

A PRELIMINARY POLLEN ANALYSIS OF THE MIAMI, FLORIDA, AREA

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IT IS the purpose of this paper to present some aerobiological data concerning the Miami, Florida, area and contiguous regions. The data presented were gathered over a two-year period extending from March 31, 1947 to March 31, 1949. This report should not be considered in any way complete for an area with such a diverse native and exotic flora. However, an attempt has been made to be selective of the material presented in order to make available representative information which may be useful in academic and applied botany as well as medical studies.

When the problem of conducting an aerobiological survey, with particular reference to pollens, was undertaken it became apparent that the reference data upon which such a study is based were almost completely lacking for this geographic area. These data consist of a botanical field survey to determine pollinating periods, the organization of a reference collection of known pollens for identification purposes, the tabulation of meteorological data, and finally the correlation of air-load factors with this information.

Until the aegis of studies of pollens as etiologic agents in certain pathologic reactions, the science of aerobiology in relation to pollens did not exist. Ray,⁵⁸ in 1693, made one of the earliest observations of the role of wind in the dissemination of pollen. He stated in his *Historia Plantarum*:

“When artificial pollination (of the date palm) cannot take place, the wind may possibly answer the same purpose.”

Apparently this phase of pollen study attracted little attention until the thorough investigations of Sprengel,⁵⁸ who conducted a complete study of flower pollination in 1812. It is of historic interest in aerobiology that he noted definite distinctions between anemophilous and entomophilous plants. He correlated the type of flower parts, lack of nectar, lightness and shape of pollen grains with their air-borne habit. Many observations of the presence of pollen grains in the atmosphere were made from time to time, but no systematic study of their incidence was undertaken until there was some need for quantitative data. The study of “pollen disease,” which developed into the branch of medicine known as allergy, presented this need.

This study required the cooperation of many individuals. I am particularly grateful to: Dr. Taylor R. Alexander, Chairman; Professor Roy Woodbury; Dr. R. Bruce Ledin; Dr. Walter Buswell; all of the University of Miami Botany Department. I greatly appreciated the courtesy of the Jackson Memorial Hospital Library staff, and helpful suggestions made by Dr. Nelson Zivitz.

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Durham,¹⁵ referring to Blackley who began a study of the pollen content of the air in Manchester, England, in 1866, wrote, "the first serious investigation of pollen incidence was as premature as it was excellent." Blackley's work was done long before there was general acceptance of the pollen theory of hay fever, yet his first series of observations, completed in 1873, established pollens as the cause of certain respiratory disorders.

Interest in further studies lagged, however, until some practical clinical method was devised to counteract "pollen disease." Ragweed and grass sensitizations were the first types of pollinosis to receive extensive study. These investigations stimulated interest in other plants as possible allergens. It was logical that the studies began with the strictly air-borne pollens.

Scheppegrell⁴⁵ began exposing slides to obtain daily pollen counts in New Orleans in 1916, and presented in 1921 one of the first comprehensive quantitative reports. It was not until 1925, however, that similar studies were undertaken in other parts of the United States. When the value of pollen counts became evident there was a deluge of reports on local surveys. These surveys were helpful but were so filled with "unknowns" because of the lack of field studies that most of the botanists working in allergy placed slide counting secondary to correlated field observations. Cooke⁹ referred to the work of Hodgson, botanist of the Department of Allergy at Roosevelt Hospital, New York:

"Hodgson, whose experience in pollen surveys and pollen counting extends over a period of thirty years, maintains that daily field surveys give a more accurate idea of the different pollens encountered in a given area, and that pollen counting should be used merely as a supplement to this."

As the studies of aerobiology in relation to pollen incidence advanced it became increasingly evident that pollen analysis in any geographic area involved investigations of: first, determination of pollen chronology; second, the establishment of an identification collection; and third, the compilation of the various climatic factors connected with dispersion. This is particularly true in southern Florida. This area, though part of continental United States, is ecologically the northernmost extension of the West Indies.¹¹ Therefore, this region constitutes an area unique in the United States. One pollen survey that has been published for the Miami area³⁷ was difficult to evaluate due to lack of correlation with field studies or meteorologic data. Consequently, it became obvious at the outset of this investigation that the organization of reference data was necessary in order to derive any significant information useful in any of the fields of botany or medicine concerned.

The first step was compilation of information on the pollinating periods of representative flora. This was done by making frequent field observations and illustrating these data graphically following the method of Hodgson (Fig. 1). Inasmuch as the method of pollination of many of the plants in this area has not been determined, no designation of this factor was made on the figure. In establishing the chronology of pollens, the periods demonstrated represent the duration of the flowering time of the plants involved. Slide counts of pollens were not considered in this case.

The second step was carried out concurrently with the field studies to determine the chronology of pollinating periods. This consisted of collecting pollens and preparing them for reference. The known pollens were defatted and dehydrated with xylol then mounted in balsam. In this type of preparation the grains appear unstained and unexpanded as they do when collected in the field or on air exposure slides.

The third of these basic reference materials was the preparation of detailed summaries of meteorologic data. These data were obtained from readings made from standard constant recording instruments placed on the campuses of the University of Miami. Wind direction and wind velocity figures were obtained from the official summaries of the United States Weather Bureau station in Miami. The computations are 24-hour averages based on 2-hour interval graphs according to preferred statistical methods.³⁸

During the two years of this investigation a determination of the pollen air-load was made. The method used was the standard technique approved by the National Pollen Survey Committee of the American Academy of Allergy in 1946.³⁹ This method standardized pollen count reports as the number of grains per square centimeter of slide area. The counts were made from slides exposed under the conditions specified and on an apparatus approved by the committee. This method was followed whenever feasible. However, it was apparent at the outset of this study that the standard procedures of aerobiologic analysis had to be modified to meet the exigencies imposed by the physiographic and meteorologic conditions of this region. Constant high humidity made it necessary to use petroleum jelly on exposure slides rather than glycerin jelly. In order to insure more accurate counts of a low air-load three slides were exposed at a time.⁶⁰ The modifications were so made that the results could be compared with those obtained throughout the United States. It was found that only from the middle of March to the first week in May was the total pollen air-load heavy enough to make this type of count significant. Consequently, correlative data were of necessity confined to a time period in which all the factors could be demonstrated.

Since only during a two month period of each year was there a discernible pollen incidence, several tentative explanations have been made to account for the lack of air-borne pollens in an area which might be expected to maintain a relatively heavy air-load. It was thought that the almost constant moderate southeast winds directly from the Atlantic Ocean would "clear" the air of pollens by blowing air-borne particles inland. Another possibility investigated was that the consistently high relative humidity would tend to keep normally buoyant pollens close to their source.

In order to examine these possibilities a chart was prepared to illustrate graphically the meteorologic factors involved (Fig. 2). The month of April, 1947, was chosen in order to correlate a total pollen air-load with these factors. During this time period, *Pinus caribaea* (Caribbean pine) was pollinating and thus afforded the opportunity to obtain a high enough count by standard methods to be significant. Notations on the chart indicate daily averages for the factors involved with the exception of rainfall for which weekly totals are designated.

The data obtained seem to indicate that wind velocity and direction had very little bearing on the maintenance of an air-load of a known anemophilous pollen. The rather small variations in relative humidity, which did not go below seventy-three per cent for the four week period, apparently did not affect the buoyancy of the pollen. The only factor which was demonstrated to have any bearing on diminishing the air-load was direct precipitation of rain. The possibility of low pollen production for this selected time period is not acceptable since the total pollen count compares favorably with the figures obtained in 1948 and 1949 in this investigation and with the data presented by Nichol and Durham in 1931.³⁷

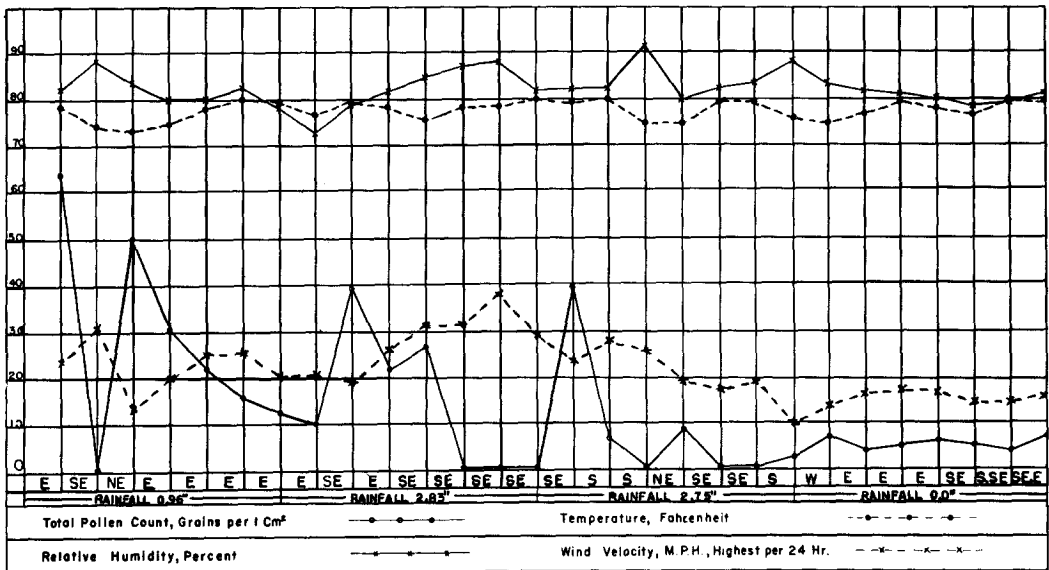


Fig. 2.—Correlation of total pollen airload with either data (April, 1947).

With the exception of precipitation it was not demonstrated that meteorologic factors affected the presence in the air of a pollen which is anemophilous in all its geographic range. Therefore it was reasonable to assume that these factors would not influence the incidence or, more accurately, the absence of other pollens whose dispersion behavior may be modified by this environment.

Since in the literature available there was found no precedent for determining the radial dispersion of pollens a method was devised to check the dispersion of pollens at the source. In an attempt to determine the distance pollen was carried from the plant or plants a radial transect was laid out. Isolated plants in flower were selected. Using the center of the stand or the bole of a tree as a hub, the radii were determined with a compass and extended with a metal tape. On each radius exposure stands were placed at the desired intervals. Radial transects are illustrated graphically in Figs. 3 and 4. This method is given simply as a possible approach to some of the problems involved in an ecologic investigation in subtropic Florida.

In order for the results of dispersion studies to have any validity, species were selected which had exhibited deviations in pollinating habits which could not be explained by their reaction to the atmospheric environment into which their pollens were shed. Consequently, ragweed and "woman's tongue" were selected to demonstrate contrasting pollinating deviations.

Ragweed has been the classic wind-pollinated plant of medical and economic significance. *Ambrosia elatior*, the short ragweed of allergy literature, grows to a height of 6 feet or more in south Florida. Why this particular species should display such phenomenal vegetative growth might be answered by studies in anatomy,⁵⁷ physiology, cytology, ecology,²⁵ and photoperiodism or temperature, singly or interrelated.²⁶ However, the most striking observations in the modified behavior pattern are the dispersion of pollen and the length of the pollinating period.

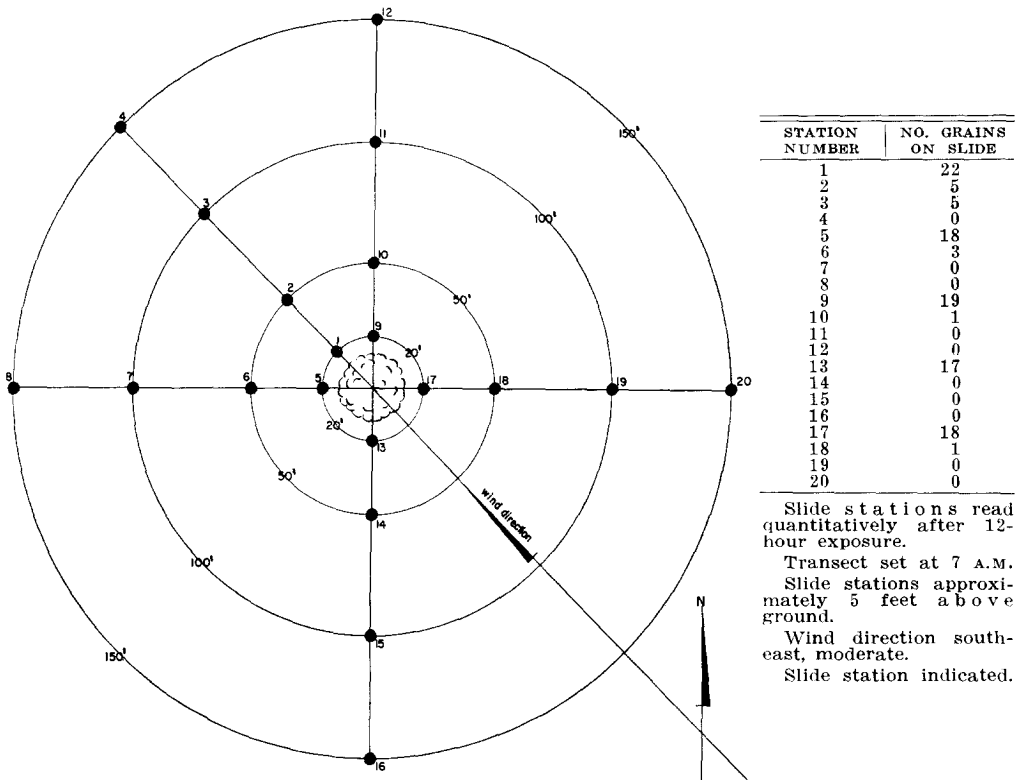


Fig. 3.—Radial dispersion of *Albizzia lebbek* pollen.

During the entire seven month pollinating period of *Ambrosia elatior* (Fig. 1) in 1947, only 20 grains were counted on exposure slides. Nichol and Durham³⁷ in 1929 found 61 grains. Correlated with this are reports of very few proved clinical cases of ragweed pollinosis in this area.⁶² Field observations on anthers indicated that mature pollen was produced in quantities comparable to that produced in areas where ragweed has a significant air-load density. Yet

pollen was not found on exposure slides in a ratio comparable to the expected density. A radial transect was arranged around an isolated stand of ragweed as illustrated in Fig. 4. The slide counts given are averages of five separate readings. The conclusion, from even such a cursory study, would seem to be that *Ambrosia elatior*, in the environment imposed by this region, could not be regarded as a strictly anemophilous plant. Medical evidence bears out this conclusion.⁶² The reasons for this behavior have not been determined but the dispersion problem has been approached.

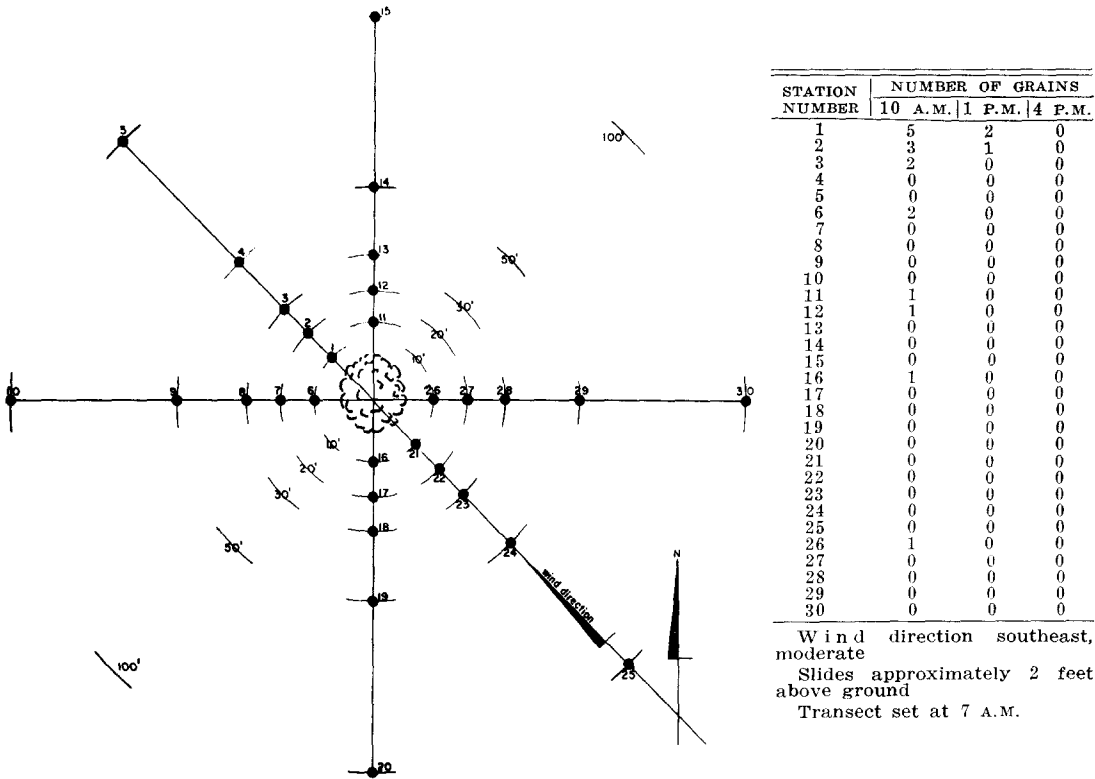


Fig. 4.—Radial dispersion of *Ambrosia elatior* pollen.

As an example of converse behavior deviation, a radial dispersion study of *Albizzia lebbek* (woman's tongue) was made (Fig. 3). *Albizzia* belongs to the order Rosales, family Mimosaceae. This order is considered to be primarily insect pollinated, although the structure of the flowers of some of the Mimosaceae suggest the possibility of transition to anemophily.⁵⁸ In this area of Florida there have been reports of proved clinical cases of sensitization to *Albizzia* pollen.⁶² An examination of the data presented in Fig. 3 may suggest a possible transition on the part of this species of Mimosaceae.

To recapitulate, *Ambrosia*, which is a notoriously heavy wind pollinator and primary cause of pollinosis in other parts of the United States, demonstrated what appeared to be a reversal in pollinating behavior. It has not been reported

to produce important clinical sensitization in this area. Albizzia, on the other hand, as a representative of an entomophilous family, apparently is transitional in the direction of anemophily. The fact that Albizzia has been reported to cause pollinosis in this area would indicate wind pollination under certain circumstances.

It should not be considered that these limited studies on dispersal are sufficient basis for any valid conclusions; but a comparison of these two examples illustrates the necessity for adapting pollen analysis methods, in a particular region, to significant environmental factors. The necessity of complete ecologic studies becomes obvious when an examination is made of two instances of behavior deviation.

The compilation of chronologic, meteorologic, and identification materials, the influence of meteorologic factors on air-load of pollens, and a suggested method of determining dispersion of pollens are presented as reference materials and as suggestions for further investigation. This preliminary investigation has brought sharply into focus the necessity of botanical field observations as a foundation for aerobiologic studies with reference to pollens.

LIST OF COMMON NAMES OF PLANTS IN FIG. 1.

<i>Acer rubrum</i> —Red maple	<i>Myrica cerifera</i> —Wax myrtle
<i>Acrostichum</i> —Strap fern	<i>Ocotea catesbyana</i> —Lancewood
<i>Albizzia lebbek</i> —Woman's tongue	<i>Panicum sp.</i> —Witch grass
<i>Amaranthus spinosus</i> —Spiny amaranth	<i>Persea americana</i> —Avocado
<i>Ambrosia elatior</i> —Short ragweed	<i>Pinus caribbaea</i> —Slash, Caribbean pine
<i>Andropogon halipensis</i> —Bunch grass, broom grass	<i>Pinus clausa</i> —Sand pine
<i>Atriplex sp.</i> —Salt-bush	<i>Pithecolobium sp.</i> —Cat's-claw, black-bead tree
<i>Capriola dactylon</i> —Bermuda grass	<i>Quercus sp.</i> —Oaks
<i>Casuarina sp.</i> —Australian pine	<i>Rapanea guayanensis</i> —Myrsine, marlberry
<i>Chenopodium album</i> —Lamb's quarters	<i>Roystonea regia</i> —Royal palm
<i>Chenopodium ambrosioides</i> —Pig weed	<i>Ruppia maritima</i> —Sea grass
<i>Chrysobalanus icaco</i> —Cocoa plum	<i>Sabal palmetto</i> —Cabbage palm
<i>Coccolobis uvifera</i> —Sea grape	<i>Salix amphibia</i> —Florida willow
<i>Cocos nucifera</i> —Coconut palm	<i>Serenoa repens</i> —Saw palmetto
<i>Conocarpus erecta</i> —Buttonwood	<i>Solidago sp.</i> —Goldenrods
<i>Dipholis salicifolia</i> —Bustic	<i>Tamala borbonii</i> —Red bay
<i>Eleocharis sp.</i> —Spike rushes	<i>Tamarindas indica</i> —Tamarind
<i>Ilex cassine</i> —Dahoon, yaupon	<i>Taxodium sp.</i> —Cypress
<i>Iva imbricata</i> —Marsh elder	<i>Trema floridana</i> —Florida Trema
<i>Laguncularia racemosa</i> —White mangrove	<i>Tricholaena rosea</i> —Natal grass
<i>Mangifera sp.</i> —Mango	<i>Typha sp.</i> —Cat-tail
<i>Mariscus jamaicensis</i> —Saw-grass	<i>Zamia floridana</i> —Coontie, Florida arrowroot
<i>Melaleuca leucodendron</i> —Cajeput, bottle brush tree	

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