SOME STUDIES ON THE AEROBIOLOGY OF SHILLONG

(MEGHALAYA)

Miss MANGLA SATPUTE, M. Sc., M. Phil.

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DEPARTMENT OF BOTANY
SCHOOL OF LIFE SCIENCES
NORTH-EASTERN HILL UNIVERSITY
SHILLONG - 793014
INDIA

NOVEMBER, 1982

phone :
Grams : NEHU

North-Eastern Hill University

LOWER LACHAUMIERE, SHILLONG - 793001

Dr R.R. Rao
M.Sc.,Ph.D.,F.B.S.

Dr B.K. Dutta
M.Sc.,Ph.D(Wales),M.I.Biol.

Department of Botany
School of Life Sciences
SHILLONG - 793 014

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.

R. Raghavendra Rao
(R. R. Rao)

Place: Shillong

Date : 24/11/82

Biman Kumar Dutta.
(B. K. Dutta)
Supervisors of Research

Forwarded
R.R. Rao
24/11

Head,
Department of Botany
School of Life Sciences
North Eastern Hill University
Shillong, Meghalaya.

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Satpute
(Miss Mangla Satpute)

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°54' N latitude and 91°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

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 effect 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., Onychium 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 (Thumb) 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.