen morphology is a prerequisite for identification of air-borne pollen. Therefore in this section brief morphological description of the more common species of the area are given.

Materials and Methods

Flowers and flower buds were collected in 70% alcohol

for preparation of pollen slides. In some cases, where the flowers could not be collected (as in the case of large trees) herbarium specimens deposited in the herbarium of North-Eastern Hill University (NEHU) were made use of for collection of pollen. Glycerin jelly method (Wodehouse method, 1935) was followed for preparing the reference pollen slides and the morphological description of the pollen is based on unacetolysed grains.

Preparation of reference pollen slide: (Glycerine jelly method) (Wodehouse, 1935)

From ground flora: Flowers and flower buds were collected and kept in 70% alcohol for making reference pollen slides of the local vegatation. Small amount of pollen are kept in the centre of slide and a drop of alcohol was added and allowed to spread. This leaves the oily and resinous substance of the pollen deposited in a ring, the oily ring was then removed with cotton moistened with alcohol. Small amount of glycerine-jelly was added to this and the pollen is stired with a needle. During this process the jelly is kept hot by passing the slide over a flame. The cover glass was was then placed over the pollen and then the slide was gently heated and pressed. The slide is now ready for observation.

From Herbarium specimens: A few anthers are crushed

on the slide; moisten with alcohol followed by a drop of water and heated. The pollen was then teased out from the anthers and other debris were removed leaving the pollen in water. Water is then drawn out with blotters and the jelly was added as described in the previous method.

Preparation of Glycerine jelly: (Nair, 1970):

Glycerine jelly was prepared by soaking one part of gelatine powder in seven parts of warm distilled water for 24 hrs, or till it completely dissolved. To this is added glycerine and this mixture was melted in water bath. Then little phenol crystals were also added and mixed with glass rod.

The glycerine jelly was then filtered through a fine muslin cloth in test tubes, which were kept on water bath to remove the air bubbles from the jelly and then the solution is transferred to a petridish and solidified.

For measurements of size, 5-10 grains have been taken into account in each case. The terminology followed for the morphological characters is after that of Nair (1965).

Key to identification of Pollen

The following key is purely artificial. Only important morphological characters are used and these refer to the pollen studied from the anthers collected

from the ground vegetation of Shillong and its environs. Where it is not possible to key out up to the species level in certain families such as Poaceae and Cyperaceae, the key refers to the group as a whole.

1a. Pollen Grains in Polyads

2a. Exine Psilate

Acacia dealbata

2b. Exine granulose

Albizia sp.

1b. Pollen grains in tetrads

3a. Pollen grains 54 μ in diam.

Rhododendron arboreum

3b. Pollen grains 35.5 μ in diam.

Gaultheria fragrantissima

3c. Pollen grains 30 μ in diam.

Lyonia ovalifolia

3d. Pollen grains 44 μ in diam.

Vaccinum sp.

1c. Pollen grains free

4a. Inaperturate

Cupressus torulosa

4b. Aperturate

5a. Aperture simple

6a. 1-Colpate

7a. Pollen grains saccate

8a. Marginal crest well developed

Pinus kesiya

8b. Marginal crest not well developed

Cedrus deodara

7b. Pollen grains non saccate

9a. Aperture papillate

Cryptomeria japonica

9b. Aperture non papillate

Disporum pullum

6b. 3-Colpate

10a. Exine psilate

11a. Pollen grains subprolate

12a. Pollen grains 36 μ in diam.

Brunella vulgaris

12b. Pollen grains 44 μ in diam

Eucalyptus globus

12c. Pollen grains 72 μ in diam.

Schima khasiana

Schima wallichii

12d. Pollen grains 84 μ in diam

Fagopyrum esculantum

11b. Pollen grains oblate

Callistemon lanceolatum

11c. Pollen grains prolate

Ranunculus contoniensis

10b. Exine reticulate

13a. Pollen grains spheroidal

14a. Pollen grains 50 u in diam.

Lantana camara

14b. Pollen grains 50 u in diam.

Duranta plumeri

13b. Pollen grains subprolate

Corylopsis himalayana

10c. Exine granulose

15a. Pollen grains spheroidal

Symplocos spicata

15b. Pollen grains prolate spheroidal

Fumaria sp.

10d. Exine spinose

Abutilon indicum

10e. Exine spinulose

Clerodendrum serratum

6c. Pantocolpate; Exine foveolate

Anemone rivularis

6d. Porate

16a. Pollen grains 1-Porate

17a. Exine granulose ... Gramineae

17b. Exine psilate ..... Cyperaceae

16b. Pollen grains 3-Porate

18a. Pores aspidote

19a. Aspis high

Oenothera sp.

19b. Aspis low

20a. Pollen grains circular to subtriangular

Betula sp.

20b. Pollen grains rectangular

Alnus sp.

18b. Pores not aspidote

21a. Exine reticulate

Urticaceae

21b. Exine Psilate

Eleocarpus accuminatus

16c. Pantoporate

22a. Exine psilate

23a. Pollen grains prolate

Thalictrum sp.

23b. Pollen grains spheroidal

Engelhardtia spicata

22a. Exine granulose-spheroidal

24b. Pollen grains 23 μ in diam.

Alternanthera sp.

24b. Pollen grains 35 μ in diam.

Chenopodium sp.

22c. Exine reticulate

25a. Pollen grains 32 μ in diam.

Amaranthus sp.

25b. Pollen grains 45 μ in diam.

Polygonum hydropiper

25c. Pollen grains 36 μ in diam

Daphne shillong

22d. Exine Pilate

Sarcococca sp.

22e. Exine spinose

26a. Exine with columella

Convolvulaceae

26b. Exine without columella

Malvaceae

5b. Apperture composite - colporate

27a. Exine psilate

28a. Pollen grain subprolate

29a. Endocolpium lalongate

30a. Flowering period in Sept-Nov.

Castenopsis sp.

30b. Flowering period in April-June

Castanea sp.

30c. Flowering period in Jan-Feb.

Quercus dealbata

30d. Flowering period in June

Quercus griffithi

29b. Endocolpium circular

31a. Pollen grains 44 μ in diam.

Photinia notoniana

31b. Pollen grains 86 μ in diam

Prunus domestica

31c. Pollen grains 80 μ in diam.

Prunus nepalensis

31d. Pollen grains 76 μ in diam

Prunus cerasoides

31e. Pollen grains 15 μ in dia.

32a. Flowering period in Aug-Oct.

Rubus acuminatus

32b. Flowering period in Sept-Nov.

Rubus assamensis

31f. Pollen grains 22 μ in diam.

Rubus ellipticus

28b. Pollen grain spheroidal

33a. Pollen grain 33 μ in diam.

34a. Flowering period Feb-March

Pyrus communis

34b. Flowering period June-July

Rubus micropetalous

33b. Pollen grain 44 μ in diam

Prunus accuminatus

33c. Pollen grain 24 μ in diam.

Osbeckia sp.

27b. Exine reticulate - spheroidal

35a. Pollen grain 18 μ in diam

Ardisia macrocarpa

35b. Pollen grain 14 μ in diam.

Neillia thrysiflora

35c. Pollen grain 44 μ in diam.

Rhus khasiana

35d. Pollen grain 22 μ in diam.

Glochidion sp.

27c. Exine spinose

36a. Pollen grain spheroidal

Ageratum conyzoides

36b. Pollen grain prolate spheroidal

Anaphalis sp.

27d. Exine granulose

37a. Pollen grain sub oblate

38a. Endocolpium circular

Macropanax sp.

38b. Endocolpium not circular

39a. Pollen grain 27 μ in diam.

Panax sp.

39b. Pollen grain 20 μ in diam.

Ambrosia sp.

37b. Pollen grain prolate spheroidal

Artemisia sp.

37c. Pollen grain subprolate

Erigeron sp.

DESCRIPTIONS OF AIR-BORNE POLLEN

The following is an enumeration of some important species which are dominant pollen shedders in Shillong. The families, genera and species under each family are arranged alphabetically. Voucher specimens of these plants are deposited in the Herbarium of North-Eastern Hill University Shillong, following routine herbarium procedures.

The dominant pollen flora of Gymnosperms are placed first, followed by Angiosperms. In the description of pollen grains the polar diameter(P) is followed by the equatorial diameter (E). The period of catches for the atmospheric pollen grains, is also given(where — mean Nil).

GYMNOSPERM

Cupressaceae

Cupressus torulosa D. Don (Pl.2, Fig.1)

Pollen grain inaperturate, spheroidal, contours circular. Exine - thin faintly granulose, intine extremely thick.

Size : P = 14 μ, E = 14.6 μ.

Period of catches : Feb-June.

PINACEAE

Cedrus deodara Loud. (Pl.2, Fig.2)

Pollen grains are 1 - aperturate (colpate, aperture indistinct); 2-winged saccate, marginal crest not well developed. Exine - thick, intine - thick and reticulate.

Size : 72 X 32 X 81 μ.

Period of catches : Sept. - Dec.

Pinus kesiya Royle ex Gardon (Pl.2, Fig.3)

Pollen grains are 1 - aperturate, 2-winged, or saccate; marginal crest well developed. Exine thick, intine

thick and reticulate.

Size : 32 X 96 X 71 μ.

Period of catches : Feb-May.

TAXODIACEAE

Cryptomeria japonica (Linn. f.) D. Don (Pl.2, Fig.4).

Pollen grains are 1 aperturate, aperture area marked by a papillate projection, spheroidal. Exine thick, psilate.

Size : P = 17 μ, E = 16 μ.

Period of catches : Oct - Nov.

ACANTHACEAE

Hypoestes triflora R. & S. (Pl.2, Fig.5).

Grains 3 - zonoporate, circular to sub triangular, prolate. Endocalpium circular. Exine thick reticulate, intine thin.

Size : ca P = 50 μ, E = 40 μ.

Period of catches : August.

Strobilanthus extensus Nees (Pl.2, Fig.6)

Grains 3 - zonoporate, prolate, exine thick, faintly granulose. Endocalpium lalongate. Brochi in 2-3 rows on the longitudinal ridge.

Size : ca P = 84 μ, E = 55 μ.

Period of catches : Sept-Nov.

AMARANTHACEAE

Alternanthera sessilis Br.

Grains - Pantoporate; spheroidal, circular. Exine thick, granulose, intine thin.

Size : ca - P = 12 μ, E = 12 μ.

Period of catches : November.

Amaranthus gracilis Desf. (Pl.2, Fig.7)

Grains pantoporate, spheroidal circular. Exine thick, reticulate, intine thin.

Size : ca - P = 16 μ, E = 16 μ.

Period of catches : June.

ANACARDIACEAE

Rhus khasiana Hk.f.

Grains 3 - zonocolporate, sub prolate, Exine - thick, Striato reticulate, reticula faint. Endocalpium lalongate.

Size : ca - P = 26 μ, E = 21 μ.

Period of catches : June.

Rhus semialata Murr. (Pl.2, Fig.8)

Grains 3 - zonocolporate, Sub prolate, Exine thick; reticulate, intine thin.

Size : ca - P = 25.2 μ, E = 22.4 μ.

Period of catches : May.

APOCYNACEAE

Melodinus khasianus Hk.f. (pl.3, Fig.9).

Grains 3 - zonoporate, spheroidal pores are vesicale type, exine thick, psilate. Endocalpium circular.

Size : ca - P = 27.5 μ, E = 27.5 μ.

Period of catches : June.

ARALIACEAE

Macropanax undulatum Seem. (Pl.3, Fig.11)

Grains 3 - zonocolporate, sub-oblate, subtriangular, exine thick, granulose, intine thin. Endocalpium circular.

Size : ca. P = 22.4 μ, E = 28 μ.

Period of catches : Oct-Nov.

Panax pseudoginseng Wall. (Pl.3, Fig.10)

Grains 3 - zonocolporate, sub-oblate, circular. exine thick granulose, intine thin.

Size : ca - P = 21 μ, E = 25 μ.

Period of catches : November.

ASTERACEAE

Ageratum conyzoides Linn. (Pl.3, Fig.12)

Grains 3 - zonocolporate; sub-prolate, triangular. exine spinose, intine thin.

Size : ca - P = 17.5 μ, E = 15.0 μ.

Period of catches : Major part of year.

Ambrosia artemisifolia Linn. (Pl.3, Fig.13)

Grain 3 - zonocolporate, sub-oblate to spheroidal, with circular to sub-triangular. Exine thick granulose, very short spines, intine thick.

Size : ca - P = 18.5 μ, E = 10.5 μ.

Period of catches : August-October.

Anaphalis contorta Hk.f.

Grain 3 - zonocolporate, prolate, spheroidal, triangular. Exine thick ; spinose, intine thick.

Size : ca - P = 32 μ, E = 30 μ.

Period of catches : August.

Artemisia vulgaris Linn.

Grains 3 - zonocolporate, Prolate spheroidal, sub-triangular. Exine thick , granulose, intine thin.

Size : P = 11.5 μ, E = 11.5 μ.

Period of catches : September.

Chrysanthemum cenerarifolium (Tnerv.) vis. (Pl.3, Fig.14).

Grains 3 - zonocolporate, prolate spheroidal, sub-triangular. Exine thick ; granulose, intine thin.

Size : P = 25 μ, E = 25 μ.

Period of catches : July.

Erigeron linifolius Willd.

Grains 3 - zonocolporate, subprolate. Exine thick granulose, intine thin.

Size : P = 17 µ, E = 16 µ.

Period of catches : August.

Eupatorium adenophorum Spreng.

Grains 3 - zonocolporate, spheroidal. Exine thick, granulose, intine thin.

Size : P = 22.4 µ, E = 22.4 µ.

Period of catches : —

Eupatorium riparium Regel. (Pl.3, Fig.15)

Grain 3 zonocolporate, spheroidal. Exine thick granulose, intine thick

Size : P = 20 µ, E = 20 µ.

Period of catches : —

Inula cappa DC.

Grains 3 - zonocolporate, prolate spheroidal. Exine thick spinose; spines short, intine thick; reticulate, Endocalpium lalongate.

Size : P = 33 µ, E = 30 µ.

Period of catches : Oct-Nov.

Vernonia cinerea Less. (Pl.3, Fig.16).

Grain - 3 zonocolporate; oblate spheroidal,

aperture elongated ends rounded, narrow in middle. Exine, lophate - spinose, lacunae 23 in number.

Size : P = 15 μ, E = 15 μ.

Period of catches : Sept-Nov.

BALSAMINACEAE

Impatiens chinensis Linn. (Pl.3, Fig.17)

Grain 4 - zonocolpate, spheroidal, rectangular, Exine thick, reticulate, intine thick.

Size : P = 37 μ, E = 19 μ.

Period of catches : September.

BETULACEAE

Alnus nepalensis D. Don (Pl.4, Fig.18).

Grain 3-4 zonoporate, spheroidal, rectangular. Exine thin, psilate, intine thin.

Size : P = 10 μ, E = 10 μ.

Period of catches : Oct-Jan.

Betula alnoides Ham. (Pl.4, Fig.19)

Grain 3 - zonoporate, spheroidal, circular to subtriangular. Exine thin, smooth to scabrrate, intine thin with an oncus beneath the pore.

Size : P = 20 μ, E = 20 μ.

Period of catches : Sept-Oct.

CHENOPODIACEAE

Chenopodium album Linn.

Grains pantoporate, spheroidal, circular, pores many, exine thick, granulose, granules being less dense at pore margins, intine thin. Size : P = 27μ , E = 27 μ.

Period of catches : May.

CONVOLVULACEAE

Argyreia capitata, Kurz. (Pl.4, Fig.23)

Grain pantoporate, spheroidal, pores circular. Exine thick, spinose, spines end pointed, collumella clear.

Size : P = 89.6 μ, E = 89.6 μ.

Period of catches : October.

Ipomoea hederacear Jacq. (Pl.4, Fig.24)

Grain pantoporate, spheroidal circular. Exine thick intine surface divided into reticulate islands, each brochus with a pore placed in the centre and spines at the periphery.

Size : P = 62 μ, E = 62 μ.

Period of catches : October.

ELAEAGNACEAE

Elaegnus latifolia Linn. (Pl.4, Fig.25)

Grain 3 - zonocolporate, oblate, endocalpium

BIGNONIACEAE

Jacranda mimosiefolia D.Don. (Pl.4, Fig.20)

Grain 3 - zonoporate, spheroidal, subtriangular. Exine thick reticulate, intine thick.

Size : P = 24 μ, E = 24 μ.

Period of catches : June-July.

CARYOPHYLLACEAE

Stellaria media Linn. (Pl.4, Fig.21)

Grains pantoporate, spheroidal, triangular, Exine thick, psilate, intine thin.

Size : P = 37 μ, E = 37 μ.

Period of catches : —

CAPRIFOLIACEAE

Viburnum khasianum Cl. (Pl.4, Fig.22)

Grains 3 - zonocolporate, prolate, circular to subtriangular, exine-thick-retipilate, intine thin, not clear.

Size : P = 30 μ, E = 20 μ.

Period of catches : June.

lalongate, exine very thin, faintly reticulate.

Size : P = 32.5 μ, E = 45 μ.

Period of catches : February.

ELAEOCARPACEAE

Elaeocarpus acuminatus Wall. (Pl.4, Fig.26)

Grains 3 - zonoporate, oblate, spheroidal. Exine thick, psilate, intine thin.

Size : P = 8.4 μ, E = 8.4 μ.

Period of catches: November.

ERICACEAE

Grains united in tetrads.

Individual grains 3 - zonocolporate. Exine psilate

Gaultheria fragrantissima Wall.

Tetrad diameter is 35.5 μ

Period of catches : August.

Lyonia ovalifolia Wall. (Pl.5, Fig.27)

Tetrad diameter is 30 μ.

Period of catches : Sept-Oct.

Rhododendron arboreum Sm. (Pl.5, Fig.28)

Tetrad diameter is 58 μ.

Period of catches : March-May.

EUPHORBIACEAE

Glochidion accuminatum Muell. (Pl.5, Fig.29)

Grains 4 - zonocolporate, spheroidal, circular. Exine thick, reticulate, intine thin.

Size : P = 22.3 μ, E = 22.3 μ.

Period of catches : Oct-Nov.

Ricinus communis Linn. (Pl.5, Fig.30)

Grains 3 - zonocolporate spheroidal. Exine thick, granulose, intine thin.

Size : P = 25.5 μ, E = 25.5 μ..

Period of catches : —

Poinsettia pulcherrima R. Grah.

Grains 3 - zonocolporate, sub-oblate circular, Exine thick, areolate, endocalpium lalongate,

Size : P = 25.5 μ, E = 25.5 μ.

Period of catches : —

Sarcococca pruniformis Thw.

Grains pantoporate, spheroidal, pores occur as foveolate areas. Exine thick, foveolate. Endocodpium faint, lalongate.

Size : 35.5 μ, E = 35 μ.

Period of catches : September.

FABACEAE

Erythrina arborescens Roxb. (Pl.5, Fig.31)

Grains 3 - zonoporate, suboblate, sub-triangular, pores restricted to one face occuring near the perimeter of the equator. Lumina of various shapes.

Size : P = 24 μ, E = 37 μ.

Period of catches : June-September.

Trifolium repens Linn. (Pl.5, Fig.32)

Grains 3 - zonocolporate, spheroidal, sub-triangular. Exine thick, psilate. Endocolpium circular, intine thin.

Size : P = 30 μ, E = 21 μ.

Period of catches : Feb-March.

FAGACEAE

Castenopsis tribuloides A.Dc. (Pl.5, Fig.33)

Grains 3 - zonocolporate, subprolate. Endocalpium lalongate. Exine very thin, psilate.

Size : P = 14 μ, E = 11 μ.

Period of catches : Sept-Nov.

Castanea sativa Miller

Grains 3 zonocolporate, subprolate, Endocalpium lalongate, Exine very thin, psilate.

Size : P = 13 μ, E = 10 μ.

Period of catches : April-June.

Quercus griffithii Hk.f & Th. (Pl.5, Fig.34)

Grains 3 zonocolporate, subprolate, endocalpium lalongate, exine thin, granulose.

Size : P = 12.5 u, E = 10.0 u.

Period of catches : June.

Q. dealbata Wall.

Period of catches : Jan-Feb.

Q. semiserrata Roxb.

Period of catches : Sept-Oct.

Q. spicata Sm.

Period of catches : April-May.

FUMARIACEAE

Fumaria parviflora Lamk.

Grain 6 - pantoporate, spheroidal, pores circular. exine thick, granulose.

Size : P = 21 u, E = 21 u.

Period of catches : October.

HAMAMELIDACEAE

Corylopsis himalayana Griff. (Pl.5, Fig,35).

Grains - zonocolpate, subprolate. endocalpium lolongate. Exine thick, faintly reticulate, lumina being

small.

Size : P = 27 μ, E = 23 μ.

Period of catches : June, August.

JUGLANDACEAE

Engelhardtia spicata Bl.

Grains pantoporate, spheroidal. Exine thin; psilate, intine thin.

Size : P = 43 μ, E = 42 μ.

Period of catches : —

LAMIACEAE

Brunella vulgaris Linn. (Pl.5, Fig.36)

Grains 3 - zonocolpate, subprolate. Exine thick, thinner towards calp; margins granulose.

Size : P = 20 μ, E = 18 μ.

Period of catches : July.

LAURACEAE

Cinnamomum glanduliferum Meissn.

Grain 3 - zonocolpate, spheroidal. Exine thin psilate, intine thin.

Size : ca P = 20 μ, E = 20 μ.

Period of catches : - —

LOGANIACEAE

Buddleia asiatica Lour. (Pl.5, Fig.37)

Grains 3 zonocolporate, spheroidal. Exine thick psilate, Endocalpium circular, intine thick.

Size : P = 12 μ, E = 12 μ.

Period of catches : June.

Buddleia macrostachya Benth.

Grains 3 - zonocolporate, prolate, Endocalpium circular. Exine thick, psilate, intine thin.

Size : P = 16 μ, E = 15 μ.

Period of catches : September.

MALVACEAE

Abutilon indicum G. Don (Pl.6, Fig.38)

Grains 3 - zonocolporate; spheroidal; colpi narrow, margin slightly thick. Exine thick; spinose, interspinal area fovealate.

Size : P = 36.5 μ, E = 36.5 μ.

Period of catches : January.

Hibiscus rosa-sinensis Linn. (Pl.6, Fig.39)

Grain pantoporate, spheroidal. Exine thick, spinose. Interspinal area punctate reticulate.

Size : P = 56μ, E = 55 μ.

Period of catches : October.

MELASTOMATACEAE

Osbeckia capitata Benth. (Pl.6, Fig.40)

Grains 3 - zonocolporate, spheroidal. Endocalpium lalongate. exine thick . Psilate.

Size : P = 12 μ, E = 12 μ.

Period of catches : December.

Osbeckia crinita Benth.

Grain - 3 zonocolporate, spheroidal, endocalpium lalongate. Exine thick Psilate.

Size : P = 11 μ, E = 11 μ.

Period of catches : October.

MIMOSACEAE

Acacia dealbata Link. (Pl.6, Fig.41)

16 grains form polyad. Individual grain possess 6 indistinct pores. Exine thick, psilate.

Size : Polyad diameter 43 μ.

Period of catches : ——

Acacia mollissima Willd.

16 grains forms polyads. The aperturerin 1 μ Polyads inconscicuous. Exine thick, granulose.

Size : Polyad diameter 40 μ.

Period of catches : ——

Albizia stipulata Boiv.

16 grains forms polyads. The apertures in the polyads inconscipicuous, Exine thick, faintly granulose

Size : Polyad diameter 71 µ.

Period of catches : March.

MYRSINACEAE

Ardisia macrocarpa Wall. (Pl. 6,Fig.42)

Grain 3- zonocolporate, spheroidal. Endocolpium, slightly lalongate. Exine thick,reticulate.

Size : P = 17.5 u, E = 17 u.

Period of catches : June-September.

Myrsine semiserrata Wall. (Pl.6, Fig.43)

Grain - 4 zonocolpate, spheroidal. Exine thick, psilate, intine thin.

Size : P = 22 µ, E = 22 µ.

Period of catches: August.

MYRICACEAE

Myrica esculenta Ham. ex D. Don

Grain 3 - zonocolporate, suboblate. Exine thick, intine thin.

Size : P = 19 µ, E = 29 µ.

Period of catches : —

MYRTACEAE

Callistemon lanceolatum DC. (Pl.6, Fig.44)

Grain 3 - zonocolpate, oblate. Exine thick, Psilate, intine thin.

Size : P = 19.6 µ, E = 19.5 µ.

Period of catches : -

Eucalyptus globulus Labill. (Pl.6, Fig.45)

Grain 3 - zonocolpate, subprolate, subtriangular, endocalpium lalongate. Exine thick, reticulate, Intine thin.

Size : P = 29 µ, E = 25 µ.

Period of catches : Oct-Dec.

OLEACEAE

ligustrum robustum Bedd. (Pl.6, Fig.46)

Grain - 3 zonocolporate, spheroidal, endocolpium faint. Exine thick, thinner towards colpi margins, retipilate.

Size : P = 35 µ, E = 35 µ.

Period of catches : July-August.

ONAGRACEAE

Oenothera rosea Soland. (Pl.6, Fig.47)

Grain 3 - zonopororate, sub-oblate, ectoporium

circular, crassmarginate, aspidote. Exine thick, reticulate intine gradually thinner towards the tip of the apertures.

Size : P = 100 μ, E = 110 μ.

Period of catches : May.

POLYGALACEAE

Polygala arillata buch. Ham. ex D. Don. (Pl.6, Fig.48)

Grain - 17 zonocolpate, sub-oblate. Exine thick, grenulose, intine thin.

Size : P = 28 μ, E = 35 μ.

Period of catches : ——

POLYGONACEAE

Fagopyrum esculantum Moench. (Pl.6, Fig.49)

Grain 3 - zonocolpate, sub-prolate, exine thick, reticulate, endocalpium circular, intine thinner towards the pore.

Size : P = 50.4 μ, E = 42 μ.

Period of catches : October.

Polygonum chinensis Linn. (Pl.6, Fig.50)

Grain 3 - zonocolporate, spheroidal, endocolpium faint. Exine thick, reticulate.

Size : P = 22 μ, E = 22 μ.

Period of catches : May.

Polygonum hydropiper Linn. (Pl.6, Fig.51)

Grain pantoporate, spheroidal, exine thick reticulate, muri irregular shaped.

Size : P = 47 μ, E = 47 μ.

Period of catches : September.

Polygonum punctatum Royle

Grain - 3 zonocolporate, spheroidal, endocolpium circular, exine thick, reticulate.

Size : P = 33 μ, E = 33 μ.

Period of catches : Aug-Sept.

Rumex nepalensis Spreng.

Grain 3 - zonocolporate, spheroidal, endocolpium lalongate, exine thin, granulose. intine thick.

Size : P = 18.5 μ, E = 19.5 μ.

Period of catches : April-June.

PLANTAGINACEAE

Plantago major Linn.

Grain - 6 pantoporate; spheroidal; circular, tenumarginate. Exine thick; granulose, intine thin.

Size : P = 28 μ, E = 28 μ.

Period of catches : July.

RANUNCULACEAE

Anemone rivularis Buch. (Pl.7, Fig.52)

Grains pantocolpate, spheroidal, curcular, exine thick, foveolate. intine thin.

Size : P = 30 µ, E = 30 µ.

Period of catches : May.

Ranunculus contoniensis (Pl.7, Fig.53)

Grain - 3 zonocolpate, prolate, circular. exine thick, Psilate, intine thin.

Size : P = 30 µ, E = 27 µ.

Period of catches : ——

Thalictrum foliolosum DC. (Pl.7, Fig.54)

Grain pantoporate, spheroidal, non circular, tenuimarginate. Exine thick. Psilate.

Size : P = 16 µ, E = 16 µ.

Period of catches : September.

ROSACEAE

Docynia indica (Wall.) Decne., (Pl.7, Fig.55)

Grain 3 - zonocolporate, prolate, spheroidal, Exine thick, reticulate, intine thin.

Size : P = 35 µ, E = 35 µ.

Period of catches : February.

Neillia thyrsiflora D. Don

Grain 3 - zonocolporate, spheroidal, endocalpium lalongate. Exine thick, reticulate.

Size : P = P = 30 μ, E = 30 μ.

Period of catches : Jul. - Sep.

*

Potentilla mooniana Wt. (Pl.7, Fig.56)

Grain - 3 zonocolporate, subprolate. Exine striato reticulate, intine thin.

Size : P = 26 μ, E = 21 μ.

Period of catches : Sep. — Nov.

*

Photinia notoniana Wt & Arn. (Pl. 7, Fig.57)

Grain 3 - zonocolporate, subprolate, circular to sub-triangular, endocolpium lalongate. Exine thick, psilate.

Size : P = 22.4 μ, E = 19.6 μ.

Period of catches : May - June.

Prunus acuminata Hook

Grain 3 - zonocolporate, spheroidal, endocolpium lalongate. exine thick, psilate

Size : P = 40 μ, E = 20 μ.

Period of catches : ——

Prunus domestica (Pl.7, Fig.58)

Grain 3 - zonocolporate, subprolate. endocolpium circular. exine thick, psilate.

Size : P = 36.4 μ, E = 44.8 μ.

Period of catches : ——

Prunus persica Benth. & Hk.f. (Pl.7, Fig.59)

Grain 3 - zonocolporate, sub-oblate. Exine thick, psilate.

Size : P = 25 μ, E = 30 μ.

Period of catches : ——

Prunus nepalensis Koch.

Grain 3 - zonocolporate, subprolate. endocolpium circular. exine thick, Psilate.

Size : P = 35 μ, E = 40 μ.

Period of catches : November

Prunus cerasoides D. Don. (Pl.7, Fig.60)

Grain 3 - zonocolporate, subprolate. Endocolpium subtriangular. Exine thick, psilate.

Size : P = 35 μ, E = 38 μ.

Period of catches : ——

Pyrus communis Linn. (Pl.7, Fig.61)

Grain 3 - zonocolporate, spheroidal. Exine thick, Psilate.

Size : P = 33.6 μ, E = 33.6 μ.

Rosa indica Linn. (Pl.7, Fig.62)

Grain 3 - zonocolporate, prolate, circular. exine thick, Psilate.

Size : P = 28 μ, E = 28 μ.

Period of catches : ——

Rubus accuminatus Sm.

Grain 3 - zonocolporate; subprolate; subtriangular, exine thick, psilate.

Size : P = 21.3 u, E = 15.2 u.

Period of catches : September

Rubus assamensis Focke.

Grain 3 - zonocolporate; subprolate, subtriangular, exine thick, psilate.

Size : P = 20.5 u, E = 16.8 u.

Period of catches: ——

Rubus ellipticus Sm. (Pl.7, Fig.64)

Grain 3 - zonocolporate, subprolate, exine thick, psilate.

Size : P = 31 u, E = 23 u.

Period of catches : October

Rubus micropetalons Gard. (Pl.7, Fig.63)

Grain 3 - zonocolporate, spheroidal, subtriangular, exine thick, psilate.

Size : P = 33.6 u, E = 33.6 u.

Period of catches : September

RUBIACEAE

Coffea khasiana Hk.f. (Pl.7, Fig.65)

Grain - 3-zonocolporate, spheroidal, circular,

exine thick , reticulate.

Size : P = 25 μ, E = 25 μ.

Period of catches :

Luculia pinceana Hook. f (Pl.7, Fig.66)

Grain 3-zonocolporate, spheroidal. endocolpium circular. exine thick, reticulate.

Size : P = 22 μ, E = 22 μ.

Period of catches : —

Oldenlandia herbacea DC. (Pl.7, Fig.67)

Grain 3-zonocolporate, spheroidal. Endocolpium lalongate. Exine thick, reticulate.

Size : P = 18 μ, E = 18 μ.

Period of catches: Aug, Nov, Dec.

Rubia cordifolia Linn. (Pl.7, Fig.68)

Grain 5-zonocolpate, subprolate, subtriangulare, exine thick, grenulose.

Size : P = 18 μ, E = 15 μ.

Period of catches : July – Aug.

Wendlandia paniculata DC.

Grain 3-zonocolporate, spheroidal. Endocolpium lalongate. Exine thick, reticulate.

Size : P = 16 μ, E = 16 μ.

Period of catches: October.

SAXIFRAGACEAE

Parnassia mysorensis Heyne ex Wt.& Arn. (Pl.7, Fig.69)

Grain 3-zonocolporate, subprolate, endocolpium circular, exine thick, faintly reticulate, lumina small.

Size : P = 24 μ, E = 24 μ.

Period of catches : —

SOLANACEAE

Cestrum nocturnum Linn. (Pl.78, Fig.70)

Grain 3-zonocolporate, spheroidal. exine thick, reticulate.

Size : P = 30 μ, E = 30 μ.

Period of catches : —

Datura stramonium Linn.

Grain 3-zonocolporate, spheroidal, endocolpium lalongate. Exine striate, striations covering at the poles.

Size : P = 31 μ, E = 31 μ.

Period of catches : —

Nicandra physaloides Goertn

Grain 3-zonocolporate, spheroidal, endocolpium circular, exine thick, psilate.

Size : P = 40 μ, E = 40 μ.

Period of catches : —

Solanum khasianum Clarke.

Grain 3-zonocolporate, spheroidal. Endocolpium circular, Exine thick, reticulate.

Size : P = 21 μ, E = 18 μ.

Period of catches : ——

Solanum indicum Linn.

Grain 3-zonocolporate spheroidal. Endocolpium circular, Exine thick, reticulate.

Size : P = 18 μ, E = 18 μ.

Period of catches : ——

SYMPLOCACEAE

Symplocos spicata Roxb. (Pl.8, Fig.71)

Grain 3-zonocolporate, spheroidal, triangular, exine thick, reticulate.

Size : P = 25 μ, E = 25 μ.

Period of catches : June

THEACEAE

Schima khasiana Dyer & Schima wallichii Chois. (Pl.8,Fig.72)

Grain 3 zenocolpate, subprolate, exine thick, psilate.

Size : P = 44.8 μ, E = 36.4 μ.

Period of catches : May - July and March - April.

THYMELAEACEAE

Daphne shillong Banergee. (Pl.8, Fig.73)

Grain pantoporate, spheroidal. Exine thick, reticulate.

Size : P = 18 μ, E = 18 μ.

Period of catches : September

URTICACEAE

Boehmeria platyphylla D. Don.

Grain 3-zonoporate, oblate, spheroidal, exine thick psilate.

Size : P = 23 μ, E = 25 μ.

Period of catches : —

Mautia puya Wedd. (Pl.8, Fig.74)

Grain 3-zonoporate, spheroidal, exine thick, psilate.

Size : P = 14 μ, E = 14 μ.

Period of catches : —

Pouzolzia hirta Hassk. (Pl.8, Fig.75)

Grain 3- colpate, colpi narrow oblate, spheroidal. Exine thick, psilate.

Size : P = 14 μ, E = 14 μ.

Period of catches : —

VACCINACEAE

Vaccinium griffithianum Wight. (Pl.8, Fig.76)

Grain united in tetrads. Individual grain 3-zonocolpate, Exine thick, Psilate.

Size : P = 22 μ, E = 22 μ.

Period of catches : —

Vaccinium serratum Wight.

Grain united in tetrads. Individual grain - 3-zonocolpate. Exine thick, Psilate.

Size : P = 21 μ, E = 21 μ.

Period of catches : October

VALERINACEAE

Valeriana wallichii DC.

Grain 3-zonocolporate, subprolate, endocolpium very faint. Exine thick, spinulose.

Size : P = 52 μ, E = 43 μ.

Period of catches : August

VERBENACEAE

Clerodendrum serratum Spreng. (Pl.8, Fig.77)

Grain 3-zonocolpate, spheroidal, exine spinulose,

spines long.

Size : P = 70 μ, E = 70 μ.

Period of catches : —.

Duranta plumieri Jacq. (Pl.8, Fig. 78)

Grain 3-zonocolpate, spheroidal. Exine thick, reticulate.

Size : P = 27.5 μ, E = 27.5 u.

Period of catches : Sept - Nov.

Lantana camara Linn.

Grain 3-zonocolpate, spheroidal. Exine thick, reticulate.

Size : P = 25 μ, E = 25 μ.

Period of catches : ——

LILIACEAE

Disporum pullum Salisb. (Pl.8, Fig.79)

Grains 1-colpate, colpus wide in the middle, reaches the ends of the larger axis. Exine thick, faintly reticulate.

Size : P = 28 μ, E = 52 μ.

Period of catches : -

POACEAE

Paspalum dilatum Poir. (Pl.8, Fig.80)

Grains 1-porate, spheroidal, pore margin thick

Forming an annular ring. Exine thick, psilate.

Size : P = 30 μ, E = 50 μ.

Period of catches : -

Discussion

Present study covers the morphological description of pollen of 135 species belonging to 53 families based on light microscope studies. Different types of pollen grains ranging from inaperturate to colporate, and exine lacking distinct columellar stratum to exines with columellar and tactal complexities (Argyrea sp.) have been examined. It is found that pollen are unique and typical for a family, genus or species. For example, pollen of Pinus and Cedrus are winged (Pl.2, Fig.2 & 3); while pollen of Cryptomeria japonica shows the aperture represented by papilla (Pl.2 Fig.4). Pollen of Cupressus are inaperturate type ((Pl.2, Fig.1).

Similarly marked size variations of pollen have also been observed with 16.4 μ diameter in Eleocarpus accuminatus to 179 μ diameter in Argyreia capitata.

The pollen of various species are marked by differences in the type of apertures and exine ornamentations. Further, on the basis of exine character, the anemophilous and entomophilous pollen can be easily differentiated. In case of anemophilous pollen the exine surface is smooth, non-sticky; while in entomophilous pollen the exine surface is rough, spiny and sticky.

It is known that the pollen grains possess several structural characteristics each of which is shown to throw light on the taxonomy of the various genera and species. These structural features are of the pollen wall with its stratified layers and surface ornamentation, the appertures on the wall, size and shape of the grain, the arrangement of individual grain in the tetrad or in the anther etc. The works, particularly those of Erdtman (1952 and 1959) and others (Faegri,1956; Nair,1958-62) gives a detailed account of the pollen morphology of several angiosperms. In the present work an account of the angiosperm and gymnosperm species of Shillong have been provided which furnishes a diversity of pollen morphological differences in these plants. This pollen morphological study has brought out a variety of sporomorph hitherto not described from Shillong (Meghalaya).

Pollen grains are the male reproductive units of

the flowering plants. When the pollen grains are mature and ready for pollination, they get liberated and are carried by wind, water or insects to reach the destination for executing fertilization. The anemophilous pollen are generally light and are produced in large quantities whereas the entomophilous pollen are relatively heavier and are produced in lesser quantity. Air-borne pollen are now recognised as one of the principal causes of respiratory allergic diseases like seasonal rhinitis, asthema etc. It is therefore, essential for the treatment of allergic diseases to identify and know the different types of pollen available in a particular area and in its atmosphere, and also to know the types responsible to cause allergic reactions and to find a possible remedy for the same. Therefore a knowledge of the local vegetation and pollen type is an essential prerequisite and was successfully attempted.

SECTION V

Aerobiological Survey

AEROBIOLOGICAL SURVEY

Introduction

A wide variety of organisms constitute the air-spora of any region (Sreeramulu, 1967) and these biological components follow a definite pathway, starting from the source of organisms to their release, dispersion, deposition and finally their impact on the plant or animal systems, including human beings. While the kind and the concentration of the atmospheric pollen depends on the ground vegetation and their phenological behaviour, the concentration of fungal spores in the atmosphere is mostly determined by the local weather conditions like rainfall, humidity, temperature, etc. Some of these pollen and fungal spores are seriously pathogenic causing various diseases in crop plants as well as allergenic diseases in human beings. The pattern of incidence of their air borne biological particles differ considerably from place to place and season to season and this knowledge of seasonal variation of these atmospheric pollen/spores is of prime importance for forecasting and controlling a disease.

Concentration of spores of a single species or a group of related species, often show diurnal rhythms which

means that at a regular interval throughout the day, the mean spore concentration shows fluctuations.

Gregory and Sreeramulu (1958); Sreeramulu (1959); Paddy et al (1962); Kramer et al (1963); Adams (1964), Pawsay (1964) have reported a minimum of spore concentration occurred at about noon. Sreeramulu (1964) and Sreeramulu and Seshayaram (1962) also reported similar results. Gregory (1961) classified the different types of diurnal periodicity pattern found in the air-borne bacteria and fungal spores into the following five groups: Bacterial, Nocturnal, Forenoon, Afternoon, and Evening. This classification was found on the part of the day at which the daily maxima recover regularly.

Kurkela (1973) discussed the diurnal periodicity of spore dispersal in rusts. According to him aecio and uredospore usually had maximum at about noon. Rajkumar and Gupta (1976) also reported that maximum number was intercepted either in afternoon, or at noon hours, while the lowest population was observed at night or morning hours.

The periodic appearance of spores on a spore trap does not mean that they have been set free in a periodic manner (Ingold, 1965). The periodic rhythm in the spore catches in the trap may be conditioned by periodic conditions.

Therefore a study was conducted to understand the diurnal periodicity of fungal spores and plant pollens.

While most of the existing aerobiological studies in India reveal the qualitative features (Kalra and Dumbrey, 1957; Lakhanpal and Nair, 1958; Karnik, 1962), quantitative studies with reference to seasons are scanty (Sreeramulu, 1967). Further, these studies have been conducted in plain regions, where more or less similar results have been obtained, and studies of their nature in hilly regions are conspicuously lacking. Present section, therefore, deals with the study of seasonal and diurnal variation of air-borne fungal spores and pollen grains in the atmosphere of Shillong.

Materials and Methods

Spores, pollen and other materials of biological origin were trapped on glycerine jelly smeared slides by simple gravity sampler making use of the Aeroscope supplied by the C.S.I.R. Centre for biochemicals, New Delhi for an "All India Co-ordinated Project on Aerobiology". The Aeroscope was placed at a height of 8 meters above ground level on the roof of a university building as well as in the departmental experimental Garden (Plate No.1).

Description of the air sampler (aeroscope)

The aeroscope fabricated by Lakhanpal and Nair (1958) has been used as a sampler on which the apparatus for the present study has been fabricated with minor modifications. The modified version consists of a circular-heavy base (diameter 15 cm) held on rubber resting nobs placed equally apart at the periphery of the base plate, and surrounded at the centre by a cylindrical vertical shaft (height 32.5 cms. diameter 2 cms.) Fastened into a socket (height 4 cms.) of the base plate and sharpened into a fine point at the tip sliding over the shaft is a moving assembly with a square shaped (4 cm each side) basal region (Height 27.5 cms) lying loose around the whole length of the cylindrical shaft, carrying a horizontal rectangular cover (18 cms X 10 cms) and a large tail shaped wind-vane (38 X 28 cms longest extremities) rivetted along with length of the basal rectangular region of the wind vane assembly. Ball bearings are provided between the vertical shaft and the cylindrical basal region of the moving assembly, one each at the base, at near the junction between the horizontal cover and the vertical cylinder. The horizontal cover has thus a wind vane end and an open end. A removable slide carrier is slide into a groove inside the horizontal cover. The slide carrier surface (8 cms base X 9 cms height) is slanting

towards the wind-wane end (45^{o} angle from base of horizontal cover to the inner face of the slant), and it has provision for carrying 3 slides. The whole exposed regions of the apparatus has been spray painted (red for base and horizontal cover, and white for the vertical cover and wind-wane.

A small drop of melted glycerine jelly with safranin was smeared on the slide just to occupy an area about equal to the cover glass. The slide was exposed in vertical position inside the sampler protected from rain water. For seasonal variations after every 24 hours, and for diurnal variations after every four hour interval, the slide was observed in the laboratory after removing the extraneous particles like sand, etc. The slide was then gently heated to drive away the moisture content and covered with a cover glass. Observations and counts were made from each slide from left to right and then from above downwards. The various categories of biopollutants trapped were counted per cm^2 per day, and the percentage of these biopollutants per day and per month were calculated. The air-borne pollen were identified with the help of reference pollen slides of common flowering plants of the area, which is based on the flowering phenology of these species, and also with the help of standard literature (Nair 1965).

Identification of Fungal Spores:

For identification of fungal spores three petri-dishes containing Czepek's culture medium were exposed for seven minutes near the spore trap. The exposed plates were then incubated at 27°C + 1°C for six days and the fungal colonies that appeared in the plates were examined, isolated and identified. Some of the unidentified air borne spores were later identified by matching with the spores of pure cultures. Spore identifications were also made with the help of standard literature (Barnett, 1955; Subramanian, 1971; Gregory, 1973).

The meteorological data of the area was obtained from the Central Seismological Observatory, Shillong.

Results

The content of air-spora in the atmosphere of Shillong is rich both quantitatively and qualitatively. It is seen that hardly any period is free from the atmospheric biopollutants, and these exhibit distinct seasonal periodicities in their day to day incidence.

A. Seasonal variations

Of the total air-spora, pollen grains contribute

21.09%, fungal spores; 72.69% and other biological components, 6.96% (Fig.3.1). Daily averages for each month for the various kinds of air-spora (pollen grains, fungal spores and other particles) identified in the catches are given in the Tables 3.1, 3.2, and 3.3, to indicate their monthwise incidence. The results of total pollen, fungal spores and other catches in various month are given in Fig.3.2, 3.3 and 3.4. Daily average in each month of the atmospheric incidence of some dominant pollen and fungal spores are represented graphically in Fig. 3.5 and 3.6, pollen calender of predominant tree species are given in Fig.3.7.

Seasonal variation of pollen and fungal spore are given in

It can be seen from the Fig.3.2 that pollen grains dominate the atmosphere during the month of February-May, after that the fungal spores become predominant and continued to be so until the month of January. The biopollutant catches other than pollens and fungal spores were present but found to be very insignificant throughout the year (Fig.3.2).

Seasonal variations in pollen content of the air

Pollen grains are comparatively easier to identify because of their size. In all 67 air borne pollen types, which contribute about 21.09% of total air-spora have been recorded in the present study. Monthwise analysis of pollen

FIG. 3:1 AIR SPORA OF SHILLONG (1980-81)

Fig. 3.1

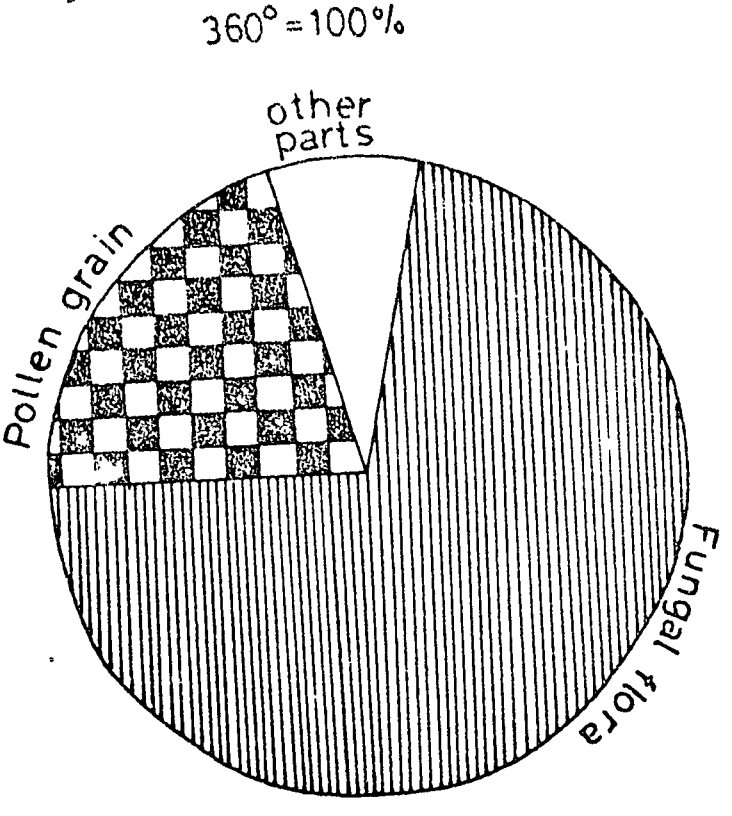


FIG. 3.2 TOTAL POLLEN, FUNGAL SPORES AND OTHER PARTS IN DIFFERENT MONTHS (1980-81)

Fig. 3.2

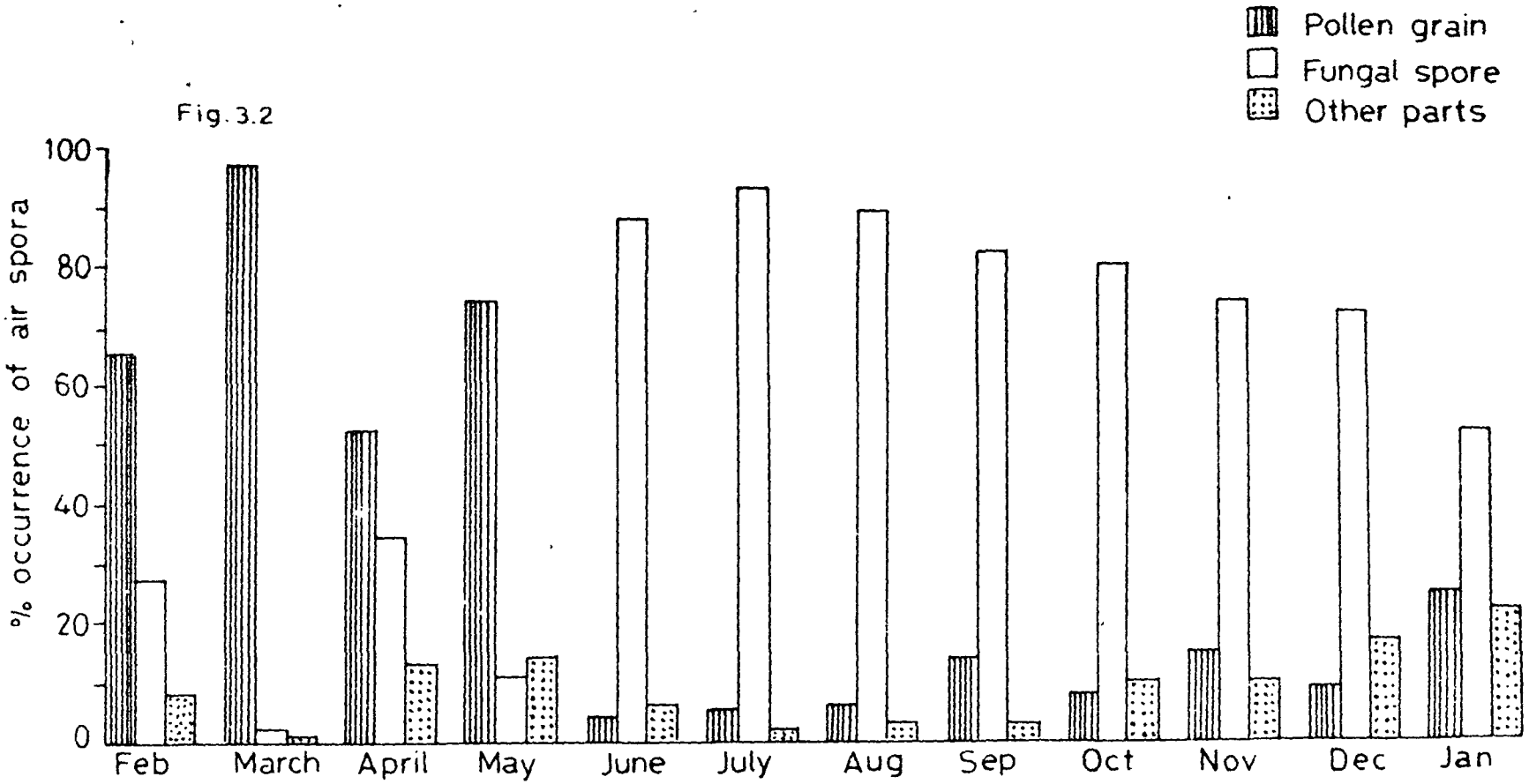

Pollen grain
Fungal spore
Other parts
% occurrence of air spora
100
80
60
40
20
0
Feb
March
April
May
June
July
Aug
Sep
Oct
Nov
Dec
Jan

FIG. 3.3 SEASONAL VARIATION OF POLLEN CONCENTRATION IN SHILLONG ATMOSPHERE

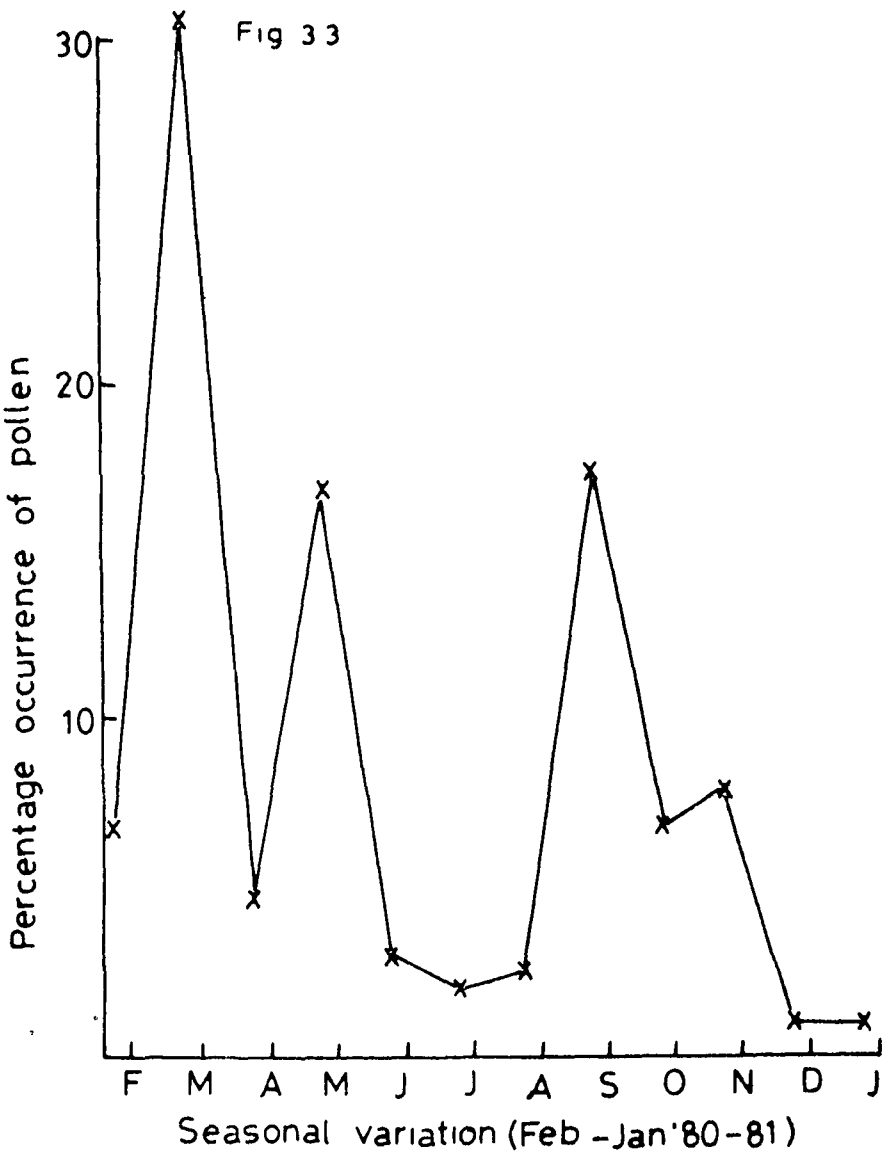


Fig 33
30
20
10
Percentage occurrence of pollen
F M A M J J A S O N D J
Seasonal variation (Feb -Jan '80-81)

FIG. 3.4 SEASONAL VARIATION OF FUNGAL SPORE CONCENTRATION IN SHILLONG ATMOSPHERE IN RELATION TO METEOROLOGICAL CONDITIONS

Fig. 3.4

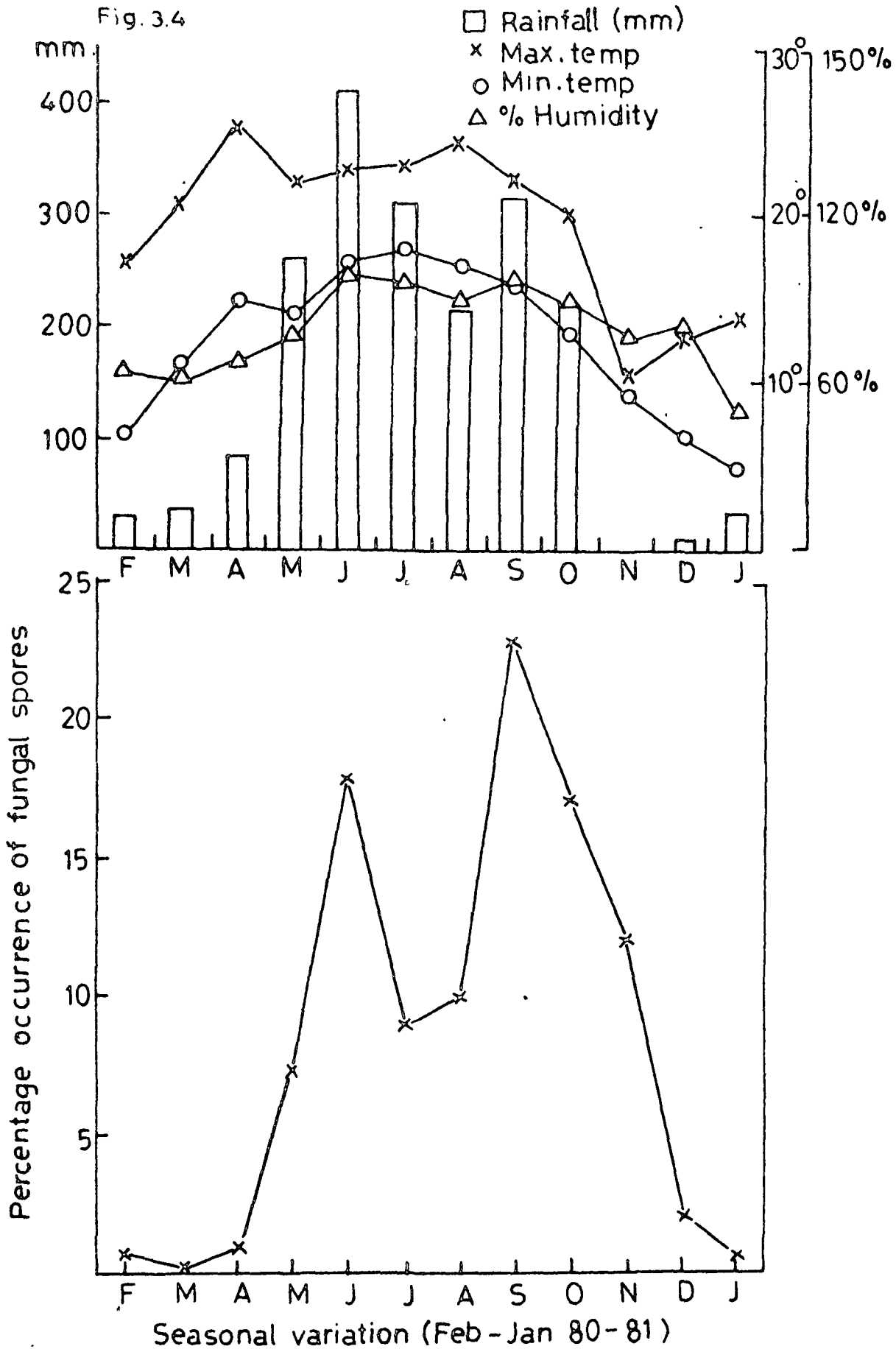

Rainfall (mm)
Max. temp
Min. temp
% Humidity
mm
400
300
200
100
30°
20°
10°
150%
120%
60%
F M A M J J A S O N D J
25
20
15
10
5
Percentage occurrence of fungal spores
F M A M J J A S O N D J
Seasonal variation (Feb - Jan 80 - 81)

FIG. 3.5 SEASONAL VARIATION OF AIR BORNE POLLEN OF SOME DOMINANT SPECIES IN THE ATMOSPHERE OF SHILLONG

Fig. 3.5

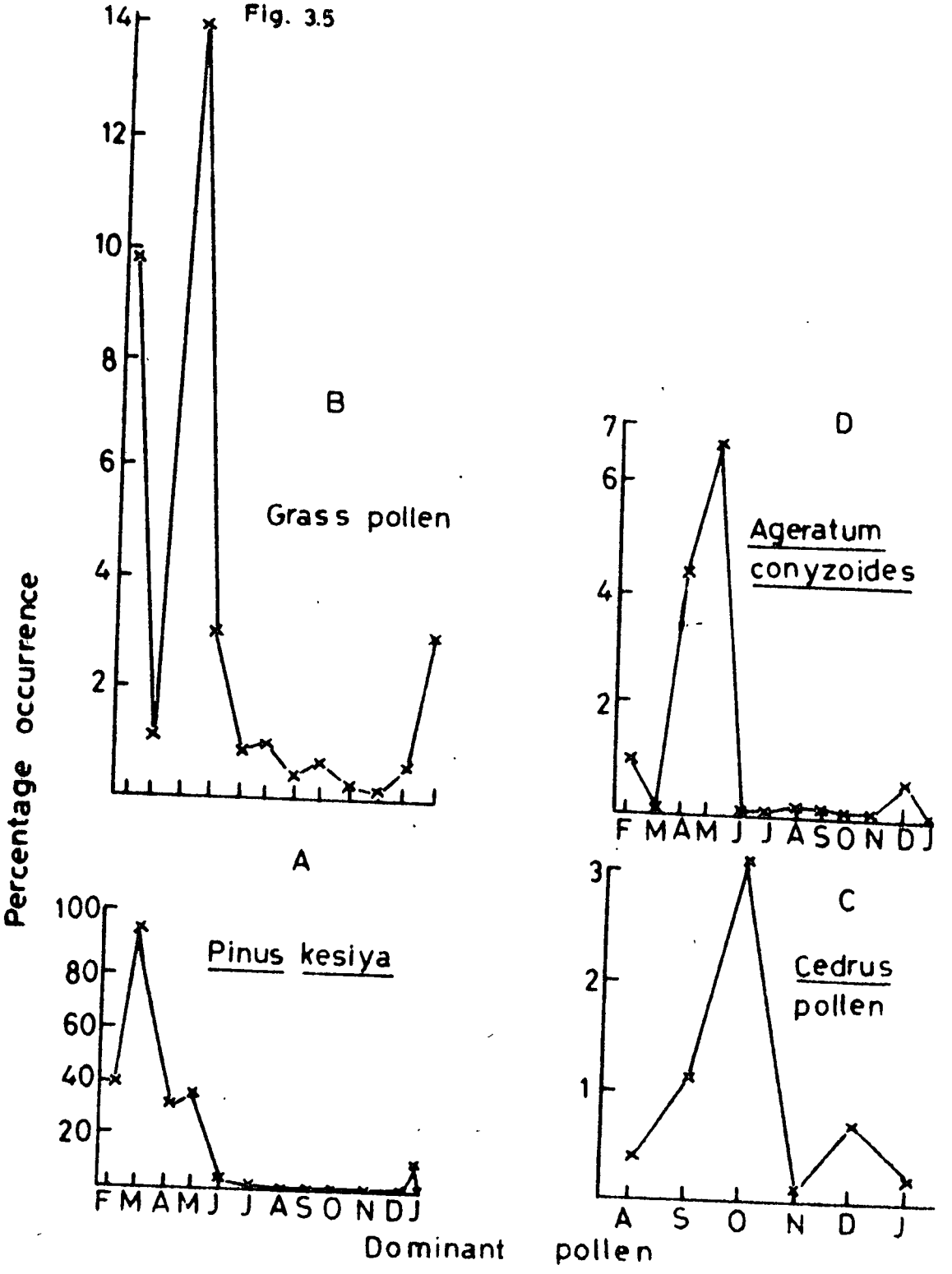

Percentage occurrence
14
12
10
8
6
4
2
B
Grass pollen
A
100
80
60
40
20
Pinus kesiya
F M A M J J A S O N D J
D
7
6
4
2
Ageratum
conyzoides
F M A M J J A S O N D J
C
3
2
1
Cedrus
pollen
A S O N D J
Dominant pollen

FIG. 3.6 SEASONAL VARIATION OF SOME DOMINANT FUNGAL SPORES IN THE ATMOSPHERE OF SHILLONG

Fig.36

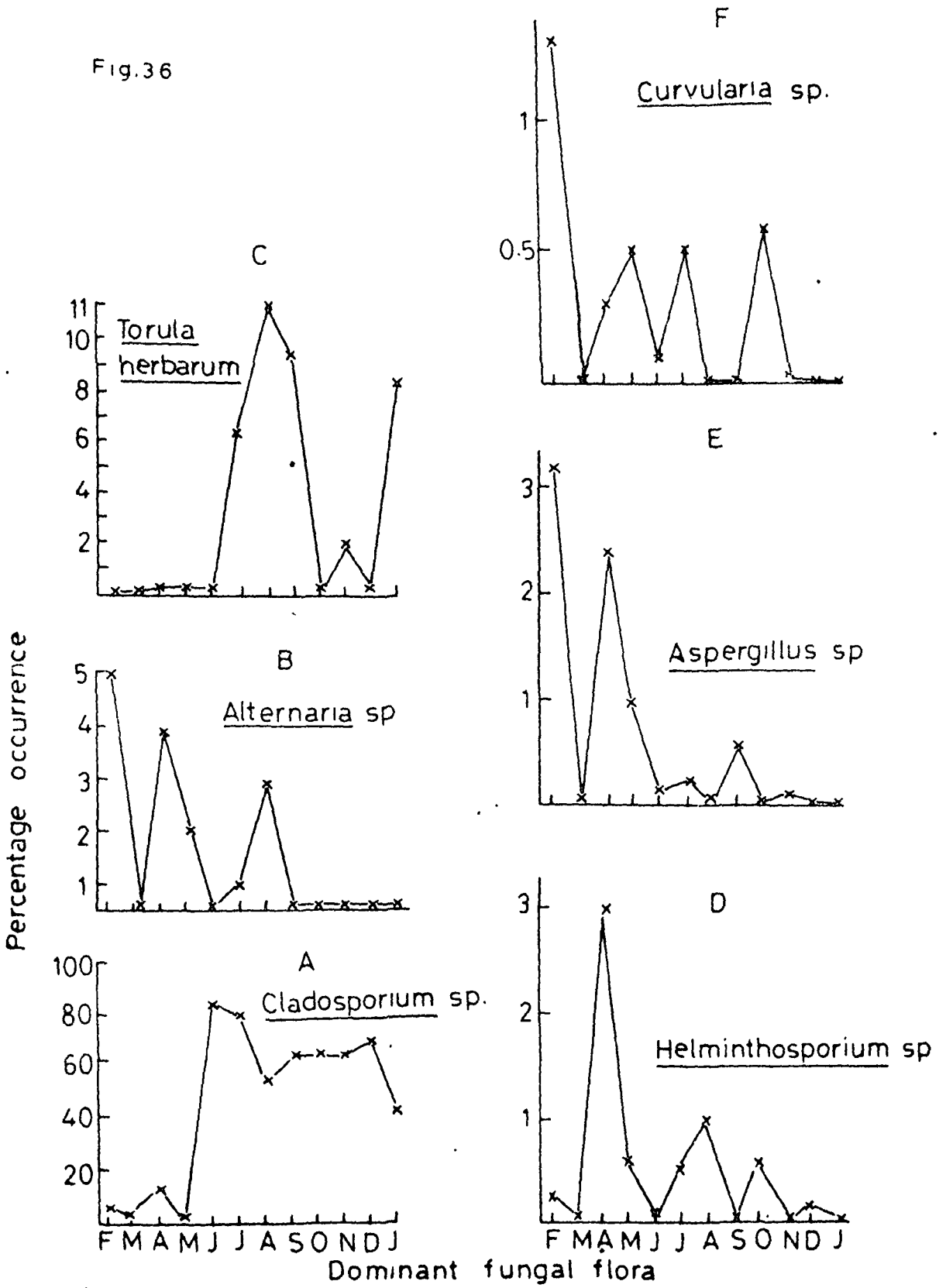

F
Curvularia sp.
1
0.5
C
Torula herbarum
11
10
8
6
4
2
E
3
2
1
Aspergillus sp
B
Alternaria sp
5
4
3
2
1
D
3
2
1
Helminthosporium sp
A
Cladosporium sp.
100
80
60
40
20
F M A M J J A S O N D J
F MA M J J A S O N D J
Percentage occurrence
Dominant fungal flora

FIG. 3.7 POLLEN CALENDER OF PREDOMINANT TREES OF SHILLONG

Fig 37

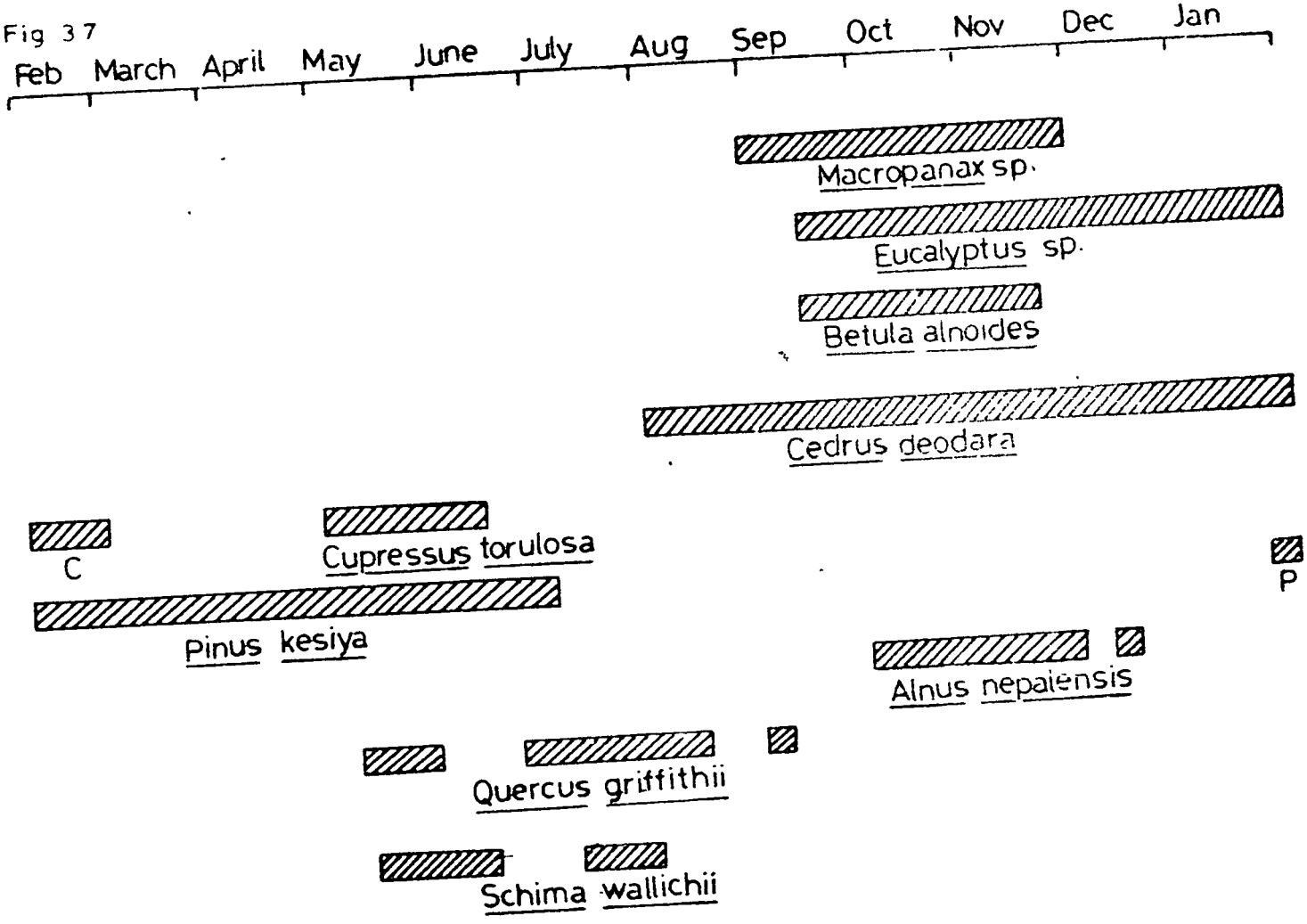

Feb
March
April
May
June
July
Aug
Sep
Oct
Nov
Dec
Jan
Macropanax sp.
Eucalyptus sp.
Betula alnoides
Cedrus deodara
C
Cupressus torulosa
P
Pinus kesiya
Alnus nepalensis
Quercus griffithii
Schima wallichii

Table 3.1. Monthly frequency of pollen grains in the air
(Feb.'80 - Jan.'81)

Name of month	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Total	Days with occurrence	Mean catch No/slide	Percentage in pollen grains (%)
No. of exposures	24	28	30	31	30	31	31	30	31	30	31	31	356			
Name of the species																
Acacia dealbata	-	-	-	-	-	-	-	1	3	-	-	-	4	4	1.00	0.061
Acacia mollissima	-	-	-	-	-	17	-	-	-	-	-	-	17	5	3.40	0.26
Abutilon indicum	8	-	-	-	-	-	-	-	-	-	-	-	8	4	4.00	0.12
Ageratum conyzoides	-	-	26	103	2	2	4	7	1	5	-	-	150	26	5.76	2.30
Alnus nepalensis	-	-	-	-	-	-	-	-	149	26	2	3	180	35	5.14	2.76
Ambrosia sp.	-	-	14	1	-	-	-	-	5	-	-	-	20	7	2.85	0.30
Ardisia macrocarpa	-	-	-	-	-	5	20	48	-	-	-	-	73	39	1.87	1.12
Artermisia sp.	-	-	-	-	4	-	-	2	-	-	-	-	6	2	3.00	0.09
Betula alnoides	-	-	-	-	-	-	-	441	11	-	-	-	452	8	56.50	6.94
Brunella vulgaris	-	-	-	-	1	-	-	-	-	-	-	-	1	1	1	0.01
Cedrus deodara	-	-	-	-	-	-	9	73	163	5	6	1	257	60	4.28	3.94
Chrysanthemum sp.	-	-	-	-	-	-	-	-	2	-	-	-	2	2	1	0.03
Corylopsis himalayana	-	1	-	4	-	-	-	-	-	-	-	-	5	2	2.50	0.07
Cryptomeria japanica	-	-	-	-	-	-	-	3	-	-	-	-	3	2	1.50	0.04

Table 31 (contd.)

Name of month —— No. of exposures ——	Feb 24	Mar 28	Apr 30	May 31	Jun 30	Jul 31	Aug 31	Sept. 30	Oct 31	Nov 30	Dec 31	Jan 31	Total 356	Days with occu-rence	Mean catch No/ slide	Percen-tage in pollen grains (%)
Cupressus torulosa	15	-	-	2	2	-	-	-	-	-	-	2	21	6	3.50	0.32
Daphne shillong	25	-	-	1	-	-	-	-	2	-	-	-	28	12	2.33	0.43
Docynia indica	10	-	-	-	-	-	-	-	-	-	-	-	10	3	3.33	0.15
Duranta rapens	-	-	-	-	-	-	-	2	-	9	-	-	11	5	2.20	0.16
Elaegnus sp.	20	-	-	-	-	-	-	-	-	-	-	3	23	4	5.75	0.35
Elaeocarpus sp.	-	-	-	-	-	-	-	-	-	5	-	-	5	1	5.00	0.07
Eucalyptus globulus	-	-	-	-	-	-	-	-	6	450	39	6	501	32	15.65	7.69
Fagopyrum esculantum	-	-	-	-	-	-	-	6	8	10	2	-	26	18	1.44	0.39
Gaultheria sp.	-	-	-	1	-	-	-	-	-	-	-	-	1	1	1.00	0.01
Glochidion sp.	-	-	-	-	-	-	-	148	27	1	-	-	176	43	4.09	2.70
Hypoestes triflora	-	-	-	-	-	-	-	2	-	-	-	-	2	1	2.00	0.03
Ligustrum robustum	-	-	-	-	6	12	19	-	-	-	-	-	37	15	1.80	0.56
Lyonia ovalifolia	-	-	-	-	-	2	1	19	-	-	-	-	22	5	5.00	0.33
Macropanax sp.	-	-	-	-	-	-	-	2	2	16	-	-	20	12	1.66	0.32
Melodinus khasiana	-	-	-	-	-	8	-	-	7	-	-	-	15	8	1.87	0.23
Myrsine semmiserrata	-	-	-	-	-	-	37	11	-	-	-	-	48	10	4.80	0.73

Table 3.1(contd.)

Name of month —— No. of exposures —	Feb 24	Mar 28	Apr 30	May 31	Jun 30	Jul 31	Aug 31	Sep 30	Oct 31	Nov 30	Dec 31	Jan 31	Total 356	Days with occurrence	Mean catch No/slide	Percentage in pollen grains (%)
Neilla thyrsiflora	-	-	-	-	-	2	-	-	--	--	--	-	2	1	2.00	0.03
Oenonthera sp.	-	-	-	5	-	-	-	-	-	-	-	-	5	2	2.50	0.09
Oldenlandia sp.	-	-	-	-	-	-	4	-	-	1	1	-	6	4	1.50	0.09
Osbeckia sp.	-	-	-	-	-	-	-	-	-	-	2	-	2	1	2.00	0.03
Parnesia sp.	-	-	-	8	-	-	-	-	-	-	-	-	8	1	8.00	0.12
Pauzalzia sp.	-	-	-	-	-	-	4	-	-	-	-	-	4	3	1.33	0.06
Photinia notioriana	-	-	-	3	-	-	-	-	-	-	-	-	3	3	1.00	0.04
Polygonum chinensis	-	-	-	-	-	-	9	-	-	-	-	-	9	21	4.50	0.13
Plantago major	-	-	1	-	-	-	-	-	-	-	-	1	2	2	1.00	0.03
Polygonum hydropiper	-	-	-	7	-	-	-	-	-	-	-	-	7	4	1.75	0.10
Polygonum punctatum	-	-	-	-	-	-	-	2	4	-	-	7	13	6	2.16	0.19
Potentilla moonia	-	-	-	-	-	-	-	12	3	-	-	-	15	4	3.75	0.23
Pinus keseya	258	1975	178	536	103	9	-	-	-	-	-	42	3100	115	26.95	47.63
Prunus cerasoides	-	-	-	-	-	-	-	-	12	13	-	-	25	9	2.77	0.38
Prunus persica	-	-	-	5	-	-	4	-	-	-	-	-	9	4	2.25	0.13
Pynes communis	-	-	-	25	-	2	-	-	-	-	-	-	27	6	4.50	0.41

Table 34(contd.)

Name of month —— No.of exposures——	Feb 24	Mar 28	Apr 30	May 31	Jun 30	Jul 31	Aug 31	Sep 30	Oct 31	Nov 30	Dec 31	Jan 31	Total 356	Days with occu-rence	Mean catch No/ slide	Percen-tage in pollen grains(%)
Quercus griffithi	-	-	-	20	2	21	10	63	-	-	-	-	116	35	3.31	1.76
Ranunculus sp.	-	-	-	-	-	-	-	11	8	3	-	-	22	17	1.29	0.33
Rhododendron arboreum	-	-	9	-	-	-	-	-	-	-	-	-	9	4	2.25	0.13
Rhus semiserrata	-	-	-	22	-	-	-	-	-	-	-	-	22	13	1.69	0.33
Rubus ellipticus	-	-	3	28	3	-	-	-	-	-	-	-	34	16	2.12	0.52
Rubus micropetalus	-	-	-	-	3	-	12	17	15	-	-	-	47	25	1.88	0.72
Rubia cordifolia	-	-	-	-	-	2	13	22	4	-	-	-	41	22	1.86	0.63
Rumex nepalensis	-	-	-	-	11	1+	-	-	-	-	-	-	11	3	3.66	0.16
Schima wallichii	-	-	-	-	19	17	[illegible]	-	-	-	-	-	36	25	1.44	0.55
Schima khasiana	-	-	-	221	[illegible]	-	-	-	-	-	-	-	221	7	31.57	3.39
Strobilanthus sp.	-	-	-	-	-	3	-	5	2	1	-	4	15	13	1.15	0.23
Symplocos spicata	-	-	-	-	1	-	7	-	-	1	-	-	9	3	3.00	0.13
Trifolium repens	16	-	-	-	-	-	-	-	-	-	-	8	24	7	3.42	0.36
Vaccinum sp.	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	-	-	-	[illegible]	1	1.00	0.01
Viburnum sp.	-	-	-	65	1	2	6	2	3	-	-	-	79	36	2.19	1.21

Table 3.1 (contd.)

Name of month ——	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Total	Days with occu-	Mean catch	Percen- tage in
No.of exposures ——	24	28	30	31	30	31	31	30	31	30	31	31	356	rence	No/ slide	pollen grains (%)
Zea mays	-	-	-	-	-	-	3	-	-	-	-	-	3	3	1.00	0.04
Grass pollen	[illegible]												-	-	-	-
Malvaceae pollen	3	-	10	5	2	1	1	4	2	7	-	1	33	15	2.20	0.50
Asteracea pollen	7	-	-	-	18	-	-	2	1	1	-	-	29	12	2.41	0.44
Convolvulaceae pollen	2	-	-	-	-	-	-	-	-	-	-	-	2	1	2.00	0.03
Urticaceae pollen	-	-	-	-	-	-	-	-	-	1	-	-	1	1	1.00	0.01
Total	430	2000	322	1111	221	131	177	952	459	562	57	89	6508			

grains are shown in the Table 3.1 and it is clear that specific pollen dominate the atmosphere in any given time (Fig. 3.7).

Fig. 3.3 clearly reveals three peak periods in the pollen concentrations and these correspond to March, May and September respectively. March is mainly predominated by the pollen of Pinus as well as grasses (Fig. 3.5 A & B), which rather form a conspicuous feature in the vegetation of Shillong. May is also predominated by pine pollen and pollen of angiospermous species like Schima wallichii, Quercus griffithii, Viburnum sp. and members of Rosaceae and Compositae. This also coincides with the phenology of these species (Fig. 2.1). Very negligible counts during June to August is mainly due to high rainfall, which the area receives. Again the atmosphere in September is dominated over by the pollen of Cedrus deodara and Quercus sp. November to January being the severe winter months supports only a few ground species and therefore low concentration of pollen is observed in the atmosphere. During this period much of the ground vegetation is either killed or lie dormant.

Seasonal variations in the Fungal spores content of the air

Air borne fungal spores belonging to 36 types (72%

of the total spora) present altogether a different picture in their seasonal concentrations (Table 3.2). Unlike pollen grains, the fungal spores exhibit two distinct peak periods with 18% and 24% (Fig. 3.4) in June and September respectively. Cladosporium sp., Alternaria sp., Humicola sp., Streptomyces sp. are dominant in June, while Cladosporium sp., Aspergillus sp., Curvularia sp., Torula sp., Arthinium sp., Pullularia sp. are dominant in September.

In respect to the spore concentration of individual species also, a marked seasonality has been observed. Cladosporium sp., Alternaria sp., Torula sp., Aspergillus sp., and Helminthosporium sp., occured more or less throughout the year (Fig. 3.6). The genus Cladosporium forms most distinctive conidia which are morphologically easily recognisable. Its significance in allergy has been pointed out by different workers and one of the reasons for causing allergic problems is surely its high abundance in air (Gregory, 1973). Cladosporium is the dominant fungal spore in the air-spora and spread over throughout the year with its seasonal maximum occurrence in June, July and December. Alternaria sp. which is known to cause allerginic respiratory troubles in man as well as diseases in various crop plants, also exhibits a marked periodicity. The highest concentration of this

Table 3.2 Monthly frequency of fungal spores in the air (Feb.'80 to Jan.'81).

Name of months / No.of exposures	Feb 24	Mar 28	Apr 30	May 31	Jun 30	Jul 31	Aug 31	Sep 30	Oct 31	Nov 30	Dec 31	Jan 30	Total 356	Days with occurrence	Catch No/slide	Percent in fungal flora
Name of species																
Absidia sp.	-	-	-	-	-	-	2	30	-	-	-	-	32	6	5.33	0.12
Acremonialla sp	-	-	-	-	-	-	38	-	-	-	-	-	38	1	38	0.14
Alternaria sp.	37	11	27	38	32	39	95	12	10	4	1	1	307	95	3.23	1.15
Arthrinium sp.	-	-	-	-	-	-	-	62	10	-	-	-	72	6	12.00	0.27
Aspergillus sp.	23	-	14	14	4	4	-	48	-	2	-	-	109	28	3.89	0.40
Asterosporium sp.	-	-	-	-	-	5	-	-	-	-	-	-	5	1	5	0.018
Bipolaris sp.	-	-	-	-	-	-	18	10	12	2	5	-	47	25	1.88	0.176
Boletus sp.	-	-	-	-	-	-	39	-	-	-	-	-	39	1	39	0.146
Brachysporiella sp.	-	-	-	-	-	-	24	-	-	1	-	-	25	4	6.25	0.094
Cercospora sp.	-	-	-	-	-	-	-	-	1	-	-	-	1	1	1.00	0.003
Chaetomium sp.	-	-	-	-	2	2	-	-	-	-	-	-	4	2	2.00	0.015
Cladosporium sp.	45	19	86	17	4092	1902	1492	4404	3536	2470	545	153	18761	205	91.52	70.53
Curvularia sp.	9	-	2	8	6	14	2	3	19	1	-	-	64	21	3.05	0.240
Epicoccum sp.	4	-	13	7	-	-	41	7	9	1	-	2	84	21	4.00	0.315

Table 3.2 (contd.)

Name of months ——	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Total	Days	Mean catch No/ slide	Percent in fungal flora
No.of exposures——	24	28	30	31	30	31	31	30	31	30	31	30	356			
Name of the species																
Helminthosporium sp.	4	1	18	10	7	14	27	1	2	2	2	-	87	30	2.90	0.327
Humicola sp.	-	-	3	-	17	8	4	10	-	-	-	-	42	6	7.00	0.157
Mucor sp.	19	2	34	3	7	28	16	-	-	-	-	-	106	23	4.61	0.398
Nigrospora sp.	-	-	-	-	-	-	-	-	-	2	-	-	2	1	2	0.007
Papularia sp.	-	-	-	-	-	-	79	25	-	-	-	-	104	3	34.67	0.391
Penicillium sp.	-	-	-	-	-	-	73	4	16	-	-	-	93	6	15.5	0.349
Pithomyces sp.	-	-	-	2	-	-	-	-	-	4	-	-	6	3	2	0.022
Pleospora sp.	3	-	-	2	-	-	2	1	1	11	-	-	20	9	2.22	0.075
Pseudotorula sp.	-	-	-	-	-	-	-	-	7	30	-	-	37	3	12.33	0.139
Pullularia sp.	-	-	-	-	-	-	-	35	60	8	-	-	103	18	5.72	0.387
Sardaria sp.	-	-	-	5	-	-	-	-	401	-	-	-	405	3	105.00	1.522
Stemphylium sp.	11	-	-	-	-	-	-	-	-	55	-	-	66	6	11.00	0.248
Stigmatea sp.	-	-	-	-	3	-	-	-	-	-	-	-	3	1	3.00	0.011
Streptomyces sp.	-	-	-	56	25	-	-	-	-	-	-	-	81	6	13.5	0.304

Table 3.2 (contd.)

Name of months ——	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Total	Days with occu-	Mean catch	Percent in
No.of exposures——	24	28	30	31	30	31	31	30	31	30	31	30	356	rrence	No/ slide	fungal flora
Name of the species																
Tetraploa sp.	-	-	-	3	8	14	2	-	-	-	-	-	27	12	2.25	0.101
Torula sp.	-	-	-	2	10	144	302	621	33	74	5	29	1220	91	13.41	4.58
Trichoderma sp.	8	-	6	-	-	23	-	-	-	-	-	-	37	7	5.29	0.39
Triposporium sp.	3	-	-	-	-	-	-	-	-	-	-	-	3	2	1.50	0.011
Urocystis sp.	-	-	-	-	-	-	-	2	-	-	-	-	2	2	1.00	0.007
Ustilago reticulata	-	-	-	-	-	-	12	-	-	-	-	-	12	7	1.71	0.45
Venturia sp.	-	-	-	-	-	-	-	2	-	-	-	-	2	1	2.00	0.007
Unidentified spores	-	-	-	7	2	-	-	-	-	-	-	-	9	3	3	0.033
" Smut spores	-	-	-	-	-	6	78	3	12	20	7	-	126	26	4.84	0.473
" Tetento spores	-	-	-	-	-	-	14	-	3	3	-	-	20	7	2.85	0.075
" Basidio spores	-	-	-	-	-	-	20	15	5	-	-	-	40	8	5	0.15
" Ascospores	-	-	-	-	-	-	13	-	7	-	-	-	20	6	3.33	0.075
Total	166	32	204	174	4132	2189	2393	5321	4288	6957	565	185	26600			

fungus has been observed in February (19.89%), April (13.23%) and August (3.97%). Torula herbarum (11.35%) in August, Helminthosporium sp. (3.10%) in April, Aspergillus sp. (3.40%) in February, and (2.41%) in April, were some other dominant air-borne fungi in the air which follow a seasonal pattern (Fig. 3.6).

Out of 36 types of fungi, Cladosporium sp., Alternaria sp., Aspergillus sp., Curvularia sp. and Helminthosporium sp. occur throughout the year, while certain fungi like Epicoccum sp., Mucor sp., Trichoderma sp., Streptomyces sp., Pithomyces sp., Stigmatia sp. and Chaetomium sp. occur only in the summer season (May-June), yet others like Pullularia sp., Papularia sp., Sardonia sp., Absidia sp., Acremonium sp., Brachysporiella sp., Stemphyllium sp., Pseudotorula sp., Venturia sp. and Urocystis sp., were observed in winter (Nov-Dec.) but some species like Penicillium sp., boletus sp., Humicola sp., Bipolaris sp. and Arthrinium sp. were recorded in rainy season only (July-August) (Table 3.2).

Other components (excluding pollen and fungal spores)

Besides pollen grains and fungal spores, a large number of components of biological origin are also revealed from the atmosphere. These include pteridophytic spores,

plant parts, epidermal peels, insect scales, hyline rods, sterile hyphae and algal parts. These occur in very low concentrations and constitute about 6.78% of total air spora (Fig. 3.1). However, these biological components are trapped throughout the year, but their maximum densities occur during December, January, April and May (Table 3.3, (Fig. 3.2).

Spores of pteridophytes were more abundant in the atmosphere during June (34.52%), while minimum percentage occured in the month of November (0.27%). (Table 3.3).

Plant parts, epidermal peels, were trapped throughout the year but the maximum densities found in the month of April, June, December and January (Table 3.3).

Insect scales and algal parts are also present in the atmosphere but the percentage occurrence is very negligible. Similarly hyline rods and sterile hyphae were more abundant in the month of April, August and September (Table 3.3).

B. Diurnal (periodicity) variation

The diurnal (periodicity) fluctuation of total air spora was studied by using the aeroscope, and for air-borne fungal spores by petridish exposure method.

Table 3.3 Monthly frequency of other components in the air (excluding pollen and fungal spores).

(Feb.'80 to Jan. '81)

Name of months ——	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Total	Days with occu-	Mean catch No/	Percent in
No.of exposures——	24	28	30	31	30	31	31	30	31	30	31	31	356	rrence	slide	(cm)
Name of components																
Pteridophyte spore	20	-	19	154	107	18	15	26	9	1	6	5	380	115	3.30	17.30
Plant parts	16	6	14	23	162	11	7	30	124	71	80	60	604	120	5.03	27.50
Epidermal peel	-	6	7	5	3	-	-	2	6	4	-	-	33	17	1.94	1.50
Insect scale	5	4	35	20	4	3	5	1	-	6	3	2	88	54	1.80	4.01
Sterile hyphae	-	-	-	-	-	-	57	131	290	211	35	10	734	3.2	22.94	33.42
Hyline rods	-	-	13	-	26	66	-	5	90	75	9	-	284	30	9.47	12.93
Fern parts	-	-	-	-	-	-	-	-	-	-	-	4	4	1	4	0.18
Algal parts	8	8	8	13	8	-	14	14	10	-	6	-	69	32	2.16	3.14
Total	49	24	96	215	310	98	88	199	529	368	139	81	2196			

Pollen and spores were counted at four hour intervals for the period May, 1981 to December 1981. This period was chosen because it included wet and dry days.

The scheme which follows differs slightly from grouping described by Meredith (1962), Sreeramulu and Ramalingam (1966), and Gregory (1973). Group I or pre-dawn pattern and Group II or post-dawn pattern.

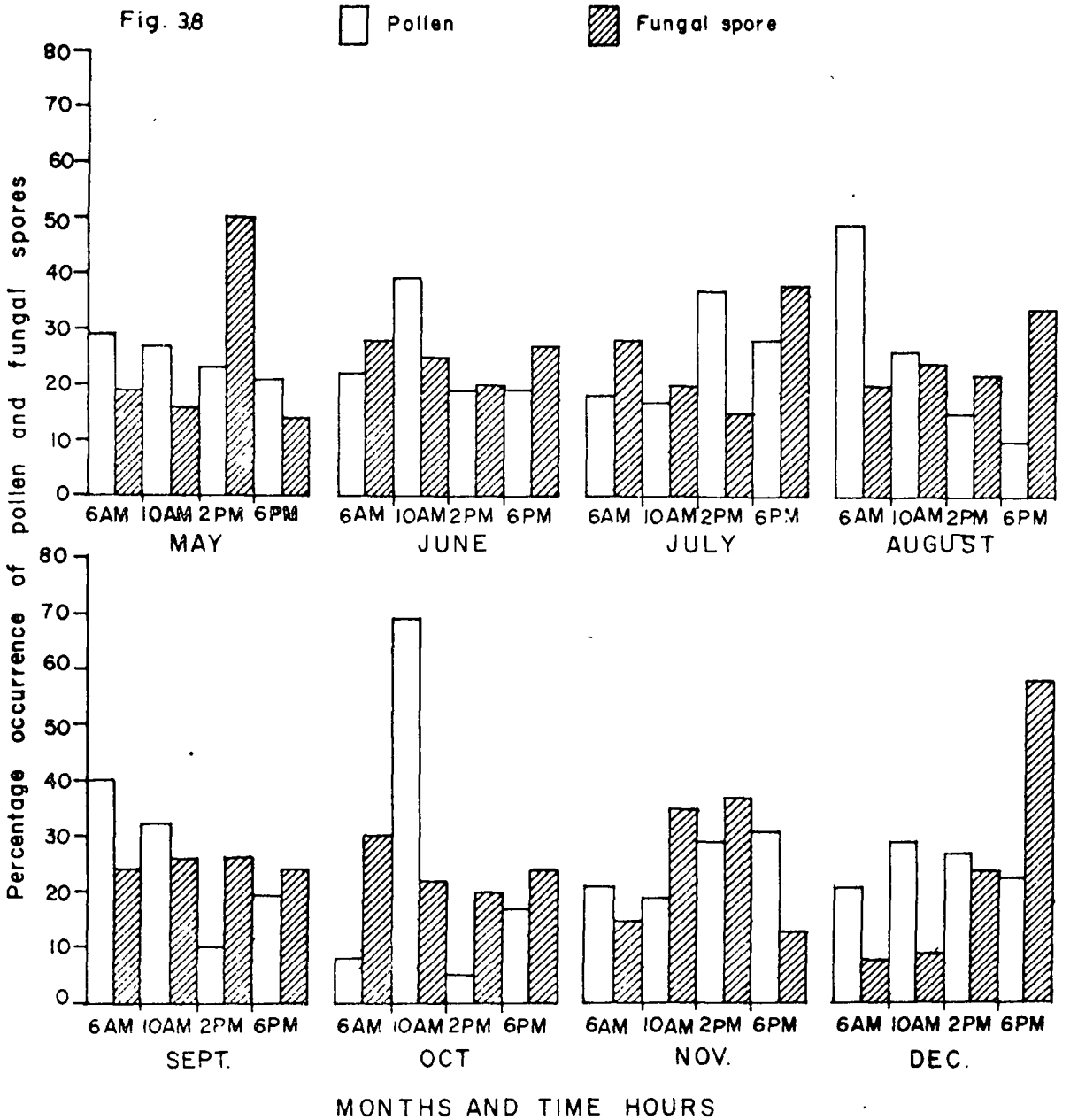
Group I : A group which occurs in the early part of the day light hours. Group I again is divided into two portion, viz., early morning and forenoon types.

Group II : A group which occurs in the later part of the day. This again was divided in two portions, viz., evening type and night type**.

The number of pollen and spores varied greatly from day to day and time to time. Monthly detail of the atmospheric incidence of total pollen and fungal spores at different times are presented graphically (Fig. 3.8) to show their density of incidence at different times. Daily averages at different times, in each month for the various kinds of pollen and fungal spores were identified in the catches are given in the Appendix.** The incidence of some

**See Appendix.

FIG. 3.8 MONTHLY DIURNAL PERCENTAGE OCCURRENCE OF POLLEN AND FUNGAL SPORE INCIDENCE



Monthly diurnal percentage occurrence of Pollen and Fungal spore incidence

dominant pollen grains are given in Fig. 3.9, which shows their day to day fluctuation in different times and occurrence of some dominant fungal spores are also shown in Fig. 3.10. Altogether 85 different pollens and 28 fungal spores type were identified from gravity slide method, during this period. The dominant pollen and fungal spore types are Pinus kesiya, Cupressus torulosa, Cladosporium sp., Alternaria sp., Chaetomium sp., Pestalotiopsis sp., Aspergillus sp., Helminthosporium sp. and some others among fungal spores.

May to August are considered as wet days while September to December are dry days. The number of pollen grains are more in wet days than during dry days.

As is evident from Fig. 3.8, significant fluctuations in the concentration of atmospheric pollen can be observed. The maximum catch was usually observed between 0.6 and 10 hours. Pollens were very low in number or not at all encountered during night, but occured in low concentration in the evenings. In case of fungal spores some species like Cladosporium sp., Chaetomium sp. were observed maximum in day time while species like Alternaria sp Helminthosporium sp. and Torula sp. were observed in the afternoon or evening times.

FIG. 3.9 DIURNAL VARIATION OF SOME PREDOMINANT POLLEN IN THE ATMOSPHERE (MONTHLY AVERAGE)

Fig. 3·9

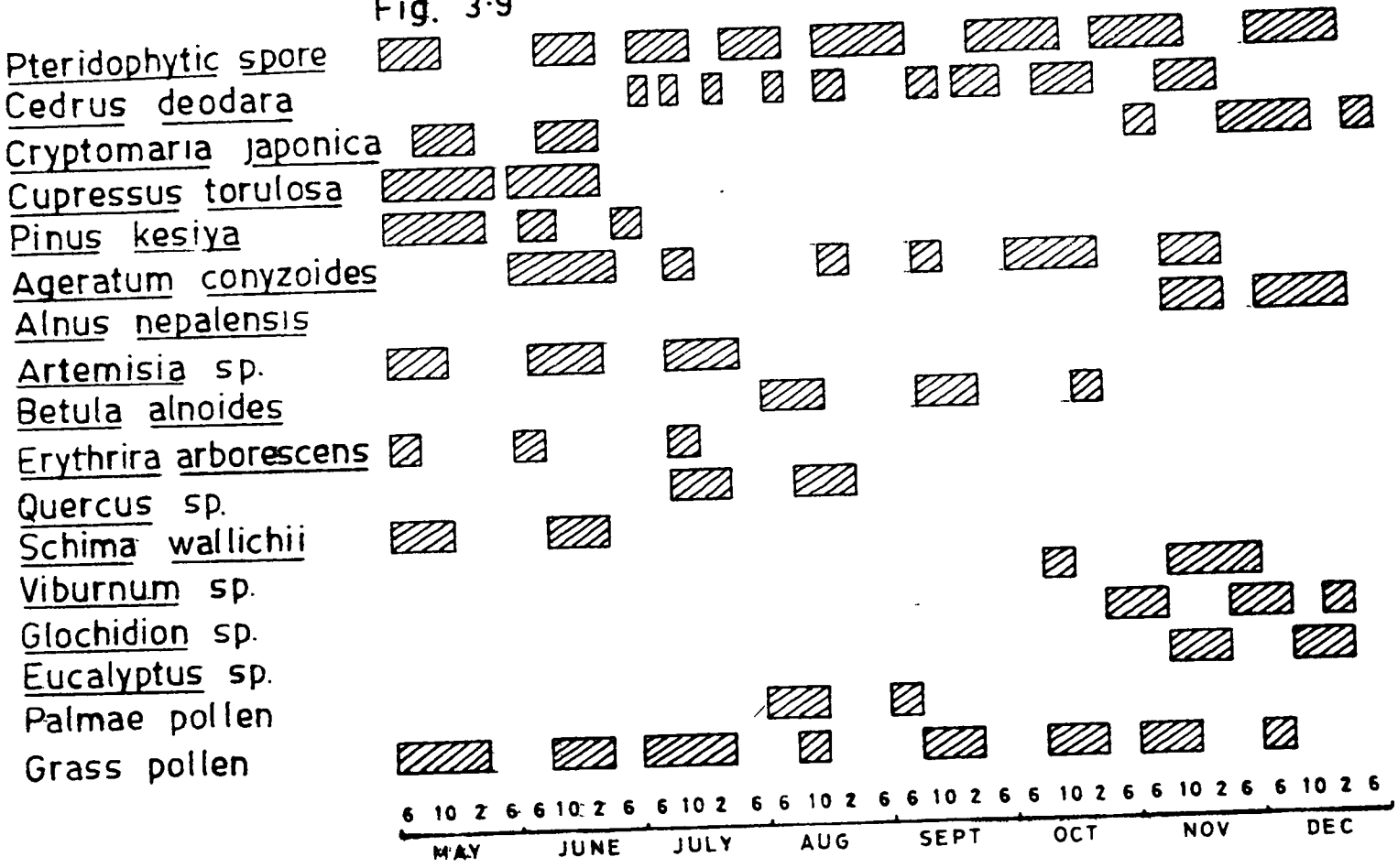
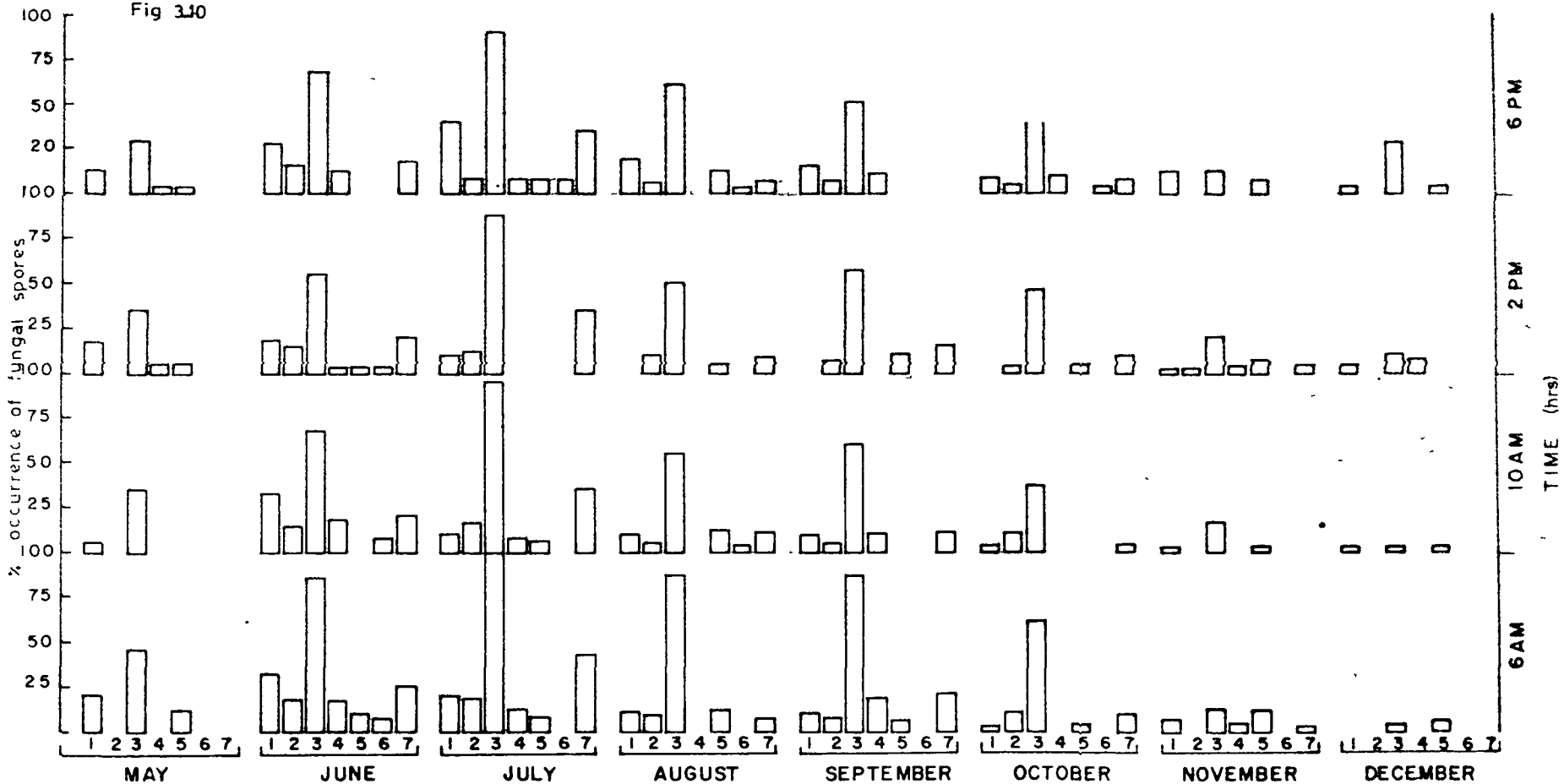

Pteridophytic spore
Cedrus deodara
Cryptomaria japonica
Cupressus torulosa
Pinus kesiya
Ageratum conyzoides
Alnus nepalensis
Artemisia sp.
Betula alnoides
Erythrira arborescens
Quercus sp.
Schima wallichii
Viburnum sp.
Glochidion sp.
Eucalyptus sp.
Palmae pollen
Grass pollen
6 10 2 6 6 10 2 6 6 10 2 6 6 10 2 6 6 10 2 6 6 10 2 6 6 10 2 6 6 10 2 6
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC

FIG. 3.10 DIURNAL VARIATION OF SOME DOMINANT FUNGAL SPORES IN THE ATMOSPHERE (MONTHLY AVERAGE)

Fig 3.10



1= ALTERNARIA sp., 2= CHAETOMIUM sp., 3= CLADOSPORIUM sp., 4= CURVULARIA sp., 5= HELMINTHOSPORIUM sp, 6=PESTALOTIOPSIS sp., 7= TORULA sp.

Culture plate surveys

Daily averages in different times in each month for the various types of fungal spores by petridish exposure method, are recorded (Appendix ⅢA-Ⅲ H). During the present investigation about 65 types of fungal spores have been isolated. Total air-borne fungal spores are given in Fig. 3.11 to indicate their day to day percentage occurrence at different times, with different weather conditions. Some dominant fungal spores are studied at fortnightly intervals throughout the year at different times are given in Fig. 3.12. Cladosporium herbarum, Alternaria alternata, [Plate No. Fig 2-4] Alternaria solani, Aspergillus niger, Penicillium implicatum, Penicillium cyclopium, Trichoderma viride, Mucor hiemalis, and Fusarium sp. were found to be dominant spp. The maximum spores were observed in the month of October and November and minimum spores in August and September. However, there is no regular pattern of distribution of fungal spores in a day. Some species like Cladosporium sp., Aspergillus sp., Absidia sp., Gliocladium sp., Papularia sp., Periconia sp., Curvularia sp., Mycogyne sp., and Gliomastix sp. were observed in mornings, while Alternaria alternata, Penicillium implicatum, Helminthosporium sp., Rhizopus sp., Mucor sp., Phoma sp., Cephalosporium sp., and Verticillium sp. were observed during noon time, but some species like Humicola sp.,

FIG. 3.11 DIURNAL VARIATION OF TOTAL FUNGAL SPORES IN THE ATMOSPHERE BY PETRIDISH METHOD (A TO H)

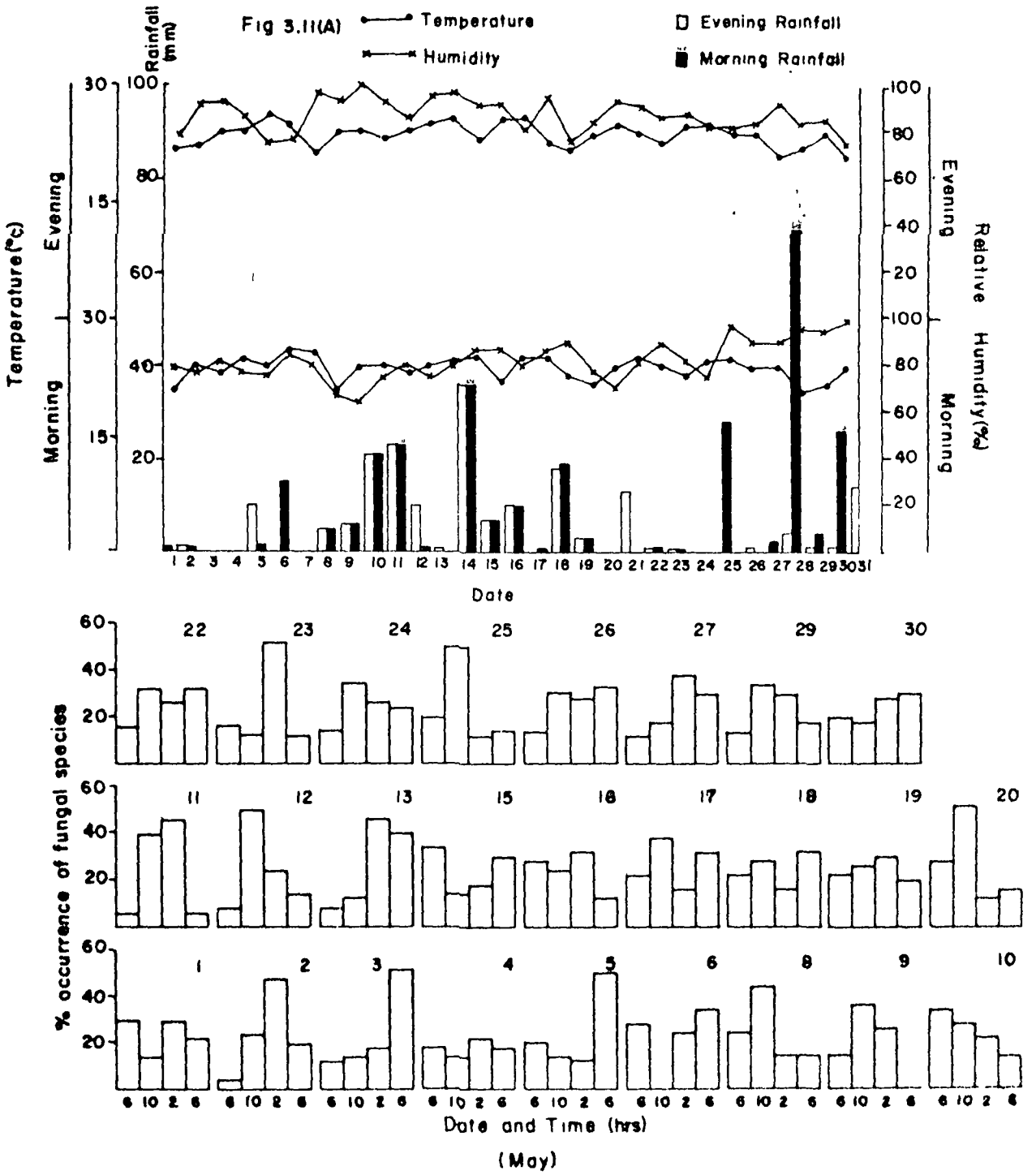
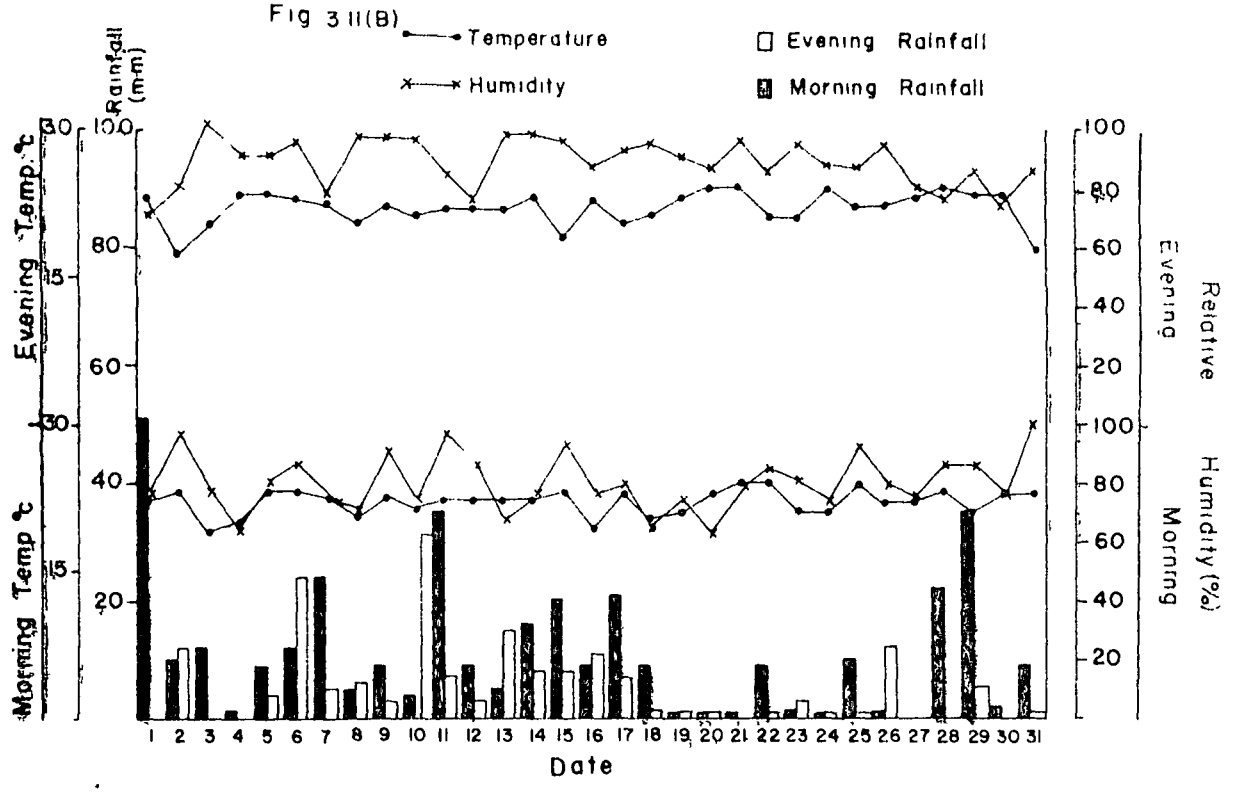
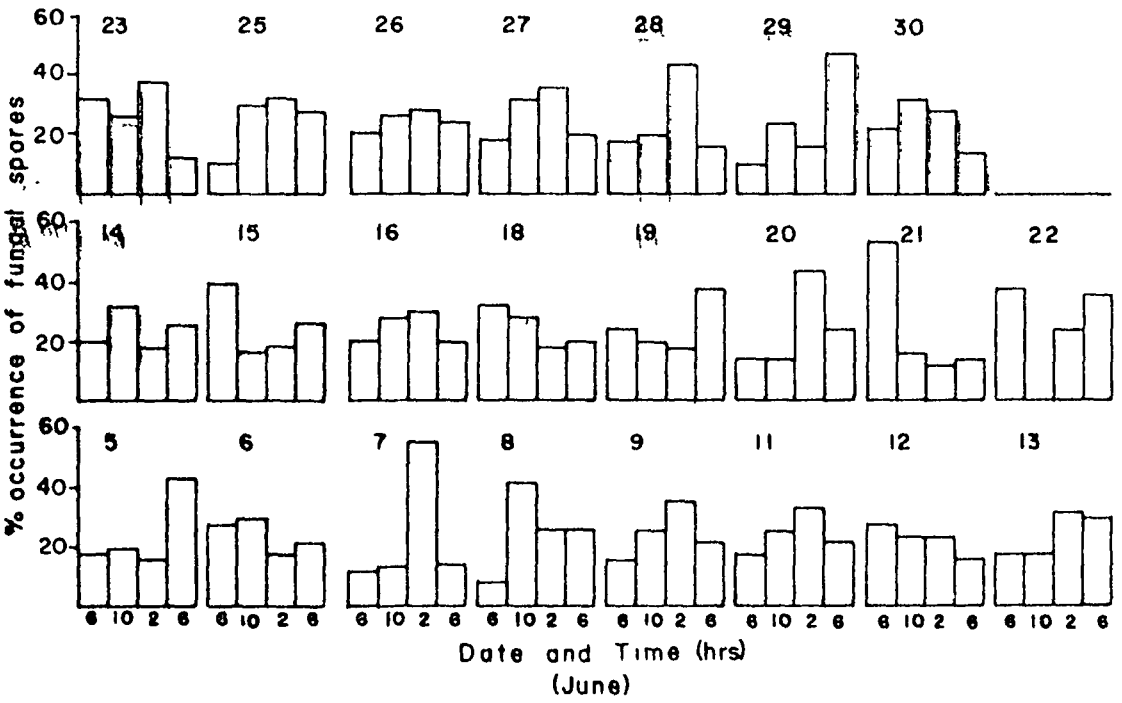


Fig 3.11(A)
Temperature
Humidity
Evening Rainfall
Morning Rainfall
Rainfall (mm)
Temperature(°c)
Evening
Morning
Relative Humidity(%)
Date
% occurrence of fungal species
Date and Time (hrs)
(May)

Fig 3.11(B)


Temperature
Humidity
Evening Rainfall
Morning Rainfall
Rainfall (m.m)
Evening Temp. °c
Morning Temp °c
Relative Humidity (%)
Evening
Morning
Date


% occurrence of fungal spores
Date and Time (hrs)
(June)

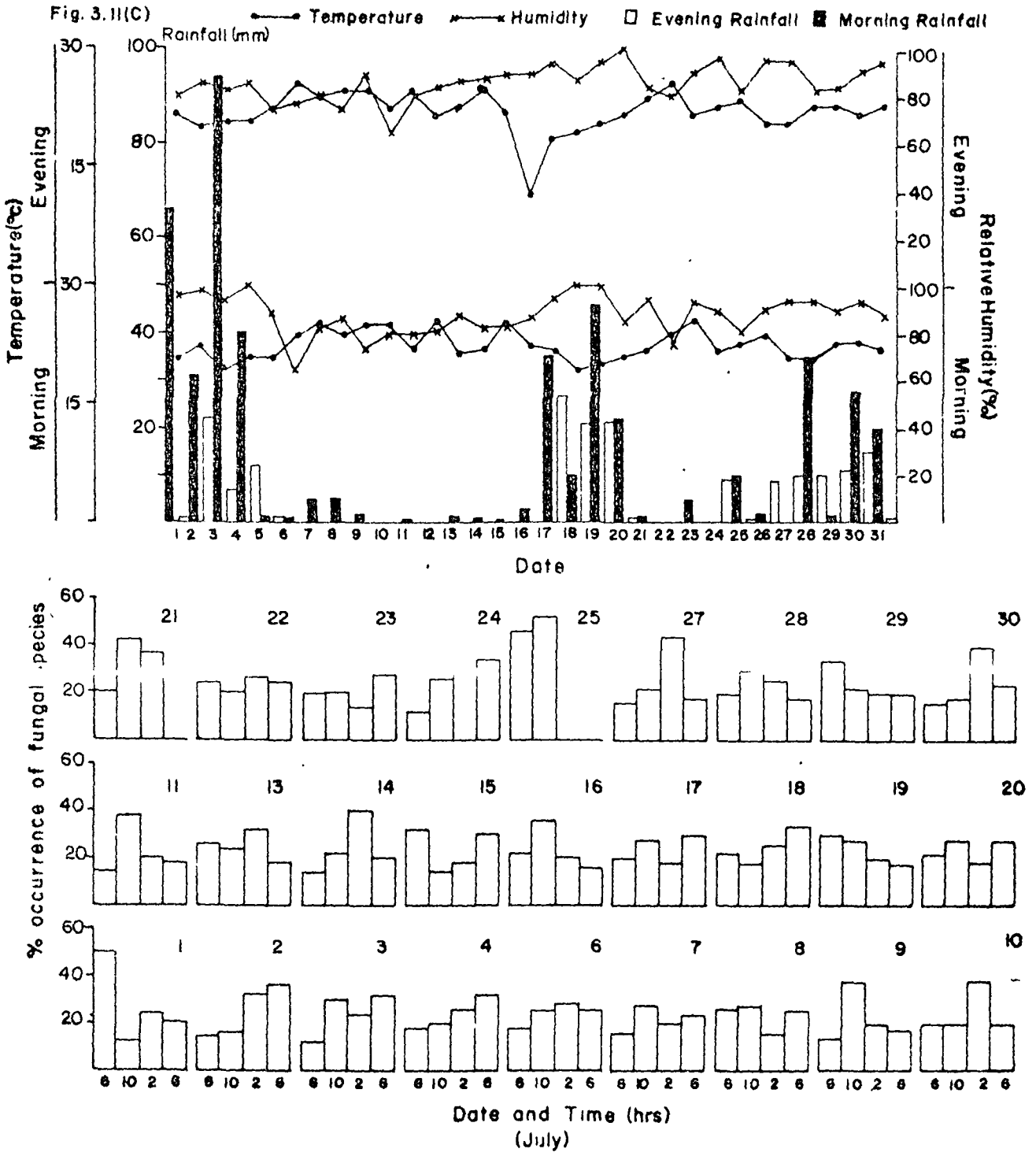


Fig. 3.11(C)
Temperature
Humidity
Evening Rainfall
Morning Rainfall
Rainfall (mm)
Temperature(°c)
Evening
Morning
Relative Humidity(%)
Date
% occurrence of fungal pecies
Date and Time (hrs)
(July)

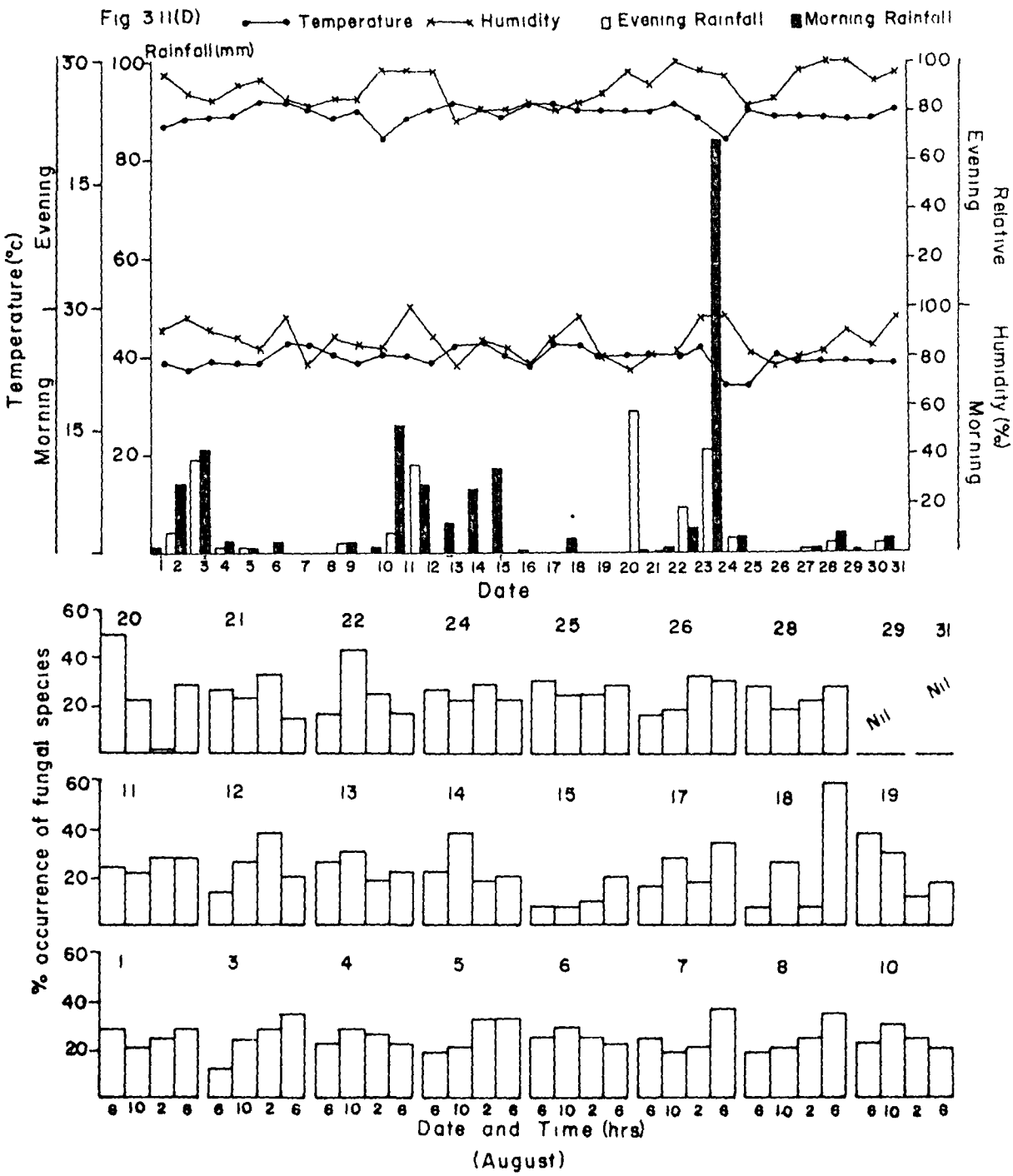


Fig 3.11(D)
Temperature
Humidity
Evening Rainfall
Morning Rainfall
Rainfall(mm)
Temperature(°c)
Evening
Morning
Relative Humidity (%)
Date
% occurrence of fungal species
Nil
Nil
Date and Time (hrs)
(August)

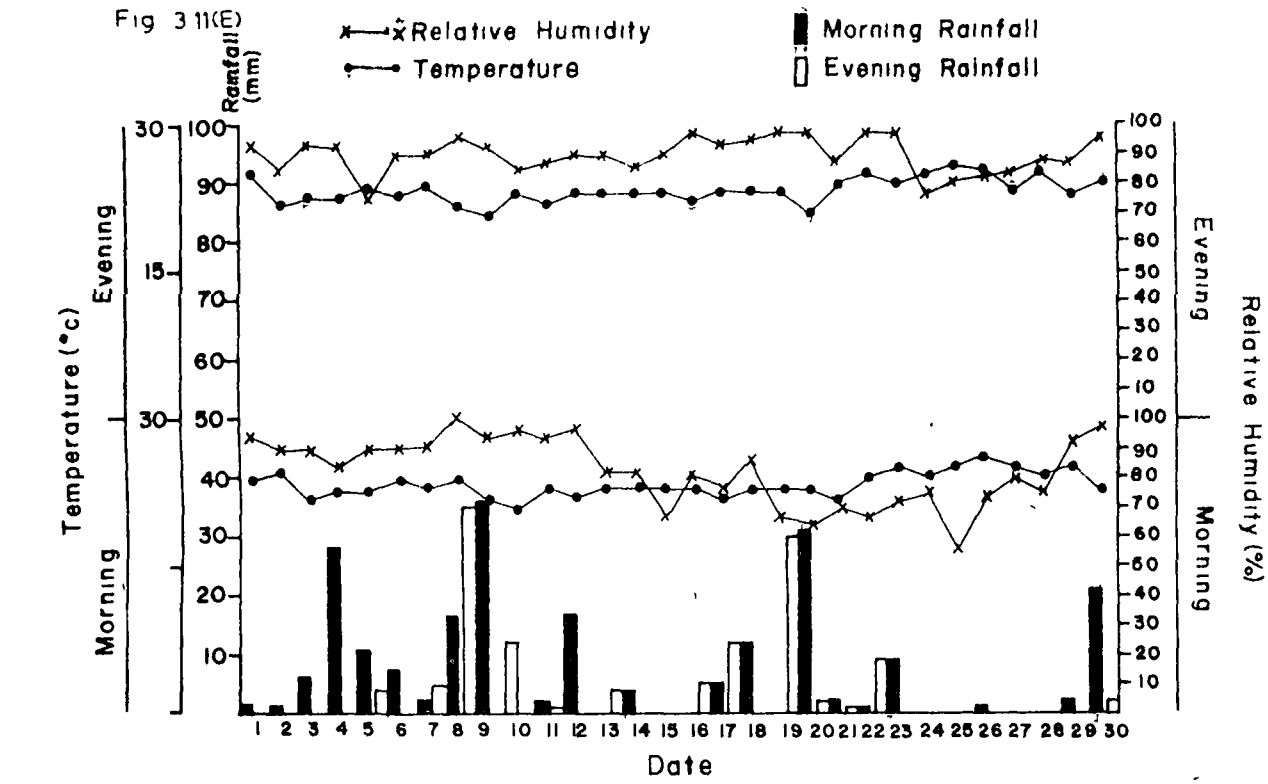
Table 4.3 Seasonal variation in the percentage occurrence of Air, Leaf surface and Soil mycoflora of a potato/field in Shillong.

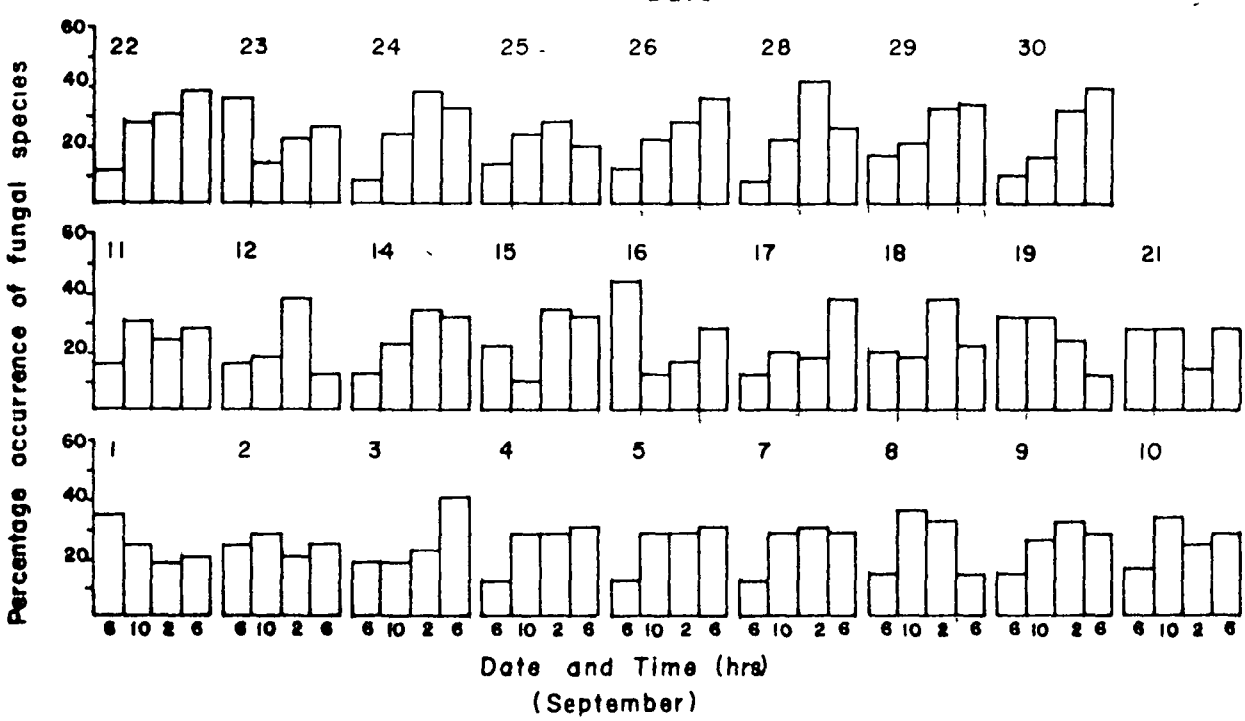
Name of the species	March			April			May			June			July		
	Air	Phy	Soil	Air	Phy	Soil	Air	Phy	Soil	Air	Phy	Soil	Air	Phy	Soil
Absidia sp.	-	-	-	-	-	5.11	-	-	-	-	-	-	-		-
Acinetobacter alcoacus Benjaminet	-	-	10.02	-	-	-	-	-	-	-	-	-	-		10.93
Alternaria alternata Keissl	9.70	-	14.32	9.09	10.52	13.62	9.66	10.97	-	6.62	16.47	5	31.15	8.14	-
Alternaria humicola oudemans	-	-	5.73	-	-	-	-	-	-	-	-	-	-		-
Alternaria solani (Ellis & Mart.)	-	-	-	-	-	-	-	-	-	-	-	-	-	5.43	-
Arthrinium Sp.	-	-	-	-	-	-	-	-	-	-	-	-	-		-
Aspergillus flavus Link	-	-	-	-	-	-	-	-	-	-	-	-	3.97		-
Aspergillus nanus Mont.	-	-	-	-	-	-	-	-	-	-	-	-	-		-
Aspergillus niger V. Tieghem	5.49	-	-	8.18	23.8	8.94	13.28	-	2.79	2.64	12.28	5	5.93	9.50	-
Aspergillus sydowii Thom & Church	-	-	-	-	-	-	-	-	-	-	-	-	-		-
Aspergillus versicolor Tirabeschi	-	-	47.19	-	-	-	-	-	-	-	-	-	-		-
Botrytis sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	9.05	-
Cephalosporium roseoriseum S.B.	-	-	13.18	23.63	15.98	-	-	12.67	-	-	-	-	11.85	12.67	-
Cladosporium cladosporioides (Fres.) de Vries.	-	-	-	-	-	-	33.8	-	-	-	-	-	-	9.50	-
Cladosporium herbarum Link ex Fries	28.27	-	-	10.90	10.52	3.40	20.53	3.35	2.79	7.94	14.93	20	10.07	5.86	3.125
Cladosporium sphaerospermum Penzig	-	-	-	-	-	8.94	-	-	-	-	17.61	-	-	-	-
Curvularia lunata (Wakker) Boedijn	5.91	-	22.85	23.63	-	4.26	-	3.65	-	-	11.01	-	0.51	3.65	-
Curvularia sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	3.43	-
Fusarium moniliforme Sheld	-	-	-	-	21.05	8.94	9.66	-	-	1.32	0.71	10	-	-	-
Fusarium roseum Link ex Fries	26.16	-	12.03	16.36	2.30	8.51	10.62	-	1.48	3.9	2.30	10	8.99	4.98	-
Fusarium solani (Mart) Sacc.	-	-	-	-	-	-	-	13.41	-	-	-	-	4.59	-	-
Fusarium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	5.43	-
Gliocladium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.37
Gliomastix sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.37
Helminthosporium oryzae Breda de Haan,	-	-	4.58	-	-	-	-	-	-	-	-	-	-	-	-
Humicola sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.56
Mortierella sp.	-	-	11.46	-	-	-	-	-	-	-	-	-	-	-	10.93
Mucor hiemalis Wehmer.	-	-	-	-	5.26	-	-	8.09	-	18.54	-	10	2.375	2.26	1.04
Populeria arundinis (corda) Fries.	-	-	-	-	-	8.51	-	-	-	-	3.71	-	-	-	-
Populeria sphaerosperma (ers ex Fries) hohnel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium cyclopium Westl.	-	-	2.86	8.18	13.15	4.26	2.41	-	90.50	3.97	6.56	-	-	5.43	-
Penicillium implicatum Biourge	18.67	-	-	-	-	-	-	1.21	-	49.66	-	17.5	23.67	-	38.54
Penicillium lutum Zukal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phoma sp.	-	-	1.14	-	-	13.62	-	-	-	-	-	-	-	12.67	-
Pythium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	3.62	-
Trichoderma viride Pers. ex Fries.	-	-	4.58	-	-	-	-	-	-	-	3.71	-	-	-	1.56
Volutella piriformis Gilman and Abbott	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Volutella sp.	-	-	-	-	-	-	-	47.85	-	-	-	-	-	-	1.56
Sclerotium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hosts sterile colony	-	-	-	-	-	-	-	-	-	-	-	-	3.38	-	-
Total Number of average colony	46.86	-	17.45	22.00	76	23.50	20.15	12.85	112.61	15.10	52.59	8.0	31.80	22.10	13.60

Name of the species	August			September			October			November			December			January		
	Air	Phy	Soil	Air	Phy	Soil	Air	Phy	Soil	Air	Phy	Soil	Air	Phy	Soil	Air	Phy	Soil
Absidia sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acinetobacter alcoacus Benjaminet	-	-	-	-	-	-	-	-	-	8.32	2.92	1.78	-	-	-	-	-	-
Alternaria alternata Keissl	11.68	5.36	8.61	2	-	4.65	4.01	27.27	7.37	-	-	-	7.14	7.87	13.33	-	-	11.11
Alternaria humicola oudemans	1.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alternaria solani (Ellis & Mart.)	-	-	8.31	-	-	-	-	-	-	3.98	1.78	22.79	-	-	-	-	-	-
Arthrinium Sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.69
Aspergillus flavus Link	3.3	3.67	9.31	7.43	63.63	15.98	6.02	-	-	-	-	-	-	8.81	8.14	-	-	-
Aspergillus nanus Mont.	-	-	-	-	-	-	-	-	-	13.43	3.80	7.01	-	-	-	-	-	-
Aspergillus niger V. Tieghem	4.16	8.92	1.06	8.25	12.5	-	13.37	-	-	11.85	4.67	-	-	-	-	2.84	-	-
Aspergillus sydowii Thom & Church	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aspergillus versicolor Tirabeschi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Botrytis sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.13
Cephalosporium roseoriseum S.B.	-	-	-	-	-	-	8.68	9.09	9.67	-	-	-	-	-	-	-	-	-
Cladosporium cladosporioides (Fres.) de Vries.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cladosporium herbarum Link ex Fries	12.78	42.85	1.06	18.92	2.27	9.30	9.34	9.09	8.52	3.16	8.77	-	22.52	22.72	3.7	40.58	-	2.13
Cladosporium sphaerospermum Penzig	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Curvularia lunata (Wakker) Boedijn	3.33	-	8.51	-	-	-	8.38	1.81	2.78	3.95	4.67	8.76	-	-	-	-	-	-
Curvularia sp.	-	-	-	4.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fusarium moniliforme Sheld	-	-	-	-	-	-	4.01	-	5.52	-	-	-	-	-	-	-	-	-
Fusarium roseum Link ex Fries	22.89	-	29.78	10.61	-	-	6.68	18.18	8.29	14.22	8.18	15.78	5.49	9.84	8.8	27.90	-	7.69
Fusarium solani (Mart) Sacc.	2.5	-	27.65	-	-	-	8.36	-	5.52	-	-	-	-	-	-	-	-	-
Fusarium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gliocladium sp.	-	-	-	-	-	-	-	7.27	1.84	1.58	2.33	17.53	3.30	9.09	16.55	5.43	-	16.23
Gliomastix sp.	-	-	-	-	2.27	13.95	-	-	-	-	5.26	-	4.39	16.66	1.4	-	-	12.82
Helminthosporium oryzae Breda de Haan,	-	-	-	-	-	-	-	-	-	3.98	3.30	8.76	-	-	-	-	-	-
Humicola sp.	-	-	8.51	-	-	-	-	-	10.47	3.95	5.26	1.75	-	-	-	-	-	-
Mortierella sp.	-	-	-	-	-	-	-	-	-	-	2.92	-	-	-	-	-	-	-
Mucor hiemalis Wehmer.	4.165	3.37	4.25	-	-	-	-	-	9.67	2.37	2.33	1.75	4.39	11.36	11.85	1.81	-	11.96
Populeria arundinis (corda) Fries.	-	-	-	-	-	-	-	-	-	-	-	-	8.49	4.84	11.85	3.99	-	9.40
Populeria sphaerosperma (ers ex Fries) hohnel	-	-	-	-	-	-	-	-	-	4.74	4.67	-	-	-	-	-	-	-
Penicillium cyclopium Westl.	-	-	-	-	-	-	9.98	3.33	5.52	-	-	-	-	-	-	1.09	-	19.68
Penicillium implicatum Biourge	7.75	-	-	14	2.27	37.20	9.02	9.09	7.37	7.90	11.69	4.38	-	-	-	9.42	-	8.12
Penicillium lutum Zukal	-	-	-	-	-	-	-	-	-	-	-	-	4.39	9.09	8.14	-	-	-
Penicillium sp.	4.16	7.14	2.12	10.25	2.27	9.30	-	-	-	-	-	-	-	-	-	-	-	-
Phoma sp.	-	-	-	-	2.27	-	6.68	10.90	9.67	-	-	-	4.39	2.27	4.44	-	-	-
Pythium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichoderma viride Pers. ex Fries.	9.95	28.57	4.06	10.25	-	-	16.72	3.63	8.68	7.90	18.12	7.89	-	-	-	8.07	-	-
Volutella piriformis Gilman and Abbott	-	-	-	-	1.13	-	-	-	-	-	-	-	-	-	-	-	-	-
Volutella sp.	-	-	-	-	-	-	-	-	-	3.50	7.01	-	-	-	-	-	-	-
Sclerotium sp.	-	-	-	-	1.13	-	-	-	-	-	-	-	-	-	-	-	-	-
Hosts sterile colony	-	-	-	-	-	-	3.34	-	4.60	-	-	-	-	-	-	2.17	-	-
Total Number of average colony	8.57	11.20	18.80	22.60	17.60	8.60	29.9	11	21.7	25.3	34.2	22.81	36.4	26.4	27.00	55.20	-	23.40

Phy = Leafsurface

Fig 3.11(E)


Relative Humidity
Temperature
Morning Rainfall
Evening Rainfall
Rainfall (mm)
Temperature (°c)
Evening
Morning
Relative Humidity (%)
Date


Percentage occurrence of fungal species
Date and Time (hrs)
(September)

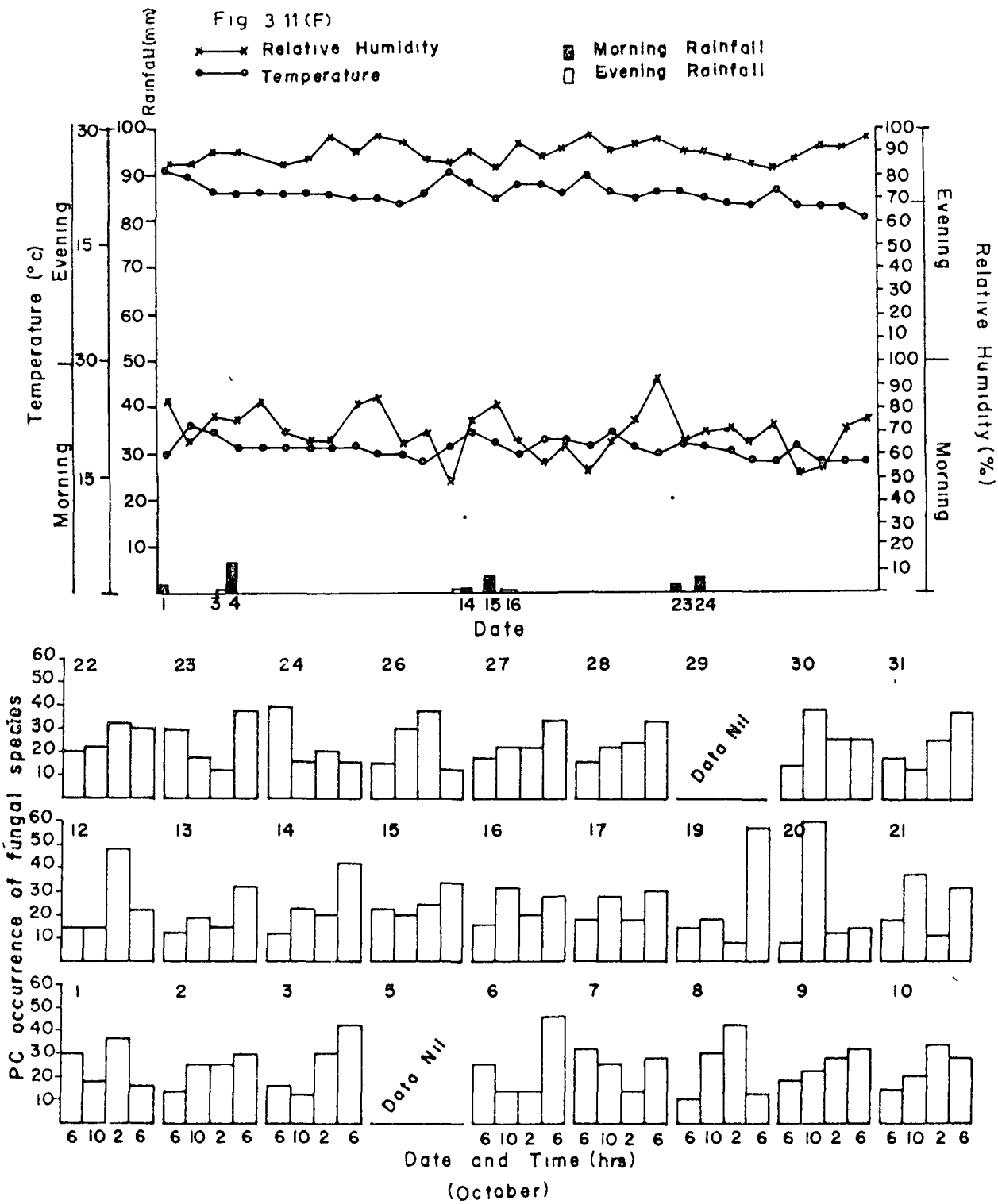


Fig 3.11(F)
Relative Humidity
Temperature
Morning Rainfall
Evening Rainfall
Rainfall(mm)
Temperature (°c)
Evening
Morning
Relative Humidity (%)
Date
Data Nil
PC occurrence of fungal species
Date and Time (hrs)
(October)

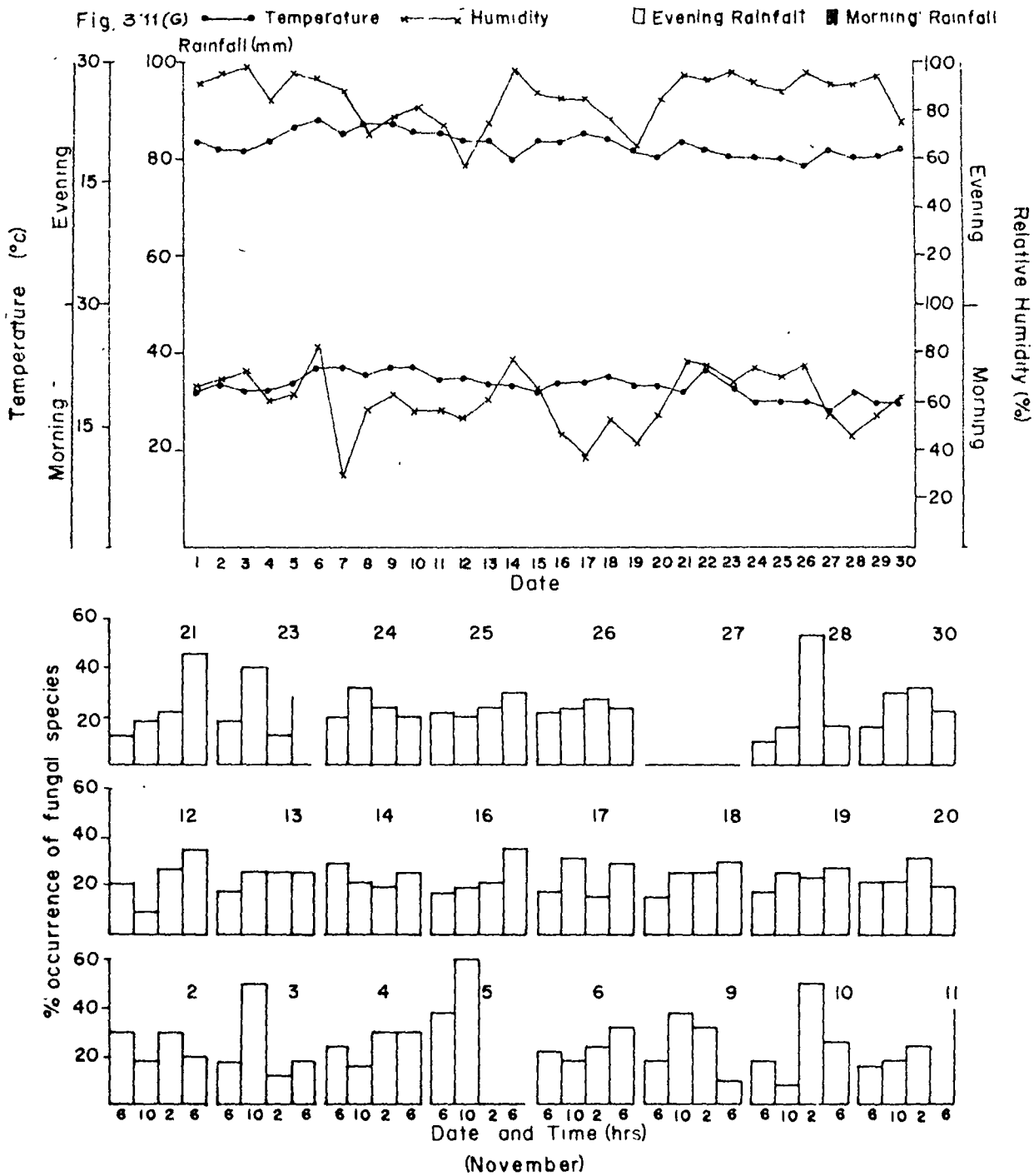


Fig. 3·11(G)
Temperature
Humidity
Evening Rainfall
Morning Rainfall
Rainfall (mm)
Temperature (°C)
Evening
Morning
Relative Humidity (%)
Date
% occurrence of fungal species
Date and Time (hrs)
(November)

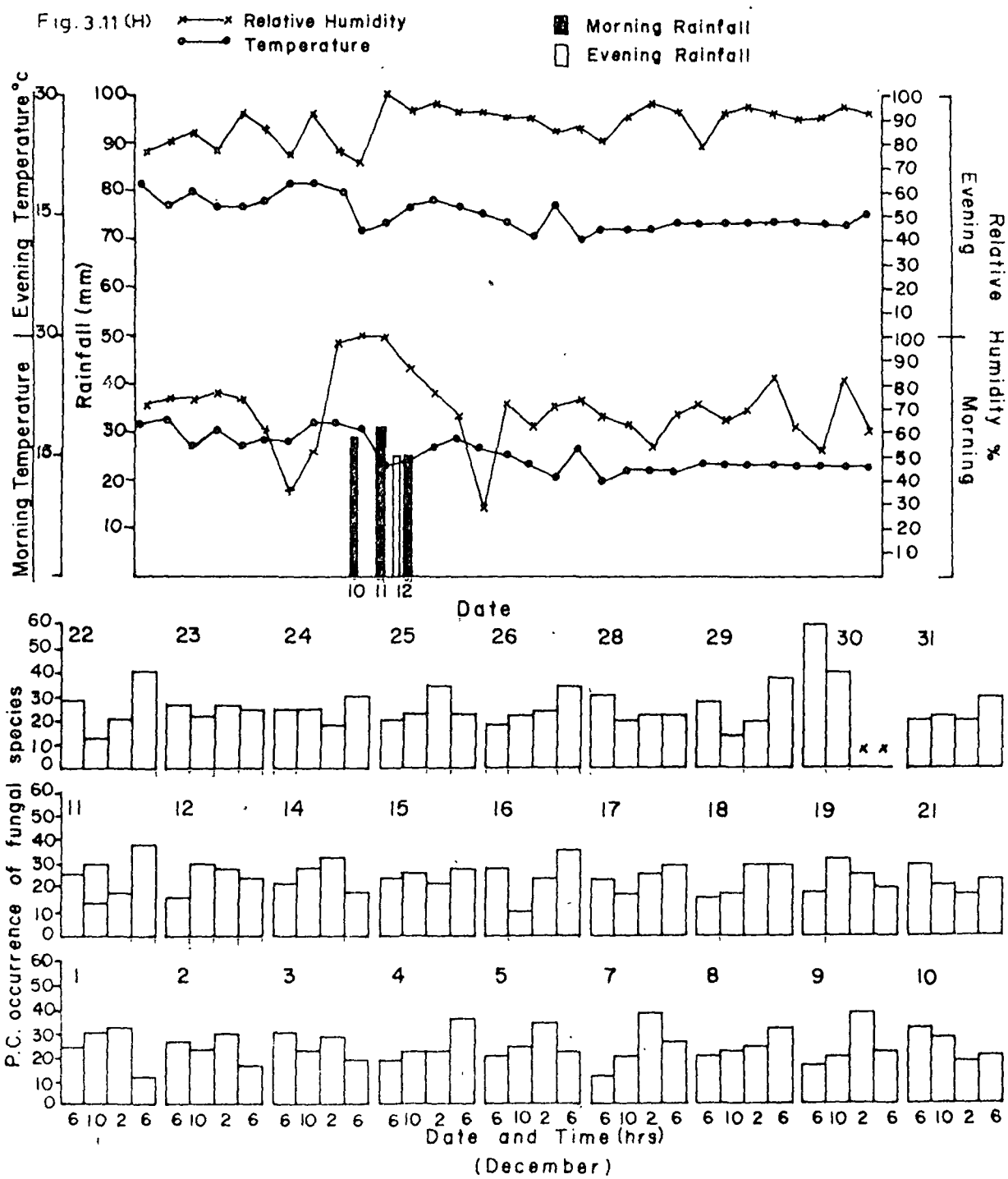


Fig. 3.11 (H)
Relative Humidity
Temperature
Morning Rainfall
Evening Rainfall
Morning Temperature | Evening Temperature °c
Rainfall (mm)
Relative Humidity %
Evening
Morning
Date
P.C. occurrence of fungal species
Date and Time (hrs)
(December)

Fusarium sp., Penicillium cyclopium, Trichocladium sp., [plate No. 9 Fig 6] Epicoccum sp., Bipolaris turcica, Gliocladium sp are mostly present in evening time. Further, it is noticed that some pathogens of rice and potato also were present in the atmosphere, like Pestalotiopsis, Helminthosporium, Bipolaris, Pythium, Alternaria solani and some others.

It can be seen from Fig. 3.12 that there is a definite diurnal fluctuation in the percentage occurrence of fungal spores in the air. Further, the predominant fungal spores show a definite morning and evening pattern.

The diurnal periodicities of the predominant air-borne spores i.e., Cladosporium herbarum, Alternaria alternata, Fusarium roseum, Penicillium implicatum, and Trichoderma viride (plate No. 9 Fig. 3), in particular were studied for one year by petridish method (Fig. 3.12). Spores of Cladosporium herbarum and T. viride show morning pattern but in winter months C. herbarum occur in the evenings also. Alternaria alternata and Penicillium implicatum showed a definite afternoon pattern while Fusarium roseum show a distinct evening pattern.

DISCUSSION

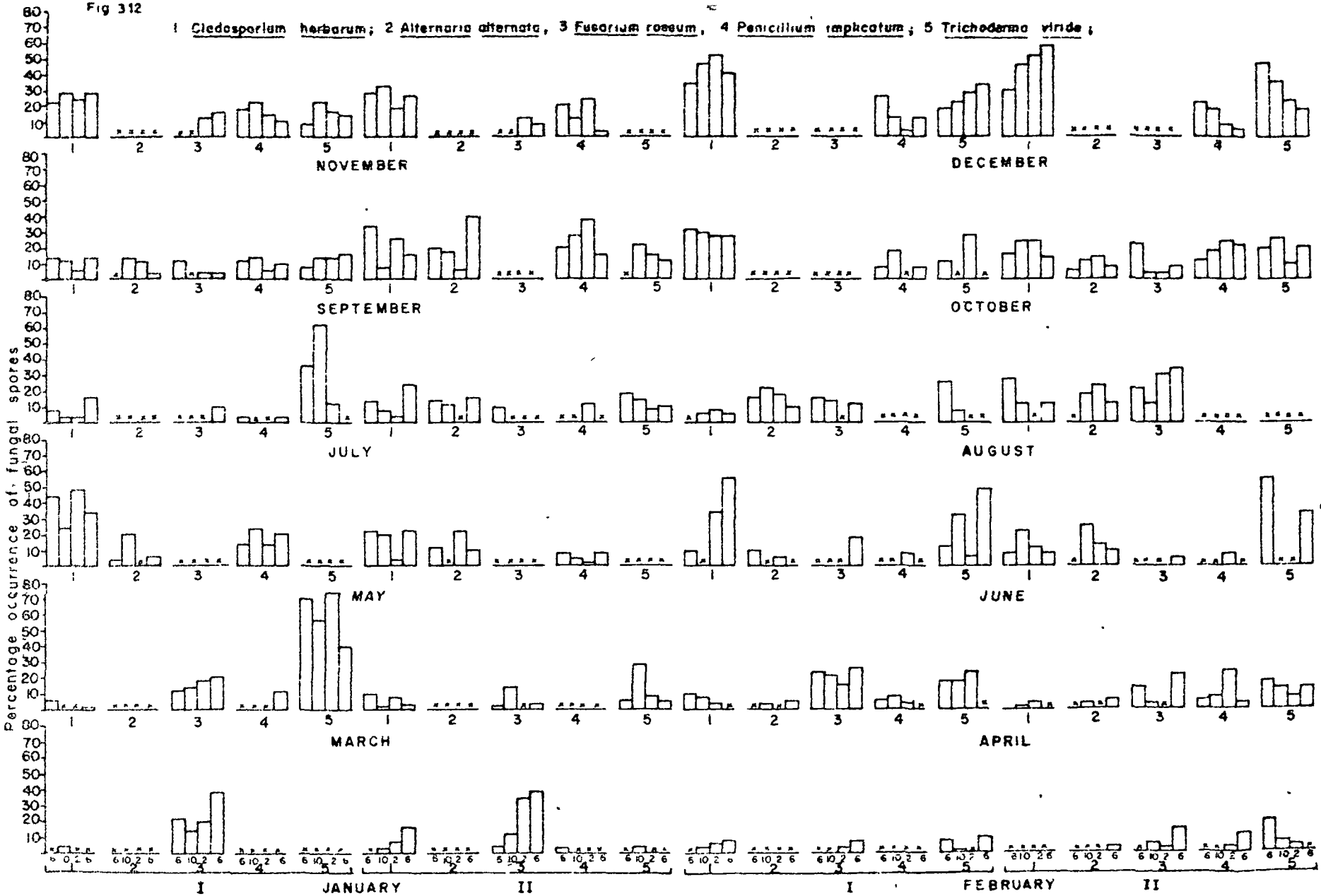
A. Seasonal variation

Seasonal fluctuation in the population of air-spora

FIG. 3.12 DIURNAL VARIATION OF SOME DOMINANT FUNGAL SPORES AT FORTHNIGHTLY INTERVALS (1981)

Fig 312

1 Cladosporium herbarum; 2 Alternaria alternata, 3 Fusarium roseum, 4 Penicillium implicatum; 5 Trichoderma viride;



in the atmosphere were studied during February 1980 to January 1981. A survey employing the simple gravity slide sampler was conducted to determine how the concentration of air spora of Shillong varies with season to season and with weather condition. It is revealed from the data that the atmosphere of Shillong was never free of pollen and fungal spores. Though the flora of Shillong is very rich and diverse, the percentage occurrence of the pollen grain is rather less. This may be due to established fact that the pollen production decreases quantitatively with increase in elevation (Ludii and Vareschi, 1937; Markgraf 1980). The concentration of pollen in the atmosphere varies not only during the same day but it also fluctuates from day to day. These variations are mainly governed by climatic factors, particularly temperature, relative humidity and wind speed.

The effect of weather conditions on the incidence of pollen and fungal spores in air is a well established fact (Hirst 1953, Sreeramulu and Ramalingam 1964, Ebell and Schmidt 1964, Ramalingam 1967). In Shillong there are three peak periods in the pollen concentration and these corresponds to March, May and September. March is mainly predominated by pine pollen and grasses. Further, during this period the temperature records in the range of 20°C to 22°C and relative humidity 60% which favour the ripening and opening

of the stamens and also dissemination of pollen. Similar result was also found by Hamilton (1959), Sreeramulu and Ramalingam 1964). The month of May was predominated by pollen of angiospermous species like Schima wallichii, Quercus sp., Viburnum sp. and member of Rosaceae and Compositae. This also coincides with the phenology of these species. Most of these species which lie dormant during severe winter, start flushing and flowering with the early heat of spring and pre-monsoon showers. During June to August with very heavy rainfall the dissemination of spore is prevented, and the concentration of pollen in the air approaches almost to zero. Heavy rainfall not only lowers the pollen production in a species but also washes down the pollen from the atmosphere (Hyde and Williams 1945; Sreeramulu and Ramalingam 1964; Ramalingam 1967, McDonald 1979). Again the atmosphere in September is dominated over by the pollen of Cedrus sp., Betula alnoides, Glochidion sp., Ardisia macrocarpa, and Quercus griffithii. Further, the wind direction, its velocity, etc. are greatly responsible for fluctuations in pollen catches. Wind being the sole dispersal agent also regulates the rate of deposition of the pollen. A wind speed during March and September (5-12 Km/h) brings out high pollen catch (Table 1 and Fig. 3.3). Ramalingam (1966) has also reported that a wind speed of 8-20 Km/h favours the pollen catches. November to January

being the severe winter months with low temperature records experience low concentration of pollen in the atmosphere.

Fungal spores:

The fungal spores exhibit two distinct peak period in June and September. Meteorological factors like heavy rainfall and high humidity during this period mainly influence the prevalence of fungal spores in the atmosphere. It is seen that June and September months record the highest percentage of humidity (88%) with gradual decrease in these factors from October onwards. The concentrations of the fungal spores also become low. Least concentration of the fungal spores were observed in the month of March which is comparatively a dry month with a higher temperature record and with lowest humidity. Too hot and too cold seasons were found to be quite unfavourable for the concentration of the fungal spores in the atmosphere as reported by earlier workers (Ramalingam, 1966; Agarwal & Shivepuri, 1969; Singh and Baruah, 1979). Cochrane (1958) stated that a temperature range of 20 to 30^{o}C is optimum for fungal growth.

B. Diurnal variation

The concentration of pollen and fungal spores in the atmosphere varies not only during the same day, but also

fluctuates from time to time within the day. These variations are mainly governed by climatic factors, particularly temperature, humidity, and sunshine. The pollens in Shillong exhibit an early morning pattern while fungal spores are evening pattern, however forenoon pattern was observed in Pantapadu and Visakhapatnum in South India by Ramalingam (1966-67), Sreeramulu and Ramalingam (1963), Sreeramulu and Sheshvataram (1962). Pinus kesiya, Alnus nepalensis, Betula alnoides, Cupressus torulosa, Ageratum conyzoides and grass pollen observed in morning time, while Cryptomeria japonica, Eleocarpus sp., Eucalyptus sp. show night pattern and Chrysanthemum sp., Artemisia sp., Pruns sp., Glochidion sp. follow noon pattern. It is likely that the different patterns of diurnal periodicity are influenced by micro-climatic factors that control the time of anthesis, dehiscence of anthers and discharge of the pollen into air. It has also been observed that the discharge and dispersal of pollen and spores are greatly influenced by temperature, rainfall, humidity, and sunshine hours (Hamilton, 1959; Ramalingam, 1966; Davis, 1969, Reiss and Kostic, 1976). Probably these weather conditions influence shedding of the pollen by inhibiting or accelerating anthesis which reflects in the result with the increase in temperature, there in increasing in pollen counts. Similar results were also obtained by Davis (1969), Rosen (1965) and Singh and Babu

(1980). Further, they considered a positive correlation between atmospheric pollen concentration and temperature inversion. Rain affects pollen concentration in the air both indirectly in preventing or delaying the dehiscence of anthers by decreasing temperature and increasing the humidity and directly by washing down pollen which is already in the air (Rosen, 1965). Rainfall has effect on pollen concentration counts for late July and August, coincides with the higher recorded levels of rainfall at these times. Concentration appeared to be greatly influenced by sunshine and relative humidity, especially during the peak hours. As the interpretation of the diurnal periodicity of fungal spores is not always clear, to analyse the variations in the times at which daily peak concentrations occurred in the day, the data in wet days and dry days were examined. The daily peak concentration for the total fungal air-spora occurred in the evening and relatively higher number occurred throughout the day in the wet days. This type of periodicity for the total air-spora in the wet days was due to the dominance of the wet-spora types. Even if the number liberated per four hours remains constant throughout the day and night, concentration of fungal spores will tend to be greater at the night, because an average of the spore cloud will suffer less dilution due to the combined effect of slower winds, decreased turbulance, absence of convection

and presence of a temperature inversion at night (Gregory 1973). In dry days the concentration of fungal spores was low because high wind speed and low temperature decreased the growth and dispersal of the spores. In dry days certain typically afternoon types occurred in the afternoon. Similar results are also observed by Cammack (1955). Some species like Fusarium, which belong to the night spora in the wet days also appeared in day time in dry days. Similarly Cladosporium which belong to the day time spora appeared in night time also. Conidia of Alternaria and Aspergillus were found almost all through the period. They occurred in very low concentrations during the night and from 6.00 hrs (A.M.) they began to appear in greater number till noon. Their concentration gradually fell to a minimum in the evening. This shifting in the time at which daily peak concentrations recurred was found to be associated with the diurnal variations in the weather conditions.

SECTION VI

Comparative study of the air, leaf surface and soil mycoflora of (A) Potato field, (B) Paddy field and (C) Fruit garden

A comparative study of the air, leaf surface and soil mycoflora of A Potato field, B. Paddy field, C. Peach (fruit garden)

Introduction

It is an established fact that not only pathogenic micro-organisms, but also populations of nonpathogenic micro-organisms can develop on the surface of living leaves and other aerial parts of plant. It is known that air components and nutritional status of the plants are the dominant factors determining the qualitative and quantitative picture of the leaf-surface micro-organisms. The population of saprophytic micro-organisms in soil, leaf surface and air borne propagules has drawn attention by various workers (Rajkumar et al 1976; Dixit and Gupta, 1980). The nutritional status of the plant and consequently the mineral and organic constituents of its leaf exudates are largely determined by the soil type. The soil must therefore be included as a factor influencing the properties of the phyllosphere as an environment for the phyllosphere population (Last, 1955; Ruinen, 1956 and Gregory, 1961). Leaf surface organisms play a significant role in the resistance mechanisms of plants from air-borne plant pathogens, while soil micro-flora is known to play a significant role in root infection (Garrett, 1970) and in other microbial activity.

Several forms of pathogenic and nonpathogenic microbes are found in the air, leaf-surface and soil. As a layer in contact with the soil and the atmosphere, the phyllosphere is subject to have a combined influence of both

Davenport (1973) defined the zones in vineyard habitat, an ecosystem forming part of the biosphere thence divided into three zones (1) Atmosphere - the air wind borne particles, (2) The phyllosphere, all aerial plant parts, (3) Rhizosphere - the soil.

The aerial surfaces of higher plants growing under natural conditions are usually covered with large and varied populations of micro-organisms. A few of these organisms are able to grow extensively on the surface of healthy plants, others apparently blow off in the air and third group of organisms having been deposited on the soil do not grow. In a classic account of the air-spora, Gregory (1973) described the features of above ground atmosphere which is the essential medium for the dispersal of many of the organisms inhabiting aerial plant surfaces. The occurrence of many fungi on aerial plant surfaces may be directly related to inoculations from the atmosphere, which in turn are related

to their successful release into the atmosphere and to their survival and dispersal in the environment. The term "exochthonous" was used by Park (1957) to describe a group of fungi found in soil which was not their habitual substrate and which did not maintain themselves in an active state in soil. There is evidence that air borne propagules act as initial source of inocula for the aerial plant parts, but there is little information on the types of fungi in the air, phyllosphere and soil of this region. Although the air-spora of the potato crop and leaf-surface flora of potatoes and paddy has been investigated by various workers (Rajkumar and Gupta, 1976; Ramalingam, 1971) but little information is available from Shillong (Konger and Baruah, 1958), and a comparative study of air, leaf-surface and soil mycoflora is still lacking. Therefore in the present study a comparison of the air, leaf surface and soil mycoflora of three fields at different altitudes has been made. Secondly, the seasonal variation in the fungal population, in relation to corresponding changes in the climatic factors and vegetation over a period of season have been worked out and discussed.

Materials and Methods

Mycoflora of air, leaf-surface and soil over a

fruit garden (peach), potato and paddy fields in Shillong were recorded during March '80 to Feb. '81 at fortnightly intervals. For air mycoflora culture plate method as adopted by Hyde and Williums(1946), Rajan et al (1952), Satyprakash (1968), and Sharma (1971) was adopted. Five petridish containing Czepek's dox culture media (Johnson & Curl, 1972) were exposed for seven minutes at the canopy level. The exposed plates were then incubated at 27°C (±1°C) for six days and fungal colonies that appeared in plates were counted separately, examined, isolated and identified and % occurrence was calculated by the formula:

$$\% \text{ occurrence} = \frac{\text{No. of colonies}}{\text{Total No. of all colonies}} \times 100$$

For leaf surface mycoflora a modified leaf washing technique adopted by Burri (1902), Dickinson (1971), and Diem (1974) was followed. Leaves of approximately same age were randomly collected in sterilized polythene bags, with the help of a sterilized scissors and forcepts and carefully brought to the laboratory. Disks (5 mm dia.) were cut at random from five different leaves with sterile cork-borer. Fifty disks were taken in 100 ml. of sterilized distilled water and were hand shaken for 20 minutes to get homogenous spore suspension. 1 ml. suspension per plate was poured in five petridishes of 9 cm. diameter containing sterilized Czepekdox Agar media (Johnson and Curl 1972) for fungi. The

plates were incubated at 27°C (± 1°C) for five days. The total mycobial population was calculated by the following formula:

$$\text{Total number of microbes per cm}^2 = \frac{\text{Total Number of microbes in 100 ml.}}{\text{Total area of leaf}}$$

(Total area of leaf = area of leaf X No. of disk X 2)

For soil mycoflora a modified soil dilution plate method as adopted by Dutta and Issac (1979) was employed. 10 gm. of soil were taken in 100 ml. of sterilized distilled water and shaken for 20 minutes and then the dilution was made 1:10,000. 1 ml suspension per plate was poured in five petridishes of 9 cm diameter containing molten Czepek dox media and was thoroughly mixed by shaking. The plates were then incubated at 27°C (± 1°C) for five days. The total mycobial population and percentage occurrence was calculated by the following formula:

$$\text{Total Number of microbial population} = \frac{\text{No. of colonies X dilution factor}}{\text{Dry wt. of soil per grams}}$$

(Dilution Factor = Dilution X Amount of inoculum taken).

The identification of fungal spores was made on the basis of morphological and cultural characteristics which was later confirmed with the help of authentic identified cultures and

pertinent literatures (Barnett 1955, Gilmen 1957, Subramanian 1971).

Result

The comparative study of the air, leaf surface and soil mycoflora of potato, paddy and peach were studied in different stages of growth of the plants and in relation to different climatic conditions. It is evident from the results that the mycobial population of the air, leaf surface and soil is greatly influenced by the climatic conditions, like rainfall, temperature, humidity, etc. Further, a distinct correlation between the number of propagules in the air, leaf surface and soil mycoflora in relation to climatic conditions was also observed.

Mycoflora of potato field:- In Shillong the potato is cultivated in two seasons viz., summer and winter crop (Table 4.2). Summer crop is sown in the month of March and harvested in the month of July-August, while winter crop is sown in the month of August and September and harvested in the month of December-January (Table 4.2).

From the result it is clear that the soil harbours greater mycoflora than leaf surface and air (Table 4.1 & 4.3).

Table 4.1 Total population of air, leaf surface and soil myco-flora of potato, paddy and peach (Fruit Garden) fields of Shillong (1980-81).

Months	Potato Field			Paddy Field			Peach (Fruit Garden)		
	Air	Leaf surface (/sq cm)	Soil (/gm)	Air	Leaf surface (/sq cm)	Soil (/gm)	Air	Leaf surface (/sq cm)	Soil (/gm)
March	46.00	-	222292.99	27.75	-	170370.37	233.0*	463.38*	119437.86*
April	22.00	38.72	263452.91	16.25	-	100000	177.2*	932.48*	240000*
May	20.15	65.47	1376923.01	17.43	94.26	132911.39	43.70*	190.06*	55846.15*
June	15.10	267.97	110344.82	9.2	32.60	101230.67	7.6	77.61	353103.42
July	31.80	112.61	211920.37	10.62	120.65	158769.23	18.1	48.67	725841.71
August	8.57	57.07	341818.18	26.10	224.86	691560.91	24.50	343.94	896336.99
September	22.80	89.56	119944.21	21.60	90.18	465950.86	35.43	86.11	466752.70
October	29.90	56.05	31088.25	49.70	81.01	154135.33	22.4	62.16	30338.73
November	25.3	174.26	322175.14	29.00	124.33	203438.39	66.00	86.62	171348.31
December	36.4	134.52	429936.30	48.6	-	481379.31	44.4	154.904	268027.21
January	55.20	-	252972.97	-	-	-	44.6	-	5009523.80
February	-	-	-	-	-	-	175.00	-	2008350.48

* Data for 1981.

Table 4.2

Stage of crop and condition of the field at sampling time (Potato Field).

	Sampling month	Condition of crop
SUMMER CROP	March	Sowing
	April	Seedling stage
	May	Young leaf (before flowering)
	June	Leaf mature Flowering
	July	After flowering
	August I	Harvesting
	August II	Fellow period
WINTER CROP	Sept. I & II	Fellow period and Sowing
	October	Seedling stage
	November	Young leaf
	December	Leaf mature (flowering)
	January	Harvesting
	February	Fellow period

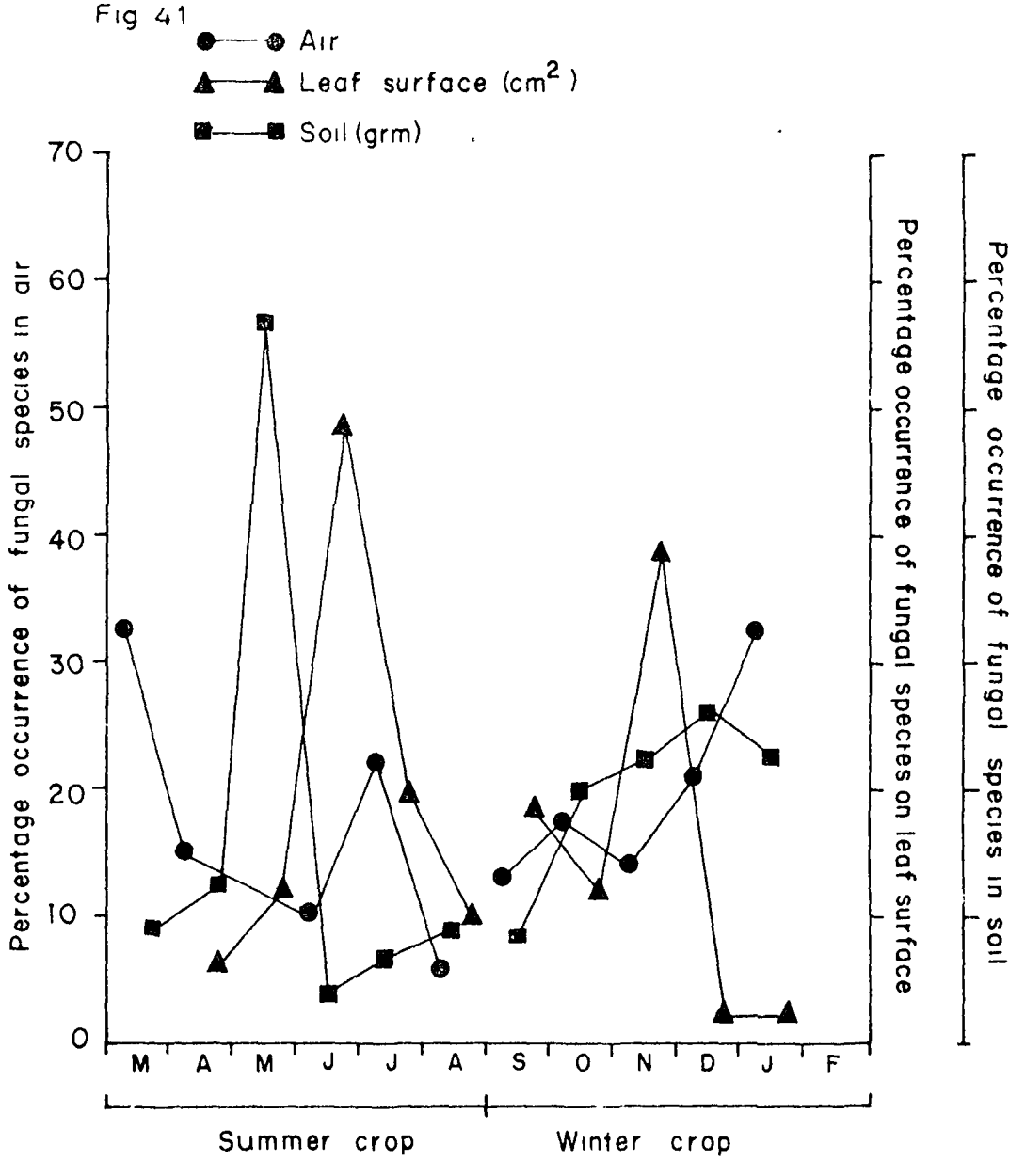
Fungal flora of the air:- The fungal population in air was found to be greater during the winter crop season than the summer crop, although the type of fungal spores were more during the summer crop. In summer crop, maximum air mycoflora was observed in the sowing time when there was no leaf, and minimum mycoflora was observed with the leaf maturation . Further the mycoflora had increased in the harvesting time while in winter crop the air mycoflora gradually increases from sowing to harvesting time (Fig. 4.1).

Cladosporium herbarum, Alternaria alternata, Aspergillus niger, Penicillium implicatum, Fusarium roseum are present throughout the year. The lowest population of fungi was counted in the summer season. In the subsequent season with a gradual fall in temperature and rise in relative humidity the total population of air enhanced continuously. With the season changed with warm to cold, Alternaria alternata, Penicillium implicatum, Trichoderma viride, Cephalosporium sp. and some others, decreased in their populations, while the population of Fusarium roseum, Cladosporium herbarum, Aspergillus sp., Curvularia lunata and Mucor sp. increased as the season advanced from warm to cold (Table 4.3).

Fungal Flora of the Leaf surface:- An analysis of the leaf surface fungal flora of potato leaf revealed that the summer crop harboured greater mycoflora than that of

FIG. 4.1 SEASONAL VARIATION OF AIR, LEAF SURFACE AND SOIL MYCOFLORA OF POTATO FIELD DURING WINTER AND SUMMER CROP

Fig 41


Air
Leaf surface (cm²)
Soil (grm)
Percentage occurrence of fungal species in air
Percentage occurrence of fungal species on leaf surface
Percentage occurrence of fungal species in soil
0
10
20
30
40
50
60
70
M
A
M
J
J
A
S
O
N
D
J
F
Summer crop
Winter crop

winter crop. It was further interesting to note that the number of fungal species isolated from leaves in seedling stage was lower than the mature leaf. The fungal population reaches its maximum during pre-harvesting stage of the crop.

The species like Aspergillus niger, Cladosporium herbarum, Alternaria alternata, Fusarium roseum, Penicillium implicatum, Penicillium cyclopium, Curvularia lunata were more or less spreaded throughout the year.

Alternaria solani occurs only in July and November and Botrytis sp. only in July. Gliocladium sp. and Gliomastix sp. were restricted only to winter crop. Papularia arundinis and Phythium sp. were observed in the month of April and May (Table 4.3).

Fungal Flora of the Soil:- It is seen that the soil fungal population of potato field increases considerably from seedling to senescence stage. A greater number is recorded from the soil of winter crop than that of summer crop (Fig. 4.1).

Trichoderma viride, Alternaria alternata; Aspergillus flavus, Cladosporium herbarum, Fusarium roseum, Penicillium implicatum etc. are common to both summer and winter crops,

while Gliocladium sp., Gliomastix sp., Fusarium solani, Fusarium moniliforme, Cephalosporium roseo-grisum, Helminthosporium oryzae, Actinomucor elegans, Alternaria solani, Aspergillus nanus, Penicillium sp., P. cyclopium, Humicola sp., Phoma sp., Papularia arundinis, were restricted to winter crop only.

Species like Volutella sp., Mortierella sp., Penicillium lutum were present during harvesting stage of the crops only(Table 4.3).

Mycoflora of Paddy field:- In Shillong paddy is cultivated only in one season, i.e. from April to December. The crop is sown in the month of mid-April to May and harvested in the month of December (Table 4.4). The results are presented in the Table (4.5), shows the seasonal variation in air, leaf surface and soil mycoflora of the paddy field.

Fungal Flora of the Air:- The maximum percentage occurrence of air mycoflora was found in the paddy field during October (22.78%) followed by December (21.78%), November (12.99%) and March (12.99%).

Cladosporium herbarum was present throughout the observation period. The percentage occurrence of this fungus was found to be the highest in the month of April.

Table 4.4

Stage of the crop and condition of the field at sampling time (Paddy Field)

Sampling month	Condition of crop
April	Fellow period
May	Sowing
June	Transplanting
July	Tillering
August	Boothing
September	Heading stage
October	Ripening stage
November + December	Harvesting
January	Fellow period.

Table 4.5 Seasonal variation in the percentage occurrence of Air, Leaf-surface and Soil mycoflora of a paddy/field in Shillong.

Name of the species	March			April			May			June			July			August			September			October			November			December		
	Air	Phy	Soil	Air	Phy	Soil	Air	Phy	Soil	Air	Phy	Soil	Air	Phy	Soil	Air	Phy	Soil	Air	Phy	Soil	Air	Phy	Soil	Air	Phy	Soil	Air	Phy	Soil
Actinomucor elegans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.81	-	-	-	-	22.13	25.38	-	-	5.79
Alternaria alternata (Fr.) Keissl.	24.32	-	-	1.83	-	-	-	-	-	4.34	-	-	-	-	-	20.10	-	-	2.5	1.40	2.77	-	-	-	-	-	-	-	-	-
Alternaria dumicola Dudemans	-	-	15.21	-	-	-	-	-	-	-	-	-	8.57	-	-	13.91	4.16	22.64	-	-	-	-	-	-	4.83	6.56	39.44	-	-	-
Alternaria solani Jones & Grout	-	-	-	-	-	-	20.29	12.43	7.61	28.26	-	-	-	-	-	-	-	-	-	-	-	9.80	-	1.62	-	-	-	-	-	-
Aspergillus flavus Link	-	-	-	7.69	-	10.9	-	-	-	17.39	-	-	-	-	4.70	-	-	-	9.16	4.46	13.84	3.21	-	-	8.00	4.92	2.82	-	-	-
Aspergillus niger V Tieghem	13.51	-	-	6.15	-	-	2.86	5.40	1.90	10.86	-	10.95	20.34	15.62	8.09	3.52	-	20.83	28.22	15.31	7.79	4.02	7.54	8.76	14.00	9.03	-	9.86	-	7.16
Aspergillus ochraceus Thom & Church.	-	-	-	-	-	5.47	-	-	-	-	-	-	-	-	-	2.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aspergillus terricolus Tiraboschi	-	-	-	-	-	-	-	-	-	-	-	-	-	15.62	19.66	3.30	12.65	15.63	-	-	-	-	-	-	-	4.92	2.82	-	-	-
Cephalosporium roseo-flavum Sukapure	-	-	18.11	27.69	-	3.73	3.44	11.35	29.62	-	-	-	-	-	-	4.16	8.79	1.42	-	-	-	-	-	-	-	-	-	-	-	-
Cladosporium cladosporioides (Fres.) de Vries	-	-	-	9.23	-	-	-	-	-	-	-	5.47	18.18	-	-	4.16	-	-	-	-	-	-	-	-	9.68	4.92	-	-	-	-
Cleosporium herbarum Link ex Fries.	28.23	-	-	38.38	-	-	1.14	12.43	-	-	-	-	-	24.99	-	20.80	13.31	-	7.91	15.06	58.53	-	-	-	22.00	9.84	-	39.62	-	48.13
Curvularia lunata Boedijn	-	-	-	-	-	-	1.72	3.70	-	-	-	-	21.21	9.37	8.47	19.44	8.47	10.20	-	-	-	4.42	-	-	9.65	4.92	-	-	-	-
Epicoccum nigrum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fusarium moniliforme Sheld	-	-	-	-	-	27.39	-	-	-	-	5.32	27.39	-	-	-	-	-	-	-	-	-	8.75	-	-	-	-	-	-	-	-
Fusarium roseum Link ex Fries	16.22	-	20.28	-	-	-	37.85	28.10	21.90	8.6	12.8	2.73	23.60	40.62	13.03	25.13	18.11	21.72	8.83	8.46	6.89	8.04	-	-	-	-	-	8.73	-	-
Gliocladium roseum Bainier	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22.64	4.87	-	-	12.68	11.82	-	6.89
Helminthosporium oryzae Breda de Haan	-	-	13.04	-	-	-	2.86	4.32	11.42	-	-	-	-	-	-	-	-	-	-	-	-	5.63	-	4.87	10.34	24.59	7.04	-	-	-
Humicola sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.11	23.72	-	6.28	9.78	-	-	-	-	-	-
Mucor hiemalis Wehmer	10.81	-	21.73	-	-	-	2.29	10.8	1.90	15.21	-	-	22.12	3.12	10.16	5.55	6.84	2.0	-	-	-	-	13.20	17.07	11.72	2.46	2.82	11.11	-	14.89
Papularia arundinis (corda) Fries.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.39	12.22	-	8.88	-	-	-	-	-	-	10.69	-	14.61
Penicillium cyclopium Westl.	-	-	3.62	12.30	-	4.52	-	-	-	-	-	5.47	-	-	4.70	-	-	11.76	-	14.08	4.16	1.60	2.81	-	-	-	-	8.99	-	-
Penicillium jenkinsii Biourge.	6.31	-	-	-	-	5.47	-	-	-	16.21	21.81	4.52	21.52	15.62	28.21	7.14	14.89	18.95	29.99	7.54	8.66	1.26	13.63	11.38	-	-	-	8.99	-	8.89
Penicillium viridicatum Dierckx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.38	1.60	-	-	-	-	-	8.99	-	-
Periconia sp.	-	-	-	-	-	-	1.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pestalotiopsis sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phoma sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.41	6.28	-	-	-	-	-	-	-
Pleospora sp.	-	-	-	-	-	-	4.58	5.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizopus sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichocladium sp.	-	-	-	-	-	-	-	-	8.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichoderma viride Pers ex Fries	-	-	2.17	-	-	-	-	-	-	-	-	-	-	-	-	4.46	31.16	8.16	14.47	17.52	13.86	4.22	-	9.76	-	-	-	-	-	2.17
Volutella sp.	-	-	5.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.65	4.10	-	-	-	-
Total number (Average No.) of colonies	27.75	-	13.8	16.25	-	82	17.43	18.50	10.50	9.20	6.40	7.30	10.60	8.40	10.15	26.10	44.13	28.7	21.60	17.7	17.7	49.7	15.9	12.3	29.00	24.80	14.20	42.8	-	34.90

a A = Air
P = Leaf surface
S = Soil

Aspergillus niger was present throughout the year but the percentage occurrence increased from April to September and then gradually decreases from October to December. Fusarium roseum was recorded in the month of March and again from June to October where the percentage occurrence increased progressively. Helminthosporium oryzae was present only in October and November. Alternaria alternata was restricted to March-April, June, August and September, while Alternaria humicola was recorded only in the month of July, August and November (Table 4.5).

Fungal Flora of the Leaf surface:- The leaf-surface of rice plants harboured highest population of fungal flora at the time of boothing (August) and lowest during transplanting and tillering time (June and July)(Table 4.4, Fig.4.2).

Aspergillus niger, Cladosporium herbarum, Penicillium implicatum, Trichoderma viride, Curvularia lunata, Fusarium roseum was observed throughout the cropping season. But the percentage occurrence of Cladosporium herbarum and Aspergillus niger increases from tillering to flowering stage and decreased at ripening time. But species like Alternaria solani and Periconia sp. were present only in seedling stage, whereas Volutella sp. Actinomucor elegans, Aspergillus versicolar, Phoma sp., Gliocladium sp. were observed uniformly

FIG. 4.2 SEASONAL VARIATION OF AIR, LEAF SURFACE AND SOIL MYCOFLORA OF PADDY FIELD

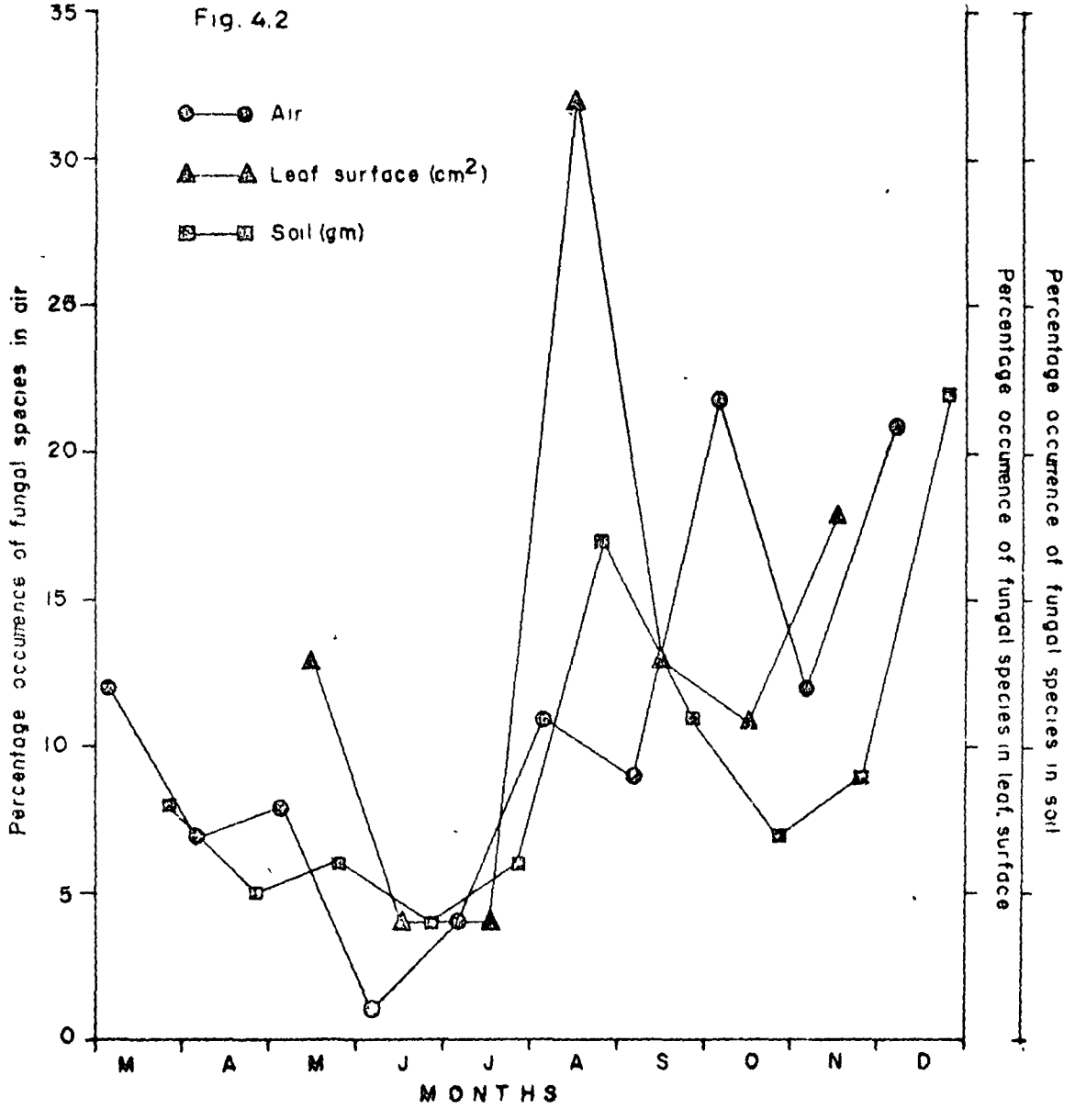


Fig. 4.2
Air
Leaf surface (cm²)
Soil (gm)
Percentage occurence of fungal species in air
Percentage occurence of fungal species in leaf surface
Percentage occurence of fungal species in soil
0
5
10
15
20
25
30
35
M
A
M
J
J
A
S
O
N
D
MONTHS

between flowering to harvesting stage. Pestalotiopsis sp. and Cephalosporium roseo-grisum were observed between boothing and heading stages. Pleospora sp. was observed only in the tillering time (Table 4.5).

Soil Fungal Flora:- The fungal population of the soil of paddy field increased gradually at different stages of paddy. Aspergillus niger, Aspergillus flavus, Alternaria humicola, Cladosporium herbarum, Curvularia lunata, Fusarium roseum, Mucor hiemalis, Penicillium implicatum, Trichoderma viride, are the dominant species observed throughout the year, Cladosporium cladosporiodes, Fusarium roseum, Aspergillus sydowii, Penicillium cyclopium were observed in the tillering time only. Cephalosporium roseo-grisum, Papularia arundinis, Penicillium miniioluteom, Alternaria alternata were restricted to boothing to flowering stage of the crop, whereas Humicola sp., Helminthosporium oryzae, Gliocladium, Aspergillus versicolar were found in harvesting time only (Table 4.5).

Mycoflora of Peach(fruit garden):- On the basis of local climatic conditions, the entire period of investigation was divided into five seasons i.e. rainy season (June-July,, moderately warm (August-October), moderately cold humid (November-December), cold humid (January-February) and warm season (March-May).

Fungal Flora of the Air:- The maximum spore concentration appearing in the period from March-April, i.e. in warm season and lowest spore concentration was observed in rainy season i.e. June and July (Table 4.1).

Cladosporium herbarum, Mucor hiemalis, Aspergillus niger, Trichoderma viride, Penicillium sp., and Fusarium roseum were observed more or less throughout the year, while species like Cladosporium variabile, Aspergillus nanus, Penicillium sp. were restricted only in rainy season. Species like Aspergillus flavus, Alternaria humicola, Papularia arundinis, Fusarium moniliforme, Aspergillus versicolor, were observed in moderate warm season. Species like Gliocladium roseum, Phoma sp., Penicillium luteum, Gliomastix sp. was observed in moderately cold season. Gliomastix sp., Absidia sp., Aspergillus proliferans, Penicillium decumbens, Humicola sp., Pythium sp. were observed only in cold humid season and the species like Sclerotium sp., Stigmina sp., Epicoccum nigram, Helminthosporium oryzae, Rhizopus sp., Alternaria humicola, Mortierella sp., Cladosporium sphaerospermum are restricted only in warm season (Table 4.6).

Fungal Flora of Leaf surface:- In the warm season significantly higher number of fungal population was observed as compared to other season. Species like Alternaria

Table 4.6 Seasonal variation in the percentage occurrence of Air, Leaf surface and Soil mycoflora of peach (Fruit garden) in Shillong.

Name of the species	June			July			August			September			October		
	Air	Leaf surface	Soil	Air	Leaf surface	Soil	Air	Leaf surface	Soil	Air	Leaf surface	Soil	Air	Leaf surface	Soil
Abeidia sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Actinomucor elegans Benjaminet Hesseltine.	-	-	-	-	1.25	-	-	-	-	-	-	-	-	-	-
Alternaria alternata Keissl.	3.26	-	1.56	10.21	-	-	8.57	8.59	1.96	6.77	1.77	8.29	7.14	-	-
Alternaria humicola Oudemans.	-	-	-	-	-	-	18.36	8.44	6.44	-	-	-	5.36	-	-
Aspergillus flavus Link	-	-	-	-	-	-	3.67	0.59	2.24	-	-	-	-	-	-
Aspergillus nanus Mont.	13.00	-	4.68	-	-	-	-	-	-	-	-	-	-	-	-
Aspergillus niger v. Tieghem	3.26	17.10	8.59	8.60	-	-	5.30	2.96	5.88	-	4.14	-	1.79	9.84	18.45
Aspergillus proliferans G. Smith.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aspergillus sydowii Thom & Church	-	-	-	5.37	-	-	-	-	-	-	-	-	-	-	-
Aspergillus versicolor Tirabasshi	-	-	-	-	-	-	-	-	-	-	-	-	9.93	13.11	1.94
Cephalosporium roseo-griseum G.L. Sakseena	-	-	1.56	-	-	-	-	0.88	1.12	2.82	5.91	-	-	3.28	-
Chlamydomyces palmarum Mason.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cladosporium cladosporoides devries.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cladosporium herbarum Link & Fries	21.73	13.15	-	23.88	-	-	38.90	11.11	0.84	16.37	20.11	-	58.93	-	-
Cladosporium variabile devries F.	-	-	-	8.83	-	-	-	-	-	-	-	-	-	-	-
Curvularia lunata Boedijn	-	-	-	2.15	-	-	1.63	-	-	-	1.77	-	-	-	-
Curvularia sp.	-	-	-	-	-	-	-	1.48	2.24	-	-	-	-	-	-
Epicoccum nigrum Link.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fusarium moniliforme Sheld	-	-	-	-	-	-	-	-	-	14.39	2.36	13.98	-	-	-
Fusarium roseum Link ex Fries	21.7	-	2.87	25.80	-	-	15.81	0.89	38.68	7.05	1.77	13.98	-	-	9.71
Fusarium solani App. & Wr.	-	-	-	-	-	-	-	-	-	-	-	-	5.36	-	-
Fusarium sp.	-	-	3.90	-	-	-	-	-	-	-	-	-	-	-	-
Gliocladium roseum Bainier	-	-	-	-	1.28	2.98	-	-	-	-	-	-	-	8.56	-
Gliomastix sp.	-	-	-	-	-	8.66	-	-	-	-	-	-	-	-	-
Helminthosporium oryzae Breda de Haan.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Humicola grisea Traaen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Monilia sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella sp.	-	-	-	-	-	6.91	-	-	-	-	-	-	-	-	-
Mucor hiemalis Wehmer	29.34	5.26	-	3.76	-	-	-	-	-	1.12	15.38	-	-	-	-
Paecilomyces sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Populeria arundinis Fries	-	-	-	-	-	-	-	0.44	0.84	38.13	-	1.50	0.90	-	1.66
Penicillium chrysogenum Thom	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium crelgonium Westl.	-	-	19.53	-	-	-	-	6.51	4.48	4.79	9.46	1.50	-	-	-
Penicillium decumbens Thom.	-	-	-	-	-	-	-	-	-	-	1.77	11.91	5.36	1.64	-
Penicillium implicatum Biourge	7.6	60.52	38.28	14.51	7.32	15.15	6.83	72.88	23.80	10.78	22.48	5.18	1.79	49.18	9.71
Penicillium lutum Zukel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	57.28
Phoma sp.	-	-	-	-	-	-	-	-	-	1.69	2.95	5.18	-	3.28	-
Pythium sp.	-	-	-	-	-	-	-	-	-	-	-	21.24	-	3.28	-
Rhizopus sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sclerotium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stigmina maculata Hughes,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichoderma viride Pers. ex Fries	-	-	-	1.61	3.14	0.73	1.63	1.48	8.96	3.10	4.14	1.50	-	8.20	-
Unidentified	-	8.94	-	-	-	-	-	-	-	0.84	0.59	4.66	-	-	-
Volutella sp.	-	-	-	-	47.1	-	-	-	-	-	-	-	-	-	-
White sterile colony	-	-	-	1.07	-	-	2.85	-	-	1.69	5.30	1.03	-	1.64	-
Total of average colonies	7.6	15.2	25.60	18.60	9.55	27.06	24.50	67.50	5.70	25.43	16.90	19.30	22.4	12.2	20.5

Name of the species	November			December			January			February			March			April			May		
	Air	Leaf surface	Soil	Air	Leaf surface	Soil	Air	Leaf surface	Soil	Air	Leaf surface	Soil	Air	Leaf surface	Soil	Air	Leaf surface	Soil	Air	Leaf surface	Soil
Abeidia sp.	-	-	-	-	-	-	4.03	-	15.95	-	-	-	-	-	-	8.57	-	-	-	-	-
Actinomucor elegans Benjaminet Hesseltine.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alternaria alternata Keissl.	3.33	4.70	-	3.15	7.89	4.06	-	-	-	1.17	-	2.04	-	-	-	-	-	-	-	-	-
Alternaria humicola Oudemans.	-	-	-	-	-	-	-	-	-	-	-	-	-	15.2	-	18.26	18.89	13.89	-	-	-
Aspergillus flavus Link	-	-	-	4.50	-	-	4.49	-	4.18	-	-	-	-	-	-	-	-	-	-	6.70	6.88
Aspergillus niger v. Tieghem	3.33	7.05	-	5.40	0.65	15.22	9.41	-	8.74	-	-	12.24	-	9.76	2.41	5.82	7.37	7.70	6.61	8.31	-
Aspergillus proliferans G. Smith.	-	-	-	-	-	-	-	-	-	4.0	-	-	-	3.82	-	-	-	-	-	-	-
Aspergillus sydowii Thom & Church	-	-	-	-	-	-	-	-	-	2.28	-	-	3.43	3.96	1.44	-	17.54	18.28	-	-	-
Aspergillus versicolor Tirabasshi	4.44	4.70	-	-	-	-	-	-	-	-	-	3.38	9.07	-	-	-	-	-	-	-	-
Cephalosporium roseo-griseum G.L. Sakseena	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlamydomyces palmarum Mason.	-	-	-	-	-	-	-	-	-	-	-	-	-	2.54	-	-	-	-	-	-	-
Cladosporium cladosporoides devries.	-	-	-	-	-	-	-	-	-	2.85	-	-	4.29	20.11	-	-	-	-	11.86	9.38	6.88
Cladosporium herbarum Link & Fries	45.15	8.88	-	35.58	37.5	-	92.82	-	8.36	2.28	-	2.72	2.14	15.20	2.16	-	-	-	23.25	-	-
Cladosporium variabile devries F.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.70	5.78
Curvularia lunata Boedijn	2.72	18.29	1.66	-	-	-	-	-	-	-	-	-	-	-	-	0.55	6.96	2.42	4.18	6.70	10.46
Curvularia sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epicoccum nigrum Link.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.41	1.63	1.78	-	-	-
Fusarium moniliforme Sheld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fusarium roseum Link ex Fries	2.72	-	1.66	11.71	7.89	16.24	5.82	-	1.14	4.57	-	6.80	1.28	3.82	8.21	-	-	-	12.09	6.04	4.13
Fusarium solani App. & Wr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fusarium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gliocladium roseum Bainier	3.33	1.17	-	5.40	3.28	3.04	1.79	-	3.80	-	-	-	-	-	-	17.21	1.74	2.42	8.11	4.82	13.77
Gliomastix sp.	-	-	-	-	-	-	3.58	-	6.46	-	-	-	-	-	-	-	-	-	-	-	-
Helminthosporium oryzae Breda de Haan.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.97	1.90	8.15	1.16	5.63	8.26
Humicola grisea Traaen	-	-	-	-	-	-	-	-	-	1.14	-	-	-	-	-	7.05	5.54	1.33	-	8.31	5.78
Monilia sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.34	-
Mortierella sp.	-	-	-	-	10.19	16.24	-	-	-	-	-	-	-	-	-	1.18	-	2.64	5.81	3.21	9.64
Mucor hiemalis Wehmer	-	-	-	-	-	-	4.93	-	5.70	2.85	-	0.6	5.15	7.54	7.72	7.39	-	8.28	-	-	-
Paecilomyces sp.	-	14.11	24.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Populeria arundinis Fries	-	-	-	5.40	5.26	4.06	12.10	-	3.04	-	-	0.75	-	-	-	-	-	-	5.58	6.43	6.88
Penicillium chrysogenum Thom	-	-	-	-	2.63	4.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium crelgonium Westl.	1.81	2.35	-	-	-	-	-	-	-	-	-	-	-	-	-	6.66	0.81	1.33	-	6.70	9.64
Penicillium decumbens Thom.	-	-	-	-	1.31	4.06	-	-	-	2.85	-	-	22.3	6.32	-	-	-	-	9.13	8.04	-
Penicillium implicatum Biourge	30.39	44.70	70.49	6.75	2.63	10.65	11.21	-	-	-	-	6.80	*	-	14.00	7.39	1.14	-	4.66	2.60	-
Penicillium lutum Zukel	-	-	-	-	-	-	-	-	-	40	-	33.30	28.75	-	61.35	-	-	-	5.34	5.36	-
Phoma sp.	-	-	-	5.40	3.28	10.65	15.69	-	117.49	0.75	-	-	-	-	-	5.92	10.98	1.91	-	-	-
Pythium sp.	-	-	-	7.20	10.52	11.67	-	-	-	2.29	-	0.68	-	-	-	-	-	-	3.48	2.68	11.84
Rhizopus sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.69	11.96	15.28	-	-	-
Sclerotium sp.	-	-	-	-	-	-	-	-	-	-	-	-	42.00	3.82	0.96	-	-	-	-	-	-
Stigmina maculata Hughes,	-	-	-	-	-	-	-	-	-	-	-	-	-	1.27	1.93	-	-	-	-	-	-
Trichoderma viride Pers. ex Fries	1.81	-	-	2.70	8.90	-	-	-	-	28.71	-	-	17.16	7.64	-	11.85	17.41	19.10	2.79	5.63	-
Unidentified	-	-	-	-	-	-	-	-	-	-	-	-	6.15	5.09	-	-	-	-	-	-	-
Volutella sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
White sterile colony	-	-	-	6.75	-	-	2.24	-	-	-	-	-	-	-	-	8.01	1.08	1.91	-	-	-
Total of average colonies	56.00	19.00	12.20	44.4	30.4	19.7	44.6	-	90	175.00	82.65	147.0	232.0	90.94	207.0	177.2	163.8	157.4	45.0	37.3	3.3

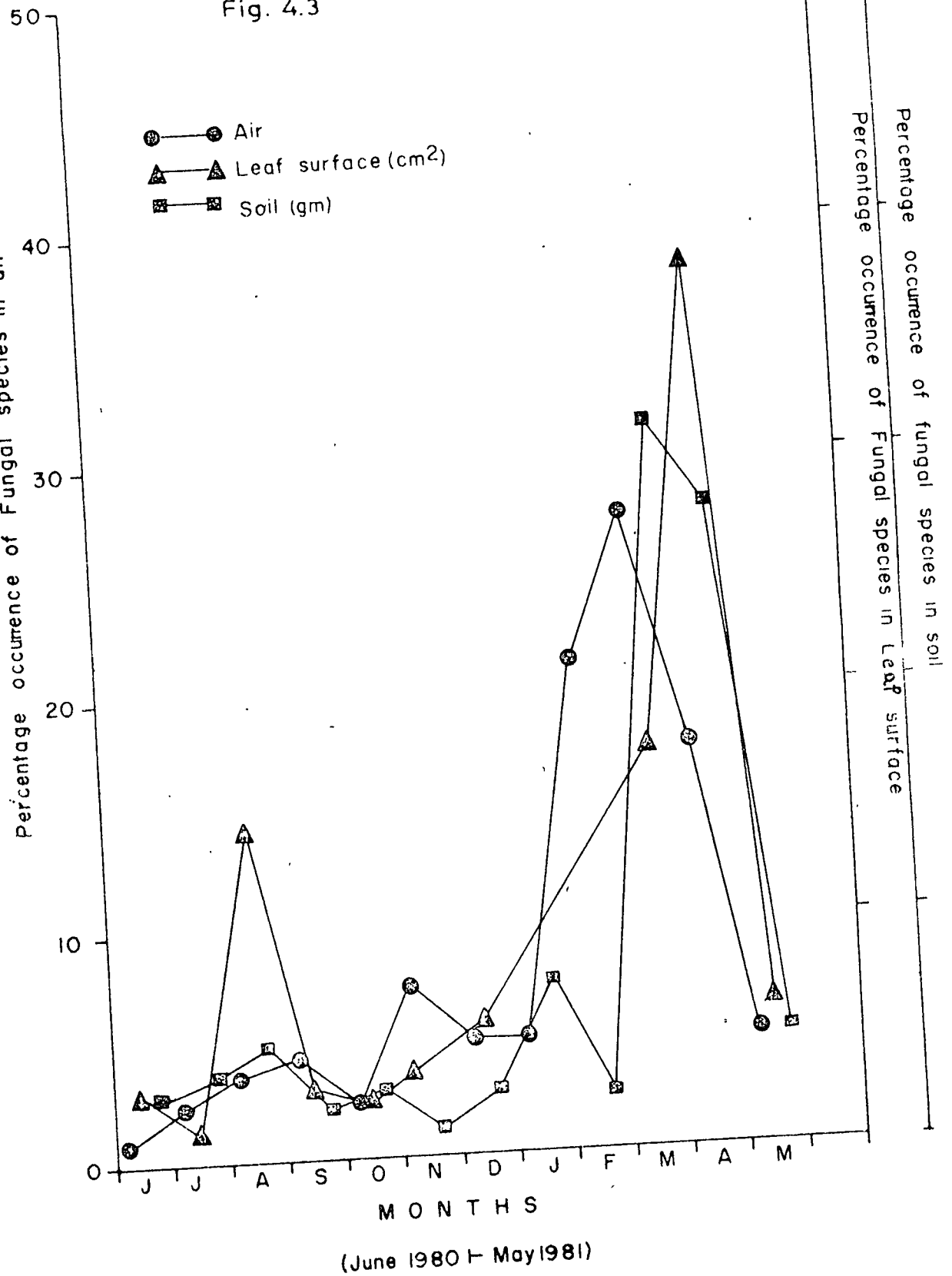
alternata, Penicillium cyclopium, Curvularia lunata were dominant fungi isolated throughout the year. Species like Volutella sp., Gliocladium sp., Actinomucor eleganus, Monilia sitophila were found to be restricted only in rainy season, while the other fungi like Cephalosporium sp., Papularia sp., Penicillium decumbens were observed in moderate warm season. The species like Paciliomyces sp., Aspergillus versicolor, Curvularia lunata, Penicillium chrysogenum, Mortierella sp. were observed in moderately cold humid seasons. Since there were no leaves in peach plant in January and February, no isolation from leaf surface was possible. In warm season the number of species were more and, Aspergillus proliferens, Helminthosporium sp., Cladosporium spharospermum, Humicola grisea, Stigmina maculata, Sclerotium sp., Rhizopus sp. were observed (Table 4.6).

Mycoflora of the Soil:- There is no regular distribution of mycoflora in the fruit garden soil, but it was observed that the population was higher in warm season and least population in moderately cold humid season (Table 4.1).

The dominant fungal species observed in the peach garden soil were Humicola sp., Alternaria alternata, Fusarium roseum, Mucor hiemalis, Penicillium sp., Aspergillus sp., Cephalosporium sp., Phoma sp. and some other fungi.

FIG. 4.3 SEASONAL VARIATION OF AIR, LEAF SURFACE AND SOIL MYCOFLORA OF PEACH (FRUIT GARDEN)

Fig. 4.3


Air
Leaf surface (cm2)
Soil (gm)
Percentage occurrence of Fungal species in air
Percentage occurrence of Fungal species in Leaf surface
Percentage occurrence of fungal species in soil
50
40
30
20
10
0
J J A S O N D J F M A M
MONTHS
(June 1980 – May 1981)

The species like Gliomastix sp., Mortierella sp., Actinomucor elegans and Gliocladium sp. observed in rainy season but the percentage occurrence of fungal-species were very low. Papularia sp., Trichoderma viride, Alternaria humicola, Curvularia lunata, Pythium sp., Phoma sp., Helminthosporium sp., Alternaria solani, Paecilomyces sp., Penicillium chrysogenum were mostly observed in moderately warm and moderately cold season.

Discussion

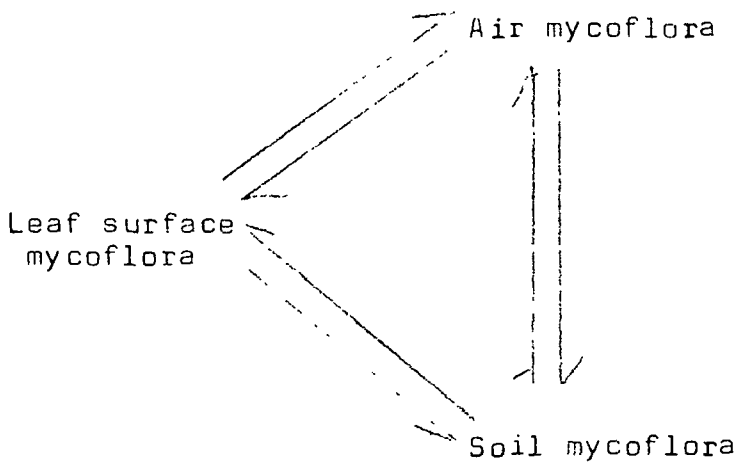
The fungal population of the air, leaf surface and soil is found to be greatly influenced by the environmental factors like light, temperature humidity and rainfall. The low temperature and high humidity in the air adversely affects the air, leaf surface and soil mycoflora, but comparatively high temperature and low humidity favours the population of saprophytic micro-organisms. According to Gregory and Hirst (1957), and Sharma and Mukerji (1972a) the season is dominating factor determining the qualitative and quantitative composition of the leaf surface microflora, and further variation in the total number of isolates indicates changes in the density of the active populations. Dixit and Gupta (1980) have also conducted a comparative study of phylloplane and air-spora of barley and found that

the fungi imperfecti was the most dominant group in both air and phylloplane in their study. They have also co-related the climatic conditions with the prevalence of the phylloplane and air-spora. These results are similar to the results obtained in the present work.

It is known that air borne propagules act as initial source of inocula for the aerial plant parts. It is also evident from the present result that phylloplane isolates were also present in the air and soil and vice versa. In addition, noticeable differences were recorded in the seasonal occurrence of micro-organisms in the air and on the surface of potato, paddy and peach leaves.

From the comparative study, it is clear that although air-borne propagules act as initial source of inocula for the aerial plant parts, but the quantitative composition of the three population is found to be very different. The present result does not support the generally accepted view that air-borne spores originate from vegetation only rather than from the soil. Although it has been suggested by different workers that air/mycoflora is either contributed by soil or from vegetation (Paddy, 1967; Gregory, 1971), results obtained in the present work show similarity of air and soil mycoflora although some of the organisms were present in the leaf surface as well. It is

known that certain air spora are liberated to the atmosphere from the particular type of vegetation i.e. Cladosporium herbarum is mainly from grass spp. (Sreeramulu, 1958; Pawsay and Heath, 1964). Therefore it can be suggested from the present comparative study results that air mycoflora is either contributed by vegetation or from soil. In fact it seems more logical that there is a continuous process of distribution of the mycoflora from soil, leaf surface and air and vice versa. This situation can be explained as follows:-



Although the availability of the air-spora may vary according to the weather conditions, as well as according to the presence of the particular plant sp. contributing to the air mycoflora. Oransfield (1966) also has suggested that the soil fungi which are active in a particular season may not

be active during other seasons.

A seasonal fluctuation in the population of the air, leaf surface and soil mycoflora is also observed which seems to depend upon the climatic conditions such as temperature, humidity, wind velocity, phenology of the local vegetation and its associated fungi and rainfall (Table 1 Fig. 4.1-4.3). In India studies of air-spora relating to seasonal and diurnal variations have been conducted by several workers (Rajkumar and Gupta,1978, Sharma,1971, Sreeramulu,1959, 1964, 1962, Singh and Baruah,1979) and results of the present investigation are also in same line with the above studies.

This study also shows that the seasonal variations of the fungal populations do exist in the soil. The fungal isolates were mostly deuteromvces. The quantitative and qualitative variation of the total population of the mycoflora may be due to inadequate soil moisture and nutrients, which affect the population (Dixon,1961, Waksman 1959, Rama Rao,1970) and activities of the micro-organisms. Waid (1962) has suggested that fertility of the soil affects the total population of mycoflora, which seems to be a more logical conclusion.

SECTION VII

General Discussion

GENERAL DISCUSSION

It is known that the particles of biological origin constitute an important fraction of particulate loading of the atmosphere. Usually such particles are investigated in relation to human allergic diseases and phytopathological problems (Finkelstein, 1969, Davis and Smith, 1973; Waggoner, 1974). Pollen and spores constitute an important fraction of the total particulate level of the atmosphere. Concentration of pollen in the atmosphere is usually determined by the stage of flowering and meteorological conditions of the area. Different sites at Shillong, viz. Upper Shillong (1951 m), Polo Ground (1300 m) and Nongthymmai (1800 m) were selected in order to obtain a comparative account of the fungal spores of the atmosphere and their seasonality. The flowering phenology of the species is directly dependent on the season and weather conditions of the area. Most species of Shillong come to bloom during March to September and flowering frequency comes down during December to February, which are winter months (Fig. 2.1). For identification of air-borne pollen, pollen morphology is very important. Therefore, present study covers the morphological descriptions of pollen of 125 species belonging to 53 families. It is found that the pollens are unique and typical for any family, genus or species (Nair, 1960). On the basis of exine character the

anemophilous and entamophilous pollens can be easily differentiated. . . . Different types of pollen grains ranging from inaperturate to colporate and exine lacking distinct columellar stratum to exines with columellar and tectal complexities (e.g. Argyreia sp.) have been found. Similarly, marked size variations of pollen have also been observed (16.4 µ - 179 µ diam.). The various pollens are found to be marked by differences in the types of apertures and exine ornamentations.

The study of the pollen morphology of Indian plants has attracted the attention of research workers in recent years (Nair, 1965; Nair, 1970, Thanikaimoni, 1976, Vasanthi, 1976). Although, pollen grains of few families have been described and illustrated, there is as yet no comprehensive account of the pollen flora of any vegatative unit (Nair, 1965). In the present work brief descriptions and some illustrations from 125 predominant species belonging to 53 families have been provided.

It is seen that hardly any period of the season is free from the atmospheric biopollutant which indicates the richness of the air-spora in the atmosphere (Sreeramulu, 1964). Seasonal variations in the population of air-spora in the atmosphere were studied during February 1980 to January 1981, with the help of simple gravity sampler (aeroscope).

Though the flora of Shillong is very rich and diverse, the percentage occurrence of pollen in the atmosphere is very less (21%). This is due to well established fact that the pollen productivity is very less in hilly regions. Similar observations were also made by Markgraf (1980). The highest counts of total pollen were recorded in the months of March, May and September. In the month of March, pine pollens are predominant, which form a conspicuous feature in vegetation of Shillong. The effect of weather condition in air is a well known fact, as during this period, temperature records range from 20°C to 22°C which favours the pollen production and spread. Subbareddy (1970) also observed similar results. May is predominated by the pollen of angiospermic species like, Schima wallichii, Quercus sp., Viburnum sp. and members of Rosaceae and Compositae. Very negligible counts of pollen were observed in the month of June to August, which is due to heavy rain the area receives. Heavy rainfall not only lowers the pollen production in a species, but also washes down the pollen from the atmosphere (Ramalingam, 1964; McDonald, 1979). The atmosphere in September is dominated over by the pollen of Cedrus spp., Betula alnoides, Glochidion spp., Ardisia macrocarpa and Quercus griffithii. November to January being the severe winter months with low temperature records show low concentration of pollen in the atmosphere. It is mainly due to the fact that ground vegetation is either

killed or lie dormant during the severe winter months.

Fungal spores on the other hand exhibit two distinct peak periods in the month of June (8%) and September (24%). Cladosporium sp., Alternaria sp., Humicola sp., Streptomyces sp., Aspergillus sp. and Torula sp. are dominant. Meteorological factors like heavy rainfall and high humidity mainly influence the prevalence of fungal spores in the atmosphere (Singh & Baruha, 1979). It is observed that June and September show the highest percentage of humidity (88%) with the gradual decrease in these factors from October onwards. The concentration of fungal spores also reduced with the lowering of humidities. In the month of March lowest percentage of spore was observed, possibly because of the high temperature and low humidity observed in this month

Diurnal fluctuation in pollen and fungal spores were observed in the atmosphere of Shillong (May '81 to December '81). Most of the pollen was observed in day time, while pollen of some species like Cryptomeria japonica, Elaeocarpus sp., Eucalyptus sp. were observed in night time. Pollen concentration appeared to be greatly influenced by sunshine and relative humidity as reported by earlier workers (Singh & Babu, 1980, Ramalingam 1966). The results of predominant fulgal spores and their diurnal variations are not similar. The fluctuation was found to vary day to day

and even with time. The highest percentage occured in the evening.

The comparative study of air, phyllosphere and soil were carried out in three different crops viz., potato, paddy and peach (fruit garden) in order to determine the source and origin of the aerospora in relation to soil and leaf surface micro-organisms. It is observed that the air-borne propagules act as one of the sources of inocula for the aerial plant parts, while some fungi originate from soil. In addition, noticeable differences were recorced in the seasonal occurrence of the air, leaf surface and soil mycoflora. Gregory (1961) has explained that the soil does not make any substantial direct contribution to the furgal spore content of the atmosphere; atmospheric moulds are derived mainly from fungi growing on vegetation. Paddy (1967) considered that most of the fungal spores in the atmosphere come from the soil. A similar condition can be observed by comparing the air, leaf surface and soil population in different crop fields at Shillong. As species like Fusarium roseum, Absidia sp., Papularia sp., Cladosporium herbarum, Penicillium implicatum are present both in soil as well as air. Dransfield (1966) reported, "it seems more likely that this air-spora is derived predominantly either from moulds, plant pathogen and other fungi"

growing on vegetation, or from surface growing fungi, equipped with mechanism which librate their spores into the free moving turbulant air layer. It is also known that into soil, bacteria, penicilli, and Aspergilli are predominant; but Cladosporium predominates in the air, seconded by basidiospores. Similarity between the soil and air-spora is mainly due to the soil being the ultimate 'sink' to which most of the air-spora is destined and awaiting extinction (Gregory, 1973) or for a host plant to cause disease if it is a pathegenic species.

The need for intensive aerobiological studies has been emphasized by both clinicians and botanists during recent years. The results of the present investigation can be a useful tool for further researches towards understanding of the implication of the air-borne pollen and spores in relation to human allergic diseases and also in forecasting diseases in crops plants of this region. However, much remains to be done in this directioh before we are able to achieve this final goal.

It has been reported by Kerling (1964) that the development of saprophytic fungi on rye leaves shows a sudden increase shortly after flowering and this increase according to him is due to the presence of pollen that has fallen on leaves after flowering. FoKkema (1968) also had

demonstrated that pollen added to the inocula of Cladosporium herbarum enhanced colonization of the leaves by this fungus. He further demonstrated that the infection of rye leaves by Septoria nodorum and Helminthosporium sativum was stimulated by pollen (Fokkema, 1971).

The interaction between pollen and fungal spores in the atmosphere however, could not be attempted in this project due to exegencies of time. Neverthless, this survey is one of the important aspects in plant Pthological and human allergic disease, and offers a promising field for future workers in the field of Aerobiology.

SECTION VIII

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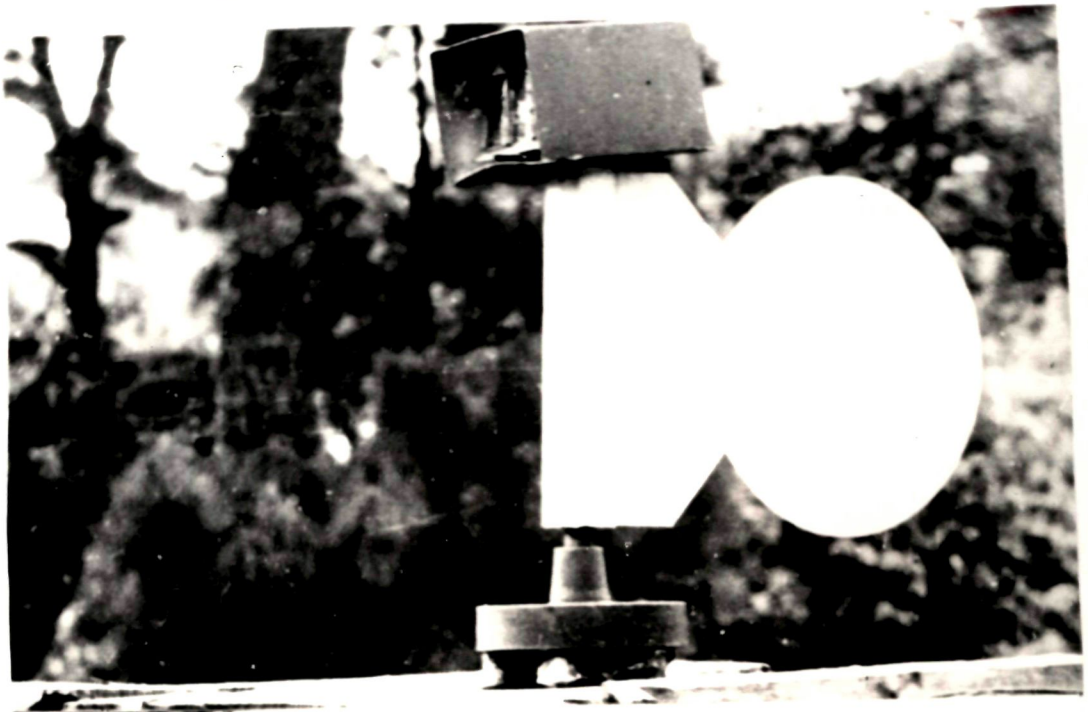
PLATE NO.

The aeroscope used at different sites of sampling.

Fig. A Aeroscope (General View)

Fig. B Aeroscope at University Building (8 meter)

Fig. C Aeroscope at Departmental garden (3 meter)



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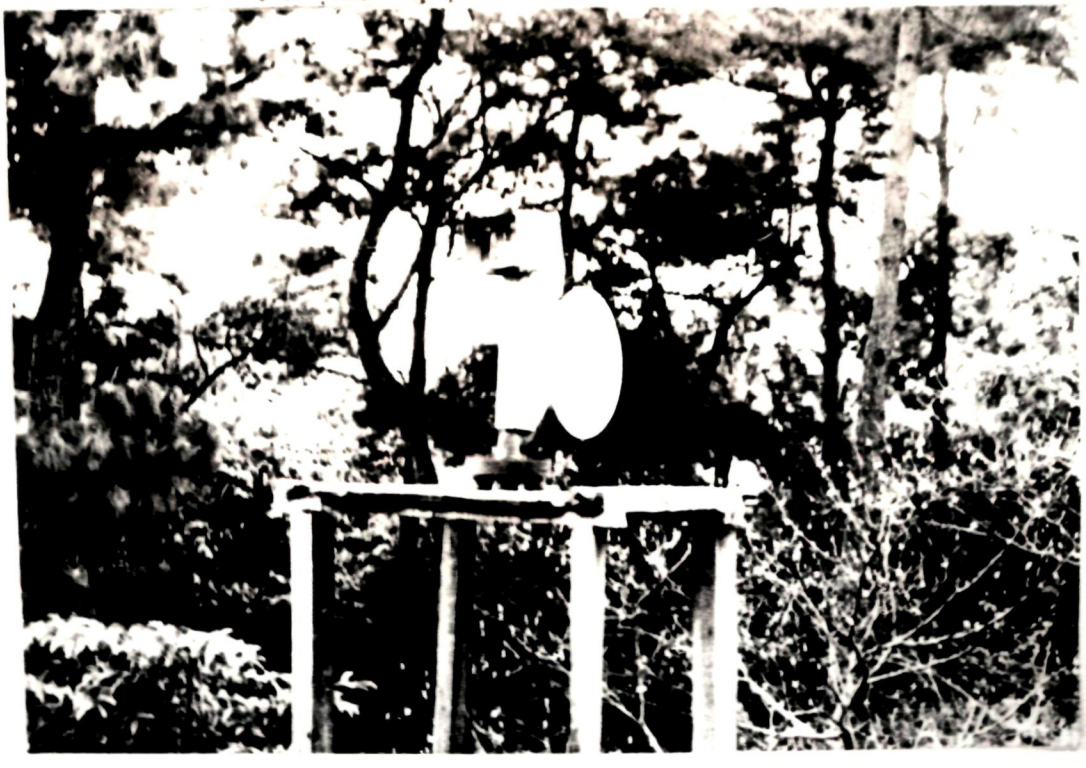


C

PLATE . 1

PLATE NO. 2

Fig. 1 Cupressus torulosa

Fig. 2 Cedrus deodara

Fig. 3 Pinus kesiya

Fig. 4 Cryptomeria japonica

Fig. 5 Hypoestes triflora

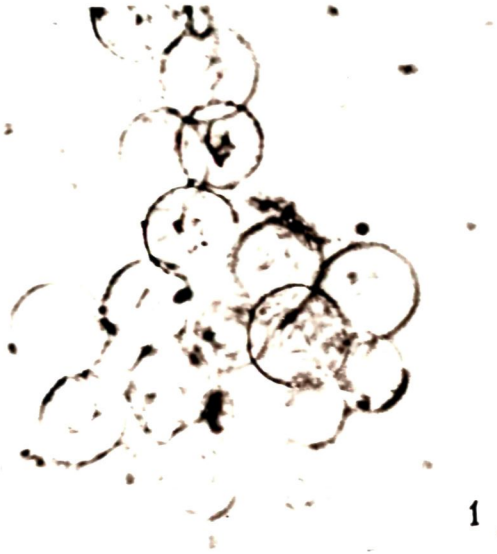
Fig. 6 Strobilanthus extensus

Fig. 7 Amaranthus gracilis

Fig. 8 Rhus semialata

NOTE : All microphotographs are at a magnification X 400, unless otherwise mentioned.

PLATE . 2



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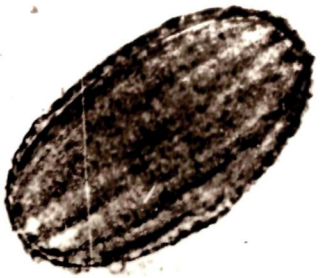

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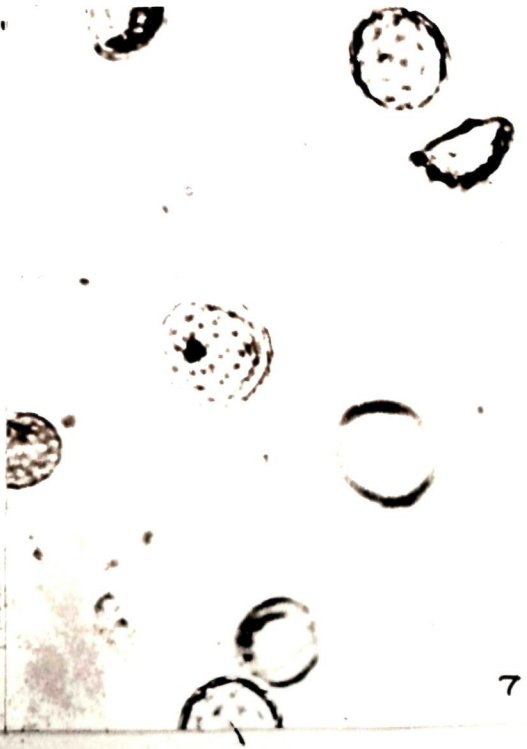

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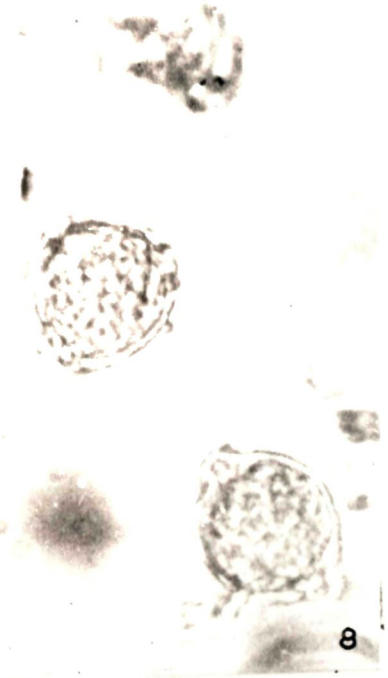

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PLATE NO. 3

Fig. 9 *Melodinus khasianus*

Fig.10 *Panax pseudoginseng*

Fig.11 *Macropanax undulatum*

Fig. 12 *Ageratum conyzoides*

Fig.13 *Ambrosia artemisifolia*

Fig.14 *Chrysanthemum cenerarifolium*

Fig.15 *Eupatorium riparium*

Fig.16 *Vernonia cinerea*

Fig.17 *Impatiens chinensis*

PLATE. 3

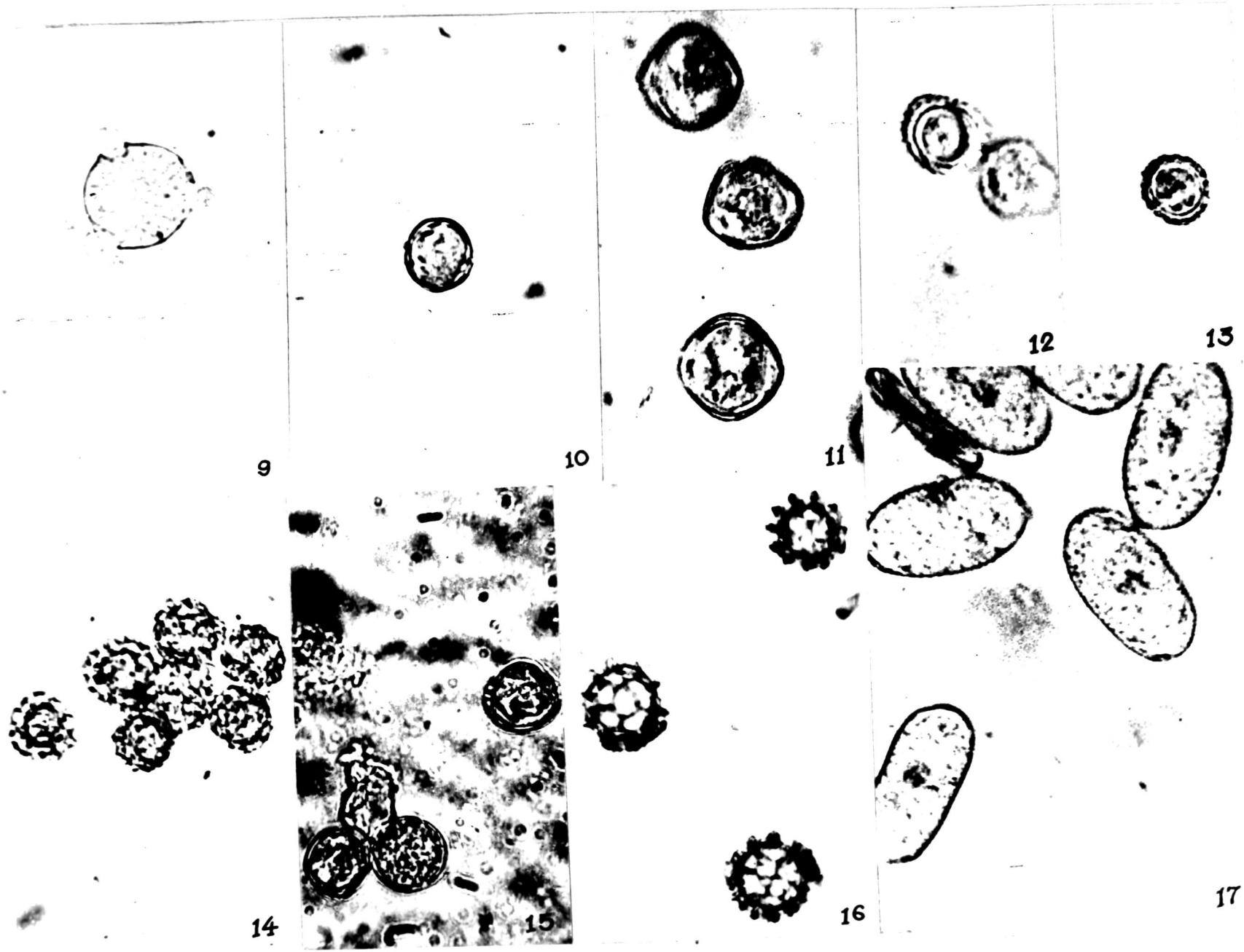


PLATE NO. 4

Fig. 18 *Alnus nepalensis*

Fig. 19 *Betula alnoides*

Fig. 20 *Jacrandra mimosiefolia*

Fig. 21 *Stellaria media*

Fig. 22 *Viburnum khasianum*

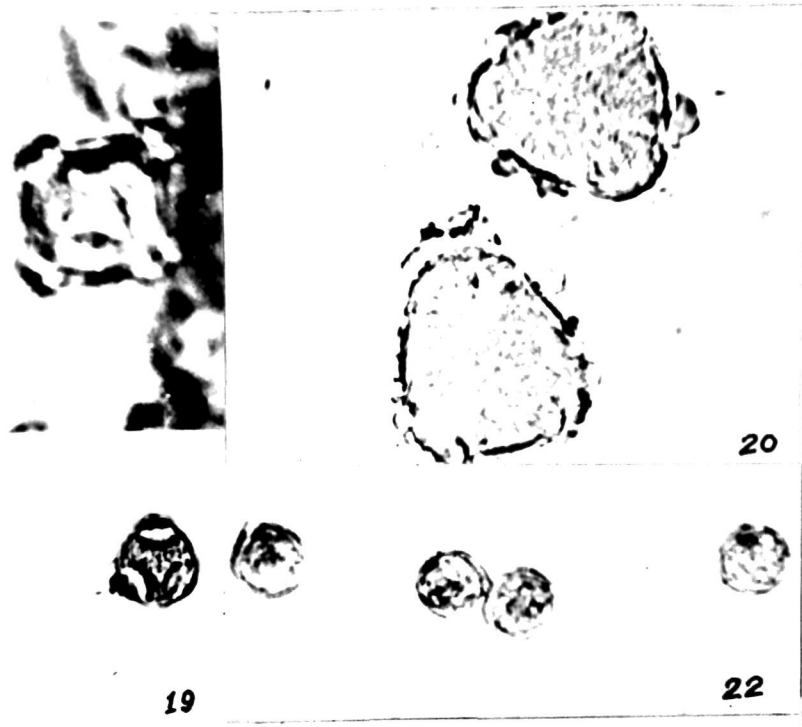
Fig. 23 *Argyreia capitata* X 100

Fig. 24 *Ipomoea hederaceae* X 100

Fig. 25 *Elaegnus latifolia*

Fig. 26 *Eleocarpus acuminatus*

PLATE . 4



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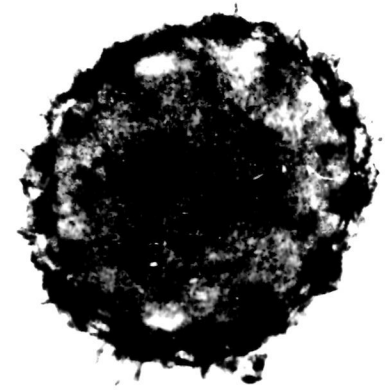

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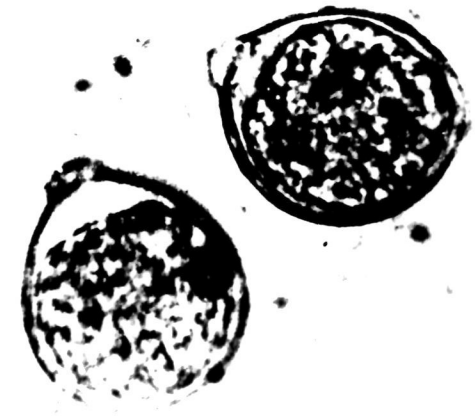

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PLATE NO. 5

Fig. 27 *Lyonia ovalifolia*

Fig. 28 *Rhododendron arborium*

Fig. 29 *Glochidion accuminatum*

Fig. 30 *Ricinus communis*

Fig. 31 *Erythrina arborescens*

Fig. 32 *Trifolium repens*

Fig. 33 *Castenopsis tribuloides*

Fig. 34 *Quercus griffithii*

Fig. 35 *Corylopsis himalayana*

Fig. 36 *Brunella vulgaris*

Fig. 37 *Buddleia asiatica*

PLATE. 5

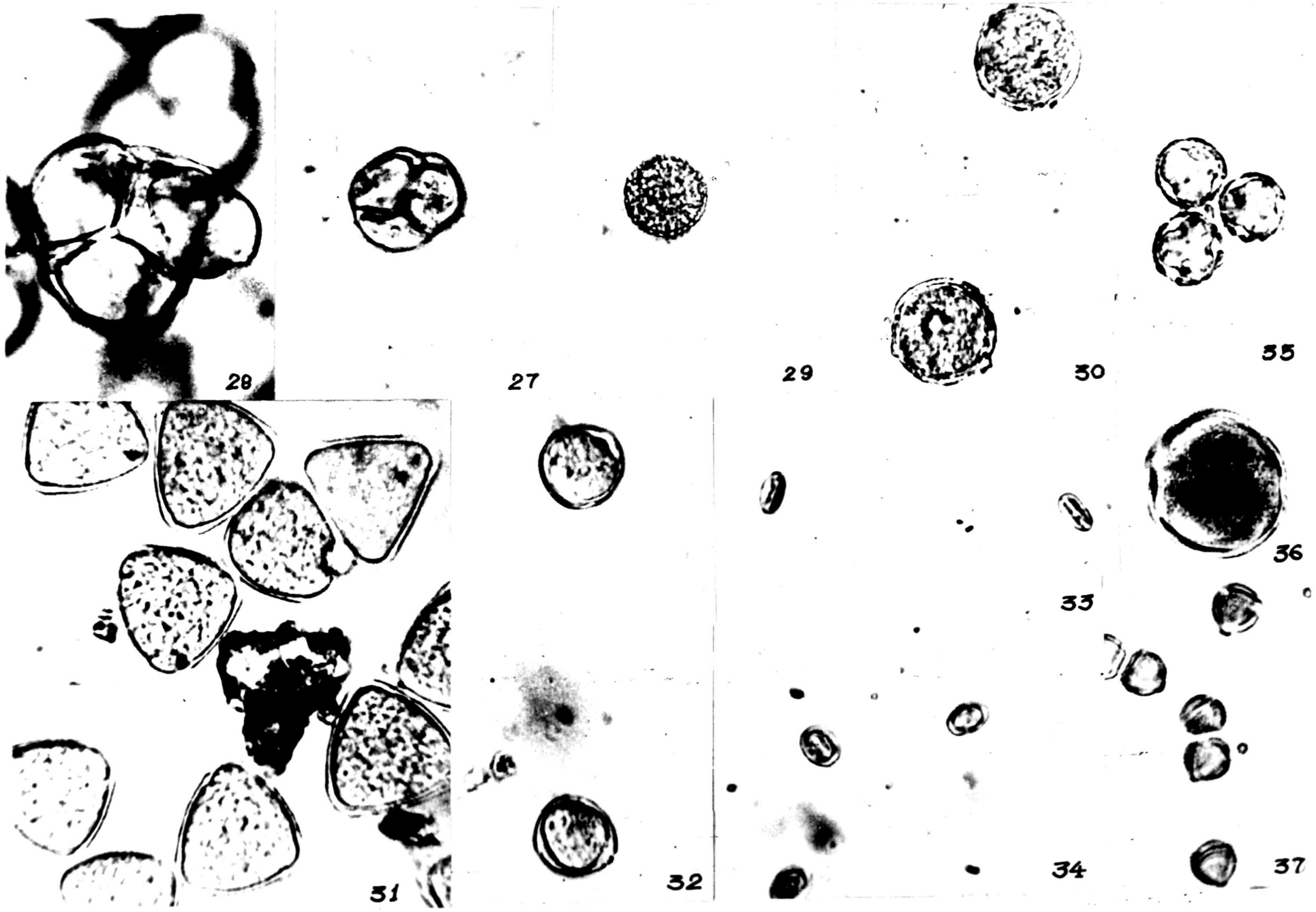


PLATE NO. 6

Fig. 38 *Abutilon indicum*

Fig. 39 *Hibiscus rosasinensis*

Fig. 40 *Osbeckia capitata*

Fig. 41 *Acacia dealbata*

Fig. 42 *Ardisia macrocarpa*

Fig. 43 *Myrsine semiserrata*

Fig. 44 *Callistemon lanceolatum*

Fig. 45 *Eucalyptus globulus*

Fig. 46 *Ligustrum robustum*

Fig. 47 *Oenothera rosea* X 100

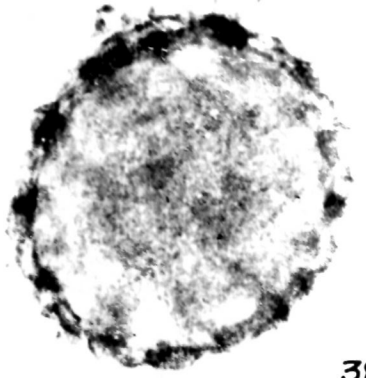
Fig. 48 *Polygala arillata*

Fig. 49 *Argyreia capitata* X 100

Fig. 50 *Polygonum chinensis*

Fig. 51 *Polygonum hydropiper*

PLATE . 6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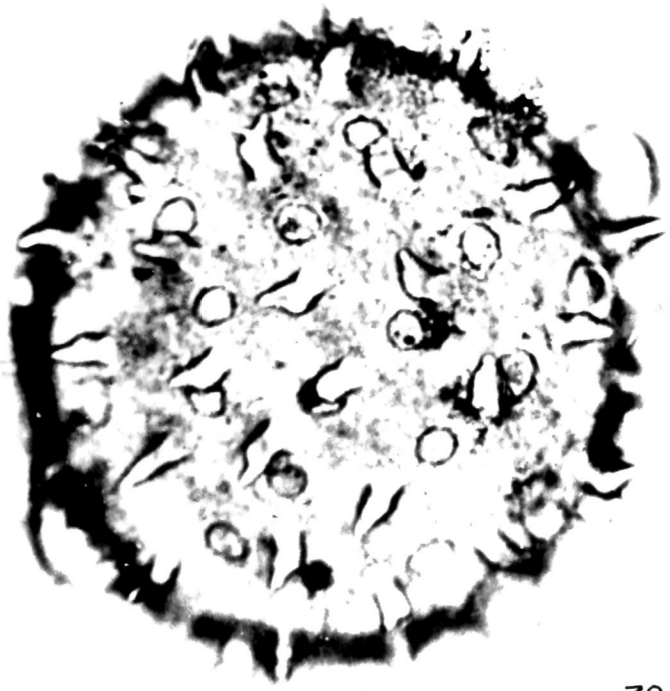
43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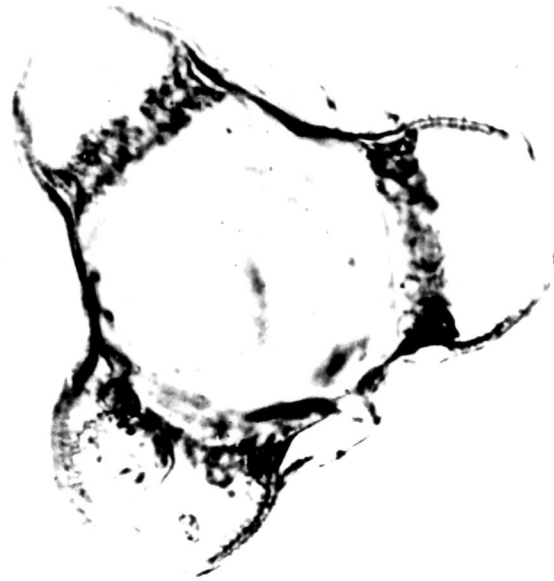
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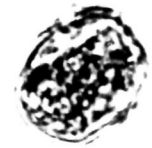
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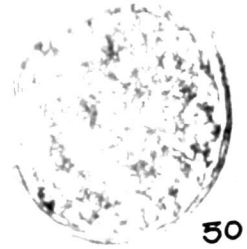
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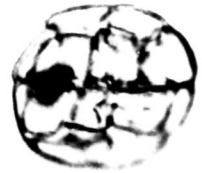
40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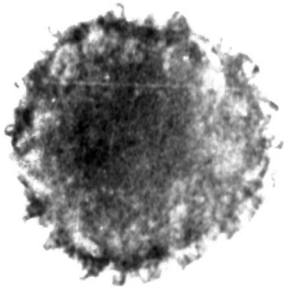
49


51


44


45

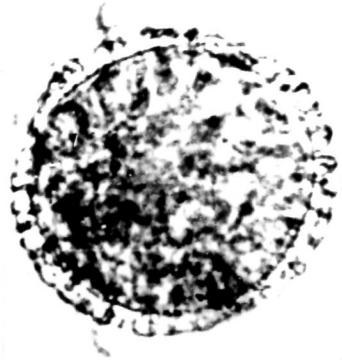

46

PLATE NO. 7

Fig. 52 *Anemone rivularis*

Fig. 53 *Ranunculus contoniansis*

Fig. 54 *Thalictrum foliolosum*

Fig. 55 *Docynia indica*

Fig. 56 *Potentilla mooniana*

Fig. 57 *Photinia notoniana*

Fig. 58 *Prunus domestica*

Fig. 59 *Prunus persica*

Fig. 60 *Prunus cerasoides*

Fig. 61 *Prunus communis*

Fig. 62 *Rosa liviqata*

Fig. 63 *Rubus micropetalous*

Fig. 64 *Rubus ellipticus*

Fig. 65 *Coffea khasiana*

Fig. 66 *Luculia pinceana*

Fig. 67 *Oldenlandia herbacea*

Fig. 68 *Rubia cordifolia*

Fig. 69 *Parnassia mysorensis*

PLATE. 7

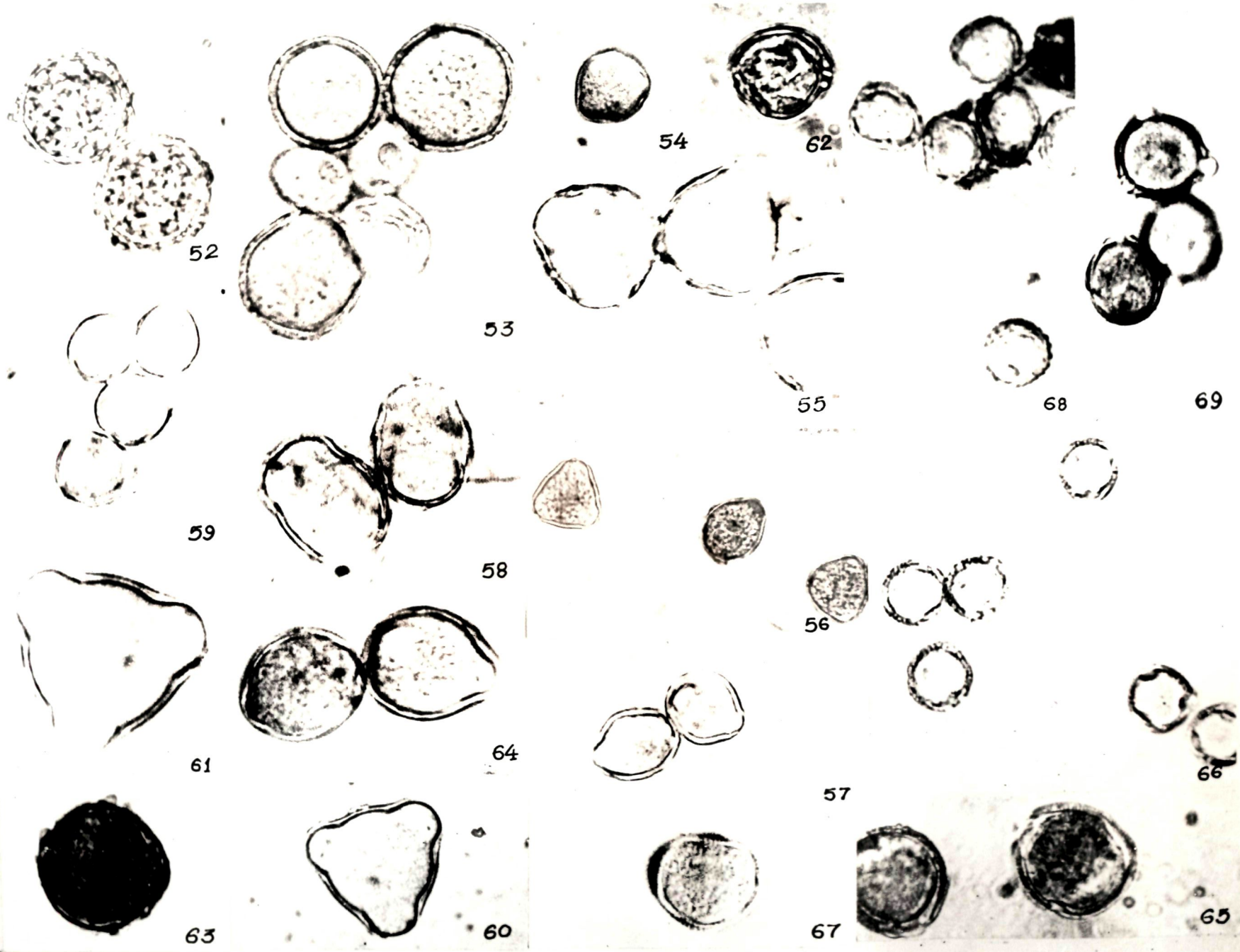


PLATE NO. 8

Fig. 70 *Cestrum nocturnum*

Fig. 71 *Symplocos spicata*

Fig. 72 *Schima wallichii*

Fig. 73 *Daphne shillong*

Fig. 74 *Mautia puya*

Fig. 75 *Poufalzia* sp.

Fig. 76 *Vaccinium griffithianum*

Fig. 77 *Clerodendron serratum*

Fig. 78 *Duranta plumeri*

Fig. 79 *Disporum pullum*

Fig. 80 *Paspallum dilatum*

Fig. 81 Monocot pollen

PLATE. 8

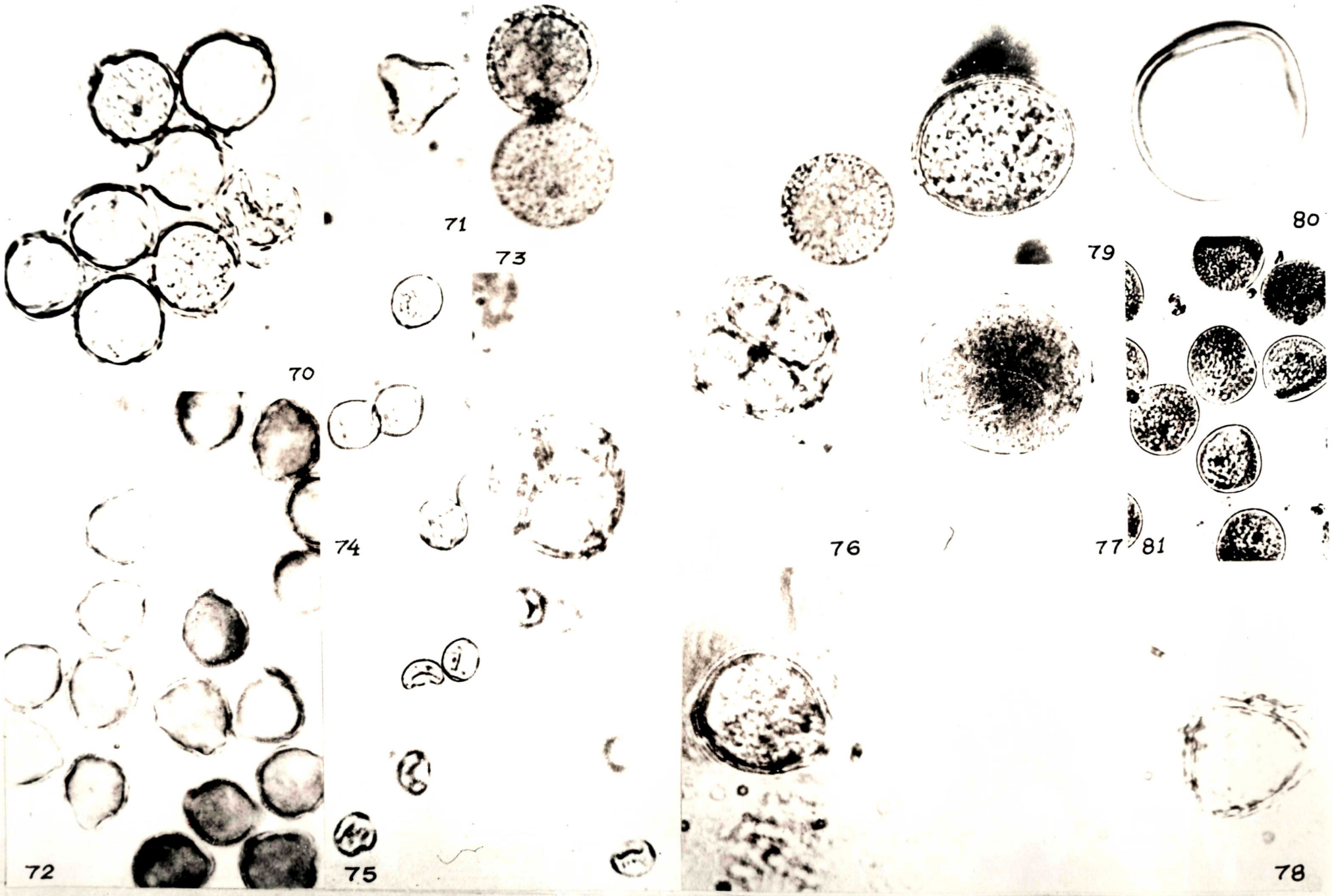


PLATE NO. 9

Fig. 1A *Curvularia lunata*

Fig. 1B *Curvularia* sp.

Fig. 2 *Alternaria* sp.

Fig. 3 *Trichoderma viride*

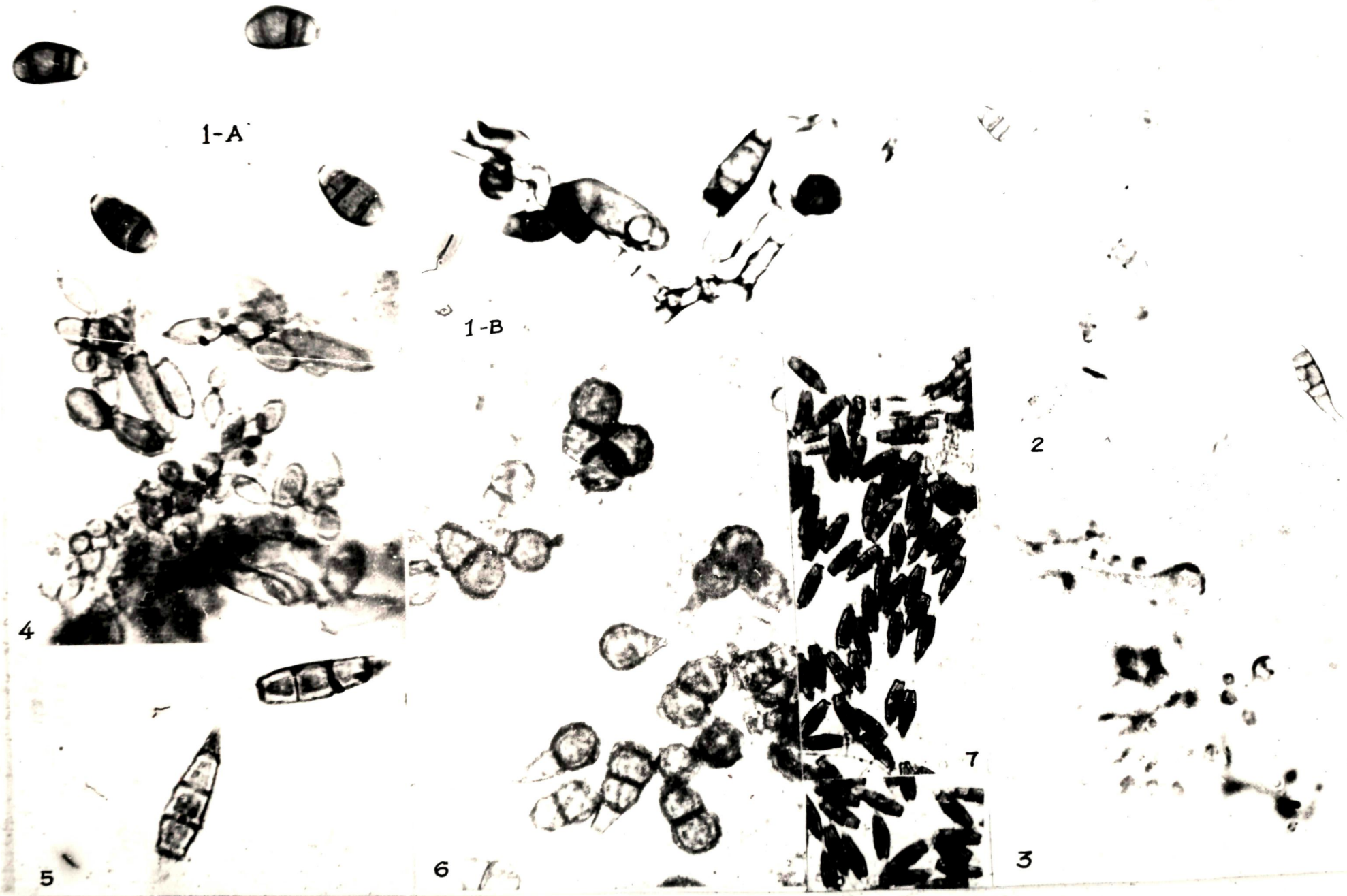
Fig. 4 *Cladosporium herbarum*

Fig. 5 *Pestalotiopsis* sp.

Fig. 6 *Trichocladium* sp

Fig. 7 *Polychaet* sp.

PLATE . 9



Appendix Table I-A Diurnal variation of air spora i.e. pollen grains, fungal spores parts in the atmosphere of Shillong [May 1981 - August '81 (wet m (Data based on the total number of air spora in each month, all c 25 X 50 sq.cm. exposed slide area).

Months—	May								June								July							
					Total No.of exposures in species occurrence								Total No.of exposures in species occurrence								Total No.of exposures in species occurrence			
No.of exposure	24	24	24	24					26	26	26	26					27	27	27	27				
Time—	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Name of species																								
Abutilon indicum	0	0	5	1	0	0	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acacia dealbata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ageratum conyzoides	-	-	-	-	-	-	-	-	5	16	5	5	3	5	2	2	0	1	4	3	0	1	2	2
Anemone rivularis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	2	0	0	0	1	0	0
Amaranthus sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	2	0	0	0	2	0
Ardisia macrocarpa	-	-	-	-	-	-	-	-	0	2	2	4	0	1	2	1	0	0	2	1	0	0	1	1
Artemisia sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Betula	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Buddleia asiatica	-	-	-	-	-	-	-	-	1	6	0	2	1	2	0	1	-	-	-	-	-	-	-	-
Castenea sp.	1	1	1	6	1	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cedrus deodara	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	140	320	190	340	19	18	19	18

Appendix Table I-A (contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Chrysanthemum sp.	8	24	5	9	5	5	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Corylopsis himalayana	-	-	-	-	-	-	-	-	7	13	5	3	4	6	3	1	0	0	0	1	0	0	0	1
Cryptomeria japonica	-	-	-	-	-	-	-	-	0	2	2	7	0	1	1	3	0	1	0	0	0	1	0	0
Cupressus torulosa	39	36	26	14	13	12	9	7	53	27	24	26	9	9	5	10	14	8	0	7	5	5	0	3
Daphne shillong	0	0	1	3	0	0	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Duranta plumer	0	2	0	0	0	1	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eucalyptus sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	5	0	0	0	2	0	0
Erythrina arborescens	13	13	12	11	8	6	4	7	4	10	6	6	3	3	3	2	0	2	0	0	0	1	0	0
Fagopyrum esculentum	-	-	-	-	-	-	-	-	7	0	4	0	4	0	1	0	-	-	-	-	-	-	-	-
Ligustrum robustum	-	-	-	-	-	-	-	-	3	3	0	1	1	1	0	1	0	0	4	0	0	0	2	0
Lyonia ovalifolia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Macropanax sp	-	-	-	-	-	-	-	-	0	2	1	2	0	1	1	1	0	3	7	1	0	2	4	1
Melodinus khasianus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	2	0	0	0	1	0	0
Oenothera sp	-	-	-	-	-	-	-	=	3	2	4	1	1	1	2	1	5	3	1	0	2	3	1	0
Pauzolzia hirta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pinus kesiya	409	401	379	352	21	20	20	19	189	175	165	192	23	22	23	23	-	-	-	-	-	-	-	-
Plantago major	0	1	0	0	0	1	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potenilla sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	2	0	0	0	1

Appendix Table I-A (contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Polygonum sp	0	4	0	0	0	1	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quercus dealbata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ranunculus sp	0	2	0	0	0	1	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhododendron arboreum	-	-	-	-	-	-	-	-	0	0	0	4	0	0	0	1	0	0	7	0	0	0	2	0
Rhus semalata	-	-	-	-	-	-	-	-	5	9	5	6	2	3	3	2	0	1	0	2	0	1	0	1
Rubus micropetalous	1	3	3	5	1	1	1	2	4	12	0	3	1	2	0	1	0	3	3	0	0	1	1	0
Rubus accuminatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rubia cardifolia	-	-	-	-	-	-	-	-	1	1	0	2	1	1	0	1	-	-	-	-	-	-	-	-
Rumex nepalensis	-	-	-	-	-	-	-	-	2	0	0	0	1	0	0	0	-	-	-	-	-	-	-	-
Schima sp.	27	24	19	20	8	8	11	10	11	20	7	0	3	7	5	0	3	9	4	5	3	3	3	
Solanum sp.	17	12	9	6	7	5	4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Strobilanthus sp.	-	-	-	-	-	-	-	-	0	1	0	0	0	1	0	0	2	0	1	2	1	0	1	
Symplocos sp.	-	-	-	-	-	-	-	-	14	14	10	9	7	6	4	4	1	2	0	0	1	2	0	
Thallictrum potentilla	-	-	-	-	-	-	-	-	0	1	0	0	0	1	0	0	-	-	-	-	-	-	-	-
Trifolium repens	6	9	4	1	3	2	2	1	1	0	0	1	1	0	0	1	-	-	-	-	-	-	-	
Vaccinium sp.	0	0	0	4	0	0	0	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Viburnum sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	7	0	0	1	1	0	

Appendix Table I-A (contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Zea mays	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	1	0	0	0	1	0
Asteraceae pollen	5	5	2	2	1	2	1	1	11	30	19	14	3	5	6	2	5	4	2	1	2	2	2	1
Malvaceae pollen	1	1	0	0	1	1	0	0	6	4	6	5	3	2	3	2	0	0	0	1	0	0	0	1
Palmae pollen	-	-	-	-	-	-	-	-	19	321	10	5	2	1	1	1	9	2	10	4	4	1	4	3
Grass pollen	-	-	-	-	-	-	-	-	10	6	3	6	5	2	2	3	1	2	0	3	1	2	0	1
Other parts																								
Pteridophyte spore	30	19	15	15	8	5	9	7	243	213	116	121	21	15	15	12	4	27	32	25	2	6	3	1
Insect scale	-	-	-	-	-	-	-	-	5	4	4	0	1	1	1	0	1	7	5	2	1	2	2	1
Algal parts	-	-	-	-	-	-	-	-	0	0	0	2	0	0	0	1	6	0	0	0	1	0	0	0
Plant parts	-	-	-	-	-	-	-	-	124	54	88	37	16	12	11	4	3	9	15	0	2	1	1	0
Sterile hyphae	-	-	-	-	-	-	-	-	38	31	51	591	5	4	4	6	32	4	58	0	3	1	4	0

Appendix Table I-B Diurnal variation of air spora i.e. pollen grains, fungal spores parts in the Shillong atmosphere [May 1981 - August 1981 (wet (Data based on the total number of air spora in each month, all c 25 X 50 sq.cm. exposed slide area).

Month—	May								June								July							
					Total No.of exposures in species occurrence								Total No.of exposures in species occurrence								Total No.of exposures in species occurrence			
No.of exposure	24	24	24	24	6	10	2	6	26	26	26	26	6	10	2	6	27	27	27	27	6	10	2	6
Time—	6 AM	10 AM	2 PM	6 PM	AM	AM	PM	PM	AM	AM	PM	PM	AM	AM	PM	PM	AM	AM	PM	PM	AM	AM	PM	PM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Name of species																								
Absidia sp.	-	-	-	-	-	-	-	-	2	0	0	0	1	0	0	0	-	-	-	-	-	-	-	-
Alternaria sp	10	4	13	14	4	1	4	6	13	34	16	19	6	7	6	7	9	16	2	44	1	1	1	4
Arthinium sp	-	-	-	-	-	-	-	-	0	0	1	0	0	0	1	0	-	-	-	-	-	-	-	-
Aspergillus sp	0	2	0	0	0	1	0	0	26	27	3	33	1	3	1	1	5	4	0	0	1	1	0	0
Bipolaris sp.	6	9	2	6	1	2	2	3	6	3	7	7	3	2	3	1	0	0	0	3	0	0	0	1
Cladosporium sp.	220	256	477	112	11	8	7	6	3380	3289	2215	2950	21	17	13	18	2749	1903	869	4358	16	15	9	13
Chaetomium sp	-	-	-	-	-	-	-	-	47	51	45	58	6	5	3	4	42	12	0	0	1	2	0	0
Curvularia sp	0	2	0	1	0	1	0	1	15	17	27	26	5	4	5	6	1	2	0	8	1	1	0	2
Epicoccum sp	15	21	10	20	1	2	1	2	49	67	36	135	4	6	4	1	42	15	27	75	5	1	3	3
Ganoderma sp	0	0	1	0	0	0	1	0	1	0	3	0	1	0	1	0	-	-	-	-	-	-	-	-
Helminthosporium sp.	4	2	4	4	2	1	2	2	-	-	-	-	-	-	-	-	2	4	0	0	1	1	0	0

Appendix Table I-B (contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Mucor sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium sp	0	0	2	0	0	0	1	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pestalotiopsis sp.	0	0	205	0	0	0	1	0	5	24	0	21	2	2	0	3	0	0	3	5	0	0	1	1
Pithomyces sp	-	-	-	-	-	-	-	-	0	0	0	1	0	0	0	1	-	-	-	-	-	-	-	-
Pleospora herbarum	-	-	-	-	-	-	-	-	3	1	4	4	2	1	2	1	0	0	0	2	0	0	0	1
Pseudotorula sp.	3	0	0	0	1	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polychaete sp	-	-	-	-	-	-	-	-	20	15	5	0	3	2	1	0	-	-	-	-	-	-	-	-
Puccinia sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tetraploa sp	-	-	-	-	-	-	-	-	4	0	0	0	1	0	0	0	-	-	-	-	-	-	-	-
Torula sp.	12	6	5	13	3	2	1	3	155	291	456	390	9	8	8	10	148	105	156	478	3	2	4	7
Trichothecium sp.	-	-	-	-	-	-	-	-	7	0	0	0	1	0	0	0	-	-	-	-	-	-	-	-
Trichocladium sp.	-	-	-	-	-	-	-	-	0	3	0	0	0	0	5	0	0	-	-	-	-	-	-	-
Venturia sp.	0	2	0	0	0	1	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ustilago reticulata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Xylaria sp.	-	-	-	-	-	-	-	-	7	0	4	0	1	0	1	0	-	-	-	-	-	-	-	-
Smut spore	-	-	-	-	-	-	-	-	2	42	6	17	1	3	2	1	2	0	12	15	1	0	1	1

Appendix Table II-A Diurnal variation of air spora i.e. pollen grains, fungal parts in the Shillong atmosphere (September '81 - Decem (Data based on the total number of air-spora in each mo 25 X 50 sq.cm. exposed slide area).

Month—	September								October								November					
					Total No.of exposure in species occurrence								Total No.of exposures in species occurrence								Total expos in sp occur	
No.of exposure—	27	27	27	27					25	25	25	25					26	26	26	26		
Time—	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM
T	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Ageratum conyzoides	0	0	0	1	-	-	-	1	-	-	-	-	-	-	-	-	4	0	1	1	2	-
Albizzia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	1	0	0	-	
Alnus nepalensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	3	16	5	2	
Ambrosia sp.	0	1	3	0	-	1	2	-	0	0	5	5	-	-	2	5	1	0	0	0	1	
Argyreia sp.	-	-	-	-	-	-	-	-	4	0	0	0	2	-	-	-	0	0	3	0	-	
Betula alnoides	25	8	0	8	4	1	-	1	5	4	6	6	3	4	2	4	1	1	3	4	1	
Cedrus deodara	19	32	9	16	5	5	5	6	22	38	7	45	8	5	2	9	12	18	18	13	6	(
Chrysanthemum sp.	-	-	-	-	-	-	-	-	586	0	0	0	1	-	-	-	-	-	-	-	-	
Cryptomeria japonica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	365	691	557	595	13	1
Cupressus tonulosa	0	5	3	1	-	2	1	1	4	0	0	0	2	-	-	-	-	-	-	-	-	
Daphne shillong	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Duranta plumeri	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Erythrina	3	0	0	0	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Appendix Table II-A (contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	2
Eucalyptus	1	0	0	0	1	-	-	-	1	0	1	1	1	-	1	1	0	1	0	3	-	1	-	
Fumaria sp.	-	-	-	-	-	-	-	-	5	1	0	0	1	1	-	-	-	-	-	-	-	-	-	
Glochidion sp	6	9	3	5	3	7	2	2	0	2	3	5	-	2	2	2	1	2	6	6	1	2	2	
Ipomea sp.	-	-	-	-	-	-	-	-	0	0	0	3	-	-	-	1	-	-	-	-	-	-	-	
Macropanax sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Melodinus khasianum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	1	-	-	-	
Oldenlandia sp	-	-	-	-	-	-	-	-	1	3	0	0	1	2	-	-	3	0	0	0	2	-	-	
Osbeckia crinia	1	0	0	0	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Palmae pollen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	0	0	0	1	-	-	
Plantago sp	-	-	-	-	-	-	-	-	3	0	0	2	1	-	-	1	-	-	-	-	-	-	-	
Prunus sp	-	-	-	-	-	-	-	-	0	3	0	7	-	1	-	3	-	-	-	-	-	-	-	
Quercus sp.	10	2	1	0	3	1	1	-	5	2	2	10	2	1	1	3	0	0	2	1	-	-	1	
Rubia cordifolia	0	0	1	2	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Rubus micropetalous	0	0	1	0	-	-	1	0	-	-	-	-	-	-	-	-	0	0	1	3	-	-	1	
Sarcocca sp	-	-	-	-	-	-	-	-	0	0	1	1	-	-	1	1	-	-	-	-	-	-	-	
Strobilanthus sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	1	-	-	-	
Symplocos spicata	-	-	-	-	-	-	-	-	0	0	3	5	-	-	2	2	1	0	2	0	1	-	1	

Table II -- A (Contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Viburnum sp	1	2	0	0	1	1	-	-	1	1	2	4	1	1	1	2	5	2	0	5	3	1	-	2	3	14	3	7	1	2	1	1
Wendenlandia sp.	1	2	0	0	1	1	-	-	0	0	1	0	-	-	1	-	-	5	-	4	-	1	-	1	-	-	-	-	-	-	-	-
Asteraceae pollen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Malvaceae pollen	0	5	0	0	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grass pollen	4	3	0	1	4	-	1	-	15	2	2	1	2	2	1	1	-	-	-	-	-	-	-	-	-	0	3	-	0	-	1	-

Appendix Table II-B Diurnal variation of air spora i.e. pollen grains, fungal spores and other plant parts in the Shillong atmosphere /September '81 - December '81 (Dry months)_7. (Data based on the total number of air-spora in each month, all counts are from 25 X 50 sq.cm. exposed slide area)

Month—	September								October								November								December							
No.of exposure	27	27	27	27	Total No.of exposure in which species occur				25	25	25	25	Total No.of exposures in which species occur				26	26	26	26	Total No.of exposure in which species occur				27	27	27	27	Total No.of exposure in which species occur			
Time—	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM
No.	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Name of species																																
Alternaria sp	0	2	3	0	-	1	1	-	1	4	3	473	1	1	1	1	2	1	1	6	1	1	1	3	0	4	6	4	-	1	1	2
Arthinium sp.	0	0	6	0	-	-	1	-	→	→	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	5	-	-	-	-
Aspergillus sp	35	0	0	0	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bipolaris sp	0	2	3	3	1	2	1	1	3	2	2	1	2	1	1	1	0	0	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Cercospora sp	-	-	-	-	-	-	-	-	0	0	5	4	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chaetomium sp	548	303	458	199	10	6	4	3	110	335	4	3	3	3	1	1	0	0	27	0	-	-	2	-	-	-	-	-	-	-	-	-
Cladosporium sp.	2414	1123	2562	2791	21	16	16	12	1949	1143	1349	1092	15	11	13	13	191	515	382	179	5	3	6	5	12	15	47	168	3	1	4	5
Curvularia sp	33	58	0	18	4	3	-	1	0	0	0	1	-	-	-	1	1	1	17	0	1	1	1	0	0	0	6	0	0	0	2	0
Epicoccum sp	21	15	11	3	4	1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Helminthosporium sp	3	0	0	3	1	-	-	2	3	0	4	0	2	-	1	-	23	4	0	0	2	1	-	-	13	4	0	7	1	2	-	1
Pestalotiopsis sp.	0	0	530	0	-	2	-	-	0	0	0	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pithomyces sp	-	-	-	-	-	-	-	-	3	0	1	2	1	-	1	1	0	0	1	1	-	-	1	1	-	-	-	-	-	-	-	-

(contd. on next page)

Appendix Table II-B (contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Pullularia sp.	-	-	-	-	-	-	-	-	0	0	0	4	-	-	-	1	0	0	0	4	-	-	-	2	-	-	-	-	-	-	-	-
Pythium sp.	0	0	0	5	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sarcocca sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Smut spore	3	0	3	3	1	-	1	1	0	0	5	4	-	-	1	2	0	2	0	10	-	1	-	2	0	0	0	12	-	-	-	2
Torula sp	72	43	149	15	5	3	4	1	9	7	8	25	2	1	2	2	1	0	5	0	1	-	2	-	-	-	-	-	-	-	-	-
Trichocladium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	1	1	0	-	1	1	-	-	-	-	-	-	-	-	-
Other plant parts																																
Pteridophyte spore	4	2	5	0	2	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	22	13	11	7	7	6	6
Insect scale plant parts	3	4	1	0	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix Table III-A Diurnal periodicity (percentage occurrence) of fungal spores by petridish method (May 1981).
(Data based on three replicates)

Date —	5th				6th				7th				8th				9th				11th				12th				13th				14th				15th				16th				18th			
Name of species / Time —	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM
Absidia butleri	-	-	-	-	-	-	-	7	13	2	-	-	15	7	1	5	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2	13	10
A. glauca	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alternaria alternata	4	20	-	5	12	-	-	-	-	16	-	-	-	8	7	28	24	21	7	15	-	-	-	-	9	14	19	12	10	19	5	15	12	16	9	4	20	34	17	15	8	15	19	25	17	14	46	22
A. humicola	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	5	-	-	4	-	-	-	-	3	-	1	-	-	-	-	-
A. solani	-	-	-	-	12	3	18	8	-	-	-	-	-	-	-	-	22	1	7	2	-	-	-	-	-	-	-	6	-	-	-	-	10	6	4	-	-	-	-	-	4	5	-	-	-	-	-	-
Arthrinium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aspergillus candidus	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2	-	-	-	-	-
A. flavus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. fumigatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. nidulans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
A. niger	4	4	-	9	-	-	-	-	-	-	47	-	-	5	2	1	5	26	7	4	13	17	2	-	8	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	0	10	4	5	11	14	16	7
A. oryzae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	4	2	-	-	-	-	-
A. sulphureus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sydowi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. ustus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	8	9	-	-	-	-
A. versicolor	-	-	-	-	3	3	10	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aureobasidium	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	3	6	7	6	5	-	-	-	30	4	5	-	-	-	-	-	-	-	-	-
Bipolaris tetramera	-	-	-	-	-	6	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. sorokiniana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. turcica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-
Cladosporium cladosporioides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C. herbarum	6	8	46	37	28	34	-	15	22	44	8	28	38	38	25	20	25	15	41	40	13	8	29	31	15	28	34	28	23	29	24	60	-	-	-	-	23	30	36	35	23	26	30	19	23	29	13	27
Cephalosporium acremonium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Curvularia lunata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C. pallescens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epicoccum nigrum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	9	27	-	-	-	12	-	-	-	-	-	-	-	-
Fusarium roseum	-	-	-	-	-	-	-	-	-	-	8	8	-	8	4	-	8	3	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	7	-	-	-	-	-
F. moniliforme	-	-	9	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	-	13	-	-	7	6	-	-	-	-	11	9	8	-	-	-	-	-	-	-	-	-
F. oxysporum	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gliocladium sp.	-	-	-	-	-	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
G. [illegible]	-	-	-	5	3	-	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gliomastix sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Helminthosporium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	7	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	-	7	-	-	-	-	-
Humicola brevis	-	-	-	-	-	-	-	-	9	2	-	8	-	-	-	14	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H. grisea	-	-	-	-	-	-	-	-	-	-	2	5	-	4	11	5	8	-	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor hiemalis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	25	-	-	-	-	5	-	-	-	6	12	-	-	-	-	-	-	-	-	-	9	-	6	-	7	8	-	14	9	8	2
Myrothecium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Papularia arundinis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium brefeldianum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
P. cyclopium	-	5	-	8	16	-	-	-	16	5	2	7	20	6	15	-	-	5	-	-	-	-	-	8	5	6	-	-	6	-	12	18	13	8	9	4	-	-	-	-	-	-	-	-	-	-	-	-
P. decumbens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	8	-	19	-	-	-	-
P. implicatum	14	25	15	21	7	3	-	20	-	11	29	12	20	2	12	2	-	-	13	22	24	25	3	5	21	19	6	-	26	12	20	6	8	-	9	4	3	9	6	12	9	2	7	-	-	-	-	-
P. rugulosum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	3	7	7	7	4	8	19	10	29	2	12	5	8	-	8	5	-	-	12	-	-	-	-	-	-	-	-
Periconia byssoides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. paludosa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phoma humicola	8	3	-	6	-	6	10	-	3	-	1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	8	6	-	-	-	-
Pseudotorula heterospora	-	-	-	-	-	-	-	-	4	-	3	-	-	12	2	4	-	-	-	-	-	-	-	3	4	-	-	-	-	-	-	-	-	-	-	-	-	9	21	6	-	-	-	-	-	-	-	-
Rhizopus sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	9	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	13	11	13	-
Sclerotium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	-	-	-
Trichoderma viride	-	-	-	-	-	15	-	15	16	8	3	-	9	14	15	31	14	9	11	10	8	16	16	7	5	4	12	5	-	6	7	10	5	8	6	19	-	-	-	-	3	14	18	-	17	14	16	12
Trichocladium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ulocladium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Verticillium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
White sterile colony	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unidentified	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
White sterile colony	8	17	20	5	7	18	10	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	-	-	4	6	-	10	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total No. of colonies	6	7	6	15	8	8	5	6									11	17	22	14	12	17	17	18	16	15	15	10	9	10	17	18	12	18	10	15	17	7	7	10	16	22	23	15	20	17	12	13

Date —	19th				20th				21st				22nd				23rd				25th				26th				27th				29th				30th			
Name of species / Time —	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM
Absidia butleri	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. glauca	3	8	4	3	-	-	-	-	-	4	7	8	-	-	-	-	-	-	-	-	-	-	-	-	7	14	16	27	-	-	-	-	-	-	-	-	-	-	3	-
Alternaria alternata	10	6	13	23	15	-	22	10	12	28	18	20	9	-	-	6	7	11	10	21	9	5	18	19	-	-	-	-	19	11	12	25	10	7	17	11	16	67	25	9
A. humicola	-	10	4	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. solani	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arthrinium sp.	-	-	-	-	-	-	2	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aspergillus candidus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-
A. flavus	-	-	-	-	8	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	17	10	9	-	-	-	-	-	-	-	-	2	14	2	5	-	-	-	-
A. fumigatus	-	-	-	-	-	10	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. nidulans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	6	-	-	-	-	-	34	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. niger	3	8	4	3	8	2	2	-	2	7	8	-	5	-	16	6	-	-	-	-	-	-	-	-	-	-	-	-	7	2	-	-	10	-	5	5	-	-	-	-
A. oryzae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	6	3
A. sydowi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. ustus	-	6	4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. versicolor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Aureobasidium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bipolaris tetramera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. sorokiniana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. turcica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Cladosporium cladosporioides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	25	8	18	21	-	-	-	-	-	-	-	-	-	-	-
C. herbarum	16	25	17	28	21	20	2	21	-	-	-	-	9	-	8	19	5	24	14	-	-	3	29	38	-	-	16	-	21	43	60	11	7	23	25	29	-	-	-	-
Cephalosporium acremonium	-	-	-	-	-	29	-	6	52	28	80	88	-	-	11	12	-	8	2	-	-	-	-	-	-	-	-	-	7	-	4	4	-	-	-	-	10	4	-	3
Curvularia lunata	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	2	-	8	9	-	-	-	-	-	-	-	-	-	-	-	-	15	14	15	8	-	-	-	-
C. pallescens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epicoccum nigrum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-	2	8	-	-	-	-
Fusarium roseum	3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	13	-	-	-	-	-	-	-	-	-	2
F. moniliforme	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	4	-	2	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-
F. oxysporum	-	-	-	-	-	-	-	-	-	-	-	-	-	7	10	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	-	3	4
Gliocladium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
G. [illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gliomastix sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Helminthosporium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Humicola brevis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	8	-	3	-	-	-	-	-	-	-	-	-	-	-	-
H. grisea	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	4	-	-	-	-	15	5	13	6	-	-	-	-	4	2	-	6	-	-	-	-	-	-	-	-
Mortierella sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor hiemalis	-	-	-	-	10	7	4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Myrothecium sp.	-	-	-	-	-	-	-	-	-	-	-	-	3	-	8	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Papularia arundinis	-	-	-	-	8	-	11	-	9	21	5	4	9	-	16	2	2	4	3	12	-	-	-	-	-	-	-	6	11	4	-	-	5	2	8	5	-	7	-	-
Penicillium brefeldianum	-	-	-	-	10	-	3	3	-	-	-	-	3	-	19	4	2	8	2	9	-	-	-	-	5	8	5	-	-	-	-	-	-	-	-	-	-	-	12	1
P. cyclopium	-	12	-	5	6	2	2	8	-	-	-	-	-	-	-	-	-	27	6	3	-	-	-	-	15	11	10	8	2	3	11	-	-	-	-	-	-	-	-	-
P. decumbens	-	2	-	3	-	-	6	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	12	4	-	6	8	-	9	8	-	10	6	3	37
P. implicatum	11	10	17	6	5	2	2	8	-	-	-	-	-	-	-	-	-	4	-	4	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. rugulosum	8	8	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Periconia byssoides	-	-	-	-	-	-	-	-	5	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	-
P. paludosa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phoma humicola	-	-	-	-	2	2	11	5	9	-	-	-	-	-	-	-	-	-	13	6	12	-	-	-	-	-	-	-	-	-	-	-	-	7	6	-	-	-	-	-
Pseudotorula heterospora	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	4	4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizopus sp.	6	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	2	-	-	12	17	7	2	20	28	-	-	3
Sclerotium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichoderma viride	13	-	19	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	-	-	-	-	-	-	12	-	-	2	-	-	-	-
Trichocladium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ulocladium sp.	-	-	-	-	8	-	2	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	2	-	-	8	-	-	-	-
Verticillium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	16	-	12	-	-	-	-	-	-	-	-
White sterile colony	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36	29	13	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unidentified	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
White sterile colony	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	10	-	-	-	-	-	-	-	-	7	8	-	3	-	-	-	-	-	-	-	-	-	-	-	-
Total No. of colonies	20	15	18	20	12	3	37	20	28	9	6	7	17	-	11	6	28	14	32	10	3	11	12	10	8	11	12	10	13	23	28	7	12	14	31	11	6	4	10	29

Appendix Table III-B Diurnal periodicity (percentage occurrence) of fungal spores in the atmosphere of Shillong by petridish exposed method (June 1981)
(Data based on three replicates)

Name of species	Date → / Time ↓	1st				2nd				3rd				4th				5th				6th				7th				8th				9th				10th				11th				12th			
		6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM
Alternaria sp		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acremoniella sp.		-	-	-	-	-	-	-	-	4	19	-	-	-	5	11	-	-	-	-	-	-	-	-	-	5	8	-	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aspergillus flavus		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alternaria alternata		10	-	3	-	-	6	1	10	-	-	8	2	-	6	5	-	5	22	-	-	57	14	7	2	10	5	18	26	17	18	34	17	19	18	29	12	32	19	14	9	18	6	18	28
A. humicola		-	-	-	-	-	10	-	-	20	7	12	12	-	-	17	7	-	-	-	-	60	-	16	29	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aspergillus flavus		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	3	6	-	-	7	-	-	-	9	6	-	4	8	6	12	18	8	9	18	13	6	14	18	9	9	-	10
A. niger		36	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	-	1	-	35	-	49	-	-	-	-	-	-	-	-	-	6	-	13	8	-	-	-	-	61	6	-
A. ochraceus		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	-	5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. flavus		6	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	-	-	-	15	-	50	-	-	-	-	27	13	-	-	-	-	-	2	1	-	-	-	-	-	-	-
A. versicolor		-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizopus nodosus		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R. turcicus		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	12	50	-	-	-	-	-	-	4	-	-	25	-	-	-	-	-	-	-	-
Saccharomyces cerevisiae		-	-	-	50	-	-	6	-	-	-	-	-	6	-	-	-	-	17	5	1	-	-	7	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cladosporium herbarum		10	-	34	35	-	16	71	19	4	3	35	50	23	58	19	38	38	26	14	10	-	-	14	10	21	70	29	3	-	30	9	8	81	23	24	8	19	51	39	25	46	10	63	31
Curvularia lunata		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fusarium sp. unidentified		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. decemcellulare		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. moniliforme		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	6	31
F. roseum		-	-	-	18	-	5	50	13	-	-	-	-	-	-	-	-	12	-	-	-	-	-	-	-	5	21	-	75	-	-	-	-	-	-	-	-	9	9	14	-	-	-	-	-
Gliocladium penicilloides		8	25	-	40	-	5	13	-	-	11	6	6	6	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Humicola brevis		-	-	9	-	-	-	-	-	8	11	6	-	-	-	-	-	6	13	19	8	24	-	-	5	13	12	4	8	-	11	-	30	-	-	-	-	6	-	1	-	-	-	-	-	-
H. grisea		-	-	-	-	-	5	8	13	-	-	-	-	-	-	-	-	-	-	-	-	-	11	-	-	-	-	-	-	17	13	6	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor hiemalis		-	-	-	-	-	11	6	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	8	12	-	8	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Paecilomyces variotii		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	-	-	-	-	-	-
Penicillium brevicompactum		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. citrinum		-	-	6	-	-	5	5	13	20	8	9	-	6	5	6	-	9	1	-	4	-	-	-	-	6	-	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
P. decumbens		6	-	6	-	-	-	-	-	-	-	-	-	4	8	-	-	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. implicatum		-	-	6	-	-	10	-	13	4	14	-	10	4	5	3	12	12	-	24	8	-	-	-	-	8	6	7	8	-	2	19	13	10	8	-	-	-	8	6	-	-	-	3	-
P. lutum		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizopus sp.		-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	9	3	12	-	-	-	-	-	-	-	28	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-
Rhizopus sp		10	-	-	48	50	16	8	-	8	-	6	4	-	-	-	-	-	-	3	20	-	-	-	15	-	28	21	-	4	3	13	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichoderma viride		10	33	3	46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	8	5	-	-	-	-	-
Unidentified sp		-	-	-	-	-	-	-	-	4	3	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unidentified		10	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	9	-	-	16	17	13	29	51	-	1	24	-	-	-	-	-	-
Total No. of colonies		9	-	10	8	4	6	11	5	8	9	11	33	15	32	17	13	10	7	6	25	11	4	9	12	4	7	3	3	6	14	10	7	16	15	12	7	5	36	44	6	4	22	10	6

Name of species	13th				14th				15th				16th				17th				18th				19th				20th				21st				22nd				23rd				24th				25th			
	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM
Alternaria alternata	33	6	8	-	-	26	16	10	9	-	-	12	-	23	44	18	11	15	38	13	-	-	13	27	11	10	-	8	21	14	8	10	24	12	9	12	6	3	15	-	-	-	3	-	-	221
A. humicola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-
Aspergillus flavus	25	12	-	8	-	-	-	10	-	-	-	-	6	2	-	-	8	9	11	4	3	-	2	-	-	8	-	12	-	-	4	15	-	-	12	-	-	-	-	-	-	-	-	-	-	-	-
A. niger	-	-	-	-	4	-	16	7	-	-	-	21	-	-	-	-	-	-	-	-	6	-	13	-	-	-	-	8	-	-	-	-	8	20	-	-	7	-	16	-	1	-	-	-	-	-
A. flavus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizopus nodosus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R. turcicus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	6	7	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Saccharomyces cerevisiae	-	-	-	-	-	-	-	-	-	-	-	-	6	19	-	9	-	-	-	-	15	-	-	13	-	1	15	-	4	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cladosporium herbarum	25	20	79	51	8	23	13	7	5	-	22	25	12	4	-	18	19	-	24	38	6	-	4	10	25	13	26	58	-	23	-	15	33	-	19	16	-	38	44	64	-	-	-	-	-
Curvularia lunata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	34	18	7	3	7	5	26	-	-	6	-	4	-	-	12	-	-	-	-	-	-	-	-	-	-	-
Fusarium sp. unidentified	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. decemcellulare	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. moniliforme	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. roseum	18	12	-	8	2	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22
Gliocladium penicilloides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Humicola brevis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H. grisea	-	-	-	-	4	17	13	-	-	-	24	-	6	4	6	8	8	18	24	23	23	16	28	-	18	8	26	-	-	-	-	12	8	8	-	3	3	13	-	7	1	-	-	-	-	-
Mucor hiemalis	-	-	-	-	5	8	8	-	3	-	-	8	12	-	-	-	3	-	-	-	18	8	4	-	-	-	-	4	-	13	6	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-
Paecilomyces variotii	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
Penicillium brevicompactum	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. citrinum	-	-	-	-	-	-	15	19	-	-	-	4	-	-	-	-	-	-	-	-	4	-	4	3	-	-	-	17	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. decumbens	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. implicatum	-	3	2	-	-	-	9	-	-	-	-	-	-	-	-	-	-	6	15	-	-	-	-	-	-	-	-	21	-	13	10	3	20	8	19	-	-	-	-	1	-	-	-	-	-	-
P. lutum	-	-	-	-	-	-	-	-	-	-	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizopus sp.	-	-	-	-	14	9	-	53	-	-	-	-	-	-	-	-	-	-	-	-	9	-	7	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizopus sp	-	-	14	6	4	-	-	9	-	-	-	17	19	-	19	18	-	16	-	39	-	-	7	3	-	-	-	-	-	-	-	-	-	8	9	-	-	19	-	-	-	12	-	-	-	-	-
Trichoderma viride	-	-	-	-	56	-	-	30	53	-	-	-	31	8	-	27	33	22	11	-	-	-	13	33	14	44	-	-	26	54	13	6	8	29	8	-	67	19	8	16	49	11	-	-	-	-	-
Rhizopus sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unidentified	-	10	5	31	-	-	-	-	-	-	-	3	-	-	19	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-	-	9	1	-	8	-	-	-	-	-	-	-	-	-	-
Total No. of colonies	4	8	9	11	25	11	14	21	18	16	20	7	5	8	6	3	11	15	8	15	10	12	14	9	8	25	6	7	7	15	7	18	10	7	34	8	10	25	19	17	13	33		

Appendix Table III-C Diurnal periodicity (percentage occurrence) of fungal spores in the atmosphere of Shillong by Petridish exposed method (July 1981).

(Data based on three replicates)

Name of species	1st 6 AM	1st 10 AM	1st 2 PM	1st 6 PM	2nd 6 AM	2nd 10 AM	2nd 2 PM	2nd 6 PM	3rd 6 AM	3rd 10 AM	3rd 2 PM	3rd 6 PM	4th 6 AM	4th 10 AM	4th 2 PM	4th 6 PM	6th 6 AM	6th 10 AM	6th 2 PM	6th 6 PM	7th 6 AM	7th 10 AM	7th 2 PM	7th 6 PM
Absidia sp.	14	6	3	12	11	9	-	6	-	7	-	7	13	4	11	4	-	3	-	11	8	10	2	10
Acremoniella sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alternaria alternata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. solani	-	23	9	-	27	23	12	13	19	13	23	22	16	17	-	-	-	7	-	9	-	-	-	-
Aspergillus flavus	10	5	-	24	-	-	-	-	14	3	7	-	-	-	11	7	-	-	3	-	-	-	-	-
A. niger	-	-	-	-	27	14	27	15	-	7	-	10	-	-	-	-	7	1	12	3	-	-	21	-
A. sclerotiorum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-
A. sydowi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus	-	-	-	-	-	-	-	-	-	5	9	-	-	-	-	-	-	-	-	-	-	-	-	-
A. ustus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. versicolor	-	-	-	-	-	-	-	-	-	-	-	-	-	13	11	22	-	9	15	-	-	7	10	-
Aureobasidium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cephalosporium roseogriseum	-	-	-	-	-	-	-	15	-	-	-	-	-	-	-	-	17	-	3	20	-	-	-	-
Cladosporium herbarum	10	-	12	16	-	4	25	13	-	7	19	10	-	22	7	18	5	3	3	16	22	36	20	20
Curvularia lunata	6	41	38	20	-	-	22	20	-	7	26	710	-	-	-	-	-	-	-	16	13	-	9	20
Fusarium moniliforme	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. roseum	22	-	12	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	11	-	-	-
Gliocladium roseum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Humicola brevis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H. grisea	-	-	-	-	-	-	-	-	14	11	-	5	-	-	-	-	17	-	3	20	16	10	-	-
Mucor hiemalis	-	-	-	-	-	-	-	-	9	9	-	-	13	9	20	15	10	7	5	-	-	7	6	-
M. racemosus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mycogone sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Papularia arundinis	-	-	-	-	-	-	-	-	19	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium decumbens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	2	-	-	-	-
P. cyclopium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	5	10	-	-	-
P. implicatum	6	11	-	-	27	9	4	6	-	9	-	-	41	7	11	7	2	-	-	2	8	-	-	-
Phoma sp.	8	11	22	3	-	-	-	-	23	15	3	22	-	-	-	-	-	-	12	2	-	4	8	18
Rhizopus sp.	4	-	-	-	5	28	15	6	-	-	9	-	8	9	16	13	-	-	-	-	11	-	-	-
Trichoderma viride	-	-	-	-	-	-	-	-	-	-	-	-	5	7	11	10	37	63	12	-	-	40	20	30
White sterile colony (unidentified)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total No. of colonies	15	5	10	8	5	6	13	15	6	17	13	18	11	13	17	21	13	18	19	17	11	28	14	28

Name of species	8th 6 AM	8th 10 AM	8th 2 PM	8th 6 PM	9th 6 AM	9th 10 AM	9th 2 PM	9th 6 PM	10th 6 AM	10th 10 AM	10th 2 PM	10th 6 PM	11th 6 AM	11th 10 AM	11th 2 PM	11th 6 PM	13th 6 AM	13th 10 AM	13th 2 PM	13th 6 PM	14th 6 AM	14th 10 AM	14th 2 PM	14th 6 PM	15th 6 AM	15th 10 AM	15th 2 PM	15th 6 PM
Absidia sp.	6	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	6	6	1	21	-	-	-	-	-	-	-	-
Acremoniella sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alternaria alternata	-	-	-	-	-	5	9	20	12	32	3	5	-	-	-	-	8	6	0	-	16	30	10	29	14	31	14	7
A. solani	10	2	13	40	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aspergillus flavus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	-	-	-	-	-	-
A. niger	-	5	-	-	-	36	14	40	67	17	9	0	-	10	-	24	-	-	-	-	19	5	-	-	-	-	-	-
A. sclerotiorum	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sydowi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	4	-	5
A. ustus	-	-	-	-	-	-	-	-	-	-	-	-	19	-	24	15	-	-	-	-	-	-	-	-	-	-	-	-
A. versicolor	-	-	-	10	-	-	-	-	-	-	-	-	22	-	17	19	-	-	-	-	-	-	-	-	-	-	-	-
Aureobasidium sp.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cephalosporium roseogriseum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cladosporium herbarum	37	12	27	-	40	30	41	26	4	6	41	22	41	45	24	3	-	-	28	6	42	15	39	11	45	8	3	20
Curvularia lunata	-	3	-	14	-	-	-	-	-	-	-	-	-	-	-	-	4	6	5	36	9	9	10	-	-	-	-	9
Fusarium moniliforme	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-	-	-
F. roseum	-	-	-	-	-	-	14	-	-	-	-	-	-	-	-	-	16	4	5	-	-	-	-	-	-	-	-	-
Gliocladium roseum	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	13	8	12	-	-	-	-	-	-	-	-
Humicola brevis	-	-	-	-	80	13	19	-	5	7	10	-	-	-	-	-	-	-	-	-	-	3	6	3	-	-	-	-
H. grisea	-	9	6	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	-	-	-	-	-	-	-	39	20
Mucor hiemalis	14	-	-	-	-	8	-	-	-	-	11	22	-	13	10	15	-	-	-	-	-	-	-	-	-	-	-	-
M. racemosus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mycogone sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	3	-	-	-	-	-	-	-	-
Papularia arundinis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium decumbens	-	-	16	6	-	-	-	-	12	7	4	41	-	-	-	-	-	-	-	-	-	-	-	-	-	13	10	-
P. cyclopium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	6	5	-	-	-	-	-	2	13	-	-
P. implicatum	-	13	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phoma sp.	8	2	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizopus sp.	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	16	11	5	15	-	-	-	22	14	31	14	-
Trichoderma viride	-	44	-	-	-	-	-	-	7	30	12	-	16	29	24	27	20	20	8	-	-	10	-	-	-	-	-	-
White sterile colony (unidentified)	-	-	-	-	-	8	-	13	-	-	-	-	-	-	-	-	6	10	8	6	-	-	-	-	-	-	17	7
Total No. of colonies	16	17	9	15	7	19	13	19	13	13	23	11	10	12	9	10	15	14	19	10	6	10	19	0	15	7	9	16

Name of species	16th 6 AM	16th 10 AM	16th 2 PM	16th 6 PM	17th 6 AM	17th 10 AM	17th 2 PM	17th 6 PM	18th 6 AM	18th 10 AM	18th 2 PM	18th 6 PM	20th 6 AM	20th 10 AM	20th 2 PM	20th 6 PM	21st 6 AM	21st 10 AM	21st 2 PM	21st 6 PM	22nd 6 AM	22nd 10 AM	22nd 2 PM	22nd 6 PM	23rd 6 AM	23rd 10 AM	23rd 2 PM	23rd 6 PM	24th 6 AM	24th 10 AM	24th 2 PM	24th 6 PM	25th 6 AM	25th 10 AM	25th 2 PM	25th 6 PM	
Absidia sp.	14	-	-	13	-	-	14	15	-	-	-	-	-	-	0	6	15	7	8	-	-	-	-	-	-	7	-	18	-	-	-	-	-	-	-	-	
Acremoniella sp.	-	-	-	-	-	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Alternaria alternata	-	21	3	-	8	15	15	42	13	11	7	26	15	12	-	16	9	21	25	-	-	-	-	-	29	7	30	5	16	4	11	15	-	-	-	-	
A. solani	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Aspergillus flavus	16	-	-	-	8	9	-	-	-	-	-	-	7	20	20	10	15	7	-	-	58	28	42	20	-	-	-	-	-	10	9	15	-	-	-	-	
A. niger	-	-	-	-	-	-	-	-	-	41	7	8	-	-	-	-	-	-	-	-	9	9	14	10	-	-	-	-	-	12	-	15	28	33	-	-	
A. sclerotiorum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
A. sydowi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	7	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
A. terreus	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
A. ustus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
A. versicolor	19	-	-	-	-	-	-	12	31	-	29	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Aureobasidium sp.	-	-	-	-	-	-	-	-	-	17	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cephalosporium roseogriseum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cladosporium herbarum	11	8	9	48	8	12	9	12	22	17	14	29	15	7	2	24	15	7	2	-	-	-	-	-	-	11	16	23	45	20	25	15	29	33	-	-	
Curvularia lunata	-	6	-	-	34	-	-	6	-	-	-	-	-	-	-	26	9	14	25	-	-	9	8	10	7	15	16	-	-	-	-	-	-	-	-	-	1
Fusarium moniliforme	-	-	-	-	-	-	-	-	-	-	-	-	7	6	17	-	7	6	17	-	-	-	14	20	-	-	-	-	-	-	-	-	-	-	-	-	
F. roseum	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Gliocladium roseum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	13	-	-	-	-	-	
Humicola brevis	-	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
H. grisea	-	28	3	-	-	-	-	-	-	-	-	-	10	21	14	4	10	21	14	-	6	22	8	30	7	7	-	10	20	4	9	16	18	6	-	-	
Mucor hiemalis	-	-	-	-	-	-	-	-	31	-	25	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
M. racemosus	-	-	-	-	-	15	55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Mycogone sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Papularia arundinis	-	-	-	-	-	-	-	-	-	-	-	-	18	9	11	4	18	9	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Penicillium decumbens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	-	7	-	-	-	-	-	-	-	-	-	
P. cyclopium	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
P. implicatum	11	-	-	13	-	-	-	-	-	18	14	5	-	-	14	-	28	-	34	-	15	32	11	10	19	-	-	-	8	4	9	4	9	4	-	-	20
Phoma sp.	-	3	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Rhizopus sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33	7	-	2	-	-	-	-	-	-	-	-	
Trichoderma viride	19	34	22	-	39	21	4	12	-	-	-	-	18	14	8	10	9	17	6	-	-	-	-	-	3	-	-	7	-	10	11	9	25	26	-	-	
White sterile colony (unidentified)	-	3	16	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	16	23	8	16	7	7	-	-	-	-	
Total No. of colonies	11	19	10	9	7	10	6	10	7	5	8	11	12	16	11	16	6	13	11	-	11	10	11	10	8	8	6	10	7	16	16	21	8	9	-	-	15

Appendix Table III J Diurnal periodicity (percentage occurrence) of fungal spores in the atmosphere of Shillong by petridish exposed method (August 1971)

(Data based on three replicates)

Name of spores	Date — Time —	1st				2nd				3rd				4th				5th				6th				7th				8th				9th				10th				11th				12th				13th			
		10 AM	2 AM	6 AM	10 PM	2 AM	6 AM	10 AM	2 PM	6 AM	10 AM	2 PM	6 PM	10 AM	2 AM	6 PM	10 PM	2 AM	6 AM	10 AM	2 PM	6 PM	10 PM	2 AM	6 AM	10 AM	2 PM	6 PM	10 PM	2 AM	6 AM	10 AM	2 PM	6 PM	10 PM	2 AM	6 AM	10 AM	2 PM	6 PM	10 PM	2 AM	6 AM	10 AM	2 PM	6 PM	10 PM	2 AM	6 AM
Alternaria sp		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	20	4	19	-	-	-	-	23	18	30	3	-	-	-	-	23	12	21	11	18	6	-	6	21	-	7	27	-	-	-	-
Arthrinium alternata		-	-	-	-	-	-	-	-	12	27	31	46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	21	18	11	-	-	-	-	-	-	-	-	-	-
A. bunicola		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	7	46	44	-	-	-	-	-	-	-	-	-	-	32	22	24	21	27	-	21	-	-	-
Aspergillus flavus		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	8	34	3	-	-
A. niger		46	24	22	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. oryzae		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	6	16	-	-	-	-	-	-	-	-	-	-	-
Diplodia zeae		-	-	-	-	47	16	12	35	-	-	-	-	-	-	-	-	20	20	36	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	13	13	6	-	-	-	-	-	-	-	-	-	-
H. nervisiana		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H. salicifera		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	13	9	-	12	44	-	-	83	13	-	16	-	23
H. turcica		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	-	-	-	18	6	-	35
Cephalosporium roseogrisa		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cladosporium cladosporoides		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C. herbarum		22	50	37	26	26	48	40	15	-	-	-	-	-	-	-	-	40	46	35	15	26	51	42	45	33	40	6	11	50	22	45	11	-	6	9	6	7	27	10	5	45	38	17	-	24	11	15	-	-	-
Curvularia lunata		9	12	17	33	26	16	15	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33	11	31	37	-	-	-	-21	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Drechslera sp.		-	-	-	-	-	-	-	-	51	45	37	38	-	-	-	-	-	-	-	-	-	-	-	-	20	40	15	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fusarium avenaceum		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	19	17	66	6	13	-	10
F. moniliforme		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. roseum		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	57	10	11	10	16	-	-	-	26	19	18	66	15	15	-	13	-	-	-	-	-	-	-	-	-	-	-	-
Gliocladium roseum		-	-	-	-	-	-	-	-	-	-	-	-	47	37	28	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Helminthosporium sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Humicola grisea		-	-	-	-	-	-	-	-	-	-	-	-	17	20	18	49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	6	22	11	14	14	7	19	-	30	-	29	-	-	-	-
Mucor hiemalis		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Populeris grandinis		-	-	-	-	-	-	-	-	36	27	31	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45	15	11	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium cyclopium		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	9	-	-	-	-	-	-	-	-	-	-	-	-
P. decumbens		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. implicatum		-	16	32	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	-	-	27	-	2	13	-	10	-	18
Pyriconia hispidula		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhoma		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	7	15	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizopus sp.		-	-	-	-	-	-	-	-	-	-	-	-	15	20	30	19	-	-	-	-	26	18	-	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichoderma viride		22	13	22	16	-	-	-	-	-	-	-	-	-	-	-	-	20	22	21	22	-	-	-	-	-	-	-	-	-	-	-	-	26	9	-	-	3	22	24	21	-	-	-	-	10	18	28	11	-	-
White sterile colony		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total No. of colonies		22	16	19	20	6	12	13	16	8	11	10	8	7	8	14	13	14	15	14	13	11	8	10	17	7	19	10	14	10	13	11	9	12	10	14	14	9	15	22	12	10	11	7	8	9	17	8	9

Name of spores	Date — Time —	14th				15th				16th				17th				18th				19th				20th				21st				22nd				23rd			
		6 AM	10 AM	2 PM	6 PM	10 PM	2 AM	6 AM	10 AM	2 PM	6 PM	10 PM	2 AM	6 AM	10 AM	2 PM	6 PM	10 PM	2 AM	6 AM	10 AM	2 PM	6 PM	10 PM	2 AM	6 AM	10 AM	2 PM	6 PM	10 PM	2 AM	6 AM	10 AM	2 PM	6 PM	10 PM	2 AM	6 AM	10 AM	2 PM	6 PM
Alternaria sp		8	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arthrinium alternata		3	28	11	17	9	4	16	9	-	-	-	-	18	-	15	48	15	25	62	28	2	24	46	-	-	8	-	-	6	3	12	22	-	-	-	-	10	-	-	-
A. bunicola		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aspergillus flavus		-	-	-	-	-	-	-	-	-	-	-	-	37	-	26	23	-	-	-	-	2	-	-	6	-	-	-	10	17	-	-	-	-	-	-	-	-	-	-	-
A. niger		-	-	-	-	-	-	-	-	19	13	10	20	24	89	26	-	14	-	-	-	-	6	-	-	6	-	6	14	-	9	-	-	-	-	-	-	-	-	-	-	-
A. oryzae		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diplodia zeae		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H. nervisiana		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H. salicifera		16	-	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H. turcica		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	6	-	35	-	-	12	-	15	-	48	-	-	-	-	-	-	-	-	-	-	-	-	-
Cephalosporium roseogrisa		18	8	-	-	9	12	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cladosporium cladosporoides		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C. herbarum		24	11	18	-	-	-	-	23	19	15	16	11	-	-	-	-	4	4	8	-	-	13	-	14	26	6	14	23	-	29	-	27	26	-	-	28	12	-	-	-	-
Curvularia lunata		-	-	-	-	-	-	-	-	8	16	-	-	-	-	-	-	-	-	-	-	2	8	-	43	-	-	-	-	-	-	-	31	10	16	15	37	26	-	-	-
Drechslera sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	68	-	-	47	-	-	10	-	-	-	-	-	-	-	-	21	29	-	-	-
Fusarium avenaceum		6	13	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. moniliforme		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	22	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. roseum		-	-	-	-	-	-	-	-	-	-	-	-	31	-	-	5	-	-	-	-	-	11	-	-	21	-	-	14	-	-	-	-	21	12	-	-	-	-	-	-
Gliocladium roseum		17	6	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Helminthosporium sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Humicola grisea		-	-	-	-	13	16	3	18	11	6	3	-	-	-	-	-	10	-	8	-	4	-	-	-	-	-	-	6	8	-	-	-	-	-	-	-	-	-	-	-
Mucor hiemalis		40	-	-	40	9	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	4	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Populeris grandinis		-	-	-	-	9	12	6	-	17	10	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium cyclopium		-	-	10	13	41	12	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	3	6	12	-	-	-	-	-	-	-	-	-	-	-
P. decumbens		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40	57	-	4	86	-	-	4	-	13	31	21	18	-	-	-	-	-
P. implicatum		10	-	18	-	12	-	25	5	-	8	13	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyriconia hispidula		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	88	-	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhoma		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	7	-	-	-	-	19	-	-	-	-	-	-	-	-	-	-	-	-
Rhizopus sp.		-	16	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	10	-	30	-	-	-	-	-	-	-	-	-	-	-
Trichoderma viride		10	18	28	11	-	-	-	-	18	20	10	9	10	10	31	-	89	51	-	13	-	18	-	-	-	-	26	82	-	16	13	15	16	21	-	-	-	-	-	-
White sterile colony		-	-	-	22	13	4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total No. of colonies		9	17	8	9	7	7	8	17	8	14	9	17	5	16	6	38	38	30	10	19	19	21	4	29	18	18	19	9	10	20	16	10	7	6	7	6	10	8	8	8

Appendix Table III-C Diurnal Periodicity (percentage occurrence) of Fungal spores by Petridish exposed method (September 1981)

(Data based on three replicates)

Name of species	1st				2nd				3rd				4th				5th				7th				8th				9th				10th				11th				12th				14th			
	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM
Absidia sp.	10	-	5	5	11	6	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alternaria alternata	7	15	17	9	-	-	-	-	16	21	23	-	-	14	14	3	-	-	-	-	-	-	-	-	36	16	16	-	-	-	-	50	8	10	14	-	-	-	-	-	-	18	-	-	-	-	-	-
Aspergillus flavus	7	-	4	7	-	-	-	-	16	9	14	17	-	-	-	-	17	31	27	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	-	-	-
A. niger	4	-	-	3	11	-	6	31	-	-	-	-	8	11	2	15	-	25	23	7	100	37	18	32	-	-	-	-	18	3	14	15	11	26	17	19	21	4	5	-	-	11	5	-	-	9	19	76
A. sclerotium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. versicolor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H. [illegible]eria turcica	-	-	-	-	7	3	15	21	19	37	30	21	10	8	2	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cladosporium cladosporioides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37	20	10	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C. herbarum	31	41	16	25	14	37	30	7	-	-	-	-	13	12	5	14	-	-	-	-	-	40	40	26	31	27	30	39	18	40	26	26	28	23	34	[illegible]	22	28	20	19	28	33	[illegible]	18	[illegible]	23	13	23
Curvularia lunata	-	-	-	-	14	-	-	5	-	-	-	-	-	2	14	7	29	6	20	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	27	4	-	-	-	-	-	-	-	-
Drechslera sp.	-	-	-	-	-	-	-	-	-	-	-	-	8	6	12	2	12	18	12	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	-	-	-
Fusarium avenaceum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. roseum	4	-	-	3	-	-	-	-	-	-	-	-	13	-	2	2	-	-	-	-	-	-	-	-	13	23	30	13	-	-	-	-	27	17	10	19	32	18	13	15	-	-	-	-	-	-	-	-
Gliocladium roseum	-	-	-	-	-	-	-	-	16	9	26	28	13	7	9	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	11	16	20	-	-	-	-	-	-	-	-
Humicola grisea	-	-	-	-	-	-	-	-	-	-	-	-	-	2	12	8	-	-	-	-	-	-	-	-	-	-	-	-	-	11	14	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor hiemalis	-	-	-	-	-	16	36	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	25	6	17	-	-	-	-	-	-	-	-	-	-	-	-	60	36	-	-
Papularia arundinis	10	-	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	18	6	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium decumbens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. implicatum	22	22	40	39	-	-	-	-	19	37	30	21	13	14	6	10	-	-	-	-	-	14	13	20	-	-	-	-	-	-	-	-	-	-	-	-	27	21	17	8	-	25	94	31	-	-	-	-
Phoma sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	21	29	-	-	-	-	-	11	-	-	-	9	11	-
Rhizopus sp.	-	-	-	-	40	22	9	-	-	-	-	-	13	5	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	18	5	33	-	-	-	-	-	-	-	-
Trichoderma viride	11	21	16	4	-	-	-	-	16	21	4	7	5	14	14	16	41	18	16	27	-	8	27	20	-	-	-	-	-	-	-	-	-	17	-	19	-	-	-	-	-	-	-	-	-	-	-	-
White sterile colony	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	16	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total No. of colonies	36	26	20	21	13	15	10	13	10	10	13	23	12	30	30	30	5	14	14	15	5	11	12	11	7	18	16	7	8	21	25	23	9	20	15	15	13	23	16	21	7	8	17	5	4	7	11	11

Name of species	15th				16th				17th				18th				19th				21st				22nd				23rd				24th				26th				2[illegible]	
	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM
Absidia sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alternaria alternata	-	-	-	-	-	-	-	-	24	5	34	19	8	-	34	25	20	4	-	-	-	-	61	40	-	-	-	-	-	-	-	-	-	-	-	-	20	17	5	41	-	5
Aspergillus flavus	-	-	-	-	4	16	20	7	-	-	-	-	-	-	-	-	10	16	-	15	58	-	23	20	30	21	-	26	18	10	14	26	19	38	-	34	-	-	-	-	16	15
A. niger	-	-	-	-	25	16	46	12	28	21	14	7	-	-	-	-	18	-	25	32	-	-	-	-	19	38	40	46	23	15	16	20	-	5	15	8	25	22	10	12	18	8
A. sclerotium	-	-	-	-	-	-	-	-	-	-	-	-	20	86	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. versicolor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H. [illegible]eria turcica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cladosporium cladosporioides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C. herbarum	-	-	-	60	-	-	-	-	-	-	-	-	29	13	29	25	24	2	33	-	41	-	15	-	-	21	43	16	11	58	18	23	30	20	22	19	35	8	26	17	16	22
Curvularia lunata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Drechslera sp.	63	18	-	10	22	-	20	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fusarium avenaceum	-	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. roseum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gliocladium roseum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Humicola grisea	-	-	-	-	-	-	-	-	-	-	-	-	12	-	18	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor hiemalis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	30	26	24	6	-	-	-	-	[illegible]	[illegible]
Papularia arundinis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium decumbens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	53	15	48	30	-	-	-	-	-	-	-	-	32	27
P. implicatum	36	18	68	30	23	66	-	12	19	21	34	9	29	-	6	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	28	36	17	-	-
Phoma sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizopus sp.	-	63	-	-	23	-	13	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50	16	16	10	-	-	-	-	19	8	9	10	-	-	-	-	-	6
Trichoderma viride	-	-	-	-	-	-	-	-	32	52	17	10	20	-	28	-	20	-	26	-	-	100	-	40	-	-	-	-	-	-	-	-	-	-	28	21	-	22	17	13	19	[illegible]
White sterile colony	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total No. of colonies	7	3	11	10	14	4	5	8	8	12	11	21	8	7	14	9	16	16	13	6	8	8	4	8	3	6	8	10	14	6	9	10	3	11	17	15	6	11	13	9	10	[illegible]

Appendix Table III-F   Diurnal periodicity (percentage occurrence) of fungal spores in the atmosphere of Shillong (October 1981).
(Data based on three replicates)

Date—	1st				2nd				3rd				6th				7th				8th				9th				10th			
Time—	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM
Absidia sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acremoniella sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alternaria alternata	-	-	-	-	-	-	-	-	36	-	15	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aspergillus candidum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	24	16	38	-	-	-	-	-	12	6	17
A. flavus	-	-	100	38	60	37	21	17	16	23	11	16	7	20	-	-	16	-	11	13	-	-	-	-	-	-	-	-	-	-	-	-
A. niger	-	-	-	-	33	5	21	12	11	30	32	12	14	4	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32	-
A. versicolor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	7	-	8
Bipolaris spicifera	-	-	-	-	-	-	-	-	19	30	15	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. turcica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cephalosporium roseogriseum	-	-	-	-	-	-	-	-	-	-	-	-	2	2	6	-	4	6	-	15	-	-	-	-	-	-	-	-	-	-	-	-
Cladosporium cladosporioides	-	-	-	-	-	-	-	-	-	-	-	-	14	16	15	24	19	18	-	7	-	-	-	-	-	-	-	-	-	-	-	-
C. herbarum	87	15	-	11	-	-	-	40	8	-	12	17	30	30	28	29	11	30	35	21	-	-	-	23	13	29	31	-	29	42	60	43
C. variabile	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Curvularia lunata	12	65	-	27	-	-	-	-	-	-	9	13	-	-	-	-	-	-	-	-	-	12	22	-	19	24	7	10	37	28	29	35
C. pallescens	-	-	-	-	16	23	48	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fusarium avenaceum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. moniliforme	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	-	-	-	-	-	-	-	-	29	-	-
F. solani	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	24	23	27	-	-	-	-	-	-	-	-
Gliocladium penicillioides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	8	8	9	-	-	-	-	-	-	-	-	-	-	-	-	-
G. roseum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Helminthosporium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Humicola brevis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H. grisea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-	11	10	4	-
Moniliforma sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor hiemalis	-	-	-	-	-	34	9	10	-	-	-	-	-	-	6	11	-	-	-	-	-	-	-	-	17	25	36	24	-	-	-	-
Mycogone sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Paecilomyces varioti	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23	6	8	-	-	-	-	-	-	-	-	-
Papularia arundinis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	-	-	9	-	-	-	-
Penicillium decumbens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	6	-	23	9	33	29	24	-	-	-	-	19	-	-	-
P. expansum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. rubrum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. implicatum	-	20	-	-	-	-	-	-	-	-	-	-	7	18	-	8	33	9	45	15	14	-	-	-	10	-	-	-	-	-	-	-
Periconia [illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	13	14	-	-	-	-	-
Rhizopus sp.	-	-	-	-	-	-	-	-	8	15	2	2	-	-	-	-	-	15	-	-	-	-	-	-	4	-	11	6	-	-	-	-
Torula herbarum	-	-	-	-	-	-	-	-	-	-	-	-	11	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichoderma viride	-	-	-	-	-	-	-	-	-	-	-	-	11	-	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total No. of colonies	10	6	13	5	6	11	11	13	12	8	23	32	22	14	48	48	14	18	16	18	26	28	20	18	18	19	28	24	18	10	19	18

Date—	12th				13th				14th				15th				16th				17th				19th			
Time—	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM
Absidia sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acremoniella sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alternaria alternata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aspergillus candidum	-	-	-	-	36	-	22	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. flavus	-	-	-	-	-	-	-	-	3	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. niger	-	-	-	-	-	-	-	-	-	-	-	-	37	21	46	27	-	-	-	-	-	-	-	-	-	-	-	-
A. versicolor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bipolaris spicifera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. turcica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	13	16	22	8	19	28	-	5	4	-	5
Cephalosporium roseogriseum	-	20	-	-	-	13	-	9	18	4	-	8	-	-	-	-	5	26	11	11	20	13	-	21	-	-	-	-
Cladosporium cladosporioides	26	-	-	-	22	80	2	29	-	-	-	-	37	38	17	24	-	-	-	-	46	17	19	25	17	-	-	11
C. herbarum	-	20	9	46	-	-	-	-	22	18	21	16	-	-	-	-	40	11	20	14	-	-	-	-	27	13	29	27
C. variabile	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	2	-	-
Curvularia lunata	-	-	-	14	-	11	15	-	11	10	13	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C. pallescens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fusarium avenaceum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. moniliforme	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	8	-	2
F. solani	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gliocladium penicillioides	-	-	4	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
G. roseum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31	-	11	13	13	10	13	13	-	-	-	-
Helminthosporium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Humicola brevis	-	-	9	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H. grisea	23	-	-	-	13	-	22	18	7	12	-	7	12	14	17	38	-	-	-	-	8	1	6	14	-	4	48	5
Moniliforma sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor hiemalis	-	-	-	-	9	18	11	14	11	6	13	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mycogone sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Paecilomyces varioti	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Papularia arundinis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium decumbens	-	-	-	-	-	-	-	-	14	12	17	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
P. expansum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27	-	-	55
P. rubrum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	21	0	5	11	22	-	-	-	-
P. implicatum	-	18	6	-	18	13	-	9	-	-	-	-	12	28	17	12	18	13	32	16	10	10	28	19	17		-	-
Periconia [illegible]	19	-	-	-	-	-	-	-	11	18	21	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizopus sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Torula herbarum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichoderma viride	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50	-	-	-	-	-	-	-	-	-	-
Total No. of colonies	8	28	28	13	16	18	18	10	16	16	18	28	8	4	8	8	11	22	14	20	11	20	12	21	14	18	7	54

Date—	20th				21st				22nd				23rd				24th				26th				27th				
Time—	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	[illegible]	[illegible]	6 AM
Absidia sp.	-	-	-	-	9	9	20	8	8	8	3	18	7	10	-	8	-	-	-	-	-	4	11	5	-	-	-	-	8
Acremoniella sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alternaria alternata	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	7	5	8	7	6	12	13	9	-
Aspergillus candidum	-	-	-	24	9	1	-	13	-	-	-	-	71	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	9
A. flavus	-	-	-	-	9	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	36	3	7	-	-	-	-	18
A. niger	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31	15	12	21	-	-	-	-	-
A. versicolor	10	-	32	-	-	-	-	-	19	7	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bipolaris spicifera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. turcica	18	4	6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cephalosporium roseogriseum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cladosporium cladosporioides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C. herbarum	36	47	32	-	32	40	38	13	25	19	51	55	6	14	32	4	35	59	71	59	20	28	14	35	17	28	23	17	19
C. variabile	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Curvularia lunata	10	5	-	11	16	7	7	9	-	27	-	8	-	-	-	-	-	-	-	-	-	-	-	-	9	13	4	11	-
C. pallescens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fusarium avenaceum	-	-	-	-	3	12	10	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. moniliforme	-	21	-	12	11	6	10	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	5	6	9	16
F. solani	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gliocladium penicillioides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
G. roseum	-	-	-	-	-	-	-	-	-	-	-	-	-	12	-	2	13	12	9	14	7	3	16	20	-	-	-	-	-
Helminthosporium sp.	-	-	-	-	7	21	31	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Humicola brevis	-	-	-	-	7	13	16	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	-	19	11	-
H. grisea	-	-	-	-	-	-	-	-	25	23	32	18	6	10	19	4	5	6	7	5	-	-	-	-	-	-	-	-	-
Moniliforma sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor hiemalis	-	-	-	-	36	-	13	3	-	-	-	-	-	-	-	-	7	12	-	8	-	-	-	-	-	-	-	-	-
Mycogone sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Paecilomyces varioti	-	-	-	-	-	-	-	-	-	-	-	-	-	12	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Papularia arundinis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium decumbens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. expansum	23	-	16	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. rubrum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. implicatum	13	40	21	-	11	11	-	9	40	23	13	-	2	17	-	4	-	-	-	-	7	9	13	5	11	14	25	22	14
Periconia [illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizopus sp.	-	-	-	-	7	8	-	-	-	-	-	-	1	10	-	-	-	10	13	14	-	-	-	-	-	-	-	-	-
Torula herbarum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichoderma viride	11	-	-	47	13	11	-	17	-	-	-	-	-	18	-	13	-	-	-	-	-	-	22	-	21	26	10	20	16
Total No. of colonies	9	62	15	15	15	26	10	27	4	9	12	11	32	20	14	41	61	36	38	32	15	27	35	14	17	22	23	34	1[illegible]

Appendix Table III-G Diurnal periodicity (percentage occurrence) of fungal spores in the atmosphere of Shillong (November 1981).

(Data based on three replicates)

Name of species	Date — 2nd				3rd				4th				5th				6th				7th				9th				10th				12th				13th				14th			
Time —	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM
Alternaria sp.	3	-	-	-	20	18	8	19	10	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	26	-	18	20	-	-	-	-	-	-	-	-	-
Aspergillus candidus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	18	12	10	-	-	-	-	-	-	-	-	-
A. flavus	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	5	11	-	13	9	38	18	39	25	12	15	-	-	-	-	44	83	8	14	-	-	-	16	7
A. niger	23	19	20	19	-	11	7	4	-	-	-	-	-	-	-	-	17	7	6	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. repens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. versicolor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bipolaris hirsica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Curvularia lunata	-	-	-	-	11	7	-	11	-	-	-	-	-	-	-	-	-	-	-	-	9	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cladosporium herbarum	32	15	19	64	22	30	31	34	36	13	10	28	25	22	-	-	21	19	25	28	52	55	59	36	28	60	89	5	46	31	33	25	19	-	18	27	23	10	33	40	15	80	39	85
Curvularia lunata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epicoccum nigrum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fusarium oxysporum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. moniliforme	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	-	21	15	14	8	29	14	7	6	17	11
F. roseum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	14	8	4	-	-	10	9	4	18	-	-	16	12	-	-	-	-	-	-	-	-	-	-	-	-
F. solani	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gliocladium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Helminthosporium sp.	16	20	3	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Humicola grisea	17	10	16	10	-	-	-	-	-	-	-	-	-	-	-	-	7	17	11	4	4	5	14	40	-	-	-	-	-	-	-	-	-	3	22	-	-	-	12	-	36	8	11	15
Mucor hiemalis	20	25	7	10	20	8	21	22	14	-	10	8	18	12	-	-	-	-	-	-	-	-	-	-	8	-	7	9	-	17	12	11	-	-	-	-	-	-	-	-	-	-	8	5
Pseudeurotium varioti	-	-	-	-	-	-	-	-	7	13	10	20	-	-	-	-	-	-	-	-	4	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	6	7	8	-	-
Penicillium cyclopium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. decumbens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. implicatum	-	-	-	-	18	2	31	-	28	46	19	9	13	19	-	-	-	-	16	-	24	-	-	-	24	-	-	19	14	25	25	3	-	-	-	-	17	-	8	12	22	26	-	8	-	-
Phoma sp	-	-	-	-	-	-	-	-	9	-	6	-	-	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizopus sp	-	-	-	-	-	-	-	-	-	-	-	-	19	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichoderma viride	-	-	-	-	-	-	-	-	-	26	30	6	14	-	-	7	22	18	15	32	3	-	-	6	-	-	4	-	-	-	-	19	82	10	-	-	-	20	17	22	-	-	8	39	23
Verticillium lutea sinus	-	-	-	-	-	-	-	-	6	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total No. of colonies	22	13	22	15	14	40	10	14	21	15	25	25	14	24	-	-	25	17	23	32	16	31	27	8	15	6	93	25	9	11	15	25	9	4	10	13	11	15	15	15	13	5	10	17

Name of species	Date — 15th				16th				18th				19th				20th				21st				22nd				24th				25th				26th				28th			
Time —	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM
Alternaria sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	12	4	7	11	13	-	4	-	-	-	-	2	2	7	-	8	11	8	6	-	-	-	-	-	-	-	-	-
Aspergillus candidus	-	-	-	-	15	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. flavus	16	7	-	7	-	-	-	-	4	-	16	7	-	-	-	-	8	6	-	-	-	-	-	-	-	29	37	10	11	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. niger	-	-	-	-	-	-	-	-	14	-	5	7	17	16	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. repens	-	-	-	-	-	-	-	-	4	-	7	4	-	-	-	-	-	-	-	-	18	6	9	11	-	-	-	-	-	-	-	-	8	4	13	18	-	-	-	-	-	-	-	-
A. versicolor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bipolaris hirsica	-	-	-	-	-	-	-	-	4	3	-	4	17	4	6	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Curvularia lunata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cladosporium herbarum	27	61	53	35	30	7	71	21	20	46	46	26	35	26	55	67	28	40	14	23	20	11	11	15	54	16	40	36	38	71	64	55	27	31	18	26	43	53	48	27	20	52
Curvularia lunata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epicoccum nigrum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	23
Fusarium oxysporum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. moniliforme	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. roseum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	9	-	-	-	-	-	-	-	-
F. solani	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	23
Gliocladium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	21	31	20	3	13	15	5	-	-	-	-	-	-	-	-	11	19	17	7	11	7	16	2	18	16	-	-
Helminthosporium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Humicola grisea	11	15	4	14	7	2	8	14	14	10	11	8	-	-	-	-	6	12	16	12	14	16	-	8	7	12	23	11	18	8	11	9	14	22	18	22	8	13	27	19	7	-	-	-
Mucor hiemalis	8	5	16	6	-	-	-	-	-	-	-	-	-	-	-	-	35	-	13	2	-	-	-	-	11	8	-	18	11	2	16	5	-	-	-	-	-	-	-	-	-	-	-	-
Pseudeurotium varioti	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium cyclopium	-	-	-	-	-	-	-	-	6	-	9	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. decumbens	-	-	-	-	-	-	-	-	-	8	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. implicatum	-	-	8	-	10	31	-	9	3	-	-	5	17	22	12	7	-	-	-	-	14	20	48	6	-	-	-	-	-	-	-	-	21	13	24	4	33	-	-	18	-	-	-	-	-
Phoma sp	-	-	-	-	-	-	-	-	6	9	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizopus sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-
Trichoderma viride	-	7	-	10	-	-	-	-	7	5	-	6	-	-	-	-	11	7	15	7	-	-	-	-	-	-	26	17	-	21	18	-	-	18	-	-	-	9	16	21	24	9	-	-	-	-
Verticillium lutea sinus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total No. of colonies	11	12	14	27	12	23	11	23	20	36	37	40	14	22	20	22	14	15	20	12	8	14	17	34	13	28	8	19	14	23	17	28	15	14	17	20	17	19	23	19	13	21

Appendix Table III-M Diurnal periodicity (percentage occurrence) of fungal spores in the atmosphere of Shillong by Petridish exposed method. (December 1981)

(Data based on three replicates)

Name of species	Date	1st				2nd				3rd				4th				5th				6th				7th				8th				9th				10th				11th				12th			
	Time	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM
Absidia sp.		13	-	-	-	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	9	17	40	-	-	-	-	-	-	-	-
Alternaria alternata		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	33	28	15	-	-	-	-
Aspergillus flavus		-	-	-	-	-	-	-	-	18	8	33	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. niger		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. versicolor		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aureobasidium sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bipolaris turcica		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blastomyces sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Botrytis sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	34	35	25	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chaetomium sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cladosporium cladosporium		-	-	-	-	18	48	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C. herbarum		36	40	51	40	24	82	18	51	45	23	28	-	37	-	40	45	53	26	36	57	26	56	46	16	29	36	56	81	31	9	38	65	10	-	-	-	-	68	68	68	68	86	63	91	41	34	48
Curvularia lunata		8	19	14	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	15	-	-	-	-
Drechslera sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	20	26	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fusarium roseum		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	37	27	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. solani		-	-	-	-	-	-	-	-	22	29	23	46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gliomastix sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24	9	3	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Helminthosporium sp.		-	-	-	-	-	-	82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Humicola grisea		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	40	34	40	-	-	-	-	-	-	-	-	-	-
Monilia sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	11	-	-	-	-	-	-	-	-	-	-	-
Mucor hiemalis		-	-	-	-	-	-	-	-	24	54	24	30	-	-	-	-	-	-	-	-	-	-	-	-	12	15	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nigrospora sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	4	6
Pescilomyces variotii		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-	-	-
Penicillium implicatum		26	12	4	13	-	-	-	-	13	41	14	17	-	-	-	-	-	-	-	-	-	-	-	-	26	27	10	19	24	10	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Periconia hispidula		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	-	-	-	-	-
Phoma sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	22	27	-	-	-	-	-	-	-	-	-	-	-
Rhizopus sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scopulariopsis sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thielaviopsis sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	53	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Torula sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43	-	-	-	-	-	-	-	18	36	68	-	-	-	-	-	-	-	-	-	16	31	8	-	-	-
Trichoderma viride		18	22	29	36	-	-	-	-	37	45	35	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39	19	-	20	-	-	-	-	-	-	-	-	-	-
Total No. of colonies		93	93	97	98	16	19	19	18	14	13	12	8	8	6	40	18	18	26	23	19	8	14	27	19	13	14	16	20	10	14	28	18	18	13	8	10	18	9	10	21	11	19	17	18	13	15

Name of species	Date	14th				15th				16th				17th				18th				19th				21st				22nd				23rd				24th				25	
	Time	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM	2 PM	6 PM	6 AM	10 AM
Absidia sp.		30	44	42	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	22	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alternaria alternata		-	-	-	-	-	-	-	-	-	-	-	-	15	25	16	-	11	7	-	-	27	-	11	-	17	7	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aspergillus flavus		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. niger		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33	-	38	23	-	-	-	-	-	-	-	-	-	-	44	50	63	26	-	-	-	-	-	-	-	-	-	-	-	-
A. versicolor		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	12	15	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aureobasidium sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bipolaris turcica		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blastomyces sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Botrytis sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25
Chaetomium sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cladosporium cladosporium		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C. herbarum		34	48	42	84	30	46	67	81	60	75	83	73	16	42	50	50	20	41	56	70	29	30	43	73	6	33	38	73	56	80	49	74	42	63	86	71	33	52	65	91	57	79	7	-
Curvularia lunata		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Drechslera sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fusarium roseum		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. solani		-	-	-	-	-	-	-	-	-	-	-	-	38	-	10	26	51	7	-	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gliomastix sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Helminthosporium sp.		-	-	-	-	-	-	-	-	-	-	-	-	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Humicola grisea		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	36	32	26	18	27	11	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Monilia sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor hiemalis		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nigrospora sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pescilomyces variotii		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium implicatum		-	-	-	-	22	19	8	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	20	8	27	10	21	-	-	-	-	-	-	-	-
Periconia hispidula		-	-	-	-	-	-	-	-	24	-	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phoma sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizopus sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scopulariopsis sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thielaviopsis sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Torula sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichoderma viride		24	6	14	6	47	34	24	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48	27	34	-	-	-	-	-	37	36	24	13	37	37	13	8	-	-	-	-	-	-
Total No. of colonies		13	15	17	10	13	13	12	14	10	4	9	13	19	14	21	25	10	12	20	20	13	23	18	13	14	10	8	12	14	6	10	20	13	11	13	11	9	10	7	12	9	16	16	-