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Pollen flight forecasting in Germany and in Europe

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Abstract. Every tenth person in Central Europe is a pollinosis patient. The time of ripening and release of pollen, as well as pollen flight, all depend on the weather. Because each year is different from every other, mean values from pollen calendars do not provide any practical help for allergy-sufferers. For this reason, in many European countries, measuring networks have been established during the last 10 years as a basis for forecasting the prevalence of airborne pollen for the following 2-3 days, in connection with the weather forecast. Cooperation and communication also exist on a European level, and a European Pollen Database has been established.
Key words. Pollen flight; pollen; pollinosis; German Pollen Information Service.

Small source – big effect

In Europe there are about a hundred species of plants which are wind-pollinated (anemophilous) and produce airborne pollen. Pollen from some 30 of these is active in causing allergies. These pollen grains are very small, with diameters of 0.01–0.03 mm, which is near to the limit of visual power of the human eye. Under a microscope with 2000-fold enlargement, however, an astonishing variety of forms comes to light. Allergic effects are due to protein components of the plasma. It has been estimated that these allergens occupy only 3–4% of the volume of the grain. These small components have a very big effect indeed. Clinical studies[1,6,7] have shown that every tenth person in Central Europe is a pollinosis patient – eight million people in Germany alone. They suffer from allergic rhinitis, allergic conjunctivitis and/or allergic bronchial asthma. For all those who cannot afford to flee to a lonely ocean island during the pollen season, there is no escape. One single grass-ear or panicle can release more than one million pollen grains, and only 20 pollen grains per cubic meter are enough to produce an allergic reaction.

Pollen flight: every year is different

At a superficial glance, the process of informing pollinosis patients about pollen flight seems to be very simple: measure what kind of pollen occurs in what season in a locality for a couple of years, calculate the mean values, enter them in pollen calendars, and exhibit these calendars for information. Unfortunately, this has no value for the allergic patients, because every year the pollen flight is different (fig. 1). The reason is that many factors which affect the allergic response, like the ripening and release of the pollen, and the pollen flight, depend on the weather[3–9]. Because atmospheric conditions in Europe vary considerably from one year to another, the pollen flight is very different. It begins at a different time every year, and the temporal sequence of the peaks of pollen from different species varies from one season to another in amount and intensity. The end of the pollen flight may differ from one year to another by weeks. Therefore a calendar showing past mean values cannot help pollinosis patients to adjust their behaviour appropriately during the pollen season. They are dependent on day-to-day monitoring of airborne pollen.

Measuring networks for airborne pollen in Europe

In many European countries, measuring networks have been established, most of them within the last 10–20 years. Measurements are made in a quite uniform way using Burkard pollen traps (fig. 2). The functioning and use of this precision-device are described in detail in the literature[1].

The first attempts at setting up pollen-warning services in various European countries date back some 20 years. Essentially, these services were restricted to publishing measured values from the past days. These values had no reference to the actual prevalence of airborne pollen, except during periods of very stable weather conditions, so the information was rarely of practical use to pollinosis patients. The worth of services of this kind was questionable, and in most cases they were discontinued after a few years.

From measurement to prognosis

From the end of the 1970s onwards new methods began to be used in many countries, including Germany. Here, the preconditions were very favourable because since 1930 Germany has had a very well-developed network of observers of plant-phenological phenomena[2]. Although this network was originally set up for agro-meteorological work, it had two characteristics that made it useful as part of a pollen-warning system: the flowering phases of some allergenic kinds of plants were already included in the programme of observations, and

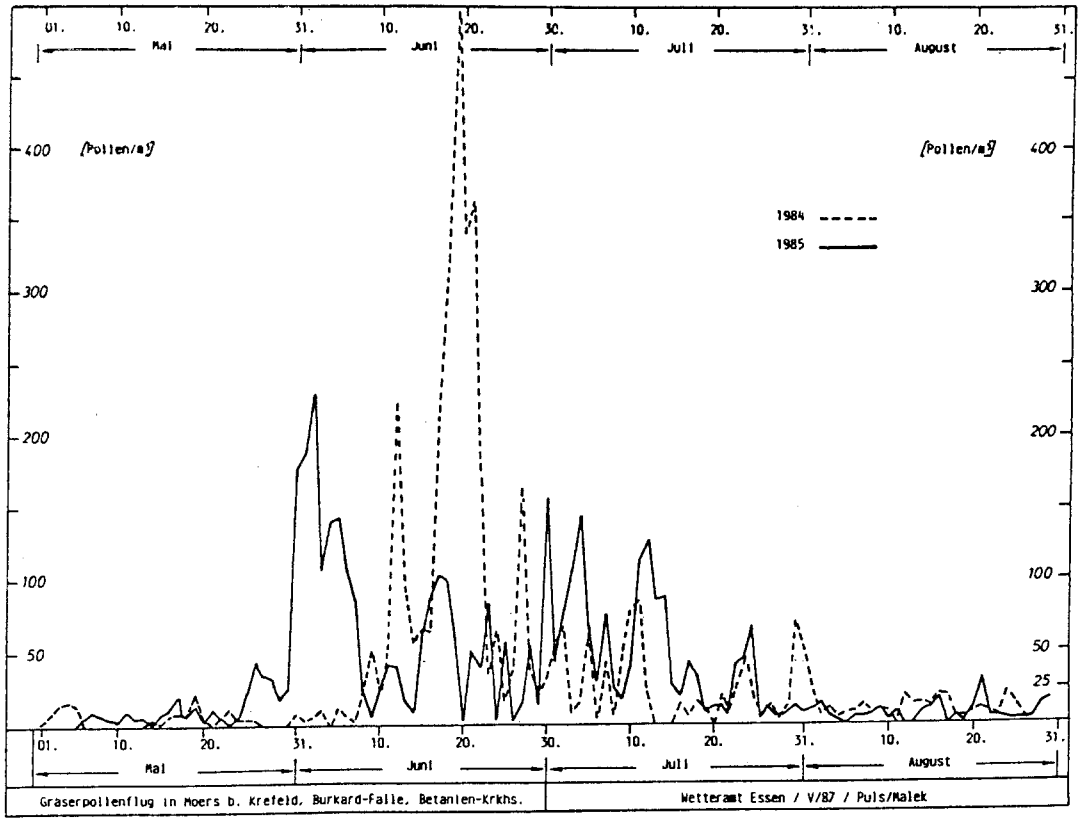
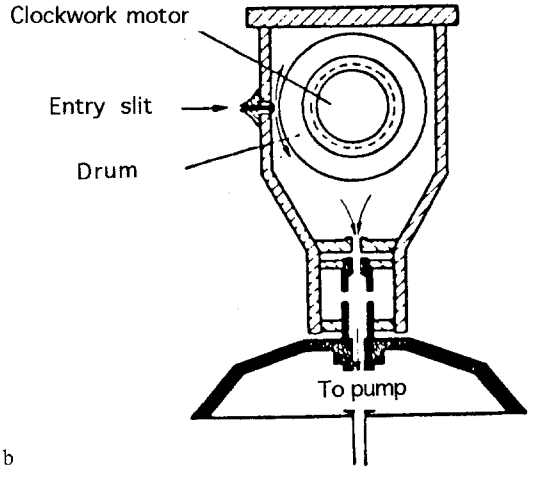


Figure 1. Grass pollen flight: no year is like another. The figure shows the records of grass pollen counts made in Moers, Germany, from May to August in 1984 and in 1985, using a Burkard pollen trap.

a



b

Figure 2. a and b. Pollen trap according to Burkard.

they were part of the so-called 'Immediate Report Programme' (SOFORT). This programme has since been completed with regard to allergic relevance. Figure 3 shows the programme of observations used. Five plants which are important to allergy-sufferers are shown in italics. The reporting-system is based on postcards; an example is shown in figure 4. As soon as the information is received it is stored in a central computer. Information is made available to the weather offices several times weekly, so that a first qualitative analysis is available, providing a Yes/No statement for the beginning of flowering of a given plant in a particular area. The network of phenological observers covers 500 localities in Germany.

A second basis for information is the network of Burkard pollen traps, which are now situated in 60 places. These provide quantitative information (pollen grains per cubic meter) for different types of pollen.

Beobachtungsprogramm für die phänologischen SOFORTmelder 1992

Nr.	Pflanzenart	Phase	Eintrittstag	Nr.	Pflanzenart	Phase	Eintrittstag
101	***Hasel***	***B***		135	Schwarzer Holunder	B	
102	Schneeglöckchen	B		***136***	***Winterroggen***	***B***	
103	Huflattich	B		137	Winterweizen	Ä	
104	Dauergrünland	ERG		138	Kartoffel	B	
105	Sal-Weide	B		139	Hafer	Ä	
106	Hafer	BST		140	Süßkirsche	F	
107	Stachelbeere	BO		141	Sommer-Linde	B	
108	Kartoffel	BST		142	Rote Johannisbeere	F	
109	Hafer	AU		143	Wintergerste	GR	
110	Beta-Rübe	BST		***144***	***Beifuß***	***B***	
111	Winterraps	SCH		145	Mais	Ä	
112	Apfel	A		146	Kartoffel	E	
113	***Birke***	***B***		147	Wintergerste	E	
114	Schlehe	B		148	Mais	B	
115	Löwenzahn	B		149	Winterraps	VR	
116	Winterraps	KNO		150	Winterweizen	GR	
117	Süßkirsche	B		151	Apfel	F	
118	Wintergerste	SCH		152	Hafer	GR	
119	Mais	BST		153	Winterweizen	E	
120	Rotbuche	BO		154–55	Dauergrünland	S2	
121	Kartoffel	AU		156	Hafer	E	
122	Beta-Rübe	AU		157	Mais	MR	
123	Winterweizen	SCH		158	Winterraps	BST	
124	Apfel	B		159	Schwarzer Holunder	F	
125	Winterraps	B		160	Winterraps	AU	
126	Mais	AU		161	Mais	TR	
127	Apfel	EB		162	Silo-Mais	E	
128	Hafer	SCH		163	Körner-Mais	E	
129	***Wiesen Fuchsschwanz***	***B***		164	Rotbuche	BV	
130	Winterroggen	Ä		165	Winterweizen	BST	
131	Wintergerste	Ä		166	Rotbuche	BF	
132	Kartoffel	BG		167	Winterweizen	AU	
133–34	Dauergrünland	S1					

Phasenabkürzungen:

A	Beginn des Austriebs	BST	Beginn der Bestellung	KNO	Beginn der Knospenbildung
AU	Beginn des Aufgangs	BV	Blattverfärbung	MR	Beginn der Milchreife
Ä	Beginn des Ährenschiebens	E	Beginn der Ernte	S1	1. Heu- bzw. Silageschnitt
B	Beginn der Blüte, erste Blüten offen	EB	Ende der Blüte	S2	2. Heu- bzw. Silageschnitt
BF	Blattfall	ERG	Beginn des Ergrünens	SCH	Beginn des Schossens/ Längenwachstums
BG	Bestand geschlossen	F	Beginn der Pflückreife, erste reife Früchte	TR	Beginn der Teigreife
BO	Erste Blattoberflächen sichtbar	GR	Beginn der Gelbreife	VR	Beginn der Vollreife

Figure 3. Plant-phenological recording programme in Germany. Observation programme for participants in the 'Immediate Report Programme' (SOFORT). The plants to be observed are listed, and the 'phase' column shows the stage to be recorded, e.g. 'B' = start of flowering (Blüte). The observations of special importance for allergy sufferers are shown in italics: flowering of *Corylus avellana*, *Betula pendula*, *Alopecurus pratensis*, *Secale cereale*, *Artemisia vulgaris*. (Deutscher Wetterdienst 1992).

In 1979/80 a method was developed for arriving at a prognosis of pollen flight by means of phenological observations (qualitative), analysis of pollen trap data (quantitative) and weather forecasting. The objective was to forecast the intensity, the sequence and the end of pollen flight from spring until the beginning of autumn for some selected types of pollen (e.g. hazel, alder, birch, grass, rye, mugwort). A pilot-study was carried out in Nordrhein-Westfalen in the years 1981 and 1982. The medical and meteorological evaluation was successful, and has been published in detail[1].

When the analyses are converted into forecasts, a working scheme is used which depends on the weather situation and applies the current weather forecast. The result is a 2–3-day prognosis of pollen flight in terms of type and intensity (4 classes of pollen concentration). Clinical knowledge is taken into account. 17 weather-offices of the Deutscher Wetterdienst (German Weather Service) serve as operational centres. From the weather-offices the pollen flight forecast is transmitted immediately to the media (radio, TV, telephone, newspapers, Btx). By this means the pollinosis patient gets pollen flight information for the next 2–3 days roughly 1 h after the preparation of the pollen flight forecast.

Work in Europe

In Germany, the 'Stiftung Deutscher Polleninformationsdienst' (German Pollen Information Service Foundation) was founded in 1983 to organise and coordinate

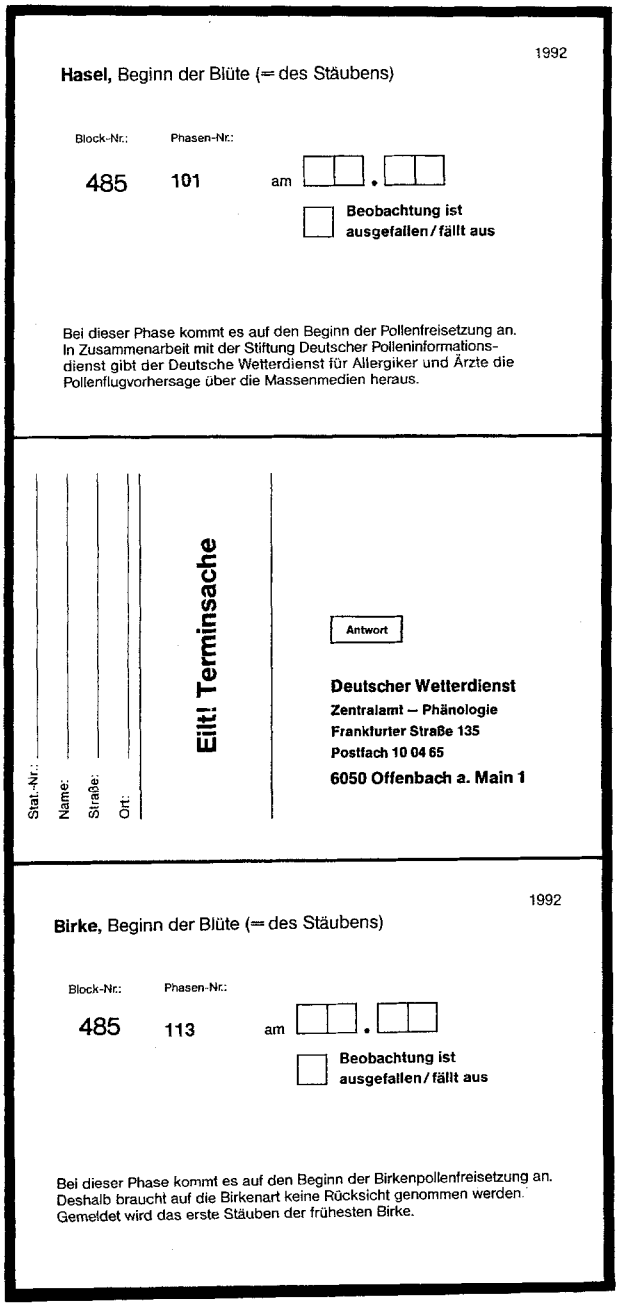


Figure 4. Postcard for reporting phenological observations. Hazel, birch: date of first release of pollen. (Deutscher Wetterdienst 1992).

the cooperation of physicians, clinics and the weather service. In 1987 and 1989 the Foundation arranged European pollen flight symposia, which offered an opportunity for a comprehensive exchange of experience, and provided impulses for further work all over Europe. The papers, reports and results of these symposia have been published in detail[6,7]. It was realized that in fact measurements are being made in many European countries, but the series of measurements were of very different lengths, ranging from 1 year to 32 years. Forecasts of pollen flight, and in some cases of fungal spores, are made in more than 10 countries. New information or forecasts may be offered to the allergic patients every day, every few days or weekly.

A European Pollen Database has already been established (S. Jäger in ref. 7). This work is carried out in Vienna with the European Academic and Research Network (EARN). To make the input of data and data-access feasible, a European Aeroallergen Network (EAN) has been linked to EARN. The European Pollen Database can provide current information for pollinosis patients across national boundaries, for example for travellers, and also data for scientific research on a European scale.

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