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The 2-hourly Airborne Pollen Monitoring Station - University of Modena (Botanical Garden/ Geophysical Observatory) and the 1994 example Pollen Calendar

Abstract

The paper introduces the "2 hourly Airborne Pollen Monitoring Station" of the Botanical Garden / Geophysical Observatory of the University of Modena and presents its "Yearly Airborne Pollen Calendar", throughout the example year of 1994, the first to be accomplished. The Station has been operating since May 1992. The spore trap, a seven-day Lanzoni VPPS 2000, is located on the roof of the Geophysical Observatory building. Pollen analyses have been carried out on a 2-hourly basis from the start. Pollen data have been elaborated using our own software "Aerobiologia 2.1". The "Yearly Airborne Pollen Calendar" was inspired by the "Osservazioni Meteorologiche" published by the Geophysical Observatory. It consists of 12 monthly tables and 1 yearly table. The tables show: 2-hourly, daily, 10-daily, monthly and yearly Total pollen concentrations, including notes on the amount of Total pollen considered by the AIA (Aerobiological Italian Association) pollen Network. The most abundant pollen types and their percentages out of the monthly pollen spectra are also shown, as well as Tree (Trees + Shrubs + Lianes) and Herb pollen concentrations and percentages. The yearly concentration/percentage pollen spectrum closes the Calendar. To qualify the different months and years based on their total pollen amount, the "Pollen Star System" was devised. In 1994 the Total pollen yearly sum was 53,038 p/m³ /24h (Trees = 52%; Herbs =

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48%; p =pollen grains). The month with most pollen was March, a "4 Star" month ($14,267 \text{ p/m}^3$ /24h-monthly sum); the daily maximum was March 31 ($1,384 \text{ p/m}^3$ /24h) and the 2-hourly maximum was April 1 ($2,760 \text{ p/m}^3$ /24h). Altogether 115 pollen types (16 - 90 per month) belonging to 57 Families were identified. The most abundant pollen types, which reached a monthly sum higher than 500 p/m^3 were 13: *Alnus* (March), *Corylus* (March), *Cupressaceae* (March), *Fraxinus* (March), *Ostrya/Carpinus orientalis* (March), *Populus* (March), *Taxus* (March), *Betula* (March, April), *Platanus* (March, April), *Quercus* (April), *Gramineae* (April, May, June, July; $5,648 \text{ p/m}^3$ /24h-monthly sum in May, maximum value in the year), *Castanea* (June, July) and *Urticaceae* (June, July, August, September).

Riassunto

Il lavoro presenta la "Stazione Aeropollinica Bioraria" dell'Orto Botanico/Osservatorio Geofisico dell'Università di Modena e il "Calendario Pollinico" messo a punto per la presentazione annuale dei dati, attraverso l'esempio del Calendario 1994, il primo compilato.

La Stazione è sorta dal desiderio di disporre di un punto di monitoraggio dei pollini in aria strettamente collegato a una rigorosa Stazione Meteorologica, per sviluppare varie linee di ricerca aeropalinologiche sia di base che applicate, partendo da impostazioni geobotaniche. La stazione ha iniziato ad operare dal 1 Maggio 1992, grazie al sostegno di Daria Bertolani Marchetti, compianto Direttore del nostro Istituto Botanico e all'ospitalità del team dell'Osservatorio Geofisico che gestisce la Stazione Meteorologica, guidato da Renato Santangelo.

Il campionatore aeropollinico volumetrico settimanale, Lanzoni VPPS 2000, è collocato sul tetto dell'Osservatorio Geofisico, accanto alle apparecchiature della Stazione Meteorologica-polo di Via Campi. Fin dall'inizio le letture polliniche sono state effettuate su base bioraria e con criteri di dettaglio. I dati aeropollinici sono archiviati ed elaborati con un software, "Aerobiologia 2.1", messo a punto nel nostro laboratorio.

Il Calendario Pollinico Annuale, che si ispira alle "Osservazioni Meteorologiche" pubblicate annualmente dall'Osservatorio Geofisico, riporta valori di concentrazione, espressi in p/m^3 (p = pollini), valori percentuali e dati sulla flora aeropollinica. I tipi pollinici rinvenuti sono divisi in 8 classi in base alla somma mensile della concentrazione giornaliera. I mesi e gli anni sono qualificati con 1 o più "Stelle" in base alla somma mensile o annuale: il numero di Stelle è pari all'esponente dell'ordine di grandezza di tali concentrazioni. Il Calendario è costituito da 12 fogli mensili, più un foglio annuale. I fogli mensili riportano valori di concentrazione relativi ai Pollini Totali (concentrazioni biorarie, giornaliere, decadali, mensili, annuali) e al Totale dei Pollini censiti dalla Rete Aeropollinica dell'AIA (Associazione Italiana di Aerobiologia). Sono inoltre riportati dati

riguardanti il numero di tipi pollinici identificati, i pollini di specie legnose (alberi + arbusti + liane) ed erbacee, e i tipi pollinici più rappresentati (Classi II-VI). Il foglio annuale riassume i dati mensili principali aggiungendo valori annuali. Il Calendario termina con lo spettro pollinico annuale (lista dei tipi pollinici rinvenuti, espressi sia in concentrazione annuale, sia in % sulla somma annuale dei pollini totali).

Il 1994 è stato un anno a 4 Stelle ($53.038 \text{ p/m}^3/24\text{h}$ -somma annuale), con uno spettro annuale in cui le specie Legnose hanno superato leggermente le Erbacee (Alberi = 52%; Erbe = 48%). Marzo è stato il mese più pollinifero, un mese a "4 stelle" ($14.267 \text{ p/m}^3/24\text{h}$ -somma mensile); il 31 Marzo è stato il giorno più pollinifero ($1.384 \text{ p/m}^3/24\text{h}$) e la fascia bioraria più pollinifera è stata osservata il giorno dopo, 1 Aprile, tra le 22 e mezzanotte ($2.760 \text{ p/m}^3/2\text{h}$). I tipi pollinici identificati hanno superato il centinaio (115 tipi pollinici; 16-90 per mese, appartenenti a 57 Famiglie). I tipi pollinici più abbondanti, che hanno raggiunto una somma mensile maggiore di $500 \text{ p/m}^3/24\text{h}$ (Classi IV,V,VI), sono stati 13: *Alnus* (Marzo), *Corylus* (Marzo), *Cupressaceae* (Marzo), *Fraxinus* (Marzo), *Ostrya/Carpinus orientalis* (Marzo), *Populus* (Marzo), *Taxus* (Marzo), *Betula* (Marzo, Aprile), *Platanus* (Marzo, Aprile), *Quercus* (Aprile), *Gramineae* (Aprile, Maggio, Giugno, Luglio; $5.648 \text{ p/m}^3/24\text{h}$ - somma mensile in Maggio, valore più alto dell'anno), *Castanea* (Giugno, Luglio) e *Urticaceae* (Giugno, Luglio, Agosto, Settembre).

Il Calendario Pollinico messo a punto sembra soddisfacente, al momento. Esso sarà migliorato da consigli e critiche degli utilizzatori. E' importante ricordare che i dati sintetici del Calendario poggiano sulle pagine giornaliere, in cui possono essere rintracciati tutti i tipi pollinici identificati, con le loro concentrazioni ogni 2 ore, e anche alcuni granuli pollinici in attesa di identificazione, che potrebbero rivelarsi importanti e che sono un inesauribile stimolo al miglioramento.

Se questa stazione continuerà a funzionare, fornirà dati per molte applicazioni, ad esempio: 1) per scoprire quale influenza hanno sul contenuto pollinico dell'aria i rimboschimenti o gli impianti del verde pubblico, spesso orientati verso specie esotiche; 2) per individuare pollini marker di masse d'aria; 3) per confrontare gli spettri pollinici in aria con quelli a terra ottenuti da muschi e altri substrati di superficie, che danno l'immagine pollinica della vegetazione in atto; 4) per fornire, mediante gli orologi pollinici di specie allergeniche, informazioni utili alle persone ad esse sensibili, per cercare di evitarle; 5) per seguire l'evolversi degli assemblaggi pollinici prodotti dalle varie comunità vegetazionali con l'evolversi del clima, una linea quest'ultima che ha il fascino del collegare la vegetazione passata a quella presente e futura.

Key words: Aerobiology; 2-hourly Airborne Pollen Station; Modena-University-Italy; Pollen Calendar 1994.

Parole chiave: *Aerobiologia, Stazione Aeropollinica Bioraria, Modena-Università-Italia; Calendario Pollinico 1994.*

Introduction

Airborne pollen is flying around us.

How many pollen grains there are every day in the air and which plants they belong to primarily depends on vegetation, be it natural or anthropic, and then on meteorological conditions.

The news reports about airborne pollen start early and finish late in the year in our country, due to the variety of allergenic pollen types, when and how long they are present during the year and to what extent they affect the population.

In Italy a hundred air pollen monitoring stations are currently operating, mainly dealing with allergenic pollen. Most of these stations provide the Aerobiological Network of the Italian Association of Aerobiology (AIA) with the weekly concentrations of a selected list of pollen types. AIA is responsible for the real time diffusion of the pollen news through the media (Mandrioli, 1990).

In the province of Modena, there are 4 monitoring stations: one in Modena itself (Via Fontanelli) managed by the ARPA - Agenzia Regionale Prevenzione e Ambiente (which was the first to start operating), one in Vignola, run by the University together with ARPA (the second) and one in Mirandola (the fourth station, recently opened). The other station (the third to start operating) is managed by the University and it is the one presented in this paper. The first two stations are linked to AIA.

Air pollen is renowned for the allergic reaction it causes in people. Nevertheless it is also a protagonist in several other fields of science and practice: plant biology, aerobiology, palynology, geobotany, agriculture, human impact on the environment, meteorology/climatology. People are becoming more and more concerned with the pollen in the air surrounding them.

In the array of roles air pollen plays, one has always appealed to us: pollen as a possible detector of climate. In fact, since there is a close relationship between air pollen assemblages and the various climates which produce their parent vegetation, in theory it should be possible to overlap the patchwork of air pollen and that of climate. This goal could be approached by adding a pollen station to every meteorological station throughout the world.

With this idea in mind, we strove to open an airborne pollen monitoring station closely linked to a meteorological one. The chance arose thanks to our late and much missed Director, Prof. Daria Bertolani Marchetti, and the staff of the Geophysical Observatory in Modena, headed by Prof. Renato Santangelo. They offered to place our pollen trap on the top of the Observatory building, at the Via Campi pole of their meteorological station, which has a long history going back to 1830, and has been operating with the current automatic methods since 1988 (Frontero *et al.*, 1998; Boccolari *et al.*, in press).

The pollen trap began operating in May 1992.

The aims of the pollen station were to perform both routine and scientific work. Pollen analyses have been continuously carried out, from the start, with a 2-hour resolution. We have always endeavoured to improve pollen identification (Torri *et al.*, 1997; Accorsi *et al.*, 1998). We designed our own software "Aerobiologia 2.1" to handle data (Mercuri *et al.*, 1994 and 1997).

Our first step was to draw a "Pollen Calendar" like the "Osservazioni Meteorologiche" the Geophysical Observatory has been publishing for more than 100 years, to present a satisfactory yearly report of the most important pollen data.

Our station, as we have said, the third to operate in the province of Modena, is not yet linked to the AIA-network because it has so far been impossible to keep up with its weekly pace.

In this paper we wanted to introduce this "2-hourly Airborne Pollen Monitoring Station", and give an example of the Airborne Pollen Calendar we intend to produce yearly. Our example Pollen Calendar concerns the year 1994.

Materials and methods

Pollen trap, sampling and analyses

The pollen trap, a volumetric seven-day Lanzoni VPPS 2000, is placed on the roof of the Geophysical Observatory building (about 15 m high; Modena, 35 m a.s.l., 44°40' N 10°55' E).

It began operating on May 1, 1992.

Sampling methods and slide mountings follow the standards codified by AIA-Aerobiological Italian Association for the Italian Aeroallergen

Network (Kumer, 1987; Mandrioli, 1990). The daily slides are divided into 2-hour strips (solar time) and analysed with a light microscope at 250/400 (1000) magnifications, observing routinely around 1/7 of each slide. Detailed research to identify the species of a particular pollen Genus, as for *Alnus* (Accorsi *et al.*, 1998) is carried out analysing the whole of each slide.

Pollen grains are identified based on current pollen atlases / keys and the pollen reference slide collection of our Laboratory. The term "Pollen types" indicates Genera or Families or Pollen types s. s. or species, according to the level of identification.

Data elaboration

Pollen data are stored and processed with Aerobiologia 2.1, software designed in our Laboratory (Mercuri *et al.*, 1997). Data input as number of pollen grains are immediately converted in the following parameters: 2-hourly concentrations, mean daily concentrations, 10-day and monthly concentrations (means and sums). The calendars of selected pollen types or total pollen, the daily and monthly percentages, the number of pollen types per day and month, are obtained by an automatic link between Aerobiologia 2.1 and Microsoft Excel 5.0.

Pollen concentration units

The pollen calendar reports some Concentration Units expressed as number of pollen grains (= p) per m^3 of air. Note that "concentration = 0" more often signifies that it is approximating 0; concentration is actually "0" only when no pollen is recorded. The basic values are: **2-hourly concentrations** ($p/m^3/2h$) and **daily concentrations** ($p/m^3/24h$). The other units are their means, sums, minimums and maximums, calculated for 10 day, monthly and yearly periods. As it is difficult to manage these units we have frequently added the abbreviation, at the cost of tiresome repetition; example: the monthly mean of daily pollen concentration is shortened to $p/m^3/24h$ -monthly mean.

The concentration units (conc. = concentration) reported in the Pollen Calendar are:

2-hourly concentration	(p/m³/2h)
2-hourly maximum conc. of the day	(p/m ³ /2h-daily max.)
2-hourly minimum conc. of the day	(p/m ³ /2h-daily min.)
Daily concentration	(p/m³/24h)
10-daily concentration	
10-day mean of daily conc.	(p/m ³ /24h-10 day mean)
10-day sum of daily conc.	(p/m ³ /24h-10 day sum)
Monthly concentration	
monthly mean of 2-hourly conc.	(p/m ³ /2h-monthly mean)
monthly minimum of 2-hourly conc.	(p/m ³ /2h-monthly min.)
monthly maximum of 2-hourly conc.	(p/m ³ /2h-monthly max.)
monthly mean of daily conc.	(p/m ³ /24h-monthly mean)
monthly sum of daily conc.	(p/m ³ /24h-monthly sum)
monthly maximum of daily conc.	(p/m ³ /24h-monthly max.)
Yearly concentration	
yearly mean of 2-hourly conc.	(p/m ³ /2h-yearly mean)
yearly minimum of 2-hourly conc.	(p/m ³ /2h-yearly min.)
yearly maximum of 2-hourly conc.	(p/m ³ /2h-monthly max.)
yearly mean of daily conc.	(p/m ³ /24h-yearly mean)
yearly sum of daily conc.	(p/m ³ /24h-yearly sum)
yearly maximum of daily conc.	(p/m ³ /24h-yearly max.)

Pollen Classes and Roles

The pollen types recorded every month are divided in eight Pollen Classes, based on their monthly sum of daily concentration. Classes II-VI are named "Main Classes". Moreover, the pollen types are qualified with different role adjectives, based on the Class they achieved in the month (High, Relevant, Low, Sporadic, Rare pollen).





Classes and Roles are listed below. In the pollen Calendar only Classes II-VI (High and Relevant pollen types) are reported; only when the Main Classes are empty, Class I is indicated.

Pollen Classes (Main Classes = II-VI)		Pollen Roles
Class VI = 5,001-10,000	p/m ³ -monthly sum	high pollen
Class V = 1,001-5,000	p/m ³ -monthly sum	high pollen
Class IV = 501-1,000	p/m ³ -monthly sum	high pollen
Class III = 101-500	p/m ³ -monthly sum	relevant pollen
Class II = 51-100	p/m ³ -monthly sum	relevant pollen
Class I = 11-50	p/m ³ -monthly sum	low pollen
Class + = 6-10	p/m ³ -monthly sum	sporadic pollen
Class r = >0-5	p/m ³ -monthly sum	rare pollen

The Pollen Star System

To qualify the different months and years based on their total pollen amount, we devised the Pollen Star System. The aim was to adopt a simple system, such as Stars which are currently used to qualify hotels and restaurants. The Stars correspond to a pollen concentration, the number of Stars being equal to the exponent of its order of magnitude; the more stars there are, the higher the concentration is. The Stars were used in our case to categorise the Total pollen monthly and yearly sums of daily concentrations, but its use could be extended to other concentration units and single pollen types. The pollen grain in the middle of the stars is *Ostrya carpinifolia* which is the symbol of our Laboratory.

Star System

	(4 stars) = 1 - 9.9999	x 10 ⁴ p/m ³
	(3 stars) = 1 - 9.999	x 10 ³ p/m ³
	(2 stars) = 1 - 9.99	x 10 ² p/m ³
	(1 star) = 1 - 9.9	x 10 ¹ p/m ³
No Stars	(0 stars) = 1 - 9	x 10 ⁰ p/m ³

The Yearly Concentration/Percentage Pollen Spectrum

The yearly pollen spectrum closes our Pollen Calendar. It is at the same time a concentration and percentage pollen spectrum. In fact it shows the list

of pollen types recorded in the year, with their yearly concentrations ($\text{p/m}^3/24\text{h}$ -yearly sum) and percentages out of the Yearly Total ($\text{p/m}^3/24\text{h}$ -yearly sum of Total pollen).

As for percentage values, we adopted, with a little modification, the same terms used by Accorsi *et al.* (1997) to define the status of each pollen type, even if in their case there were tree pollen spectra, while in our case there is a total pollen spectrum including both the trees and herbs. The terms are:

- | | |
|-----------------------|--|
| a. Leading pollen | = with a percentage from 5.1% |
| 1.1. Dominant pollen | = with a percentage from 41% |
| 1.2. Main pollen | = with a percentage between 11% and 40% |
| 1.3. Partner pollen | = with a percentage between 5.1 % and 10 % |
| b. Escort pollen | = with a percentage between 1.1 % and 5% |
| 2.1 Secondary pollen | = with a percentage between 2.6% and 5% |
| 2.2. Companion pollen | = with a percentage between 1.1% and 2.5% |
| c. Minor pollen | = with a percentage $\leq 1\%$ |

Results

What the Pollen Calendar shows

The Yearly Pollen Calendar is composed of 12 Monthly pages (Tabb. 1-12) plus 1 Yearly page (Tab. 13) and the Yearly Pollen Spectrum (Tab. 14). Concentrations and percentages concern Total pollen, where not otherwise stated, and approximate the unit. For easy identification we have circled some maximum values. The months are indicated by their initials.

The Monthly table

Each Monthly table (Tabb.1-12) is divided into four blocks: A, B, C, D.

Block A

Includes concentration units and percentages of Total Pollen and Pollen of the AIA List, as well as the number of pollen types recorded.

Starting from the left, after the day, the second column, regarding Total Pollen concentrations, is divided into three subcolumns.

The first shows the daily concentrations of Total pollen (Daily pollen concentration = $p/m^3/24h$). These figures are the base on which the 10 daily, monthly and yearly sums are calculated. Actually the daily concentration is a mean value, as the pollen concentration varies, sometimes notably, during the day (see 2-hourly concentrations). At the end of each ten days, the sum and mean of that period is reported. These figures are useful for quick reference about the variation of the pollen content throughout the month. Concentration units are: 10-day sum of daily concentration ($p/m^3/24h$ -10 day sum) and 10-day mean of daily concentration ($p/m^3/24h$ -10 day mean). At the bottom, the monthly values are reported, that is the monthly sum, mean and maximum. These values are helpful for drawing synthetic pollen calendars and comparing pollen calendars of different countries. They are: monthly sum of daily concentrations ($p/m^3/24h$ -monthly sum); monthly mean of daily concentrations ($p/m^3/24h$ -monthly mean) and monthly maximum of daily concentrations ($p/m^3/24h$ -monthly max.).

The second and third subcolumns report the minimum and maximum 2-hourly concentrations of Total pollen per each day. At the bottom of the third subcolumn the monthly maximum is shown under which an arrow indicates the main pollen types responsible for that maximum.

The 2-hour concentrations are very important because they show how much the pollen content of the air varies throughout the day and reveal peaks which otherwise would remain undetected. The three 2-hour concentration units reported are: minimum 2-hour concentration of the day ($p/m^3/2h$ -daily min.); maximum 2-hour concentrations of the day ($p/m^3/2h$ -daily max.) and maximum 2-hour concentration of the month ($p/m^3/2h$ -monthly max.). The third column, concerning the AIA List is divided into two subcolumns. The first reports the daily concentrations of AIA-Total pollen, that is the Total pollen of the types included in the AIA Aeroallergen Network list. In the same subcolumn, at the end of each ten days, the sum of that period is reported. At the bottom, the monthly values are reported, that is the monthly sum and maximum. The second subcolumn shows the percentage of AIA-pollen out of the Total daily concentration value (column 2, subcolumn 1). The AIA List includes at the moment, 25 pollen types: Aceraceae, Betulaceae (*Alnus*, *Betula*), Chenopodiaceae/Amaranthaceae, Total Compositae, plus the values of *Ambrosia* and *Artemisia*, Corylaceae (*Corylus*, *Carpinus/Ostrya*), Cupressaceae/Taxaceae, Cyperaceae, Euphorbiaceae, Fagaceae, Gramineae, Myrtaceae, Total Oleaceae, plus the values of *Fraxinus* and *Olea*, Pinaceae, Plantaginaceae, Platanaceae, Polygonaceae, Salicaceae, Ulmaceae, Urticaceae. The comparison between the Total

amount of pollen and AIA-pollen is helpful to be continuously forewarned if pollen types off the AIA List are going to become important.

Block B

Includes only 2-hour concentrations.

The first column lists the twelve 2-hourly periods. The second column reports the monthly mean values of Total Pollen for each 2-hourly period. These figures are useful to see what periods during the day more or less pollen is usually in the air. The concentration unit is: monthly mean of each 2-hourly concentration ($\text{p/m}^3/2\text{h}$ -monthly mean).

Block C

Includes Tree pollen (Trees = trees + shrubs + lianas) and Herb pollen. The first column reports the Monthly sum of daily concentration for Trees and Herbs; the second column shows their percentages out of the monthly sum of total pollen.

Block D

Includes the Main Pollen Classes together with their Pollen types, in concentration order. If the Main Classes are empty, Class I is shown. For each Pollen type the monthly sum and its percentage out of the Total pollen monthly sum is reported.

The Yearly table

It summarises the monthly tables reporting means, sums and maximums (Tab. 13). Also this table is divided into four blocks: A, B, C, D.

Block A

Includes concentration and percentages about Total Pollen.

Starting from the left, after the month initials, the second column is divided into six subcolumns.

The first three give the 10-day means of Total Pollen for each month.

The next three subcolumns report the monthly values (monthly mean, sum, and maximum of daily concentrations) for each month. At the bottom of subcolumn five there is the highest monthly sum of the year ($\text{p/m}^3/24\text{h}$ -monthly sum-yearly max.) and the yearly sum = yearly total of all the monthly sums ($\text{p/m}^3/24\text{h}$ -yearly sum). At the bottom of the sixth subcolumn there is the highest monthly maximum of the year ($\text{p/m}^3/24\text{h}$ -monthly max. of year). The last column of the block reports the number of pollen types recorded in each month. At the bottom there is the highest monthly number

(yearly max.) and the total number of pollen types recorded in the year (yearly total).

Block B

Includes only 2-hour mean concentrations. The first column lists the initials of the months. The second column shows the monthly mean of Total Pollen for each 2-hourly period of all the months. The daily periods with more or less pollen can be seen immediately.

Block C

Includes the monthly sums of Tree pollen and Herb pollen and their comparative percentages. At the bottom of the first and third subcolumns the highest monthly sum of the year and the yearly sum (= Yearly total) of Trees and Herbs are reported. At the bottom of the second and fourth subcolumns the comparative percentages of Trees and Herbs out of the Yearly Total are reported.

Block D

Includes the High Pollen Classes (VI, V, IV) with their Pollen types and the month/months they were present in the Class.

The illustration shows the location of the Air pollen Station and the percentage Ratio between Trees and Herbs out of the Yearly Total for 1994.

The Yearly concentration/percentage pollen spectrum

It shows the pollen types recorded in the year with their concentration and percentages values (Tab. 14). The first column lists the pollen types, in alphabetical order per Families. The second column shows their yearly sum of daily concentration ($\text{p/m}^3/24\text{h}$ -yearly sum); the third column reports their percentages out of the yearly sum of Total pollen- excluding unidentifiable pollen grains ($\text{p/m}^3/24\text{h}$ -yearly sum of Total pollen - excl. unidentifiable). At the bottom, the numbers of Leading Pollen Types and Families as well as the numbers of Families and Pollen Types (Total, Trees, Herbs) are reported.

This Yearly Concentration/Percentage Pollen Spectrum is a key point of our Airborne Pollen Calendar, as interesting as daily and monthly sequences are. In fact it gives an airpollen picture of the surrounding vegetal landscape which could be placed side by side to the ones shown by surface pollen spectra (from mosses, lichens, soil surface samples etc.) and together, these "recent pollen spectra" provide keys helpful for interpreting past pollen spectra and diagrams.

The Pollen Calendar 1994

The main features of 1994 were:

Pollen Concentrations and Percentages

1994 was a “4 Star” year. The Total pollen yearly sum was in fact 53,038 p/m³. Pollen data were missing on two days (June 12, August 19) as the pollen trap did not work.

The months of 1994 had different amounts of pollen (Fig. 1; Tab. 13).

The monthly sum range was 34-14,267 p/m³. The month with less pollen in the air was December, a “1 Star” month, which represented 0.006% of the Yearly sum. The month with most pollen was March, a “4 Star month” which represented 27% of the Yearly sum. Between the extremes there were November, a “1 Star” month; October and January, “2 Star” months, and the others, all “3 Star” months.

The Yearly mean of the monthly sums was 4,421 p/m³.

The single days of 1994 had very different Total pollen concentrations (Fig.2; Tabb. 1-12). The days with less pollen were at the end of the year, in November and December, where the daily concentration fell to 0 p/m³/24h on several days (6 in November, 11 in December; actually only in 2 and 7 days respectively, the concentration was 0, since no pollen was recorded; on the other days concentration approximated to 0). The days with most pollen were from March to June where the daily concentration was frequently over 500 p/m³/24h; it occurred mainly in March, April and May when on one or two days more than 1,000 p/m³ was in the air. The 1994 range of daily concentration was 0-1,384 p/m³/24h. The minimum, 0 p/m³/24h, as we have said, was observed only in November and December. The maximum, 1,384 p/m³/24h, occurred on March 31, mainly due to tree pollen (*Platanus*, *Betula* and *Ostrya/Carpinus orientalis*). The range of the monthly mean of daily concentration was 1- 460 p/m³; the minimum mean in December, the maximum mean in March. The monthly mean of daily concentration suggested a “Pollen Autumn-Winter” (< or around 50 p/m³/24h-monthly mean: January and February, and from October to December) which included 2 very low-pollen months (November and December with less than 5 p/m³/24h-monthly mean), a “Pollen Spring” from March to June (200-500

p/m³/24h-monthly mean) and a "Pollen Summer" (around 100 p/m³/24h-monthly mean) in July, August and September. The 1994 yearly mean of daily concentration was 145 p/m³/24h-yearly mean.

The 2-hourly concentrations showed that the total pollen amount had significant variation throughout the day. They revealed daily periods with notably higher pollen amounts on days which had poor, fair or anyway not outstanding concentrations. For example on May 2 the daily concentration was 381 p/m³/24h and the 2-hour concentration had a maximum ca. 6 times higher, in the early hours, at 0-2 a.m. (2,392 p/m³/2h). The widest 2-hourly daily range of 1994 was 428-2,760 p/m³/2h, observed on April 1 (Fig. 3; Tabb. 1-12) and the 1994 2-hourly range was 0-2,760 p/m³/2h; the maximum was observed late at night (10-12 p.m.) and was mainly due to *Platanus*.

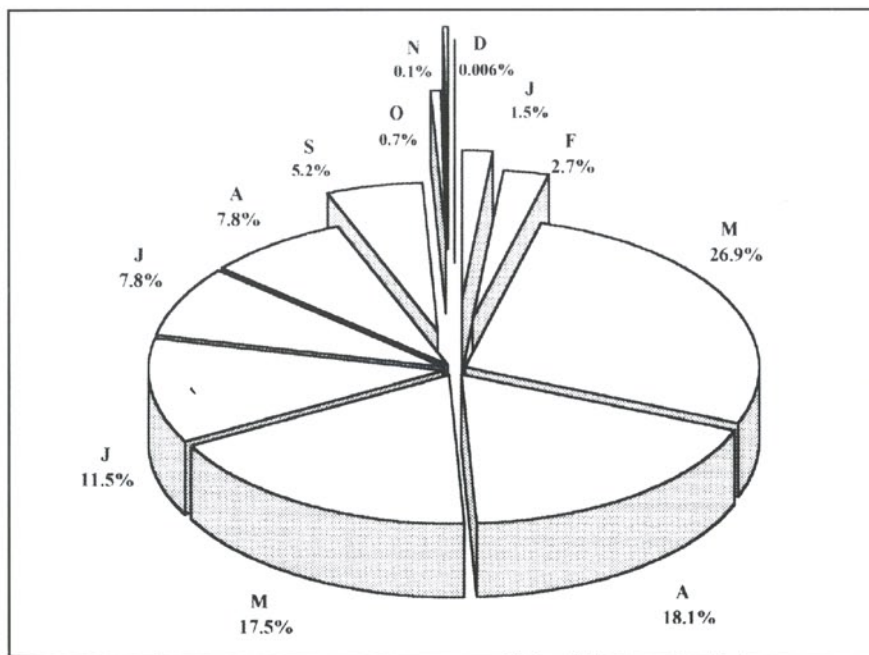


Fig. 1 - Monthly percentages of Total yearly pollen (Airborne Pollen Station - University of Modena - Botanical Garden/Geophysical Observatory)

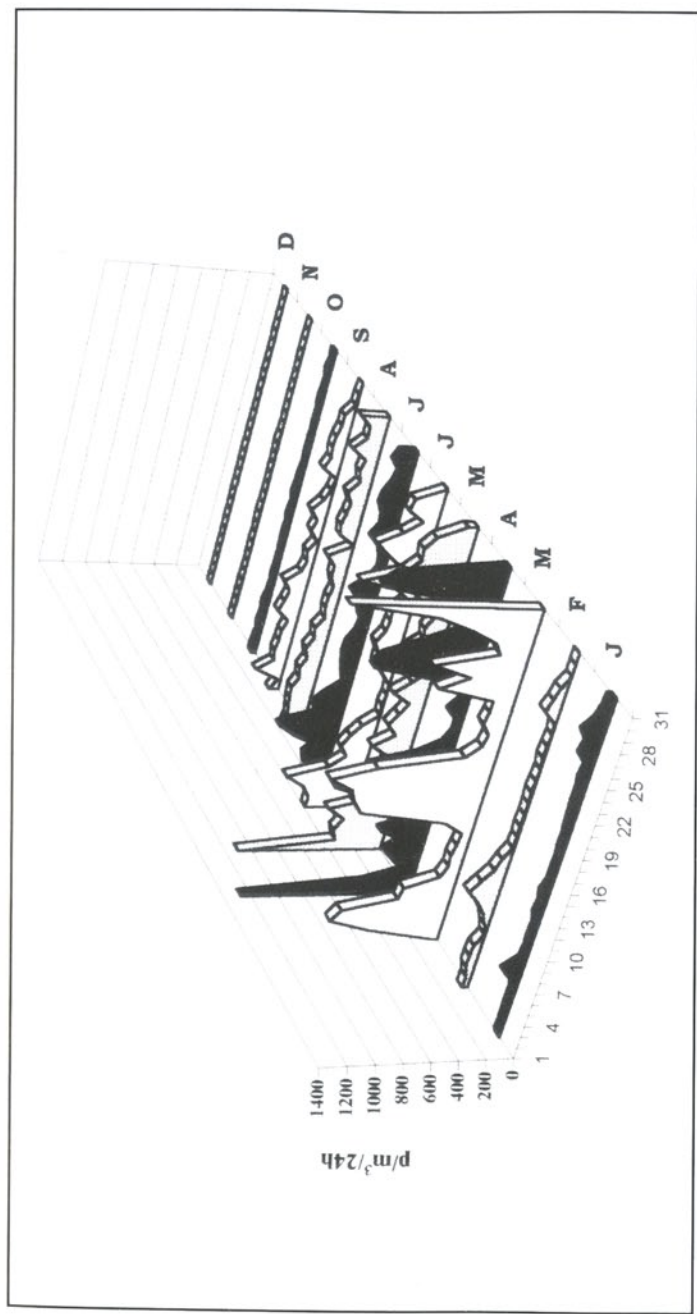


Fig. 2 - Total Pollen Calendar 1994; Daily concentrations
 (Airborne Pollen Station - University of Modena - Botanical Garden/Geophysical Observatory)

Pollen types

The number of pollen types identified in 1994 was 115; 50 per month on average, from 16 in November to 90 in June.

The Relevant and High pollen types, that is those which reached the Main Classes (II-VI) in at least one month, were 34, ca. 1/3 of the total number of pollen types recorded. Among them there were 24 Trees (trees/shrubs/lianas): *Acer*, *Alnus*, *Betula*, *Carpinus betulus*, *Castanea*, *Cedrus*, *Corylus*, Cupressaceae, *Fagus*, *Fraxinus*, *Ostrya/Carpinus orientalis*, *Humulus*, *Juglans*, *Ligustrum*, Moraceae, *Olea*, *Pinus*, *Platanus*, *Populus*, *Quercus*, *Salix*, *Syringa*, *Taxus*, *Ulmus* and 10 Herbs: *Artemisia*, Chenopodiaceae, Compositae undiff., Gramineae, Leguminosae, *Papaver*, *Plantago*, Ranunculaceae, *Rumex*, Urticaceae. The other 81 pollen types were Low, Sporadic or Rare pollen (Classes I, +, r). Among the High pollen types seven entered the top Classes (VI, V): *Populus* (5,156 p/m³ in March) and Gramineae (5,648 p/m³ in May, maximum value in the year) in Class VI, followed by *Alnus*, *Betula*, *Corylus*, *Platanus*, Urticaceae (Fig. 4). Among Low, Sporadic and Rare pollen (not reported in the monthly pages) note: *Aesculus*, *Campanula*, *Cannabis*, Caryophyllaceae, *Catalpa*, *Celtis*, *Crataegus*, Cyperaceae, *Erica*, *Eucalyptus*, *Forsythia*, *Galium* type, Liliaceae, *Nymphaea*, *Picea*, *Polygonum*, *Potentilla* type, *Prunus*, *Rhododendron*, *Rosa*, *Sambucus nigra*, *Tilia*, *Typha/Sparganium*, Umbelliferae. Tree pollen was dominant in the monthly pollen spectrum from January to March, where it was 95-99% of the monthly pollen spectrum, while later on, Herb pollen progressively took over until, in September, it reached 99% of the monthly pollen spectrum. From October to the end of 1994 tree pollen began to increase again, to 20-37%. The 1994 Tree : Herb ratio was 52 : 48 % out of the whole yearly sum of daily concentration.

The “most abundant pollen type of the month” was a title conferred to only five pollen types: 3 were trees (Cupressaceae, *Alnus*, *Populus*) and 2 were herbs (Gramineae and Urticaceae). Their sequence throughout the year was: January: Cupressaceae (Class III); February: *Alnus* (Class III); March: *Populus* (Class VI); April: Gramineae (Class V); May: Gramineae (Class VI); June: Gramineae (Class V); July: Urticaceae (Class V); August: Urticaceae (Class V); September: Urticaceae (Class V); October: Urticaceae

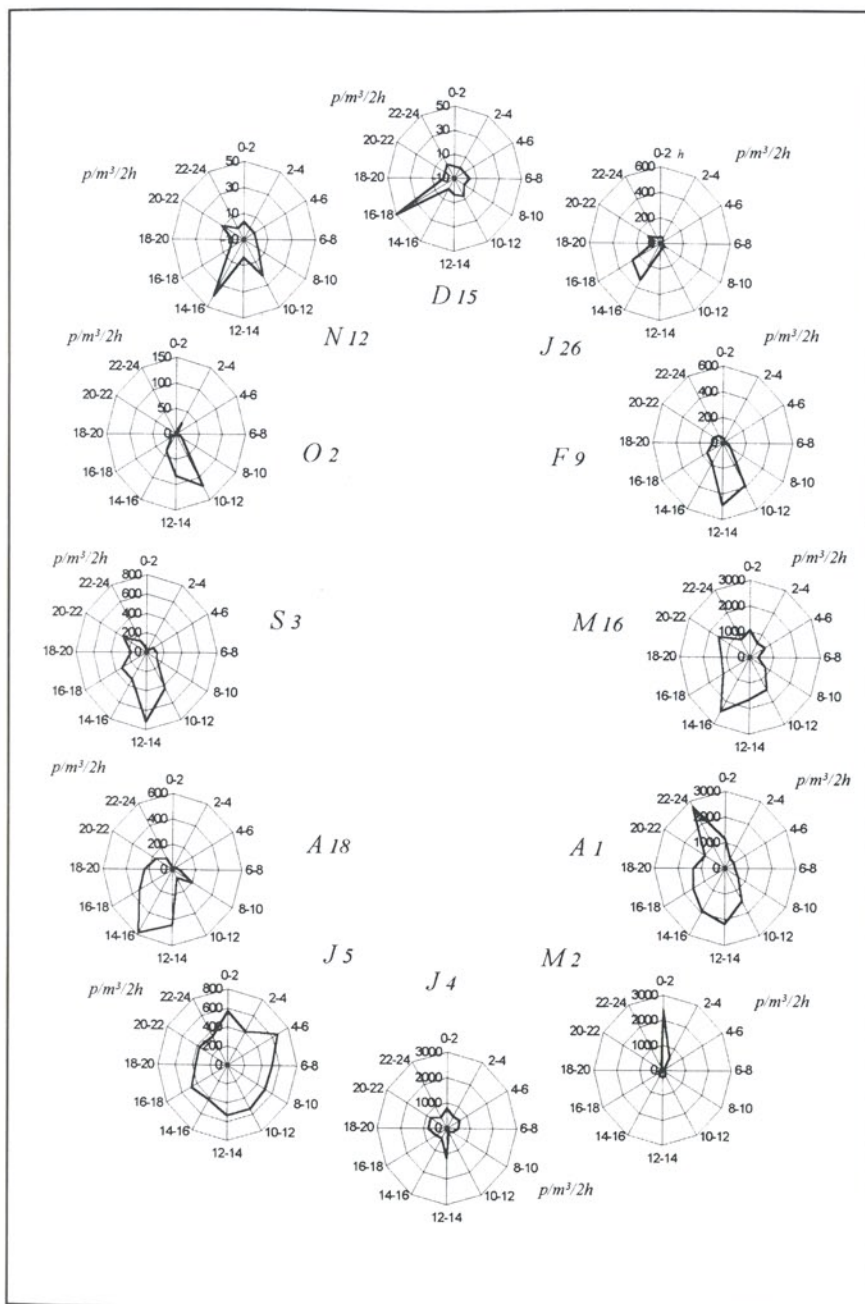


Fig. 3 - Pollen clocks: 2 hourly concentrations of Total pollen for the day with the maximum value of each month 1994 - Note the variation in scale of the clocks (Airborne Pollen Station - University of Modena - Botanical Garden/Geophysical Observatory)

(Class III); November: Urticaceae (Class I); December: Urticaceae (Class I). Note there was a continuous renewal till April; then Gramineae took the leadership up to June, giving way to Urticaceae from July to the end of 1994.

The AIA-pollen

The amount of AIA pollen often covered 95-100% of the daily Total pollen concentration. However, from April to September, its percentage was a little more frequently under 95%. The most significantly low percentage (62%) was observed on June 8 when a considerable number of pollen types was in the air; on that day the difference between AIA-Pollen and Total Pollen was mainly due to Leguminosae, *Galium* type and *Typha/Sparganium*.

The 1994 Pollen Spectrum

The 1994 Concentration/Percentage Pollen Spectrum (that is the list of pollen types with their yearly concentration and percentages out of the whole yearly sum of daily concentration) showed 115 Pollen types belonging to 57 Families. Among them there were 61 Tree pollen types and 54 Herb pollen types.

As for concentrations the yearly pollen spectrum showed that Gramineae had the maximum value of 1994, higher than 10,000 p/m³/24-yearly sum. Grasses were therefore the most abundant pollen type in 1994, we could say "the 4 Stars pollen type of 1994".

As for percentages, the yearly pollen spectrum showed that the 1994 Leading Pollen (with a percentage higher than 5 % in the yearly pollen spectrum) were only 4 and covered a little more than half the yearly pollen spectrum (56.4%). Among them there were 2 Tree pollen types (*Betula*, *Populus*) and 2 Herb pollen types (Gramineae and *Urtica dioica* type, which includes mainly *Urtica*-triporate pollen and *Parietaria*). The 1994 Escort Pollen types (with a percentage between 1.1 % and 5 % in the yearly pollen spectrum) were 12 (10 Trees and 2 Herbs). All the other were Minor Pollen (with a percentage $\leq 1\%$ in the yearly pollen spectrum). Note among them a number of exotic woody plants (*Aesculus*, *Ailanthus*, *Carya*, *Catalpa*, *Cedrus*, *Forsythia*, *Parthenocissus*, *Robinia*, *Sequoia/Taxodium*, *Sophora*).

Trees : Herb ratio of 1994, as we have said above, was 52 : 48%.

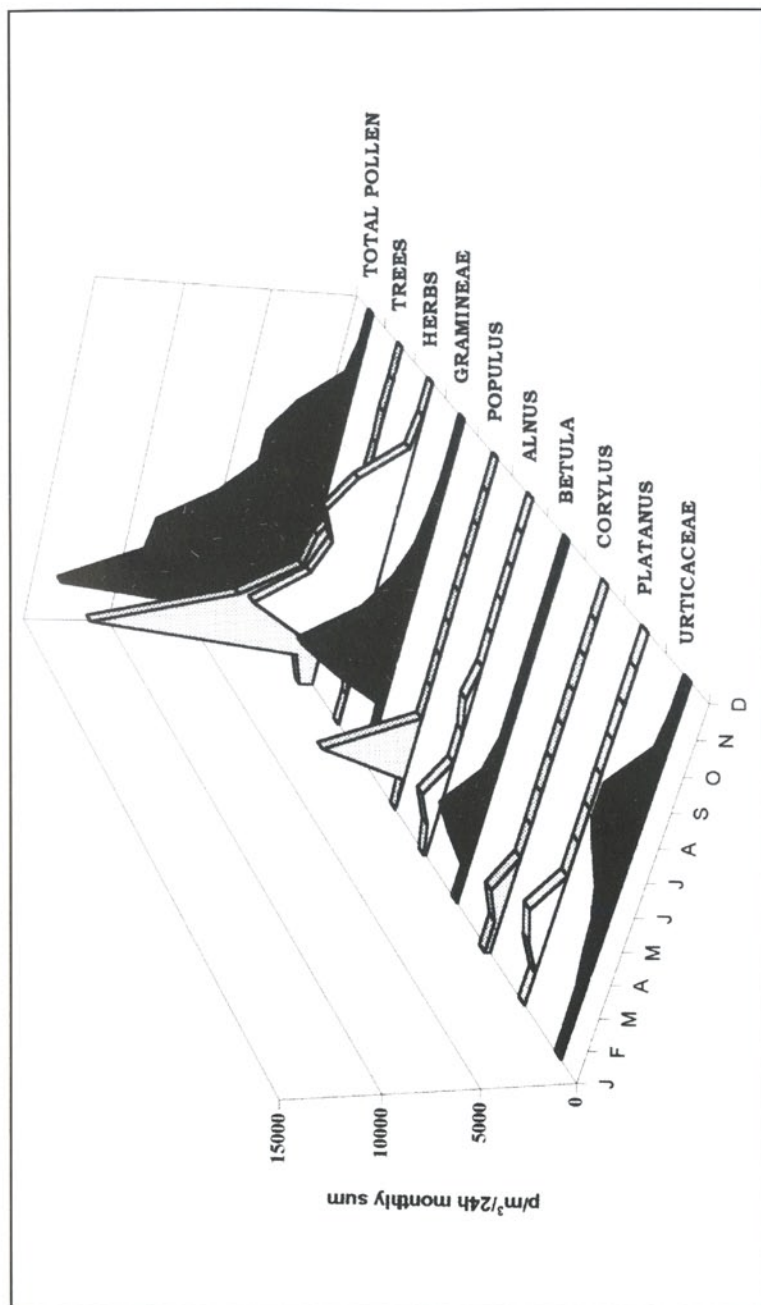


Fig. 4 - Yearly trend of Total Pollen, Tree pollen, Herb pollen and Pollen types which reached Classes VI and V in 1994 (data are expressed as monthly sums of daily concentrations)
(Airborne Pollen Station - University of Modena - Botanical Garden/Geophysical Observatory)

The pollen features of the 1994 months

January

It was a “2 Star month”, with a poor air pollen flora.

Total pollen concentration was low. The monthly sum of daily concentrations was $<1,000 \text{ p/m}^3$ (817 p/m^3) and the monthly mean was $<50 \text{ p/m}^3$ (26 p/m^3). The monthly range of daily concentration was 1-134 $\text{p/m}^3/24\text{h}$; the minimum daily conc. (1 p/m^3) was observed on January 11, 15, 17 and the maximum (134 p/m^3) was on January 28.

Air pollen flora was little varied: the total number of pollen types recorded in the month was 19 (2-8 per day). Only 3 tree pollen types entered the Main Classes (II and III). The “most abundant pollen type of the month” were Cupressaceae (318 p/m^3)

Tree pollen prevailed (Trees = 95%; Herbs = 5% of the monthly pollen spectrum). Trees were both conifers and deciduous broadleaf woods, mainly *Corylus* and Cupressaceae (Class III), followed by *Alnus* (Class II). Among Herbs none achieved the Main Classes.

The widest 2-hour daily range was 18 - 328 $\text{p/m}^3/2\text{h}$ on January 26, and the monthly range was 0-328 $\text{p/m}^3/2\text{h}$. In 21 days the 2-hour conc. fell to 0. The 2-hour maximum of the month was observed at 2-4 p.m.; note it was more than three time higher than the daily concentration of that day (94 p/m^3), and was mainly due to Cupressaceae and *Corylus*. In January the monthly mean of the 2-hours intervals was very similar: 15-40 $\text{p/m}^3/2\text{h}$. The afternoon, from 12 to 6 p.m. was the daily period with more pollen in the air (31- 40 $\text{p/m}^3/2\text{h}$ -monthly mean) while the period with less pollen was in the late afternoon, at 6-8 p.m. (15 $\text{p/m}^3/2\text{h}$ -monthly mean).

JANUARY 1994



A

DAY	TOTAL POLLEN			AIA LIST		POLLEN TYPES n°/24h
	p/m ³ /24 h	p/m ³ /2h		p/m ³ /24 h	%	
		min	max			
1	2	0	10	2	100	4
2	2	0	7	2	100	3
3	5	0	23	5	100	4
4	5	0	14	5	100	3
5	4	0	11	4	100	4
6	25	7	71	25	100	4
7	120	25	288	120	100	6
8	10	0	37	10	100	5
9	4	0	23	4	91	3
10	5	0	18	5	92	7
p/m ³ /24 h						
10-day sum						
10-day mean						
11	1	0	9	0	50	2
12	25	0	164	25	100	3
13	13	0	32	13	100	4
14	34	7	72	34	100	3
15	1	0	7	1	100	3
16	5	0	32	5	100	4
17	1	0	13	1	100	2
18	9	0	64	9	100	2
19	7	0	32	7	100	2
20	15	0	40	15	100	4
p/m ³ /24 h						
10-day sum						
10-day mean						
21	18	4	32	18	100	5
22	24	5	59	24	100	4
23	22	0	64	22	100	4
24	31	0	103	31	100	6
25	18	0	50	18	100	5
26	94	18	328	92	99	8
27	70	18	184	69	100	7
28	134	43	245	134	100	6
29	58	25	90	58	100	5
30	32	0	65	32	100	6
31	25	7	68	25	100	4
p/m ³ /24 h						
10-day sum						
10-day mean						
p/m ³ /24 h						
monthly sum						
monthly mean						
monthly max						

⇓ Cupressaceae - *Corylus*

B

2 HOURS	TOTAL POLLEN p/m ³ /2h monthly mean
0-2	29
2-4	26
4-6	19
6-8	18
8-10	26
10-12	27
12-14	37
14-16	40
16-18	31
18-20	15
20-22	24
22-24	24

C

TREES	
p/m ³ /24 h	
monthly sum	%
777	95
HERBS	
p/m ³ /24 h	
monthly sum	%
40	5

D

POLLEN CLASSES	
monthly sum	
VI:	
V:	
IV:	
III:	Cupressaceae (318 p/m ³ ; 38.9%); Corylus (314 p/m ³ ; 38.4%)
II:	Alnus (92 p/m ³ ; 11.3%)

Tab. 1 - Airborne Pollen Calendar 1994: Pollen data of January (Airborne Pollen Station - University of Modena - Botanical Garden/Geophysical Observatory)

February

It was a "3 Star month", with a poor air pollen flora.

Pollen concentration rose a little: the monthly sum of daily concentration was about $1,500 \text{ p/m}^3$ ($1,449 \text{ p/m}^3$) and the monthly mean was around 50 p/m^3 , double that of January. The monthly range of daily conc. was greater than in January ($4\text{-}228 \text{ p/m}^3/24\text{h}$). The maximum daily concentration was observed on February 10 (228 p/m^3), also double that of January, and the minimum on February 21 and 24 (4 p/m^3).

Air pollen flora was altogether similar to the previous month; there was only a little increase in the number of daily pollen types (19 pollen types; 4-10 per day). Nevertheless note the number of pollen types in the Main pollen Classes doubled, as three tree pollen types joined the three of January. As in January no pollen type was over Class III. The "most abundant pollen type of the month" was *Alnus* (435 p/m^3).

Tree pollen was almost alone (Trees = 99%; Herbs = 1% of the monthly pollen spectrum). Pollen assemblages again included deciduous broadleaf woods and conifers and were mainly formed by the former *Alnus*, Cupressaceae and *Corylus* joined by *Ulmus* (Class III), *Fraxinus* and *Populus* (Class II). Among Herbs no pollen type reached the Main Classes.

The widest 2-hour daily range was observed on February 9 ($11\text{-}490 \text{ p/m}^3/2\text{h}$) and the monthly range was $0\text{-}490 \text{ p/m}^3/2\text{h}$. The maximum 2-hour value in the month was at 12-2 p.m., more than three time higher than the daily concentration of that day. It was mainly due to Cupressaceae, *Ulmus* and *Fraxinus*. The intervals with concentration = 0 were observed on 15 days, mainly in the last 10-days. In February the monthly mean of the 2-hour intervals was $36\text{-}90 \text{ p/m}^3/2\text{h}$. The daily period with most pollen was from 10 a.m. to 4 p.m. ($74\text{-}90 \text{ p/m}^3/2\text{h}$ -monthly mean), when the maximum value of the month fell, while the daily periods with less pollen were in the early morning and at night (6-8 a.m. and 10-12 p.m.: $36\text{-}37 \text{ p/m}^3/2\text{h}$ -monthly mean, respectively).

FEBRUARY 1994



A

DAY	TOTAL POLLEN			AIA LIST		POLLEN TYPES n°/24h
	p/m ³ /24 h	p/m ³ /2h		p/m ³ /24 h	%	
		min	max			
1	41	22	65	41	99	7
2	38	11	108	38	99	7
3	66	18	180	66	100	6
4	68	0	156	67	100	8
5	59	0	148	59	100	6
6	6	0	23	6	100	6
7	33	0	90	33	100	5
8	72	18	137	72	100	7
9	138	11	490	138	100	7
10	228	90	389	228	100	7
p/m ³ /24 h						
10-day sum	748			747		
10-day mean	75					
11	164	8	483	162	99	10
12	96	32	188	96	100	7
13	65	18	144	64	99	7
14	14	4	32	13	96	7
15	11	4	22	11	100	6
16	17	4	47	17	98	7
17	8	0	26	8	100	8
18	9	0	25	9	100	7
19	17	0	32	17	100	6
20	11	0	42	11	100	6
p/m ³ /24 h						
10-day sum	411			407		
10-day mean	41					
21	4	0	12	3	75	5
22	16	0	66	15	94	7
23	12	0	19	12	100	6
24	4	0	13	4	100	4
25	16	0	68	16	100	8
26	111	0	428	110	98	9
27	76	0	223	71	93	7
28	51	4	137	47	92	8
p/m ³ /24 h						
10-day sum	290					
10-day mean	36					
p/m ³ /24 h						
monthly sum	1449			1434		19
monthly mean	52					
monthly max	228		490	228		10

⇓ *Cupressaceae, Ulmus, Fraxinus*

B

2 HOURS	TOTAL POLLEN p/m ³ /2h monthly mean
0-2	41
2-4	49
4-6	40
6-8	36
8-10	41
10-12	74
12-14	90
14-16	78
16-18	49
18-20	39
20-22	46
22-24	37

C

TREES	
p/m ³ /24 h	
monthly sum	%
1429	99
HERBS	
p/m ³ /24 h	
monthly sum	%
20	1

D

POLLEN CLASSES
monthly sum
VI:
V:
IV:
III: <i>Alnus</i> (435 p/m ³ ; 30.0%); <i>Cupressaceae</i> (392 p/m ³ ; 27.1%); <i>Corylus</i> (291 p/m ³ ; 20.1%); <i>Ulmus</i> (138 p/m ³ ; 9.6%)
II: <i>Populus</i> (90 p/m ³ ; 6.2%); <i>Fraxinus</i> (66 p/m ³ ; 4.6%)

Tab. 2 - Airborne Pollen Calendar 1994: Pollen data of February (Airborne Pollen Station - University of Modena - Botanical Garden/Geophysical Observatory)

March

March was a “4 Star month”, the one with most pollen in the air in 1994, and with a rich air pollen flora.

The monthly sum of daily conc. rose abruptly 10 times higher compared to February ($14,267 \text{ p/m}^3/24\text{h}$) and the monthly mean approached 500 p/m^3 ($460 \text{ p/m}^3/24\text{h}$). The monthly range of daily conc. was decidedly greater than before ($46\text{--}1,384 \text{ p/m}^3/24\text{h}$). In two days pollen conc. was over $1,000 \text{ p/m}^3/24\text{h}$: one of them was March 31 when the maximum daily conc. was observed ($1,384 \text{ p/m}^3$), over sixfold higher than the February one. The minimum was on March 1 (46 p/m^3). The March maximum was the highest in the year and was mainly due to *Platanus*, *Betula* and *Ostrya/Carp. or.*

Airpollen flora was rich and testified the blooms of many plants: 59 pollen types were recorded, 3 times more than in February (7-35 per day). In all the Main Classes there were pollen types, 15 altogether, nearly 3 times more than in February. The 6 February pollen types were in fact joined by 9 new ones (*Betula*, *Taxus*, *Platanus*, *Ostrya/Carp. or.*, *Quercus*, *Salix*, *Acer*, *Carpinus betulus*, Gramineae, in decreasing order). The “most abundant pollen type of the month” was *Populus* ($5,156 \text{ p/m}^3$).

Trees were still highly dominant (97% of the monthly spectrum) and several of them entered the higher Classes (IV-VI) deserving the rank of High Pollen: *Populus* had its highest peak (Class VI: $5,156 \text{ p/m}^3$ -monthly sum); 3 pollen types were over $1,000 \text{ p/m}^3$ = Class V (*Alnus*, *Betula*, *Corylus*) and 5 were over 500 p/m^3 = Class IV (*Taxus*, *Platanus*, *Fraxinus*, Cupressaceae, *Ostrya/Carp. or.*). Several other deciduous trees were in Class III (*Quercus*, *Salix*, *Ulmus*, *Acer*, *Carpinus betulus*). Among herb pollen one type became relevant: it was Gramineae, which entered Class II. Pollen assemblages were largely dominated by deciduous broadleaf woods.

The widest 2-hour daily range was on March 3 ($65\text{--}2,390 \text{ p/m}^3/2\text{h}$); the monthly range was $0\text{--}2,449 \text{ p/m}^3/2\text{h}$. The maximum 2-hour conc. of the month, almost fivefold more than February, was observed on March 16 at 2-4 p.m. It was double the mean daily conc. of that day, and was mainly due to *Populus* and *Fraxinus*. As for the minimum values, note that the 2-hour conc. fell to 0 only on one day, March 1. In March, despite the wide gap between minimum and maximum, since the time schedule of the variation changed during the month, a daily period with significantly more or less pollen did not emerge. In fact the monthly mean of the 2-hour intervals were similar, their range being $331\text{--}540 \text{ p/m}^3/2\text{h}$ -monthly mean. The day periods with relatively most pollen, from 500 to $540 \text{ p/m}^3/2\text{h}$ -monthly mean, were observed in the late morning (10-12 a.m. when the maximum fell), at 2-4 p.m. and in the early hours (0-2 a.m.); on the contrary, the periods with the least pollen ($330\text{--}400 \text{ p/m}^3/2\text{h}$) were observed in the early morning, between 4 and 8 p.m., and in the early evening, at 6-8 p.m.

MARCH 1994



A

DAY	TOTAL POLLEN		AIA LIST		POLLEN TYPES n°/24h
	p/m ³ /24 h	p/m ³ /2h min max	p/m ³ /24 h	%	
1	46	0 248	45	98	11
2	548	36 1130	548	100	7
3	865	65 2390	864	100	10
4	804	402 1686	800	100	14
5	402	173 602	400	100	12
6	384	164 698	384	100	9
7	136	58 191	136	100	8
8	96	23 178	96	100	8
9	102	45 192	102	100	8
10	87	36 139	87	100	9
p/m ³ /24 h 10-day sum	3470		3463		
10-day mean	347				
11	72	10 152	70	98	8
12	225	52 522	225	100	11
13	877	384 1790	875	100	13
14	945	317 2052	944	100	15
15	983	464 2030	981	100	18
16	1164	360 2449	1162	100	17
17	846	305 2245	842	99	19
18	233	86 351	226	97	20
19	132	52 298	123	93	25
20	114	55 194	110	96	22
p/m ³ /24 h 10-day sum	5591		5557		
10-day mean	559				
21	181	62 366	179	99	20
22	159	45 277	150	94	24
23	157	81 207	155	99	17
24	585	155 1640	576	98	26
25	375	187 689	358	95	27
26	674	338 1487	663	98	33
27	214	33 1106	201	94	27
28	273	162 483	261	96	21
29	474	150 971	459	97	22
30	732	306 1154	728	99	16
31	1384	590 2106	1366	99	35
p/m ³ /24 h 10-day sum	5206		5096		
10-day mean	473				
p/m ³ /24 h monthly sum	14267		14117		59
monthly mean	460				
monthly max	1384	2449	1366		35

⚡ *Populus, Fraxinus*

B

2 HOURS	TOTAL POLLEN p/m ³ /2h monthly mean
0-2	502
2-4	471
4-6	398
6-8	331
8-10	462
10-12	540
12-14	473
14-16	529
16-18	430
18-20	404
20-22	498
22-24	484

C

TREES	
p/m ³ /24 h monthly sum	%
13860	97
HERBS	
p/m ³ /24 h monthly sum	%
408	3

D

POLLEN CLASSES
monthly sum
VI: <i>Populus</i> (5156 p/m ³ ; 36.1%)
V: <i>Alnus</i> (1229 p/m ³ ; 8.6%);
<i>Betula</i> (1218 p/m ³ ; 8.5%);
<i>Corylus</i> (1051 p/m ³ ; 7.4%)
IV: <i>Taxus</i> (947 p/m ³ ; 6.6%);
<i>Platanus</i> (935 p/m ³ ; 6.6%);
<i>Fraxinus</i> (741 p/m ³ ; 5.2%);
<i>Cupressaceae</i> (736 p/m ³ ; 5.2%);
<i>Ostrya/Car.or.</i> (636 p/m ³ ; 4.5%)
III: <i>Quercus</i> (347 p/m ³ ; 2.4%);
<i>Salix</i> (344 p/m ³ ; 2.4%);
<i>Ulmus</i> (327 p/m ³ ; 2.3%);
<i>Acer</i> (170 p/m ³ ; 1.2%);
<i>Carpinus betulus</i> (121 p/m ³ ; 0.9%)
II: <i>Gramineae</i> (76 p/m ³ ; 0.5%)

Tab. 3 - Airborne Pollen Calendar 1994: Pollen data of March (Airborne Pollen Station - University of Modena - Botanical Garden/Geophysical Observatory)

April

It was a “3 Star month”, with a rich air pollen flora.

After the peak of March the pollen content of the air began to thin. The monthly sum of daily conc. decreased to 2/3 of March (9,613 p/m³/24h) and the monthly mean decreased to 320 p/m³/24h. The monthly range of daily conc. was always very wide (10-1,275 p/m³/24h). The daily conc. was over 1,000 p/m³/24h on one day, April 1: it was the monthly maximum (1,275 p/m³), similar to that of March 31. The minimum was on April 17 (10 p/m³).

While pollen conc. decreased significantly, the variety in airpollen flora was on an upward trend: 74 pollen types were recorded (8-34 per day), 15 more than in March. The Main Classes (except Class VI which was empty) included 13 pollen types, 2 less than in March. While in the previous two months there had been only an addition of new pollen types, in April there began a renewal. Only half of March pollen types were left (8 out of 15: Gramineae, *Betula*, *Platanus*, *Quercus*, *Fraxinus*, *Ostrya/Carp. or.*, *Taxus*, *Salix*), and 5 new pollen types joined (Urticaceae, Moraceae, *Olea*, *Juglans*, *Syringa*). In the higher Classes (V, IV) there were 4 pollen types (Gramineae, *Betula*, *Platanus*, *Quercus*).

Trees began to give way to herbs (Trees = 60%; Herbs = 40% in the monthly spectrum). Among tree pollen, only three were major ones, two of which had a monthly conc. over 1,000 p/m³ (*Betula* and *Platanus*: Class V) and one over 500 p/m³ (*Quercus*: Class IV). The others crowded Class III; among them note Moraceae, *Juglans* and *Olea*. Gramineae, which jumped to Class V (3,137 p/m³) were responsible for the sharp rise in herb pollen, and were “the most abundant pollen type in the month”. They were accompanied by Urticaceae (Class III). The monthly pollen assemblage was characterised by deciduous broadleaf trees and grasses.

The widest 2-hour daily range was 428-2,760 p/m³/2h, observed on April 1 and the monthly range was 0-2,760 p/m³/2h, similar to March. The latter value, the maximum of the month, exceeded the March one and was the highest of the year. It was late at night (10-12 p.m.) and was double the daily conc., mainly due to *Platanus*. The 2-hours conc. fell more often to 0 (on 8 days), mainly in the second 10-days. Also in April, as in March, the mean values of the 2-hour intervals were almost similar: 251-423 p/m³/2h-monthly mean; the highest conc. (423 p/m³/2h-monthly mean) was in the early hours (0-2 a.m.); the lowest (ca. 250 p/m³/2h), early in the morning, at 4-8 a.m., and in the evening, at 8-10 p.m.

APRIL 1994



A

DAY	TOTAL POLLEN			AIA LIST		POLLEN TYPES n°/24h
	p/m ³ /24 h	p/m ³ /2h		p/m ³ /24 h	%	
	h	min	max			
1	1275	428	2760	1247	98	30
2	344	9	1309	325	95	27
3	67	0	277	61	91	20
4	171	0	437	164	96	21
5	270	7	1206	268	99	22
6	131	3	279	123	94	24
7	358	75	562	347	97	23
8	100	14	421	98	98	22
9	276	22	814	270	98	25
10	112	43	184	105	94	22
p/m ³ /24 h						
10-day sum	3105			3008		
10-day mean	311					
11	27	0	65	18	68	11
12	163	12	600	149	91	22
13	584	371	806	560	96	27
14	233	139	351	222	95	30
15	61	16	147	52	86	20
16	16	0	50	16	98	8
17	10	0	37	9	90	10
18	107	0	375	101	94	21
19	24	0	69	24	97	11
20	103	12	261	101	98	15
p/m ³ /24 h						
10-day sum	1329			1252		
10-day mean	133					
21	283	166	490	257	91	25
22	777	461	1573	737	95	34
23	706	442	1208	678	96	29
24	463	326	755	443	96	26
25	242	0	762	219	91	21
26	120	5	369	112	93	23
27	636	78	1254	585	92	22
28	314	126	625	287	91	27
29	873	404	2115	853	98	28
30	765	194	2192	687	90	32
p/m ³ /24 h						
10-day sum	5178			4857		
10-day mean	518					
p/m ³ /24 h						
monthly sum	9613			9117		74
monthly mean	320					
monthly max	1275		2760	1247		34

♣ *Platanus*

B

2 HOURS	TOTAL POLLEN p/m ³ /2h monthly mean
0-2	423
2-4	377
4-6	251
6-8	257
8-10	289
10-12	378
12-14	363
14-16	330
16-18	344
18-20	273
20-22	256
22-24	305

C

TREES	
p/m ³ /24 h	
monthly sum	%
5764	60
HERBS	
p/m ³ /24 h	
monthly sum	%
3849	40

D

POLLEN CLASSES
monthly sum
VI:
V: Gramineae (3137 p/m ³ ; 32.6%); Betula (2291 p/m ³ ; 23.9%); Platanus (1442 p/m ³ ; 15.0%)
IV: Quercus (546 p/m ³ ; 5.7%)
III: Fraxinus (415 p/m ³ ; 4.3%); Ostrya/Car.or. (315 p/m ³ ; 3.3%); Urticaceae (276 p/m ³ ; 2.9%); Moraceae (188 p/m ³ ; 2.0%); Olea (124 p/m ³ ; 1.3%); Juglans (118 p/m ³ ; 1.2%); Taxus (104 p/m ³ ; 1.1%)
II: Salix (82 p/m ³ ; 0.9%); Syringa (68 p/m ³ ; 0.7%)

Tab. 4 - Airborne Pollen Calendar 1994: Pollen data of April (Airborne Pollen Station - University of Modena - Botanical Garden/Geophysical Observatory)

May

It was a “3 Star month”, with a very rich air pollen flora.

The pollen content of the air was almost stationary; the monthly sum of daily concentration dropped a little ($9,305 \text{ p/m}^3/24\text{h}$) compared to April as well as the monthly mean ($300 \text{ p/m}^3/24\text{h}$). The monthly range of daily conc. was still quite wide ($56\text{--}1,105 \text{ p/m}^3/24\text{h}$). Only on one day the concentration was over $1,000 \text{ p/m}^3/24\text{h}$: it was on May 1 when the maximum daily conc. was observed ($1,105 \text{ p/m}^3$), similar to April 1. The minimum was on May 18 (56 p/m^3).

Airpollen flora variety increased further: 89 pollen types were recorded, 15 more than in April as well as the pollen types per day (15–37). Pollen types also increased in Main Classes (17 instead of 13). It must be noted that two high Classes (IV, V) were empty and Class III was crowded (10 pollen types). The renewal continued. Only half of April's pollen types were left (7: Gramineae, *Betula*, *Quercus*, *Fraxinus*, *Olea*, *Syringa*, Moraceae) while 9 new types joined the Main Classes: *Pinus*, *Rumex*, Compositae, *Fagus*, *Ligustrum*, *Papaver*, *Plantago*, Leguminosae, Ranunculaceae; and one, Cupressaceae, returned. The “most abundant pollen type of the month” were Gramineae ($5,648 \text{ p/m}^3$).

In April pollen assemblages were dominated by herbs for the first time (Trees = 26%; Herbs = 74% in the monthly spectrum). All tree pollen were $<500 \text{ p/m}^3$ (*Pinus* and *Betula* being the highest: $460\text{--}470 \text{ p/m}^3$) and one was $<100 \text{ p/m}^3$ (*Ligustrum*). The increase in herb pollen was brought about by Gramineae, which occupied Class VI ($5,648 \text{ p/m}^3 = 60\%$ of the monthly spectrum). Grasses were escorted by some other herbs (III–II Classes: *Rumex*, Compositae, *Papaver*, etc.). The monthly pollen assemblage was characterised by herbs, mainly grasses.

The widest 2-hour daily range was $71\text{--}2,392 \text{ p/m}^3/2\text{h}$, on May 2 and the monthly range was $0\text{--}2,392 \text{ p/m}^3/2\text{h}$, similar to April. Gramineae were largely accountable for the 2-hour peak value of the month, which was observed in the early hours (0–2 a.m.) on May 2, and was 6 times higher than the daily concentration. Note that the 2-hour concentration fell less frequently to 0 (on 3 days). Also in May, as in April and March, the mean values of the 2-hour intervals were quite similar: $243\text{--}401 \text{ p/m}^3/2\text{h}$. The relatively highest mean value, $401 \text{ p/m}^3/2\text{h}$, was also observed in the early hours (0–2 a.m.); the lowest mean values (around $250 \text{ p/m}^3/2\text{h}$), were in the early morning, at 4–8 a.m., and in the evening, at 8–12 p.m., almost the same concentrations and trend as in April.

MAY 1994



A

DAY	TOTAL POLLEN			AIA LIST		POLLEN TYPES n°/24h
	p/m ³ /24 h	p/m ³ /2h		p/m ³ /24 h	%	
		min	max			
1	1105	461	1728	1076	97	37
2	381	71	2392	375	98	25
3	418	162	922	402	96	34
4	360	94	938	332	92	36
5	502	5	1295	486	97	24
6	170	0	500	163	96	24
7	494	47	1274	476	96	29
8	259	32	579	250	97	18
9	171	8	626	170	99	15
10	160	4	475	151	94	22
p/m ³ /24 h						
10-day sum	4020			3880		
10-day mean	402					
11	309	16	889	303	98	29
12	152	28	388	148	97	24
13	236	25	432	226	96	22
14	174	58	324	159	91	28
15	120	61	269	104	87	37
16	270	131	645	261	97	22
17	149	20	314	127	85	35
18	56	0	171	48	85 ^b	18
19	274	16	709	263	96	26
20	265	82	763	238	90	37
p/m ³ /24 h						
10-day sum	2003			1876		
10-day mean	200					
21	158	73	253	147	93	30
22	179	48	313	171	96	28
23	125	65	224	110	88	31
24	242	83	529	197	82	29
25	306	51	535	297	97	25
26	754	356	1263	715	95	32
27	440	191	612	401	91	34
28	352	182	491	341	97	31
29	362	204	551	338	93	36
30	288	8	388	264	91	36
31	75	0	230	75	99	19
p/m ³ /24 h						
10-day sum	3281			3055		
10-day mean	298					
p/m ³ /24 h						
monthly sum	9305			8811		89
monthly mean	300					
monthly max	1105		2392	1076		37

⌋ Gramineae

B

2 HOURS	TOTAL POLLEN p/m ³ /2h monthly mean
0-2	401
2-4	296
4-6	248
6-8	269
8-10	338
10-12	293
12-14	349
14-16	336
16-18	296
18-20	281
20-22	243
22-24	253

C

TREES	
p/m ³ /24 h	
monthly sum	%
2458	26
HERBS	
p/m ³ /24 h	
monthly sum	%
6847	74

D

POLLEN CLASSES	
monthly sum	
VI: Gramineae (5648 p/m ³ ; 60.7% incl. Avena/Triticum type: 82 p/m ³ ; 0.9%)	
V:	
IV:	
III: Pinus (471 p/m ³ ; 5.1%);	
Betula (459 p/m ³ ; 4.9%);	
Quercus (338 p/m ³ ; 3.6%);	
Fraxinus (238 p/m ³ ; 2.6%);	
Olea (225 p/m ³ ; 2.4%);	
Syringa (148 p/m ³ ; 1.6%);	
Rumex (144 p/m ³ ; 1.5%);	
Cupressaceae (137 p/m ³ ; 1.5%);	
Compositae (117 p/m ³ ; 1.3%);	
Fagus (115 p/m ³ ; 1.2%)	
II: Ligustrum (91 p/m ³ ; 1.8%); Papaver (75 p/m ³ ; 0.8%); Plantago (71 p/m ³ ; 0.8%); Moraceae (65 p/m ³ ; 0.7%); Leguminosae (54 p/m ³ ; 0.6%); Ranunculaceae (52 p/m ³ ; 0.6%)	

Tab. 5 - Airborne Pollen Calendar 1994: Pollen data of May (Airborne Pollen Station - University of Modena - Botanical Garden/Geophysical Observatory)

June

It was a “3 Star month”, with a very rich air pollen flora, the richest in the year.

The pollen content of the air decreased significantly to ca. 2/3 of May. The monthly sum of daily concentration was 6,086 $\text{p/m}^3/24\text{h}$ and the monthly mean was 210 $\text{p/m}^3/24\text{h}$. The daily conc. no longer reached 1,000 $\text{p/m}^3/24\text{h}$. The monthly range of daily conc. was less wide (7-597 $\text{p/m}^3/24\text{h}$). The maximum daily conc. was observed on June 4 (597 $\text{p/m}^3/24\text{h}$), half of May's maximum. The minimum conc. fell under 10 $\text{p/m}^3/24\text{h}$; it occurred on two days, June 10 and 13 (7 $\text{p/m}^3/24\text{h}$).

Air pollen flora had the richest variety in the year, even if it had only one pollen type more than in May: 90 pollen types were recorded (4-38 per day), the highest number in 1994. Nevertheless the pollen types entering the Main Classes (II-V; Class VI was empty) decreased (12 pollen types compared to 17 in May). The renewal of the pollen flora continued. Half of the May pollen types were left over (8: Gramineae, *Pinus*, *Plantago*, *Olea*, Compositae, *Ligustrum*, Cupressaceae, *Rumex*) and 4 joined: Urticaceae, *Alnus*, *Castanea* and Cheno-Amaranthaceae, the latter two new to these Classes).

Tree/Herb ratio was almost stationary (Trees = 33%; Herbs = 67 % in the monthly spectrum). Among trees *Castanea* was over 500 p/m^3 (976 p/m^3 ; Class IV). Herb pollen mainly consisted of Gramineae, again “the most abundant pollen of the month” (2,467 p/m^3 ; Class V) but a little under half the May value, and Urticaceae (Class IV) accompanied by some relevant pollen types, mainly weeds (III-II Classes: *Plantago*, Cheno-Amaranthaceae, Compositae, *Rumex*). The monthly pollen assemblage was dominated by herbs, mainly grasses and weeds. Trees were mainly represented by *Castanea*, *Alnus*, *Pinus*.

The 2-hour concentration fell fivefold to 0. The widest 2-hour range, observed on June 4, was 141-1,158 $\text{p/m}^3/2\text{h}$, and the monthly range was 0-1,158 $\text{p/m}^3/2\text{h}$. The highest 2-hour conc. was attained at 12-2 p.m. It was double the mean daily concentration of that day (597 $\text{p/m}^3/24\text{h}$) and was produced by Gramineae and *Pinus*. Also in June, as occurred from March onwards, the mean values of the 2-hour intervals were similar to each other (181-274 $\text{p/m}^3/2\text{h}$ -monthly mean); the day period with most pollen (274 $\text{p/m}^3/2\text{h}$ -monthly mean) was observed early in the afternoon, at 12-2 p.m.; the ones with less pollen (around 180 $\text{p/m}^3/2\text{h}$ -monthly mean), were in the early morning, at 2-4 a.m. and 6-8 a.m.

JUNE 1994



A

DAY	TOTAL POLLEN			AIA LIST		POLLEN TYPES n°/24h
	p/m ³ /24 h	p/m ³ /2h		p/m ³ /24 h	%	
		min	max			
1	385	114	319	371	96	25
2	382	222	519	370	97	32
3	444	205	684	391	88	38
4	597	141	1158	559	94	37
5	292	158	483	271	93	36
6	179	78	351	152	85	37
7	242	150	324	225	93	34
8	188	103	257	117	62	30
9	122	5	301	117	95	20
10	7	0	24	7	100	4
p/m ³ /24 h 10-day sum	2839			2578		
10-day mean	284					
11	14	0	40	11	79	14
12	-	-	-	-	-	-
13	7	0	33	8	100	6
14	84	24	249	82	97	18
15	160	41	224	152	95	29
16	166	86	298	156	94	30
17	212	111	289	203	96	22
18	154	53	290	146	95	25
19	145	29	257	138	96	30
20	151	20	404	147	97	21
p/m ³ /24 h 10-day sum	1094			1043		
10-day mean	122					
21	64	23	141	62	96	15
22	180	37	406	177	99	21
23	159	67	281	157	99	20
24	194	61	290	188	97	26
25	312	205	470	309	99	17
26	419	115	1093	410	98	25
27	241	0	579	236	98	20
28	114	0	432	110	97	21
29	244	103	638	241	99	15
30	227	72	565	224	99	22
p/m ³ /24 h 10-day sum	2153			2114		
10-day mean	215					
p/m ³ /24 h monthly sum	6086			5735		90
monthly mean	210					
monthly max	597		1158	559		38

⇓ **Gramineae, Pinus**

B

2 HOURS	TOTAL POLLEN p/m ³ /2h monthly mean
0-2	194
2-4	183
4-6	192
6-8	181
8-10	212
10-12	249
12-14	274
14-16	222
16-18	214
18-20	199
20-22	205
22-24	192

C

TREES	
p/m ³ /24 h monthly sum	%
2026	33
HERBS	
p/m ³ /24 h monthly sum	%
4060	67

D

POLLEN CLASSES	
monthly sum	
VI:	
V: Gramineae (2467 p/m ³ ; 40.5%)	
IV: Castanea (976 p/m ³ ; 16.0%); Urticaceae (840 p/m ³ ; 13.8%)	
III: Alnus (403 p/m ³ ; 6.6%); Pinus (263 p/m ³ ; 4.3%); Plantago (188 p/m ³ ; 3.1%); Olea (143 p/m ³ ; 2.4%); Cheno-Amar. (125 p/m ³ ; 2.1)	
II: Compositae (72 p/m ³ ; 1.1%); Ligustrum (65 p/m ³ ; 1.1%); Cupressaceae (66 p/m ³ ; 1.1%); Rumex (56 p/m ³ ; 0.9%)	

Tab. 6 - Airborne Pollen Calendar 1994: Pollen data of June (Airborne Pollen Station - University of Modena - Botanical Garden/Geophysical Observatory)

July

It was a “3 Star month” with a very rich air pollen flora.

The pollen content of the air continued to thin out. The monthly sum of daily concentration (4,130 p/m³/24h) and the monthly mean (133 p/m³/24h) were now reduced to nearly 1/4 of that of March, the month with most pollen. The monthly range of daily conc. was less wide (25-475 p/m³/24h). The maximum daily concentration was <500 p/m³/24h (475 p/m³ observed on July 5), and there were 11 days <100 p/m³/24h, mainly in the middle of the month. The minimum daily conc. was on July 20 (25 p/m³/24h).

Air pollen flora was a little less rich: 77 pollen types were recorded, 13 less than in June (9-26 per day). In particular the Main Class flora was impoverished: only 5 pollen types were left over from the 12 of June, spread throughout the middle Classes, as Classes VI and II were empty. The “most abundant pollen of the month” were Urticaceae, followed by Gramineae, *Castanea*, *Plantago*, Cheno-Amaranthaceae.

Trees decreased significantly going down to ca. 20% (Trees = 21%; Herbs = 79 % in the monthly spectrum). The only tree in the Main Classes was *Castanea*, which was over 500 p/m³ (781 p/m³; Class IV). The increase in herb pollen was brought about by Urticaceae and Gramineae. The monthly pollen assemblage was dominated by herbs, mainly grasses and weeds; trees were mainly represented by *Castanea*.

The widest 2-hour daily range (0-416 p/m³/2h) was observed on July 8. The monthly range was 0-661 p/m³/2h. The maximum was on July 5, in the early morning, at 4-6 a.m. when mainly *Castanea*, Gramineae and Urticaceae were in the air. Note the 2-hour conc. fell to 0 on 5 days, as in June. Also in July the mean values of the 2-hour intervals were similar (109-187 p/m³/2h-monthly mean). The highest value was from 10 a.m. to 2 p.m.; the lowest in the night, at 10-12 p.m.

JULY 1994



A

DAY	TOTAL POLLEN			AIA LIST		POLLEN TYPES n°/24h
	p/m ³ /24 h	p/m ³ /2h		p/m ³ /24 h	%	
		min	max			
1	171	58	288	166	97	25
2	204	115	428	200	98	20
3	122	24	559	115	94	24
4	336	169	544	333	99	26
5	475	345	661	468	99	26
6	197	86	355	189	96	26
7	229	115	461	223	97	20
8	151	0	416	149	98	17
9	39	0	101	38	99	10
10	74	32	133	70	94	17
p/m ³ /24 h						
10-day sum	1995			1950		
10-day mean	200					
11	94	36	158	92	98	18
12	114	58	166	110	96	18
13	104	65	173	99	95	20
14	58	4	99	57	98	12
15	38	0	144	37	98	9
16	90	40	133	88	98	15
17	110	55	182	108	98	17
18	193	58	288	185	96	25
19	79	11	198	76	97	17
20	25	0	83	25	100	10
p/m ³ /24 h						
10-day sum	906			877		
10-day mean	91					
21	29	4	119	29	97	10
22	71	0	176	70	98	13
23	156	55	329	153	98	14
24	103	29	248	100	98	12
25	110	54	173	107	97	17
26	161	91	222	155	96	18
27	148	86	238	140	95	22
28	101	50	160	100	99	14
29	83	32	176	82	99	13
30	154	83	281	147	96	23
31	110	36	205	105	95	18
p/m ³ /24 h						
10-day sum	1227			1188		
10-day mean	112					
p/m ³ /24 h						
monthly sum	4130			4015		77
monthly mean	133					
monthly max	475		661	468		26

⇓ *Castanea*, *Gramineae*, *Urticaceae*

B

2 HOURS	TOTAL POLLEN p/m ³ /2h monthly mean
0-2	122
2-4	111
4-6	113
6-8	122
8-10	149
10-12	174
12-14	187
14-16	154
16-18	125
18-20	114
20-22	117
22-24	109

C

TREES	
p/m ³ /24 h monthly sum	%
887	21
HERBS	
p/m ³ /24 h monthly sum	%
3243	79

D

POLLEN CLASSES
monthly sum
VI:
V: <i>Urticaceae</i> (1531 p/m ³ ; 37.1%); <i>Gramineae</i> (1172 p/m ³ ; 28.4%)
IV: <i>Castanea</i> (781 p/m ³ ; 18.9%)
III: <i>Plantago</i> (261 p/m ³ ; 6.3%); <i>Cheno-Amar.</i> (120 p/m ³ ; 2.9%)
II:

Tab. 7 - Airborne Pollen Calendar 1994: Pollen data of July (Airborne Pollen Station - University of Modena - Botanical Garden/Geophysical Observatory)

August

It was a “3 Star month”, with a rich pollen flora.

The pollen content of the air was quite similar to that of July.

The monthly sum of daily concentrations was 4,126 p/m³/24h, practically identical to July, and so was the monthly mean =138 p/m³/24h. Nevertheless note that the maximum daily conc., observed on August 28, was hardly half that of July (227 p/m³) but there were fewer days (5) with a daily conc. less than 100 p/m³/24h. The monthly range of daily conc. was narrower (69-227 p/m³/24h). The highest value was observed on August 28 and the lowest on August 15.

The Air pollen flora list continued to shorten; 61 pollen types were recorded (9-22 per day). The Main Classes (only Classes V and III) were occupied by 4 pollen types left over from the five of July (Urticaceae, Cheno-Amaranthaceae, Gramineae, *Plantago* - *Castanea* had gone) which were joined by two new types: *Artemisia* and *Humulus*.

Trees became insignificant (Trees = 7%; Herbs = 93 % in the monthly spectrum). No trees nor shrubs entered the main Classes, woody plants being represented only by a liana, *Humulus* (205 p/m³; Class III). Herb pollen was mainly represented by Urticaceae (2,205 p/m³, the “most abundant pollen of the month”) followed by weeds and grasses (Class III: *Artemisia*, Cheno-Amaranthaceae, Gramineae, *Plantago*). Weeds were predominant in the monthly pollen assemblage.

The widest daily range of 2-hour conc. was 11-580 p/m³/2h, observed on August 18 and the monthly range was 0-580 p/m³/2h. The maximum value occurred in the early afternoon, at 2-4 p.m. It was threefold the daily concentration and was mainly due to *Humulus* and Urticaceae. The 2-hour concentrations fell to 0 on 3 days. In August the mean values of the 2-hour intervals varied a little more compared to July (95-206 p/m³/2h-monthly mean); the day periods with most pollen (ca. 200 p/m³/2h-monthly mean) fell in the early afternoon, at 12-2 p.m.; the periods with low pollen, <100 p/m³/2h, were observed early in the morning, at 4-8 a.m.



A

DAY	TOTAL POLLEN			AIA LIST		POLLEN TYPES n°/24h
	p/m ³ /24 h	p/m ³ /2h		p/m ³ /24 h	%	
		min	max			
1	162	20	337	159	98	15
2	151	50	263	143	95	21
3	161	83	248	156	97	19
4	176	107	329	174	99	16
5	182	108	270	181	99	12
6	140	76	230	139	99	11
7	162	99	285	158	97	16
8	122	43	241	121	99	14
9	155	86	238	143	93	22
10	109	71	182	105	96	16
p/m ³ /24 h						
10-day sum	1519			1478		
10-day mean	152					
11	131	36	266	125	96	17
12	71	25	148	69	97	14
13	91	44	154	84	92	16
14	89	11	191	66	74	14
15	69	11	130	69	99	9
16	112	32	190	99	88	18
17	110	0	281	98	89	16
18	188	11	580	129	69	20
19	-	-	-	-	-	-
20	136	59	273	117	86	15
p/m ³ /24 h						
10-day sum	997			856		
10-day mean	111					
21	152	61	281	131	87	17
22	135	61	245	134	99	10
23	119	25	259	116	98	13
24	170	0	465	136	80	15
25	92	0	346	91	99	9
26	123	25	328	123	100	12
27	101	40	194	100	99	15
28	227	68	392	222	98	14
29	132	50	212	131	99	14
30	134	50	403	134	99	14
31	225	87	351	211	94	14
p/m ³ /24 h						
10-day sum	1610			1529		
10-day mean	146					
p/m ³ /24 h						
monthly sum	4126			3863		61
monthly mean	138					
monthly max	227		580	222		22

⇓ *Humulus, Urticaceae*

B

2 HOURS	TOTAL POLLEN p/m ³ /2h monthly mean
0-2	104
2-4	104
4-6	95
6-8	96
8-10	155
10-12	188
12-14	206
14-16	180
16-18	156
18-20	140
20-22	123
22-24	102

C

TREES	
p/m ³ /24 h	%
monthly sum	
65	2
HERBS	
p/m ³ /24 h	%
monthly sum	
4061	98

D

POLLEN CLASSES	
monthly sum	
VI:	
V: Urticaceae (2205 p/m ³ ; 53.5%)	
IV:	
III: Artemisia (462 p/m ³ ; 11.2%); Cheno-Amar. (461 p/m ³ ; 11.2%); Gramineae (449 p/m ³ ; 10.9%); Humulus (205 p/m ³ ; 5.0%); Plantago (118 p/m ³ ; 2.9%)	
II:	

Tab. 8 - Airborne Pollen Calendar 1994: Pollen data of August (Airborne Pollen Station - University of Modena - Botanical Garden/Geophysical Observatory)

September

It was a “3 Star month” with a modest air pollen flora.

The pollen content of the air continued to thin. The monthly sum of daily concentrations ($2,755 \text{ p/m}^3/24\text{h}$) was $2/3$ of that of August, now reduced to $1/5$ compared to March, the 1994 month with most pollen. The monthly mean went under 100 p/m^3 ($92 \text{ p/m}^3/24\text{h}$) for the first time after February. The monthly range of daily conc. was similar to August ($8\text{--}233 \text{ p/m}^3/24\text{h}$). The maximum daily conc. ($233 \text{ p/m}^3/24\text{h}$) was observed on September 3. On 18 days the daily conc. was $<100 \text{ p/m}^3/24\text{h}$, mainly in the 2nd and 3rd 10-days, and the lowest conc. was on September 22.

Air pollen flora became impoverished: 42 pollen types (4-15 per day) were recorded (less than half that of June, the month with the richest pollen flora). The Main Classes were being cleared out: only 4 pollen types, all left over from August were in three Main Classes (V, III, II).

Trees had the minimum monthly percentage in the year (Trees = 1%; Herbs = 99 % in the monthly spectrum). No tree appeared in the Main Classes. Among the herb pollen Urticaceae ($2,175 \text{ p/m}^3$) were again the “most abundant pollen type of the month”; they were followed by grasses and other weeds (III-II Classes: Cheno-Amaranthaceae, Gramineae, *Artemisia*). The monthly pollen assemblage consisted almost entirely of weeds and grasses.

The widest daily range of 2-hour conc. was $18\text{--}716 \text{ p/m}^3/2\text{h}$, observed on September 3. The monthly range was $0\text{--}716 \text{ p/m}^3/2\text{h}$. The 2-hour maximum was observed at 12-2 p.m. It was threefold the daily mean conc. of that day ($233 \text{ p/m}^3/24\text{h}$) mainly due to Urticaceae. The minimum (0) was observed on many days (14), mainly in the third 10-days. In September the mean value range of the 2-hour intervals was a little higher than in August ($32\text{--}189 \text{ p/m}^3/2\text{h}$ -monthly mean). The day period with most pollen ($189 \text{ p/m}^3/2\text{h}$ -monthly mean) was observed again in the early afternoon at 12-2 p.m.; the periods with less pollen ($<50 \text{ p/m}^3/2\text{h}$ -monthly mean), early in the morning, at 0-8 a.m. and in the evening (10-12 p.m.).

SEPTEMBER 1994



A

DAY	TOTAL POLLEN			AIA LIST		POLLEN TYPES n°/24h
	p/m ³ /24 h	p/m ³ /2h		p/m ³ /24 h	%	
		min	max			
1	79	14	220	79	100	10
2	29	0	155	29	100	7
3	233	18	716	232	99	10
4	105	18	187	104	100	7
5	122	32	251	121	99	11
6	110	24	273	109	99	12
7	108	12	269	107	100	8
8	80	8	214	79	100	12
9	184	0	679	183	100	10
10	156	0	598	156	100	9
p/m ³ /24 h						
10-day sum	1205			1200		
10-day mean	121					
11	134	14	296	132	99	13
12	196	28	463	192	98	7
13	82	0	198	79	97	9
14	56	0	365	55	99	10
15	78	8	190	75	96	15
16	24	0	87	24	100	6
17	93	0	382	93	100	6
18	66	7	205	66	100	5
19	135	27	269	135	99	7
20	59	0	220	59	100	8
p/m ³ /24 h						
10-day sum	923			909		
10-day mean	92					
21	23	0	108	23	100	5
22	8	0	20	8	100	6
23	130	5	324	127	97	11
24	91	18	180	91	100	5
25	106	4	223	106	100	7
26	97	0	187	96	99	8
27	75	0	263	75	100	5
28	75	9	160	75	99	11
29	12	0	44	10	86	4
30	11	0	27	11	100	7
p/m ³ /24 h						
10-day sum	628			621		
10-day mean	63					
p/m ³ /24 h						
monthly sum	2755			2729		42
monthly mean	92					
monthly max	233		716	232		15

Urticaceae

B

2 HOURS	TOTAL POLLEN p/m ³ /2h monthly mean
0-2	44
2-4	32
4-6	32
6-8	39
8-10	66
10-12	139
12-14	189
14-16	179
16-18	158
18-20	111
20-22	72
22-24	41

C

TREES	
p/m ³ /24 h	
monthly sum	%
17	1
HERBS	
p/m ³ /24 h	
monthly sum	%
2738	99

D

POLLEN CLASSES
monthly sum
VI:
V: Urticaceae (2175 p/m ³ ; 78.9%)
IV:
III: Cheno-Amar. (245 p/m ³ ; 8.9%); Gramineae (193 p/m ³ ; 7.0%)
II: Artemisia (60 p/m ³ ; 2.1%)

Tab. 9 - Airborne Pollen Calendar 1994: Pollen data of September (Airborne Pollen Station - University of Modena - Botanical Garden/Geophysical Observatory)

October

It was a "2 Star month", with a modest air pollen flora.

The pollen content of the air drastically dissipated. The monthly sum of daily concentrations fell to $391 \text{ p/m}^3/24\text{h}$ and the monthly mean to $13 \text{ p/m}^3/24\text{h}$, the lowest values from the beginning of the year, seven times lower than in September. For the first time the daily conc. was always $<50 \text{ p/m}^3/24\text{h}$. The monthly range of daily conc. was low ($2\text{--}33 \text{ p/m}^3/24\text{h}$). The maximum daily conc. was 33 p/m^3 , observed on October 1. On 13 days the daily conc. fell under $10 \text{ p/m}^3/24\text{h}$, mainly in the third 10-days, and the lowest daily conc. was on October 20 and 23.

Air pollen flora variety decreased a little further: 39 pollen types were recorded (3-12 per day), 3 pollen types less than in September. The Main Classes were almost empty. Only 2 pollen types entered them: Urticaceae, left over from September (Class III) and *Cedrus*, a new arrival in the Main Classes (Class II).

Trees regained a little of their importance in pollen assemblages (Trees = 21%; Herbs = 79 % in the monthly spectrum), thanks to *Cedrus* (74 p/m^3). Herb pollen was mainly represented by Urticaceae (224 p/m^3 , the "most abundant pollen of the month" as it had been since July). Pollen assemblages were dominated by weeds. Cedar was relevant among trees.

The 2-hour concentrations, which were the lowest so far, fell to 0 almost every day (on 28 days) and exceeded $100 \text{ p/m}^3/2\text{h}$ only on two days. The widest daily range, which coincided with the monthly range, was $0\text{--}119 \text{ p/m}^3/2\text{h}$, and was observed on October 2. The maximum 2-hourly conc. occurred in the morning, at 10-12 a.m., was ca. fivefold the mean daily conc. of that day ($25 \text{ p/m}^3/24\text{h}$) and was again mainly produced by Urticaceae. In October the mean values of the 2-hour intervals, the lowest observed so far, were $4\text{--}27 \text{ p/m}^3/2\text{h}$ -monthly mean; the day periods with pollen ($22\text{--}27 \text{ p/m}^3/2\text{h}$ -monthly mean) were observed early in the afternoon (12-2 p.m.); the period with less pollen ($<5 \text{ p/m}^3/2\text{h}$), was observed early in the morning, at 4-6 p.m.

OCTOBER 1994



A

DAY	TOTAL POLLEN			AIA LIST		POLLEN
	p/m ³ /24 h	p/m ³ /2h		p/m ³ /24 h	%	TYPES n°/24h
		min	max			
1	33	8	79	32	99	8
2	25	0	119	24	96	12
3	14	0	36	14	100	6
4	26	0	68	25	97	12
5	16	0	59	16	98	7
6	28	0	115	28	100	5
7	10	0	28	10	100	6
8	5	0	11	5	94	7
9	12	0	32	12	100	5
10	9	0	16	9	100	5
p/m ³ /24 h 10-day sum	177			174		
10-day mean	18					
11	5	0	29	5	100	4
12	8	0	25	8	100	5
13	15	0	43	14	94	6
14	10	0	40	10	100	5
15	21	4	43	20	99	10
16	10	0	24	10	100	4
17	23	4	58	22	95	7
18	15	0	44	14	96	7
19	12	0	32	12	100	6
20	2	0	4	2	100	3
p/m ³ /24 h 10-day sum	118			115		
10-day mean	12					
21	5	0	18	5	100	7
22	7	0	25	7	100	5
23	2	0	7	2	100	3
24	6	0	18	5	95	4
25	3	0	11	2	78	5
26	16	0	43	15	96	10
27	9	0	25	9	97	8
28	3	0	11	3	100	3
29	22	0	54	22	97	6
30	8	0	18	8	96	4
31	15	0	36	14	92	9
p/m ³ /24 h 10-day sum	96			92		
10-day mean	11					
p/m ³ /24 h monthly sum	391			381		39
monthly mean	13					
monthly max	33		119	32		12

♂ **Urticaceae**

B

2 HOURS	TOTAL POLLEN p/m ³ /2h monthly mean
0-2	6
2-4	6
4-6	4
6-8	5
8-10	9
10-12	22
12-14	27
14-16	24
16-18	16
18-20	13
20-22	13
22-24	7

C

TREES	
p/m ³ /24 h monthly sum	%
81	21
HERBS	
p/m ³ /24 h monthly sum	%
310	79

D

POLLEN CLASSES
<i>monthly sum</i>
VI:
V:
IV:
III: Urticaceae (224 p/m ³ ; 57.4%)
II: Cedrus (74 p/m ³ ; 18.8%)

Tab. 10 - Airborne Pollen Calendar 1994: Pollen data of October (Airborne Pollen Station - University of Modena - Botanical Garden/Geophysical Observatory)

November

It was a " 1 Star month ", with a very poor pollen flora.

The pollen content of the air was vanishing. The monthly sum of daily concentration fell under 100 ($66 \text{ p/m}^3/24\text{h}$) and the monthly mean became insignificant: $2 \text{ p/m}^3/24\text{h}$. The daily conc. was never over $10 \text{ p/m}^3/24\text{h}$. The monthly range of daily conc. was insignificant ($0-7 \text{ p/m}^3/24\text{h}$). On several days (6), mainly in the third 10-days, the daily conc. fell to 0 p/m^3 and the maximum daily conc. (7 p/m^3) was observed on November 12.

Air pollen flora of November was poor: 16 pollen types were recorded (0-5 per day). The Main Classes were empty. Only two pollen types were present in Class I: Urticaceae and Cheno-Amaranthaceae.

Trees were stationary in the monthly spectrum (Trees = 20%; Herbs = 80 %). All of them were Sporadic or Rare pollen, less than 11 p/m^3 (Classes +, r). Herb pollen was again brought about by Urticaceae: 35 p/m^3 , the "most abundant pollen type in the month".

The 2-hour concentrations fell to 0 every day. The widest 2-hour daily range, which coincided with the monthly range was $0-40 \text{ p/m}^3/2\text{h}$. The maximum value was observed on November 12, in the afternoon at 2-4 p.m., a value sixfold the mean concentration of that day ($7 \text{ p/m}^3/24\text{h}$), which was again mainly due to Urticaceae. In November the mean values of the 2-hour intervals were all under $10 \text{ p/m}^3/2\text{h}$ ($1-6 \text{ p/m}^3/2\text{h}$ -monthly mean, a very low range). The day period with a little more pollen ($6 \text{ p/m}^3/2\text{h}$ -monthly mean) was in the afternoon, at 2-4 p.m. The periods with less pollen, here almost devoid of pollen ($1 \text{ p/m}^3/2\text{h}$ -monthly mean), were frequent in the day.

NOVEMBER 1994



A

DAY	TOTAL POLLEN			AIA LIST		POLLEN TYPES n°/24h
	p/m ³ /24 h	p/m ³ /2h		p/m ³ /24 h	%	
		min	max			
1	6	0	24	6	100	2
2	5	0	20	5	100	5
3	4	0	11	3	92	5
4	4	0	16	4	100	5
5	4	0	16	4	100	4
6	1	0	7	1	67	3
7	1	0	8	1	100	3
8	1	0	4	1	100	2
9	3	0	11	3	91	4
10	1	0	7	1	100	1
p/m ³ /24 h						
10-day sum						
10-day mean						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
p/m ³ /24 h						
10-day sum						
10-day mean						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
p/m ³ /24 h						
10-day sum						
10-day mean						
p/m ³ /24 h						
monthly sum						
monthly mean						
monthly max						

Urticaceae

B

2 HOURS	TOTAL POLLEN p/m ³ /2h monthly mean
0-2	1
2-4	2
4-6	2
6-8	2
8-10	1
10-12	3
12-14	4
14-16	6
16-18	3
18-20	1
20-22	2
22-24	1

C

TREES	
p/m ³ /24 h	
monthly sum	%
14	20
HERBS	
p/m ³ /24 h	
monthly sum	%
53	80

D

POLLEN CLASSES	
	monthly sum
VI:	
V:	
IV:	
III:	
II:	
I:	
I: Urticaceae (35 p/m ³ , 45.6%); Cheno-Amar (14 p/m ³ , 17.9%)	

Tab. 11 - Airborne Pollen Calendar 1994: Pollen data of November (Airborne Pollen Station - University of Modena - Botanical Garden/Geophysical Observatory)

December

It was a "1 Star month", with a poor air pollen flora.

The air was almost cleared of all pollen. The monthly sum of daily concentration was under 50 ($34 \text{ p/m}^3/24\text{h}$), half that of November. The monthly mean of daily conc. was only $1 \text{ p/m}^3/24\text{h}$. The monthly range of daily conc. was insignificant ($0-6 \text{ p/m}^3/24\text{h}$). On 11 days the concentration fell to $0 \text{ p/m}^3/24\text{h}$. The maximum ($6 \text{ p/m}^3/24\text{h}$), was observed on December 15.

Air pollen flora was poor: 20 pollen types were recorded ($0-6$ per day), four more than in November. The Main Classes were empty. Even in Class I there was only one pollen type (Urticaceae).

Trees became more important in the monthly percentage spectrum compared to November (Trees = 37%; Herbs = 63 % in the monthly spectrum), but their concentration continued to be very low, as before, less than $15 \text{ p/m}^3/24\text{h}$. The amount of herb pollen was due to Urticaceae (12 p/m^3). Note that Urticaceae had been "the most abundant pollen type of the month" for six months, since July.

The daily variation was low. The 2-hour concentration fell to 0 every day. The widest daily range was observed on December 15 and coincided with the monthly range ($0-50 \text{ p/m}^3/2\text{h}$). The highest value, occurred in the afternoon, at 4-6 p.m. It was eight times the mean concentration of that day, ($6 \text{ p/m}^3/24\text{h}$) and also this time Urticaceae were responsible. In December the mean values of the 2-hour intervals had a very narrow range ($0-3 \text{ p/m}^3/2\text{h}$ -monthly mean). Note there were for the first time some day periods with mean conc. = 0, which occurred 3 times, in the morning (6-8 a.m.), in the evening (6-8 p.m.) and at night (10-12 p.m.). Also the other day periods were very poor in pollen: the highest mean, observed in the afternoon at 4-6 p.m. where the peak fell, was in fact $3 \text{ p/m}^3/2\text{h}$ -monthly mean, the lowest value of 1994.

DECEMBER 1994



A

DAY	TOTAL POLLEN			AIA LIST		POLLEN TYPES n°/24h
	p/m ³ /24 h	p/m ³ /2h		p/m ³ /24 h	%	
		min	max			
1	3	0	7	2	78	4
2	0	0	0	0	-	0
3	2	0	14	2	83	3
4	0	0	4	0	0	1
5	1	0	7	1	100	2
6	0	0	4	0	0	1
7	2	0	11	2	100	2
8	1	0	4	1	100	2
9	0	0	4	0	100	1
10	0	0	4	0	100	1
p/m ³ /24 h						
10-day sum	9			8		
10-day mean	1					
11	1	0	11	1	75	4
12	0	0	0	0	-	0
13	3	0	14	2	75	6
14	1	0	7	1	100	3
15	6	0	50	5	95	5
16	1	0	4	1	100	1
17	3	0	14	3	89	6
18	0	0	0	0	-	0
19	1	0	8	1	100	1
20	0	0	0	0	-	0
p/m ³ /24 h						
10-day sum	16			14		
10-day mean	2					
21	0	0	0	0	-	0
22	1	0	4	1	100	1
23	1	0	4	1	100	2
24	1	0	4	1	100	2
25	1	0	9	1	100	2
26	1	0	4	1	100	2
27	1	0	4	1	100	2
28	1	0	5	1	100	2
29	0	0	0	0	-	0
30	0	0	0	0	-	0
31	3	0	14	0	0	4
p/m ³ /24 h						
10-day sum	9			6		
10-day mean	1					
p/m ³ /24 h						
monthly sum	34			28		20
monthly mean	1					
monthly max	6		50	5		6

⇓ Urticaceae

B

2 HOURS	TOTAL POLLEN p/m ³ /2h monthly mean
0-2	1
2-4	1
4-6	1
6-8	0
8-10	2
10-12	2
12-14	1
14-16	2
16-18	3
18-20	0
20-22	1
22-24	0

C

TREES	
p/m ³ /24 h monthly sum	%
13	37
HERBS	
p/m ³ /24 h monthly sum	%
21	63

D

POLLEN CLASSES	
monthly sum	
VI:	
V:	
IV:	
III:	
II:	
I: Urticaceae (12 p/m ³ ; 34.0%)	

Tab. 12 - Airborne Pollen Calendar 1994: Pollen data of December (Airborne Pollen Station - University of Modena - Botanical Garden/Geophysical Observatory)

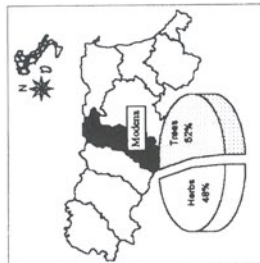


YEAR 1994

C

A

MONTH	TOTAL POLLEN CONCENTRATION p/m ³ /24 h										POLLEN TYPES		TREES		HERBS	
	1st 10-day	2nd 10-day	3rd 10-day	monthly mean	monthly sum	monthly max	monthly mean	monthly sum	monthly max	monthly mean	n°	%	monthly sum	%	monthly sum	%
	mean	mean	mean	mean	sum	max	mean	sum	max	mean	n°	%	sum	%	sum	%
J	18	11	48	26	817	134	19	777	95	40	5		777	95	40	5
F	75	41	36	52	1449	228	19	1429	99	20	1		1429	99	20	1
M	347	559	473	460	14267	1384	59	13860	97	408	3		13860	97	408	3
A	311	133	518	320	9613	1275	74	5764	60	3849	40		5764	60	3849	40
M	402	200	298	300	9305	1105	89	2458	26	6847	74		2458	26	6847	74
J	284	122	215	210	6086	597	90	2026	33	4060	67		2026	33	4060	67
J	200	91	112	133	4130	475	77	887	21	3243	79		887	21	3243	79
A	152	111	146	133	4126	227	61	270	7	3856	93		270	7	3856	93
S	121	92	63	92	2755	233	42	17	1	2738	99		17	1	2738	99
O	18	12	11	13	391	33	39	81	21	310	79		81	21	310	79
N	3	3	1	2	66	40	16	13	20	53	80		13	20	53	80
D	1	2	1	1	34	6	20	13	37	21	63		13	37	21	63
yearly max					14267	1384	90	13860		6847			13860	52	25444	48
yearly total					53038		115	27594								



D

B

MONTH	TOTAL POLLEN (2 - HOURS) p/m ³ /2h - monthly mean																Pollen Classes	
	0-2h	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	monthly sum				monthly sum	
	mean	mean	mean	mean	mean	mean	mean	mean	mean	mean	mean	mean	sum	%	sum	%	sum	%
J	29	26	19	18	26	27	37	40	31	15	24	24	15	24	24	24	15	24
F	41	49	40	36	41	74	90	78	49	39	46	37	49	39	46	37	49	39
M	502	471	398	331	462	540	473	529	430	404	498	484	529	430	404	498	529	430
A	423	377	251	257	289	378	363	330	344	273	256	305	378	363	330	344	273	256
M	401	296	248	269	338	293	349	336	296	281	243	253	338	293	349	336	296	281
J	194	183	192	181	212	249	274	222	214	199	205	192	212	199	205	192	212	199
J	122	111	113	122	149	174	187	154	125	114	117	109	149	174	187	154	125	114
A	104	104	95	96	155	188	206	180	156	140	123	102	188	206	180	156	140	123
S	44	32	32	39	66	139	189	179	158	111	72	41	139	189	179	158	111	72
O	6	6	4	5	9	22	27	24	16	13	13	7	22	27	24	16	13	13
N	1	2	2	2	1	3	4	6	3	1	2	1	3	4	6	3	1	2
D	1	1	1	0	2	2	1	2	3	0	1	0	2	1	0	1	0	1

Tab. 13 - Airborne Pollen Calendar 1994; Summary Pollen data of the year
(Airborne Pollen Station - University of Modena - Botanical Garden/Geophysical Observatory)

Conclusion

The Airborne Pollen Calendar described appears quite satisfactory to us. Undoubtedly it will be improved by advice and criticism by the users.

Its foundations are the daily pages, where the 2-hourly concentrations of all identified pollen types can be found, as well as the morphological description of pollen records waiting for identification.

If this airpollen station continues to operate, it will provide data for a number of applications, for example: 1) to detect the impact in the air due to massive reforestation or introduction of exotic ornamental plants; 2) to pick out pollen types as markers for air masses from long distances; 3) to compare air pollen spectra with surface ones, from mosses and other surface materials, which give the pollen pictures of today's vegetation; 4) the 2 hourly pollen data may reveal the different daily rhythms of pollen release of the various plants and their changes in time. These daily pollen clocks, if drawn up for allergenic pollen, could advise allergic people the best hours to go out to avoid it; 5) to follow the changes in air pollen assemblages produced by plant communities, following the undergoing changes in climate, a path which could link the history of vegetation to its present and future.

→

Tab. 14 - Airborne Pollen Calendar 1994: Yearly Concentration/Percentage Pollen Spectrum
-Percentages are calculated out of the Basic Pollen Sum (Airborne Pollen Station -
University of Modena - Botanical Garden/Geophysical Observatory)

AIRBORNE POLLEN MONITORING STATION - UNIVERSITY OF MODENA

(Modena, 35 m a.s.l.; 44°40' N 10°55' E - Northern Italy)

BOTANICAL GARDEN / GEOPHYSICAL OBSERVATORY - Spore trap at 15 m



YEARLY CONCENTRATION / PERCENTAGE POLLEN SPECTRUM

1994 ★★★★★

FAMILIES/POLLEN TYPES	p/m/24h-yearly sum	% out of Yearly Total Pollen Sum	FAMILIES/POLLEN TYPES	p/m/24h-yearly sum	% out of Yearly Total Pollen Sum
ACERACEAE	219,67	0,415	CRUCIFERAE	51,99	0,098
Acer campestre type	219,07	0,413	Cruciferae	51,99	0,098
Acer cf. negundo	0,60	0,001	CUPRESSACEAE	1708,65	3,225
AQUIFOLIACEAE	1,28	0,002	Chamaecyparis/Thuja	1,28	0,002
Ilex	1,28	0,002	Juniperus type	1707,37	3,223
ARALIACEAE	0,76	0,001	CYPERACEAE	51,99	0,098
Hedera	0,76	0,001	Cyperaceae	51,99	0,098
BALSAMINACEAE	0,38	0,001	ELEAGNACEAE	0,76	0,001
Impatiens	0,38	0,001	Hippophae	0,76	0,001
BETULACEAE	6183,10	11,670	ERICACEAE	92,61	0,175
Alnus	2204,99	4,162	Erica	8,56	0,016
Betula	3978,11	7,508	Ericaceae undiff.	83,71	0,158
BIGNONIACEAE	1,14	0,002	Rhododendron cf.	0,34	0,001
Catalpa	1,14	0,002	EUPHORBIACEAE	18,09	0,034
CAMPANULACEAE	5,92	0,011	Euphorbia	3,40	0,006
Campanulaceae	5,92	0,011	Ricinus	5,01	0,009
CANNABACEAE	285,10	0,538	Mercurialis cf.	9,68	0,018
Cannabis	13,28	0,025	FAGACEAE	3271,59	6,175
Humulus lupulus L.	269,56	0,509	Castanea	1804,76	3,406
Humulus/Cannabis type	2,26	0,004	Fagus	141,33	0,267
CAPRIFOLIACEAE	5,66	0,011	Quercus deciduous	1300,34	2,454
Sambucus cf. nigra	5,66	0,011	Q. ilex	25,16	0,047
CARYOPHYLLACEAE	15,64	0,030	GRAMINEAE	13225,59	24,962
Caryophyllaceae	15,64	0,030	Avena/Triticum cf.	233,26	0,440
CHENOPODIACEAE/ AMARANTHACEAE	1000,65	1,889		12875,05	24,301
Cheno-Amranthaceae	1000,65	1,889	Gramineae undiff.		
COMPOSITAE	933,72	1,762	Hordeum cf.	112,22	0,212
Ambrosia	86,15	0,163	Zea	5,06	0,010
Anthemis type	46,68	0,088	HIPPOCASTANACEAE	84,90	0,160
Artemisia	560,39	1,058	Aesculus	84,90	0,160
Aster type	22,08	0,042	IRIDACEAE	0,30	0,001
Asteroidae undiff.	166,57	0,314	Iridaceae	0,30	0,001
Centaurea	5,98	0,011	JUGLANDACEAE	157,42	0,297
Cichorioideae	37,58	0,071	Carya	2,38	0,004
Helianthus cf.	5,40	0,010	Juglans	155,04	0,293
Xanthium	2,89	0,005	JUNCACEAE	0,60	0,001
CONVOLVULACEAE	0,60	0,001	Juncaceae	0,60	0,001
Convolvulus	0,60	0,001	LABIATAE	0,71	0,001
CORYLACEAE	2823,23	5,329	Labiatae - hexazonocolpate	0,33	0,001
Corylus	1658,77	3,131	Labiatae - trizonocolpate	0,38	0,001
Carpinus betulus	163,81	0,309	LAURACEAE	0,64	0,001
Ostrya carpinifolia/Carp.orientalis type	1000,65	1,889	Laurus	0,64	0,001
			LEGUMINOSAE	132,33	0,250

(continued)

(Continued Table 14)

FAMILIES/POLLEN TYPES	p/m/24h-yearly sum	% out of Yearly Total Pollen Sum	FAMILIES/POLLEN TYPES	p/m/24h-yearly sum	% out of Yearly Total Pollen Sum
Leguminosae undiff.	5.06	0.010	Thalictrum	3.29	0.006
Lotus	8.12	0.015	Ranunculaceae undiff.	34.38	0.065
Medicago	46.50	0.088	RHAMNACEAE	1.36	0.003
Onobrychis	0.38	0.001	Rhamnus	1.36	0.003
Robinia	3.34	0.006	ROSACEAE	97.27	0.184
Sophora	49.96	0.094	Crataegus	0.68	0.001
Spartium	11.59	0.022	Filipendula	14.16	0.027
Trifolium	7.38	0.014	Potentilla type	11.23	0.021
LILIACEAE	12.15	0.023	Prunus	10.07	0.019
Liliaceae	12.15	0.023	Rosa	22.27	0.042
MORACEAE	267.73	0.505	Rosaceae undiff.	38.86	0.073
Moraceae	267.73	0.505	RUBIACEAE	46.76	0.088
MYRTACEAE	13.93	0.026	Galium type	46.76	0.088
Eucalyptus	13.60	0.026	SALICACEAE	5722.61	10.801
Myrtus	0.33	0.001	Populus	5291.64	9.988
NYPHEACEAE	0.68	0.001	Salix	430.97	0.813
Nymphaea	0.68	0.001	SAXIFRAGACEAE	38.86	0.073
OLEACEAE	2400.75	4.531	Philadelphus cf.	38.86	0.073
Forsythia	2.24	0.004	SCROPHULARIACEAE	0.38	0.001
Fraxinus	1488.05	2.809	Scrophulariaceae	0.38	0.001
Ligustrum	165.76	0.313	SIMAROUBACEAE	0.68	0.001
Olea cf.	518.88	0.979	Ailanthus	0.68	0.001
Syringa cf.	225.82	0.426	TAXACEAE	1079.86	2.038
PALMAE	0.68	0.001	Taxus	1079.86	2.038
Palmae	0.68	0.001	TAXODIACEAE	1.86	0.004
PAPAVERACEAE	141.60	0.267	Sequoia/Taxodium	1.86	0.004
Papaver	141.60	0.267	TILIACEAE	14.40	0.027
PINACEAE	960.48	1.813	Tilia	14.40	0.027
Abies	0.30	0.001	TYPHACEAE/SPARGANIACEAE	32.94	0.062
Cedrus	131.81	0.249	Typha latifolia type	22.27	0.042
Picea	6.63	0.013	Typha/Sparganium	10.67	0.020
Pinus	821.74	1.551	ULMACEAE	541.88	1.023
PLANTAGINACEAE	653.13	1.233	Celtis	55.69	0.105
Plantago ccf. lanceolata	165.96	0.313	Ulmus	486.19	0.918
Plantago sp. pl.	487.17	0.919	UMBELLIFERAE	55.69	0.105
PLATANACEAE	2398.25	4.526	Umbelliferae	55.69	0.105
Platanus	2398.25	4.526	URTICACEAE	7767.08	14.660
POLYGONACEAE	274.21	0.518	Urtica dioica type	7764.59	14.655
Polygonum	14.58	0.028	Urticaceae undiff.	2.49	0.005
Rumex	259.63	0.490	VITACEAE	1.01	0.002
PRIMULACEAE	1.96	0.004	Parthenocissus	0.63	0.001
Anagallis cf.	0.60	0.001	Vitis	0.38	0.001
Primulaceae undiff.	1.36	0.003	Unidentified	22.27	0.042
RANUNCULACEAE	157.08	0.296	Unidentifiable	55.69	0.105
Clematis	1.53	0.003	Yearly Total Pollen Sum	53038.25	
Ranunculus	117.88	0.222	Yearly Total Pollen Sum (excl. Unidentifiable) = Basic Pollen Sum	52982.56	
Leading Pollen types: Gramineae undiff., Urtica dioica type, Populus, Betula					
Leading Families: GRAMINEAE, URTICACEAE, BETULACEAE, SALICACEAE, FAGACEAE, CORYLACEAE					
Families: n° 57; Pollen types: n° 115; Tree pollen types: n° 61; Herb pollen types: n° 54					

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